



OMC

High-performanceHMI Function Block Reference

**IM41S60-E
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Symbol Definitions



WARNING:

Indicates a potentially hazardous situation which, if not avoided, could result in serious injuries or death.



RISK OF ELECTRICAL SHOCK:

Indicates a Potential shock hazard where HAZARDOUS LIVE voltages greater than 30V RMS, 42.4V peak, or 60V DC may be accessible.



ESD HAZARD:

Indicates the Danger of an electro-static discharge to which equipment may be sensitive. Observe precautions for handling electrostatic sensitive devices



ATTENTION:

Identifies information that requires special consideration.



TIP:

Identifies advice or hints for users.

Table of Contents

1 About.....	1
2 Overview.....	2
2.1 Classification and Composition.....	2
2.2 Active/Inactive.....	2
2.3 Flag.....	3
2.4 Data Type.....	3
2.5 Parameter Property and Parameter Setting Illustration.....	4
2.6 Function Block Panel.....	5
2.6.1 Fixed Button.....	6
2.6.2 Close Button.....	6
2.6.3 FB Tag Name.....	6
2.6.4 Selected, Alarm, ACK.....	6
2.6.5 Detailed Information of Alarm.....	7
2.6.6 Analog Data Area.....	7
2.6.7 Basic Operation Area.....	7
2.6.8 Digital Button or Analog Bar Diagram Display Area.....	7
2.6.9 Auxiliary Operation Area.....	8
2.6.10 Switchover Button Area.....	8
2.6.11 Tag Description.....	9
2.6.12 Operation Authority of Panel.....	9
2.6.13 Operator Keyboard Operation.....	9
2.6.14 Function Block Panel Example.....	9
3 Control Function Block Library.....	14
3.1 Working Modes of Function Block.....	14
3.1.1 OOS.....	15
3.1.2 Initial mode (IMAN).....	16
3.1.3 Track (TR).....	16
3.1.4 Manual (MAN) / Auto (AUTO).....	16
3.1.5 Remote Cascade (RCAS).....	16
3.1.6 Remote Out (ROUT).....	17

3.1.7 Cascade (CAS).....	17
3.1.8 Force Manual (EMMAN).....	17
3.1.9 Override (OR).....	17
3.2 Application Foundation of Control Function Block.....	17
3.2.1 Transition Process of Function Block Modes.....	18
3.2.2 Input Process.....	19
3.2.3 Set Variable Process.....	21
3.2.4 Operation Process.....	22
3.2.5 Output Process.....	28
3.2.6 Integral Cutting.....	29
3.2.7 Alarm.....	30
3.2.8 Others.....	35
3.2.9 PID Parameter Tune.....	36
3.2.10 Difference between Various PID Function Blocks.....	40
3.3 General PID Function Block (PID).....	43
3.3.1 Parameter Description.....	43
3.3.2 Mode Illustration.....	54
3.3.3 Algorithm Illustration.....	56
3.3.4 Application Illustration.....	58
3.3.5 Panel Parameter.....	58
3.3.6 Flag.....	65
3.3.7 Application Example.....	66
3.4 PIDEP Function Block (PIDEP).....	73
3.4.1 Parameter Description.....	73
3.4.2 Application Illustration.....	84
3.4.3 Panel Parameter.....	84
3.4.4 Flag.....	90
3.4.5 Application Example.....	91
3.5 Extended PID Control Function Block (PIDEX).....	92
3.5.1 Parameter Description.....	92
3.5.2 Mode Illustration.....	110
3.5.3 Application Illustration.....	112
3.5.4 Panel Parameter.....	112

3.5.5 Flag.....	119
3.5.6 Application Example.....	120
3.6 EPID Control Function Block (EPID).....	125
3.6.1 Parameter Description.....	126
3.6.2 Application Illustration.....	130
3.6.3 Panel Parameter.....	130
3.6.4 Flag.....	134
3.6.5 Application Example.....	134
3.7 LEPID Function Block (LEPID).....	134
3.7.1 Parameter Description.....	135
3.7.2 Application Illustration.....	140
3.7.3 Panel Parameter.....	140
3.7.4 Flag.....	144
3.7.5 Application Example.....	144
3.8 PID for Pulse Output Function Block (PID_TP).....	144
3.8.1 Parameter Description.....	145
3.8.2 Panel Parameter.....	156
3.8.3 Flag.....	163
3.9 Pulse PI Control Function Block (PI_PLS).....	164
3.9.1 Parameter Description.....	164
3.9.2 Application Illustration.....	177
3.9.3 Panel Parameter.....	177
3.9.4 Flag.....	184
3.10 Integral of Manual Set PD Function Block (PD_SI).....	185
3.10.1 Parameter Description.....	185
3.10.2 Panel Parameter.....	197
3.10.3 Flag.....	204
3.11 Error Cumulation PI Control Function Block (PI_AE).....	205
3.11.1 Parameter Description.....	206
3.11.2 Panel Parameter.....	218
3.11.3 Flag.....	224
3.12 Ratio Control Function Block (RATIO).....	225
3.12.1 Parameter Description.....	225

3.12.2 Panel Parameter.....	233
3.12.3 Flag.....	236
3.12.4 Application Example.....	237
3.13 Split Control Function Block (SPLIT).....	241
3.13.1 Parameter Description.....	241
3.13.2 Panel Parameter.....	254
3.13.3 Flag.....	258
3.13.4 Application Example 1.....	259
3.13.5 Application Example 2.....	260
3.13.6 Application Example 3.....	264
3.14 Handheld Function Block (MANUAL).....	265
3.14.1 Parameter Description.....	265
3.14.2 Mode Illustration.....	273
3.14.3 Application Illustration.....	274
3.14.4 Panel Parameter.....	275
3.14.5 Flag.....	276
3.14.6 Application Example.....	277
3.15 Electric Manual Operation Function Block (MANUAL_EP).....	279
3.15.1 Parameter Description.....	279
3.15.2 Application Illustration.....	287
3.15.3 Panel Parameter.....	287
3.15.4 Flag.....	289
3.15.5 Example.....	290
3.16 Maximum Selection Function Block (ASH).....	292
3.16.1 Parameter Description.....	292
3.16.2 Panel Parameter.....	296
3.16.3 Flag.....	298
3.16.4 Application Example	298
3.17 Minimum Selection Function Block (ASL).....	299
3.17.1 Parameter Description.....	300
3.17.2 Panel Parameter.....	303
3.17.3 Flag.....	305
3.17.4 Application Example.....	305

3.18 Signal Distribution Function Block (FOUT).....	308
3.18.1 Parameter Description.....	309
3.18.2 Panel Parameter.....	317
3.18.3 Flag.....	321
3.18.4 Application Example.....	321
4 Logical Control Function Block Library	324
4.1 Software Pulse Sequence Output Function Block (SPO).....	324
4.2 Digital Status Change Function Block (DSCA).....	326
4.2.1 Parameter Description.....	326
4.2.2 Application Example.....	327
4.3 3-Channel Digital Selection Function Block(D2OO3).....	328
4.4 Switch Status Time Accumulation Function Block (SSTA).....	329
4.4.1 Parameter Description.....	329
4.4.2 Application Example.....	331
4.5 8 Input QOR Function Block (QOR_8).....	332
4.5.1 Parameter Description.....	332
4.5.2 Application Example.....	333
4.6 Digital First SN Indicator Function Block (FIRST).....	334
4.7 Blink Function Block (BLINK).....	337
4.8 Interval Control Function Block (DGAP).....	337
4.8.1 Parameter Description.....	338
4.8.2 Panel Parameter.....	343
4.8.3 Flag.....	344
4.9 Pulse Position Function Block (PULPOS).....	345
4.10 Motor Control Function Block (MOTOR).....	347
4.10.1 Parameter Description.....	347
4.10.2 Work Flow.....	355
4.10.3 Fault Diagnosis and Solution.....	360
4.10.4 Panel Parameter.....	362
4.10.5 Flag.....	364
4.10.6 Application Example.....	365
4.11 Command Level Motor Equipment Control Function Block (MOTOR_EX).....	368
4.11.1 Parameter Description.....	369

4.11.2 Output Mode.....	373
4.11.3 Detect and Deal Fault	374
4.11.4 Command Priority.....	376
4.11.5 REVTYPE	377
4.11.6 IGNORSTA.....	381
4.11.7 Output Process of Command Response.....	382
4.11.8 Status Definition.....	385
4.11.9 Flag	385
4.11.10 Panel Parameter	386
4.12 Valve Control Function Block (VALVE)	388
4.12.1 Parameter Description.....	389
4.12.2 Work Flow.....	394
4.12.3 Fault Diagnosis and Solution.....	399
4.12.4 Panel Parameter.....	400
4.12.5 Flag.....	402
4.12.6 Application Example.....	403
4.13 Command Level Valve Equipment Control Function Block (VALVE_EX).....	405
4.13.1 Parameter Description.....	405
4.13.2 Output Mode.....	411
4.13.3 Detect and Deal Fault.....	412
4.13.4 Command Priority.....	414
4.13.5 REVTYPE.....	415
4.13.6 IGNORSTA.....	427
4.13.7 Mode.....	427
4.13.8 Status Definition.....	429
4.13.9 Flag.....	430
4.13.10 Panel Parameter.....	431
4.14 Two Outputs Balance Control Function Block (BALANCE).....	433
4.14.1 Parameter Description.....	434
4.14.2 Panel Parameter.....	436
4.14.3 Flag	438
4.14.4 Function Illustration.....	438
4.15 Single DI/DO Start/Stop Control Function Block (DIO-11M).....	439

4.15.1 Parameter Description.....	440
4.15.2 Work Flow.....	443
4.15.3 Fault Diagnosis and Solution.....	444
4.15.4 Panel Parameter.....	445
4.15.5 Flag.....	447
4.15.6 Application Example.....	447
4.16 Single DI and Single DO Switch Function Block (DIO-11V).....	449
4.16.1 Parameter Description.....	449
4.16.2 Work Flow.....	452
4.16.3 Fault Diagnosis and Solution.....	454
4.16.4 Panel Parameter.....	455
4.16.5 Flag.....	456
4.16.6 Application Example.....	457
4.17 Dual DI and Single DO Start & Stop Function Block (DIO-21M).....	458
4.17.1 Parameter Description.....	458
4.17.2 Logical Process.....	461
4.17.3 Panel Parameter.....	463
4.17.4 Flag.....	464
4.17.5 Application Example.....	465
4.18 Dual DI and Single DO Switch Function Block (DIO-21V).....	466
4.18.1 Parameter Description.....	467
4.18.2 Logical Control.....	470
4.18.3 Panel Parameter.....	472
4.18.4 Flag.....	474
4.18.5 Application Example.....	474
4.19 Dual DI Start/Stop Valve Observe Function Block (DI-2M).....	476
4.19.1 Parameter Description.....	476
4.19.2 Panel Parameter.....	477
4.19.3 Flag.....	478
4.20 Dual DI Switch Valve Observe Function Block (DI-2V).....	478
4.20.1 Parameter Description.....	479
4.20.2 Panel Parameter.....	480
4.20.3 Flag.....	480

4.20.4 Application Example.....	480
4.21 Interlock Function Block (INTERLOCK).....	481
4.21.1 Parameter Description.....	482
4.21.2 Panel Parameter.....	483
4.21.3 Logic Time Sequencing.....	484
4.21.4 Flag.....	485
4.22 Analog Signal Interlock Function Block (ITLK_A).....	485
4.22.1 Parameter Description.....	485
4.22.2 Other Parameters.....	486
4.22.3 Flag.....	496
4.22.4 Configuration.....	497
4.22.5 Logical Illustration.....	501
4.22.6 Panel Parameter.....	505
4.22.7 Application Illustration.....	506
4.23 Digital Signal Interlock Function Block (ITLK_D).....	507
4.23.1 Parameter Description.....	507
4.23.2 Other Parameters.....	508
4.23.3 Flag.....	524
4.23.4 Configuration.....	525
4.23.5 Logical Illustration.....	528
4.23.6 Panel Parameter.....	532
4.23.7 Application.....	535
4.24 Digital Setting Function Block (DSET_DI_EP).....	535
4.24.1 Parameter Description.....	536
4.24.2 Logic Time Sequencing.....	536
4.24.3 Panel Parameter.....	537
4.24.4 Flag.....	538
4.24.5 Example Application.....	538
4.25 Control Function Block for Single Output (DIO-01V).....	539
4.25.1 Parameter Description.....	539
4.25.2 Logic Time Sequencing.....	541
4.25.3 Panel Parameter.....	542
4.25.4 Flag.....	543

4.25.5 Example Application.....	544
4.26 Digital Interlock Function Block (LOCK16).....	545
4.26.1 Parameter Description.....	546
4.26.2 Logic Time Sequencing.....	549
4.27 Dual-DI/ Dual-DO Switch Control Function Block (DIO-22V).....	549
4.27.1 Parameter Description.....	549
4.27.2 Logic Control.....	553
4.27.3 Panel Parameter.....	555
4.27.4 Flag.....	556
5 Analog Processing Function Block Library.....	558
5.1 ACCUM_E.....	558
5.1.1 Parameter Description.....	558
5.1.2 Operation Illustration.....	559
5.1.3 Abnormal Operation Instruction.....	559
5.2 ACCUM_T.....	559
5.3 Integral Function Block (INTEGRAL).....	561
5.3.1 Parameter Description.....	561
5.3.2 Application Illustraton.....	564
5.3.3 Panel Parameter.....	564
5.3.4 Flag.....	566
5.4 Differential Function Block (DIFF).....	567
5.5 Nonlinear Error Calculation Function Block (DEV)	568
5.6 H Limit Alarm Function Block (HIGHMON).....	570
5.7 L Limit Alarm Function Block (LOWMON).....	571
5.8 H/L Limit Delay Alarm Function Block (HLMON).....	571
5.9 Leading and Hysteresis Function Block (LDLAG).....	574
5.10 Pure Hysteresis Function Block (DED).....	578
5.11 Deadband Function Block (DB).....	579
5.12 Steam Compensation Function Block (STMCOMP).....	580
5.12.1 Parameter Description.....	581
5.12.2 Algorithm Illustration	582
5.12.3 Application Example.....	584
5.12.4 Application Illustration.....	585

5.13 Ideal Gas Compensation Function Block (PTCOMP).....	585
5.14 Limiting Function Block (LIM).....	586
5.15 Filter function Block (FILTER).....	588
5.15.1 Parameter Description	588
5.15.2 Application Illustration.....	590
5.15.3 Application Example.....	590
5.16 Statistic Function Block (STAT).....	591
5.17 Hysteresis Compare Function Block (CMP_LAG).....	593
5.18 Error alarm Function Block (DVALM).....	594
5.19 Signal Generation Function Block (SGNLGEN).....	595
5.20 Water Enthalpy Compensation Function Block (ENTHALPY).....	596
5.21 Natural Gas Compensation Function Block (GASCOMP).....	597
5.21.1 Natural Gas Compensation Function Block (GASCOMP).....	604
5.21.2 Flag.....	612
5.22 Air Compensation Function Block (ATMCOMP).....	612
5.23 Linearization Function Block (FXY).....	618
5.23.1 Parameter Description.....	618
5.23.2 Panel Parameter.....	622
5.23.3 Flag.....	626
5.23.4 Application Example.....	626
5.24 Indication Function Block (PVI).....	629
5.24.1 Parameter Description.....	629
5.24.2 Panel Parameter.....	633
5.24.3 Flag.....	635
5.25 Segment Signal Generate Function Block (CURVE).....	636
5.26 Expended Segment Signal Generate Function Block (CURVEEX).....	639
5.26.1 Parameter Description.....	639
5.26.2 Algorithm Illustration.....	641
5.26.3 Output Illustration.....	643
5.26.4 Panel Parameter.....	650
5.26.5 Flag.....	652
5.27 Text Calculation Function Block (CALC).....	652
5.27.1 Parameter Description.....	652

5.27.2 Application Example.....	654
5.28 Text Logic Calculation Function Block (ACTION).....	656
5.29 Extended Indicator Function Block (PVIEX)	659
5.29.1 Parameter Description.....	659
5.29.2 Application Illustration.....	666
5.29.3 Panel Parameter.....	667
5.29.4 Flag.....	670
5.29.5 Application Example.....	671
5.30 Extended Linearization Chart Functional Block (FXYEX).....	671
5.30.1 Parameter Description.....	671
5.30.2 Panel Parameter.....	679
5.30.3 Flag.....	686
5.31 Alarm Auto Track Function Block (ALMTR).....	686
5.32 Extended Integral Function Block (INTERGRALX).....	688
5.32.1 Parameter Description.....	688
5.32.2 Application Illustration.....	693
5.32.3 Panel Parameter.....	694
5.32.4 Flag.....	696
5.32.5 Application Example.....	697
5.33 Extended Ideal Gas Compensation Function Block (PTCOMPX).....	698
5.33.1 Parameter Description.....	698
5.33.2 Application Example.....	700
5.34 Setting Function Block (DSET).....	702
5.34.1 Parameter Description.....	702
5.34.2 Application Illustration.....	707
5.34.3 Panel Parameter.....	707
5.34.4 Flag.....	709
5.35 Setting Function Block (DSET_EP).....	710
5.35.1 Parameter Description.....	710
5.35.2 Application Illustration.....	712
5.35.3 Panel Parameter.....	712
5.35.4 Flag	713
5.36 Ramp Function Block (RAMP).....	714

5.37 Date Timer Function Block (DATETIMER).....	715
5.38 Moving-average Block (AVE_M).....	718
5.39 Sampling Function Block (SAMPLE).....	720
5.40 Extended Natural Gas Compensation (GASCOMP_EX).....	721
5.40.1 Calculation process.....	724
5.40.2 Auxiliary calculations.....	725
5.40.3 Calculation of basic flow parameters.....	729
5.40.4 Calculate the final flow output.....	733
6 String Process Function Block Library.....	735
6.1 String Function Block (STRING64).....	735
6.2 String Communication Output Function Block (SETSTR64).....	735
6.3 String Communication Input Function Block (GETSTR64).....	736
6.4 String Function Block (EQ_STR64).....	737
7 Selection Operation Function Block Library.....	739
7.1 2-to-1 Selector Function Block (TWOSEL).....	739
7.1.1 Parameter Description.....	739
7.1.2 Panel Parameter.....	741
7.1.3 Flag.....	743
7.2 3-to-1 Selector Function Block (THRSEL).....	743
7.2.1 Parameter Description.....	744
7.2.2 Panel Parameter.....	746
7.2.3 Flag.....	748
7.3 Eight Input Signal Select Function Block (ISEL8).....	749
7.3.1 Parameter Description.....	749
7.3.2 Panel Paramter.....	752
7.3.3 Flag.....	754
7.3.4 Application Example.....	754
7.4 Digital Switch Function Block (DS).....	755
7.5 Analog Switch Function Block (ASW).....	756
7.6 Multi-choice of Eight Digital Signal Select Function Block (SS8).....	757
7.6.1 Parameter Description.....	757
7.6.2 Panel Parameter.....	758
7.6.3 Flag.....	760

7.7 USINT Select Function Block (USINTSW).....	760
7.8 UINT Select Function Block (UINTSW).....	761
7.9 UDINT Select Function Block (UDINTSW).....	761
7.10 SINT Select Function Block (SINTSW).....	762
7.11 INT Select Function Block (INTSW).....	762
7.12 DINT Select Function Block (DINTSW).....	763
7.13 16-channel Digital Selection Function Block (BSEL16).....	764
7.14 Extended Two Input Signal Selector Function Block (TWOSELX).....	765
7.14.1 Parameter Description.....	765
7.14.2 Panel Parameter.....	768
7.14.3 Flag.....	770
7.14.4 Application Example.....	771
7.15 Extended three Input Signal Selector Function Block (THRSELX).....	772
7.15.1 Parameter Description.....	773
7.15.2 Panel Parameter.....	776
7.15.3 Flag.....	778
7.15.4 Application Example.....	779
7.16 Maximum Selection Function Block (THRSELH).....	781
7.16.1 Parameter Description.....	781
7.16.2 Flag.....	784
7.17 Median Selection Function Block (THRSELM).....	784
7.17.1 Parameter Description.....	785
7.17.2 Flag.....	788
7.18 Minimum Selection Function Block (THRSELL).....	788
7.18.1 Parameter Description.....	789
7.18.2 Flag.....	791
8 Arithmetic Operation Function Block Library.....	793
8.1 ADD Function Block (ADD).....	793
8.2 ADD Function Block (ADDEX).....	793
8.3 Eight-Channel ADD Function Block (ADD8).....	794
8.4 Subtraction Function Block (SUB).....	795
8.4.1 Parameter Description.....	795
8.4.2 Application Example.....	795

8.5 (Multiplication) Function Block (MUL).....	797
8.6 Division Function Block (DIV).....	797
8.7 Square Root Function Block (SQRT).....	798
8.8 Absolute Value Function Block (ABS).....	799
8.9 EXP Function Block (EXP).....	799
8.10 POW Function Block (POW).....	800
8.11 Natural Logarithm Function Block (LN).....	800
8.12 Logarithm Function Block (LOG).....	801
8.13 Module Function Block (MOD).....	801
8.14 Polynomial Function Block (POLY).....	802
8.15 DINT to REAL Function Block (DINT2REAL).....	803
8.16 REAL to DINT Function Block (REAL2DINT).....	803
8.17 DOUBLE to REAL Function Block (DOUBLE2REAL).....	804
8.18 INT to REAL Function Block (INT2REAL).....	804
8.19 REAL to INT Function Block (REAL2INT).....	805
8.20 REAL to LREAL Function Block (REAL2LREAL).....	805
8.21 LREAL to REAL Function Block (LREAL2REAL).....	806
8.22 SINT to INT Function Block (SINT2INT).....	806
8.23 INT to SINT Function Block (INT2SINT).....	807
8.24 UDINT to DINT Function Block (UDINT2DINT).....	807
8.25 DINT to UDINT Function Block (DINT2UDINT).....	807
8.26 UINT to INT Function Block (UINT2INT).....	808
8.27 INT to UNIT Function Block (INT2UNIT).....	808
8.28 USINT to SINT Function Block (USINT2SINT).....	808
8.29 SINT to USINT Function Block (SINT2USINT).....	809
8.30 INT to DINT Function Block (INT2DINT).....	809
8.31 DINT to INT Function Block (DINT2INT).....	810
8.32 BOOL Assignment Sentence Function Block (MOV_BOOL).....	810
8.33 SINT Assignment Function Block (MOV_SINT).....	810
8.34 INT Assignment Function Block (MOV_INT).....	811
8.35 DINT Assignment Function Block (MOV_DINT).....	811
8.36 REAL Assignment Function Block (MOV_REAL).....	812
8.37 LREAL Assignment Function Block (MOV_LREAL).....	812

8.38	UINT Assignment Function Block (MOV_UINT).....	813
8.39	UDINT Assignment Function Block (MOV_UDINT).....	813
8.40	USINT Assignment Function Block (MOV_USINT).....	814
8.41	Matrix Add Function Block (MADD).....	814
8.42	Matrix Multiply Function Block (MMUL).....	817
8.43	UINT Add Function Block (ADD_UINT).....	819
8.44	INT Add Function Block (ADD_INT).....	819
8.45	UINT Subtraction Function Block (SUB_UINT).....	820
8.46	INT Subtraction Function Block (SUB_INT).....	820
9	Logical Operation Function Block Library.....	822
9.1	AND Function Block.....	822
9.2	ANDEX Function Block.....	822
9.3	OR Function Block.....	823
9.4	OREX Function Block.....	824
9.5	NOT Function Block.....	824
9.5.1	Parameter Descripton.....	824
9.5.2	Application Example.....	825
9.6	XOR Function Block.....	825
9.7	XOREX Function Block.....	826
9.8	AND8 Function Block.....	826
9.9	OR8 Function Block.....	827
9.10	WIPEOUT Function Block.....	828
9.11	PVDI Function Block.....	828
9.11.1	Parameter Description.....	829
9.11.2	Parameter of Function Block Panel.....	830
9.11.3	Flag.....	831
9.12	RS Function Block.....	832
9.13	SR Function Block.....	833
9.14	DFF Function Block.....	834
9.15	COUNTER Function Block.....	835
9.16	TRIG Function Block.....	836
9.17	TON Function Block.....	837
9.17.1	Parameter Description.....	837

9.17.2 Application Illustration.....	838
9.17.3 Application Example.....	838
9.18 TOFF Function Block.....	839
9.19 TP Function Block.....	840
9.19.1 Parameter Description.....	841
9.19.2 Application Illustration.....	841
9.19.3 Application Example.....	841
9.20 TIMER Function Block.....	842
9.21 TIMERSE Function Block.....	843
9.21.1 Function Illustration.....	844
9.21.2 Panel Parameter.....	847
9.21.3 Flag.....	848
9.22 TON_HOLD Function Block.....	848
9.23 TP_TR Function Block.....	849
9.24 TIMEREX Function Block.....	850
9.24.1 Parameter Description.....	851
9.24.2 Application.....	851
9.25 Bypass Monitoring Function Block (MOS_SOR_WD).....	852
9.25.1 Parameter Description.....	852
9.25.2 Usage.....	853
9.25.3 Panel Parameter.....	856
9.25.4 Flag.....	857
9.25.5 Examples.....	857
10 Comparison Function Block Library.....	859
10.1 NE Function Block.....	859
10.2 EQ Function Block.....	859
10.3 GT Function Block.....	860
10.4 GE Function Block.....	860
10.5 LT Function Block.....	860
10.6 LE Function Block.....	861
10.7 NE_INT Function Block.....	861
10.8 EQ_INT Function Block.....	862
10.9 GT_INT Function Block.....	862

10.10 GE_INT Function Block.....	863
10.11 LT_INT Function Block.....	863
10.12 LE_INT Function Block.....	864
10.13 NE_UNIT Function Block	864
10.14 EQ_UNIT Function Block.....	865
10.15 GT_UNIT Function Block.....	865
10.16 GE_UNIT Function Block.....	866
10.17 LT_UNIT Function Block.....	866
10.18 LE_UNIT Function Block.....	866
11 I/O Special Process Function Block Library.....	868
11.1 PATCON Function Block.....	868
11.1.1 Parameter Description.....	868
11.1.2 Panel Parameter.....	873
11.1.3 Flag.....	874
11.2 TC_CJC Function Block.....	875
11.3 TC_CJC_N Function Block.....	877
11.4 CABALM Function Block.....	878
11.5 CS_STATUS Function Block.....	880
11.6 PIACCUM Function Block.....	881
11.6.1 Parameter Description.....	882
11.6.2 Application Illustration.....	883
11.6.3 Panel Parameter.....	883
11.6.4 Flag.....	885
11.6.5 Application Example.....	885
11.7 SOEACCUM Function Block.....	886
11.7.1 Parameter Description.....	886
11.7.2 Application Illustration.....	887
11.7.3 Panel Parameter.....	888
11.7.4 Flag	889
11.7.5 Application Example.....	889
11.8 SOEACCUM_N Function Block.....	889
11.8.1 Parameter Description.....	890
11.8.2 Panel Parameter.....	891

11.8.3 Flag	892
11.9 IO_FLAG Function Block.....	892
11.9.1 Parameter Description.....	893
11.9.2 Application Example.....	895
11.10 TC_CJCX Function Block.....	896
11.11 PTM Function block.....	897
11.12 HCM Function Block.....	903
11.13 SSIM Function Block.....	907
11.14 PI_MIG Function Block (Calculation PI Signal Process).....	911
11.14.1 Parameter Description.....	911
11.14.2 Panel Parameter.....	914
11.14.3 Flag.....	915
11.15 PAT_MIG Function Block (PAT Position Adjust Function Block).....	915
11.15.1 Parameter Instruction.....	915
11.15.2 Panel Parameter.....	920
11.15.3 Flag.....	922
11.16 SERVO_MIG Function Block (Valve Servo Control Module).....	923
11.17 SERVOCON Function Block (Valve Servo Control Module).....	927
11.17.1 Parameter Description.....	927
11.17.2 Panel Parameter.....	932
11.17.3 Flag.....	935
11.18 SERVOCON_R Function Block.....	936
11.18.1 Parameter Description.....	936
11.18.2 Function Illustration.....	942
11.18.3 Panel Parameter.....	947
11.18.4 Flag list.....	952
11.19 SPEED_MIG Function Block (Speed Detection and Overspeed Protect Module)	953
11.20 SPEEDTST Function Block (Speed Detection and Overspeed Protect Module).....	954
11.20.1 Parameter Description.....	955
11.20.2 Panel Parameter.....	958
11.20.3 Flag.....	960
11.21 MODULECOMM Function Block.....	960

11.22 MODULECOMM_N Function Block.....	962
11.23 CANCOMM Function Block.....	963
11.24 Cold Startup Function Block (COLD_START).....	964
11.25 GET_BUF Function Block.....	964
11.25.1 Parameter Illustration.....	964
11.25.2 Function Illustration.....	964
11.25.3 Application Example.....	965
11.26 GET_BUF16 Function Block.....	965
11.26.1 Parameter Description.....	965
11.26.2 Function Illustration.....	966
11.26.3 Application Example.....	966
11.27 Analog Communication R/W Function Block (COMM_A).....	967
11.27.1 Parameter Description.....	967
11.27.2 Flag.....	970
11.28 Digital Communication R/W Function Block (COMM_D).....	971
11.28.1 Parameter Description.....	971
11.28.2 Flag.....	972
11.29 Temperature And Humidity Diagnosis Function Block (MODULETRH).....	973
12 Sequence Control Function Block.....	974
12.1 CR Function Block.....	974
12.1.1 Logical Instruction.....	974
12.1.2 Configuration Instruction.....	976
12.1.3 Panel Parameter.....	982
12.1.4 Configuration Examples.....	983
12.2 SQC Function Block.....	987
12.3 STP Function Block.....	989
12.3.1 Flag.....	998
12.3.2 Panel Parameter.....	999
12.3.3 Program Example.....	999
13 Communication Auxiliary Function Block Library.....	1001
13.1 BCD2DEC Function Block	1001
13.2 DEC2BCD Function Block.....	1002
13.3 HEX2DEC Function Block.....	1003

13.4 DEC2HEX Function Block.....	1003
13.5 BIN2BCD Function Block.....	1004
13.6 BCD2BIN Function Block.....	1004
13.7 BLOGIC_16 Function Block.....	1005
13.8 BLOGIC_32 Function Block.....	1006
13.9 LSH_16 Function Block.....	1008
13.10 LSH_32 Function Block.....	1009
13.11 RSH_16 Function Block.....	1009
13.12 RSH_32 Function Block.....	1010
13.13 ASCTRAN Function Block.....	1011
13.14 ASCPARSE Function Block.....	1012
13.15 USIPARSE Function Block.....	1012
13.16 GETUDI Function Block.....	1013
13.17 REALTRAN Function Block.....	1013
13.18 UINTPARSE Function Block.....	1014
13.18.1 Parameter Instruction.....	1014
13.18.2 Application Example.....	1015
13.19 UDINTPARSE Function Block.....	1019
13.20 BOOL2UDINT Function Block.....	1021
13.21 Parse REAL to UDINT Function Block (SREAL_UDINT).....	1024
13.22 Parse 2 REAL to UDINT Function Block(SREAL2_UDINT).....	1024
13.23 Parse UDINT to REAL Function Block (GREAL_UDINT).....	1025
13.24 Parse UDINT to 2 REAL Function Block (GREAL2_UDINT).....	1025
14 Inter-station Communication Function Block Library.....	1027
14.1 Introduction.....	1027
14.2 SEND_MIX Function Block.....	1028
14.2.1 Parameter Description.....	1029
14.2.2 Application Example.....	1031
14.3 GET_MIX Function Block.....	1033
14.3.1 Parameter Instruction.....	1034
14.3.2 Application Example.....	1037
14.4 SEND_REAL Function Block.....	1037
14.5 GET_REAL Function Block.....	1038

14.6 SENDSPEC Function Block.....	1040
14.7 GETSPEC Function Block.....	1042
14.8 UDINT Data Inter-station Send Function Block (SEND_UDINT).....	1044
14.9 UDINT Data Inter-station Get Function Block (GET_UDINT).....	1046
14.10 Inter-station Communication Programming Example.....	1047
15 Industrial Function Block Library.....	1049
15.1 BLDSET Function Block.....	1049
15.1.1 Parameter Description.....	1050
15.1.2 BLDSET Single Period Execution Steps.....	1052
15.1.3 Flow Pre-processing and Accumulation Calculation.....	1055
15.1.4 Control Step Process.....	1055
15.1.5 Control Mode.....	1058
15.1.6 Cumulative Deviation Proportional Integral Control.....	1060
15.1.7 Alarm Processing.....	1060
15.1.8 Panel Parameter.....	1061
15.1.9 Flag.....	1064
15.2 BLDMST Function Block.....	1065
15.2.1 Parameter Description.....	1065
15.2.2 Internal Process Procedure.....	1071
15.2.3 Types of Blend Process	1071
15.2.4 Flow Statistics and the Calculation of Actual Blend Rate.....	1073
15.2.5 Alarm Processing.....	1074
15.2.6 SV Distribution and Command Transmission.....	1074
15.2.7 Control Steps and Orders.....	1075
15.2.8 Component Addition and Deletion.....	1081
15.2.9 Panel Parameter.....	1082
15.3 Temperature Compensate 15 Function Block (VCF15).....	1084
15.4 Temperature Compensation 20 Function Block (VCF20).....	1085
15.5 F_AI_ALM.....	1086
15.5.1 Function Illustration.....	1088
15.5.2 Alarm Limit Calculation.....	1089
15.6 M_AI_ALM.....	1098
15.6.1 High and Low Limit Alarm Management.....	1100

15.6.2 Rate Alarm Management.....	1103
15.7 Fuzzy Control Function Block(FLC).....	1104
15.7.1 Parameter Description.....	1104
15.7.2 Application.....	1115
15.7.3 Panel Parameter.....	1115
15.7.4 Flag.....	1121
15.7.5 Programming Example for Application	1122
15.8 Predictive Function Control Function Block For Single Variable(PFC).....	1122
15.8.1 Parameter Description.....	1122
15.8.2 Application.....	1133
15.8.3 Panel Parameter.....	1133
15.8.4 Flag.....	1139
15.8.5 Prediction Control Algorithm	1140
15.8.6 Method of Place in Service.....	1141
15.9 PID Self-tune Function Block (PID_TUN).....	1141
15.9.1 Parameter Description.....	1142
15.9.2 Panel Parameter.....	1154
15.9.3 PID Parameters Self-Tuning.....	1163
15.9.4 Flag.....	1163
15.9.5 Programming Example For Apply.....	1164
15.10 SMITH Predictor Function Block (SMITH).....	1164
15.10.1 Parameter Description.....	1165
15.10.2 Application.....	1174
15.10.3 Panel Parameter.....	1175
15.10.4 Flag.....	1181
15.10.5 Programming Example For Apply.....	1181
15.10.6 Matters Need Attention.....	1182
15.11 Branches Balance Control of Oil Furnace Function Block (BALANCE8).....	1182
15.11.1 Parameter Description.....	1184
15.11.2 Application Illustration.....	1206
15.11.3 Panel Parameter.....	1206
15.11.4 Function Block Flag Code.....	1216
15.11.5 HMI Parameters	1216

15.11.6 Define branch running status (RUN_STAT)	1217
15.11.7 Define Branch Mode (RUN_MODE)	1217
15.11.8 Switch Mode	1217
15.11.9 Algorithm.....	1222
15.11.10 Keep Difference (Only Valid for Differential Method)	1228
15.11.11 Dead Zone	1229
15.12 One Driver Common Motor Control Function Block(MOTOR_PT).....	1229
15.12.1 Parameter Instruction.....	1229
15.12.2 Function Block Panel Parameters.....	1232
15.12.3 Flag.....	1234
15.12.4 Logic Time Sequencing.....	1235
15.13 Positive/Negative Rotating Motor Control Function Block (MOTOR_FM).....	1235
15.13.1 Parameter Description.....	1235
15.13.2 Panel Parameter.....	1239
15.13.3 Flag.....	1240
15.13.4 Logic Time Sequencing.....	1241
15.13.5 Application Example.....	1242
15.14 One Driver Common Motor Control Function Block With Simulation Function (MOTOR_SIM).....	1246
15.14.1 Parameter Description.....	1246
15.14.2 Flag.....	1251
15.14.3 Logic Time Sequencing.....	1252
15.15 Valve Control Function Block With Simulation Function (DIO21V_SIM).....	1253
15.15.1 Parameter Description.....	1253
15.15.2 Flag.....	1258
15.16 WATER_P2H(Computing Specific Enthalpy with Saturated Pressure).....	1258
15.16.1 Parameter Instruction.....	1259
15.16.2 Alarm Status	1259
15.17 WATER_P2S(Computing Specific Entropy with Saturated Pressure).....	1260
15.18 WATER_P2T(Computing Saturated Temperature with Saturated Pressure)...	1260
15.19 WATER_P2V(Computing Specify Volume with Saturated Pressure).....	1261
15.20 WATER_PH2T(Computing Temperature with Pressure and Specific Enthalpy).....	1261

15.21 WATER_PS2T(Computing Temperature with Pressure and Specific Entropy).....	1262
15.22 WATER_PT2H(Computing Specific Enthalpy with Pressure and Temperature).....	1263
15.23 WATER_PT2S(Computing Specific Entropy with Pressure and Temperature).....	1263
15.24 WATER_PT2V(Computing Specific Volume with Pressure and Temperature).....	1264
15.25 WATER_T2H(Computing Specific Enthalpy with Saturated Temperature).....	1265
15.26 WATER_T2P(Computing Specific Pressure with Saturated Temperature).....	1265
15.27 WATER_T2S(Computing Specific Entropy with Saturated Temperature).....	1266
15.28 WATER_T2V(Computing Specific Volume with Saturated Temperature).....	1266
15.29 WATER_TH2P(Computing Pressure with Temperature and Specific Enthalpy).....	1267
15.30 WATER_TS2P(Computing Pressure with Temperature and Specific Entropy).....	1268
16 FF Standard Function Block Library.....	1269
16.1 Foundation Overview.....	1269
16.1.1 Modes.....	1269
16.1.2 I/O Block Channel Setting.....	1270
16.1.3 Failsafe Function.....	1271
16.1.4 Process Alarm.....	1271
16.1.5 Extend Pin.....	1272
16.1.6 Function Block Options.....	1272
16.2 Status Process.....	1274
16.2.1 Pin Status Instruction	1275
16.2.2 Notice of FF and DCS Blocks.....	1278
16.3 FFAI.....	1279
16.3.1 Overview	1279
16.3.2 Parameter Description.....	1279
16.3.3 Instruction Details.....	1284
16.3.4 Panel Parameter.....	1286
16.3.5 Flag.....	1288
16.4 FFPID.....	1288
16.4.1 Overview.....	1289

16.4.2 Parameter Description.....	1289
16.4.3 Instruction Details.....	1299
16.4.4 Panel Parameter.....	1303
16.4.5 Flag.....	1306
16.5 FFAO.....	1307
16.5.1 Overview.....	1307
16.5.2 Parameter Description.....	1308
16.5.3 Instruction Details.....	1316
16.5.4 Panel Parameter.....	1318
16.5.5 Flag.....	1320
16.6 FFDI.....	1321
16.6.1 Overview.....	1321
16.6.2 Parameter Description.....	1321
16.6.3 Instruction Details.....	1325
16.6.4 Panel Parameter.....	1326
16.6.5 Flag.....	1328
16.7 FFDO.....	1328
16.7.1 Overview.....	1328
16.7.2 Parameter Description.....	1329
16.7.3 Instruction Details.....	1334
16.7.4 Panel Parameter.....	1335
16.7.5 Flag.....	1337
16.8 FFARTHM.....	1337
16.8.1 Overview.....	1337
16.8.2 Parameter Description.....	1337
16.8.3 Instruction Details.....	1343
16.8.4 Panel Parameter.....	1346
16.8.5 Flag.....	1349
16.9 FFCTLSL.....	1349
16.9.1 Overview.....	1349
16.9.2 Parameter Description.....	1349
16.9.3 Instruction Details.....	1356
16.9.4 Panel Parameter.....	1357

16.9.5 Flag.....	1359
16.10 FFCUSTOM.....	1359
16.10.1 Overview.....	1359
16.10.2 Parameter Description.....	1360
16.10.3 Instruction Details.....	1366
16.10.4 Flag.....	1366
16.11 FFINT.....	1366
16.11.1 Overview.....	1366
16.11.2 Parameter Description.....	1367
16.11.3 Instruction Details.....	1374
16.11.4 Panel Parameter.....	1378
16.11.5 Flag.....	1380
16.12 FFISEL.....	1380
16.12.1 Parameter Description.....	1381
16.12.2 Instruction Details.....	1386
16.12.3 Panel Parameter.....	1388
16.12.4 Flag.....	1390
16.13 FFISEL_EX.....	1390
16.13.1 Overview.....	1390
16.13.2 Parameter Description.....	1390
16.13.3 Instruction Details.....	1397
16.13.4 Panel Parameter.....	1397
16.13.5 Flag.....	1399
16.14 FFMAI.....	1399
16.14.1 Overview.....	1399
16.14.2 Parameter Description.....	1399
16.14.3 Instruction Details.....	1405
16.14.4 Panel Parameter.....	1406
16.14.5 Flag.....	1408
16.15 FFMAO.....	1408
16.15.1 Overview.....	1408
16.15.2 Parameter Description.....	1408
16.15.3 Instruction Details.....	1414

16.15.4 Panel Parameter.....	1415
16.15.5 Flag.....	1417
16.16 FFMDI.....	1417
16.16.1 Overview.....	1417
16.16.2 Parameter Description.....	1417
16.16.3 Instruction Details.....	1422
16.16.4 Panel Parameter.....	1423
16.16.5 Flag.....	1425
16.17 FFMDO.....	1425
16.17.1 Overview.....	1425
16.17.2 Parameter Description.....	1425
16.17.3 Instruction Details.....	1431
16.17.4 Panel Parameter.....	1432
16.17.5 Flag.....	1433
16.18 FFSGCR.....	1433
16.18.1 Overview.....	1433
16.18.2 Parameter Description.....	1434
16.18.3 Instruction Details.....	1441
16.18.4 Panel Parameter.....	1442
16.18.5 Flag.....	1444
16.19 FFSPLIT.....	1445
16.19.1 Overview.....	1445
16.19.2 Parameter Description.....	1445
16.19.3 Instruction Details.....	1452
16.19.4 Panel Parameter.....	1455
16.19.5 Flag.....	1456
17 Revision.....	1457

1 About

This user manual mainly introduces the working principles, configuration methods, monitoring methods and application examples of the function blocks in the OMC system configuration software.

- Working principle: For some complex function blocks, introduce their working principle and internal processing logic.
- Configuration Method: Mainly introduces the various parameters of the system function blocks and the configuration requirements of the parameters, etc. The content is mainly in the "Parameter Illustration" of each function block. For the detailed configuration method of the function block, please refer to the *VFFBDBuilder User Manual*.
- Monitoring method: It mainly introduces the panel example of the system function block in the real-time monitoring system and the meaning of each parameter in the panel. This content is mainly in the "Function Block Panel Parameter" section of each function block. For detailed monitoring methods of function blocks, please refer to Function Block Panel.
- Application examples: For some complex function blocks, the application methods of function blocks in actual projects are introduced. This content is mainly in the "Application Examples" of each function block.

2 Overview

The function block is the conversion of a part of the program code block that is used repeatedly into a general component that can realize a certain function.

2.1 Classification and Composition

The function block types provided by the the system software are as follows:

- Control Function Block Library
- Logical Control Function Block Library
- Analog Process Function Block Library
- String Process Function Block Library
- Selection Operation Function Block Library
- Arithmetic Operation Function Block Library
- Logic Operation Function Block Library
- Comparison Function Block Library
- I/O Process Function Block Library
- Sequential Control Function Block Library
- Communication Auxiliary Function Block Library
- Inter-Station Communication Function Block Library
- Industry Function Block Library
- FF Standard Function Block Library
- Custom Function Block Library

Among them, the custom function block library contains user-defined function blocks according to on-site requirements. For details on how to develop methods, please refer to the *VFSTModule User Manual*.

2.2 Active/Inactive

In the function block programming software VFFBDBuilder, the input status and output status of the function block can be configured as active or Inactive. Different status determine whether the input/output data of the function block can be transmitted normally between upstream and downstream blocks.

The following table illustrates the effect of the input/output status of the function block on the input and output data.

Table 2.1 Relation between the input and output status and data

Input Status	Output Status	Function Block Input	Function Block Output	Application
Active	Active	Output from the upstream	As downstream input	Set by default, normal transfer
Active	Inactive	Output from the upstream	Not as downstream input	make debugging produce no disturbance
Inactive	Active	Remain values of last period or set values manually	As downstream input	Debug
Inactive	Close	Remain values of last period or set values manually	Not as downstream input	Debug

**TIP:**

Switching the input/output status of the function block may affect the processing of the input/output data by the function block. Please confirm before performing the switch.
After changing the input and output status of the function block, you need to re-download the corresponding FBD program before you can enter the online debugging.

2.3 Flag

The function block flag objectively displays the function block's working mode, alarm and status information. It is calculated based on the current function block status and does not support manual modification. The flag is a set of decimal numbers, which should be converted into binary numbers in actual use, and then the meaning of each digit should be determined according to the content of the "Flag" section of each function block. When a binary number is 1, it means that the function block is in the status corresponding to that bit.

For example: the value of the flag of the conventional PID function block is "33554433", the decimal value is converted into a binary number as "100000000000000000000001", the 0th and 25th digits are 1, and the corresponding status of the function block is D0 of the flag table and the status of D25, that is, the function block is prohibited and the alarm is shielded.

2.4 Data Type

The table below shows data type each parameter supports:

Table 2.2 Parameter table of data types

Type	Byte	Range	Illustration
BOOL	1	ON/OFF	0=OFF, not 0=ON
USINT	1	0~255	-

Table 2.2 Parameter table of data types (continued)

Type	Byte	Range	Illustration
SINT	1	-128~127	-
UINT	2	0~65535	-
INT	2	-32768~32767	-
UDINT	4	0~4294967295	-
DINT	4	-2147483648~2147483647	-
REAL	4	$(-10^{38.53} \sim -10^{-44.85} \text{ } 0 \text{ } 10^{-44.85} \sim 10^{38.53})$	Exponent part has 8 digits and the decimal part has 23 digits.
STRING	64	ASCII character set, 'A','b' and so on.	-

2.5 Parameter Property and Parameter Setting Illustration

Function block parameters can be divided into operating parameters, configuration parameters, monitoring parameters, alarm parameters, input pins and output pins.

- **Operating parameters**
The parameter setting can usually be realized by calling the function block panel in the system running status. The operability of specific parameters is also related to the working mode of the function block.
- **Configuration parameters**
Set parameters when executing FBD programming. When it is programming, open the function block properties window to set the corresponding parameters.
- **Monitoring parameters**
Monitoring parameters are parameters that can be displayed on the monitoring screen or panel when the system is running.
- **Alarm parameters**
Used to set the alarm enable of various parameters. You can enter the alarm enable dialog box through the function block properties window to check.

- Input pins and output pins

For the connection objects of input pins and output pins, refer to the "Application Examples" column in the parameter list of each function block.



ATTENTION:

- In addition to configuration and monitoring parameters, other various parameters can be modified during commissioning.
 - The function block attribute setting interface is divided into two sub-setting interfaces, basic parameter and extended parameter. For regular PID adjustment and control, only basic parameter setting is required.
-

2.6 Function Block Panel

Function block evolves from instrument panel, which includes information list of function block and operation commands of operators. It has 3 functions: monitor and modify status and parameters of function block, set parameters and operation and switch to different supervision panels.

Only complex function blocks, which can be renamed as they are in the configuration status, have function block panels, while simple function blocks don't have function block panels.

In the Real-time monitoring software, the function block panel can be opened in the following ways:

- Click the "Find" button on the monitoring meter header, and enter the corresponding function block number to open its panel;
- In the flowchart screen, the panel can be opened by the associated function block number;
- Open the control grouping screen, and the associated function block panel can pop up;
- In the trend screen. The panel can be opened through the associated function block number;
- In the process alarm table, you can open the function block panel associated with the alarm information.

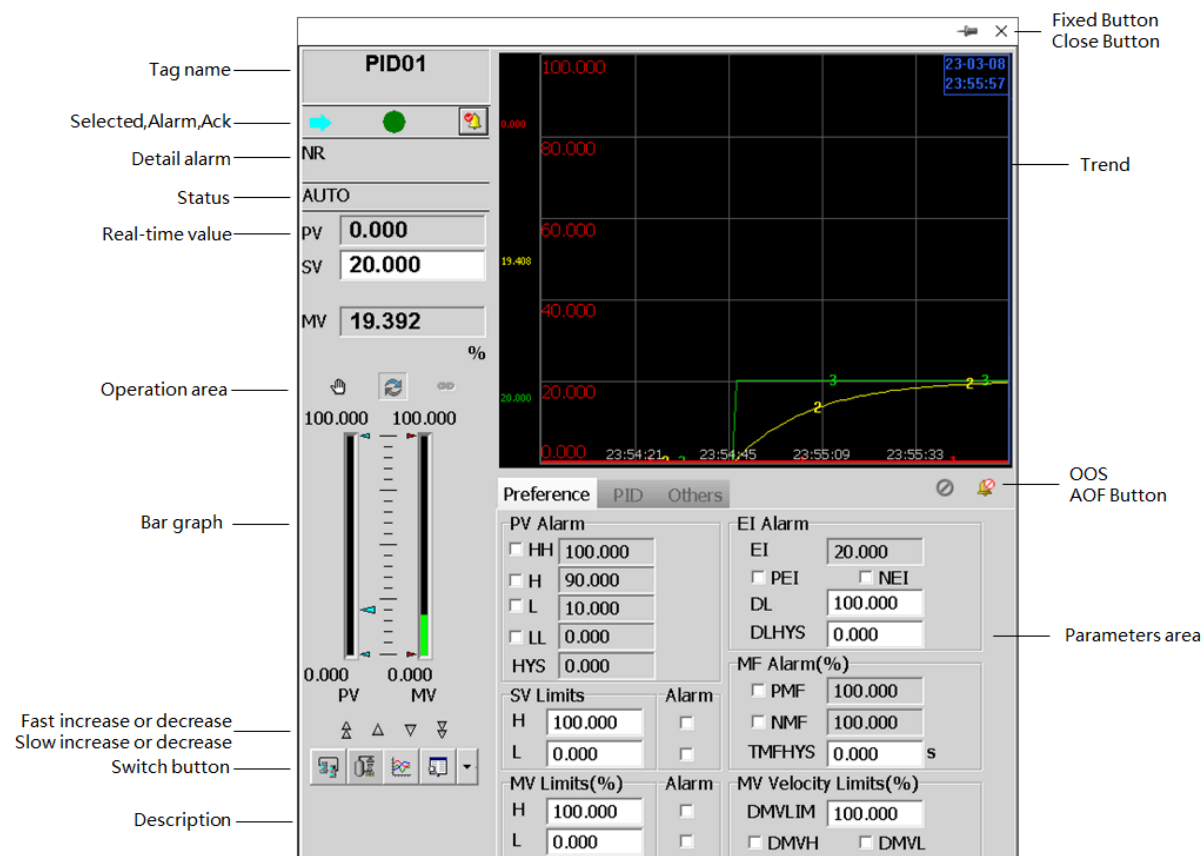





Figure 2.1 Window of panel layout of function block and function block pane

2.6.1 Fixed Button

The button is on the top right of the pop-up panel. When click the button , it will become  and the panel will always be on top.

2.6.2 Close Button

The button  is on the top right of the panel and there is no close button on the panel of control group display.

2.6.3 FB Tag Name

Tag name or instance name of function block will be displayed in the part of tag instance name, which is used to distinguish function blocks.

2.6.4 Selected, Alarm, ACK



Select: Select the panel to be operated currently.



Alarm: indicate alarm status of the tag which the panel corresponds to.



ACK: Alarm acknowledgement of corresponding tags is implemented.




2.6.5 Detailed Information of Alarm

Display the current alarm information (such as HH, LL and so on) and status (such as manual, auto, cascade and OOS, etc.) of tags or function blocks.

2.6.6 Analog Data Area

Display value and unit of analogy in tag or function block, for example, PV, MV, SV in PID function block.

2.6.7 Basic Operation Area

Basic operation of operators area in tag or function block, which includes manual , auto , cascade , is used to set work status of function block.

2.6.8 Digital Button or Analog Bar Diagram Display Area

- Digital data: display digital value by bottom. Text likes “ON” or “OFF” will be shown on the button. DI and DO button color can be set when configuring tag.
- Analog data: Real-time values of import parameters are dynamically displayed in form of histogram. High and low span values are displayed on two sides of scale. There are also marks of HH Limit, high Limit, low Limit and LL Limit. Color of bar diagram is same with alarm status of function block or tag. As shown below, the bar diagram is green because there parameter has no alarm.

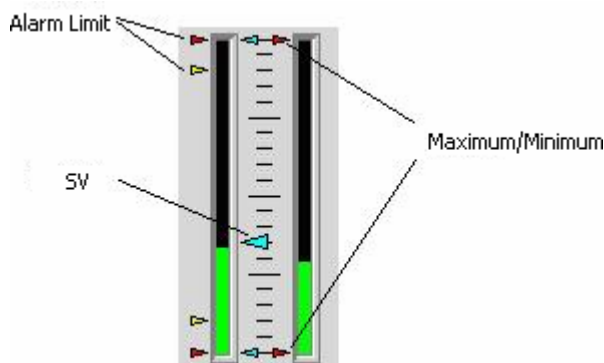






Figure 2.2 Trend display

Color of bar diagram is shown by following rules:

- If tag only has H limit alarm, color of bar diagram is shown as configured in monitoring configuration for H limit alarm.
- If tag has H/ HH limit alarms together, color of bar diagram is shown as configured in monitoring configuration for HH limit alarm.
- Other alarms are also shown in the same manner.

2.6.9 Auxiliary Operation Area

Data can be operated by keyboard besides by basic operation buttons.

1.  Fast-increased button: set the percentage when configuring function block properties. The default value is 2.5%.
2.  Slowly-increased button: set the percentage when configuring function block properties. The default value is 0.25%.
3.  Slowly-decreased button: its value is the same as the slowly-increased value.
4.  Fast-decreased button: its value is the same as the fast-increased value.

2.6.10 Switchover Button Area

There are 5 switchover buttons at the bottom of the panel, from left to right, logic diagram, graphics button, trend display button, adjust screen button, and drop-down button:



Figure 2.3 Switchover buttons

- Logic diagram button: Pop up the logic diagram associated with tag (set in VFFBDBuilder). The button will be grey and cannot be clicked if the function block isn't configured in logic diagram.
- Graphics button: Pop up graphics associated with the tag (set in supervision configuration). The button will be grey and cannot be clicked if the function block isn't configured in graphics.
- Trend display button: Pop up trend display associated with the tag (set in supervision configuration). The button will be grey and cannot be clicked if the function block isn't configured in trend.
- Adjust screen button: the adjust screen pops up.
- Drop-down button: Click to select the screen you want to view in the extended menu.
 - Select "Alarm Screen" to jump to the process alarm associated with this tag.
 - Select Operation Log to jump to the operation log associated with this tag.

2.6.11 Tag Description

Display description information of the tag or function block. It includes 64 English characters or 32 Chinese characters.

2.6.12 Operation Authority of Panel


There are operation authorities for each parameter in panel or tuning panel, which can be set in panel authority setting of supervision configuration software.

There are ten Authorities, including: unavailable, operator-, operator, operator+, engineer-, engineer, engineer+, privilege-, privilege, privilege+.

2.6.13 Operator Keyboard Operation

Some parameters can be operated by operator keyboard:

DO digital operation, fast-increased and fast-decreased of function block operation

 and tuning panel switch.

2.6.14 Function Block Panel Example

PID Tuning Panel is shown in the figure below.

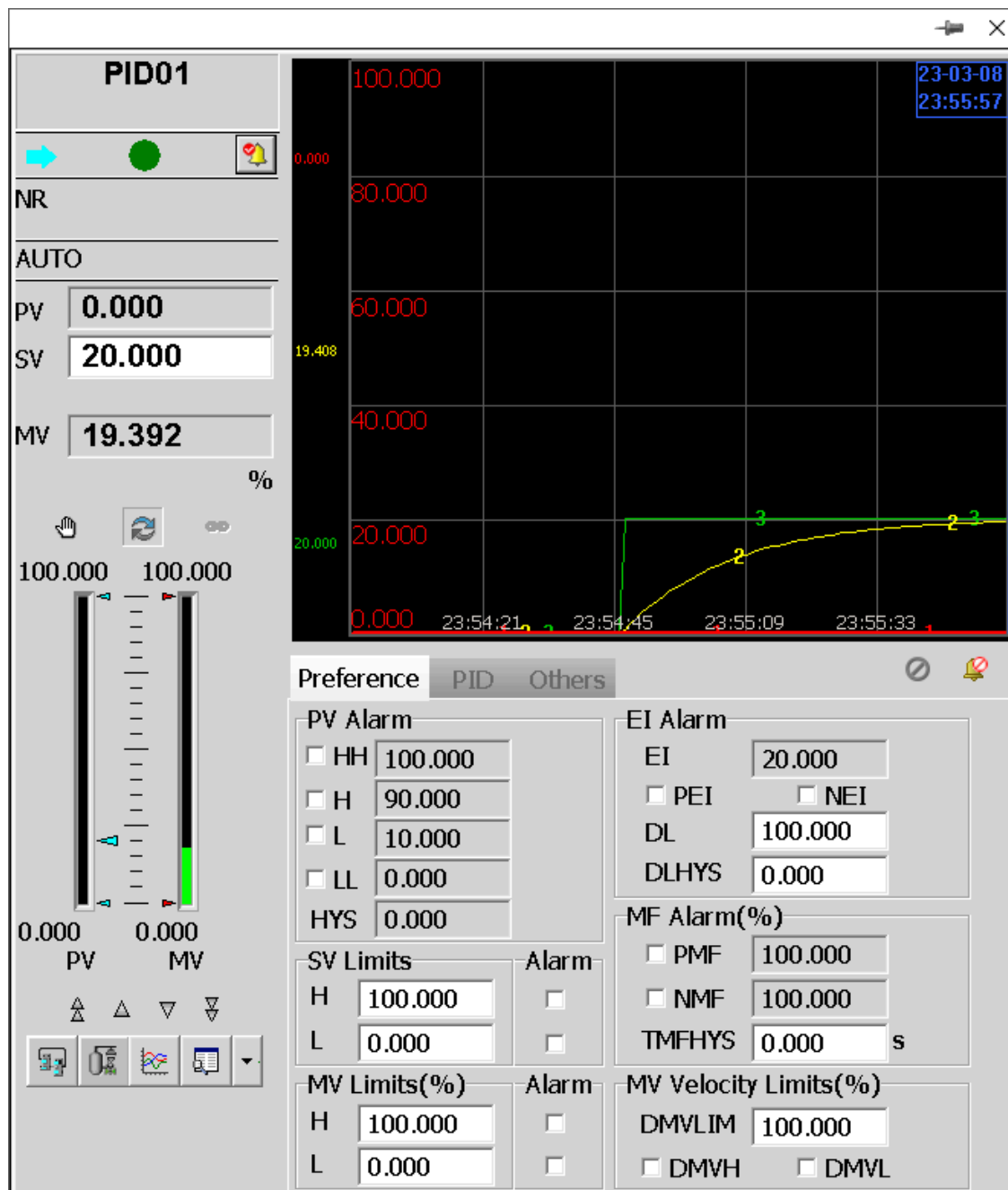





Figure 2.4 PID tuning panel













Main operations can be implemented on function block panel is shown as follows:

1. Status Switch

Click , ,  to switch work status. As shown in Figure 2.4 the function block is in the auto status, and the status area displays “AUTO”.

2. Set Value for SV&MV

The value of SV can be set in the status of auto while the value of MV can be set in the status of manual. Two modes of setting value are shown as follows:

- Input the value via keyboard and then press “Enter”.
- Click     to set value. ,  are fast increase button and normal increase button, ,  are fast decrease button and normal decrease button. The fast increase/decrease values are set in the function block properties interface. As default, click  once to increase by 2.5% of range, click  once to increase by 0.25% of range, click  once to decrease by 0.25% of range, click  once to decrease by 2.5% of range.

3. Parameter Setting

- Set parameter via select the “select box “or not.
- Modify parameter value via Input the value and press “Enter”.

- Some parameters such as HH Limit, high Limit, etc, should be selected the “select box” first, and then the corresponding parameter will be modified, as shown in Figure 1-4.





Figure 2.5 Set the HH limit

4. Switchover Window



Click to switch to corresponding window. Logic diagram should be configured in VFFBDBuilder, and graphics and trend should be configured in VFHMICfg first.

5. Alarm Acknowledgement and Alarm Shield

- Click  to acknowledge alarm.
- Click  to implement alarm shield or cancel alarm shield.

6. Parameter Page Switch

Click **Preference** **PID** **Others** to switch to each parameter page.

7. Trend View

Right-click on the trend display area of function block tuning panel, then implement trend setting in the pop-up right-click menu, as shown in Figure 2.6. The function of commands in right-click menu is the same as the right-click menu in trend display, please refer to *Real-time Supervision Software User Manual* for the corresponding instruction. Your changes will be automatically saved.

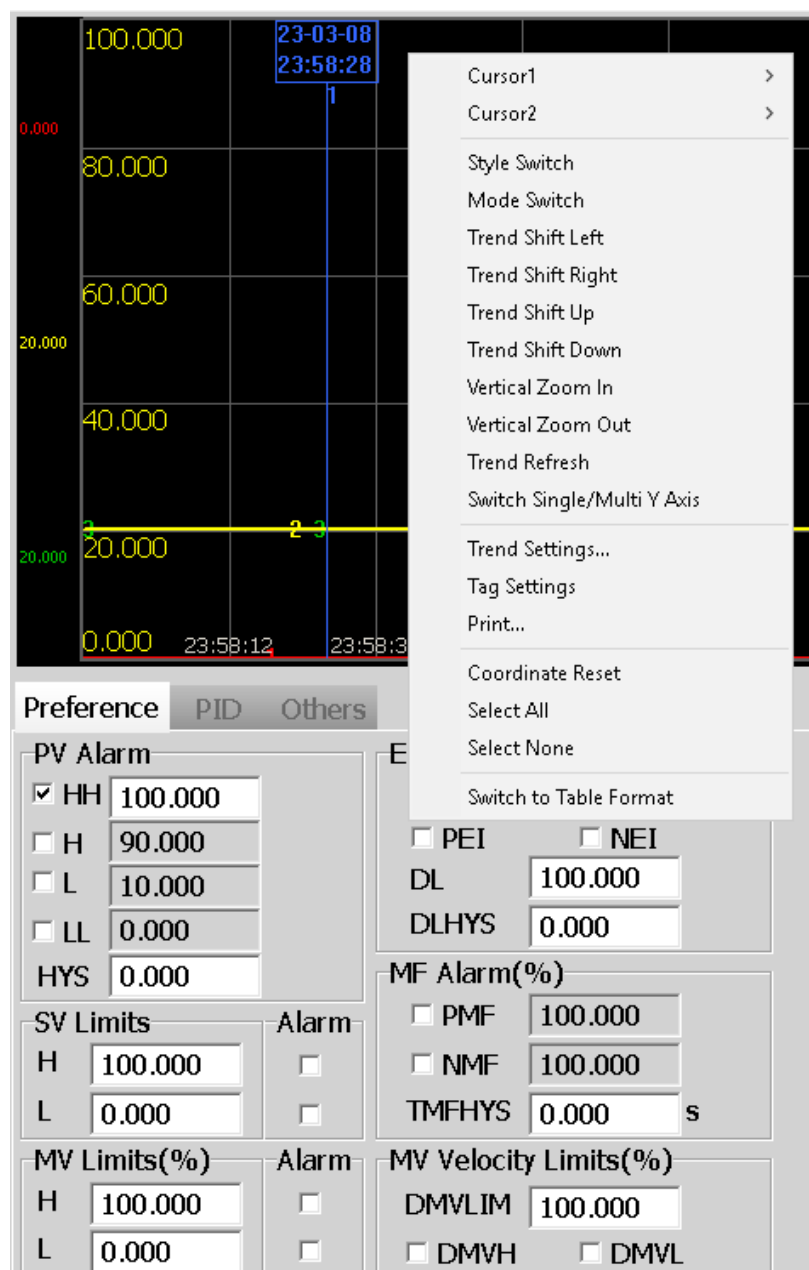


Figure 2.6 Trend view

3 Control Function Block Library

The control function block library contains 16 control function blocks. They are complex function blocks and each has corresponding function block panel, and can invoke the function block panel in the monitoring software.

3.1 Working Modes of Function Block

In order to cope with different application scenarios, a variety of working modes are designed for the function blocks, and different working modes represent different control status and output status information of the function blocks.

The control function block supports multiple basic working modes, and the logic operation and input and output processing of the function block are different under different working modes.

According to priority from high to low, the working modes of the function blocks are: OOS (Out of Service), IMAN (Initialization Manual), TR (Tracking), ROUT (Remote OUT), RCAS (Remote Cascade), MAN (Manual), AUTO (Automatic) and CAS (Cascade).

The function block will only be in any one of the modes when it is working, and the parameter MODE will correspondingly display the priority number of the current mode. Each working mode supports manual setting, and the function block can calculate the working mode that the current parameter satisfies. The corresponding parameter conditions in each working mode are shown in the following table:

Table 3.1 Function block working modes and parameter condition

Mode	Number	Priority	Parameter condition						
			SWOOS	BKINERR	SWTR	SWROUT	SWCAS	SWAM	SWSV
OOS	1	<div style="display: flex; align-items: center; justify-content: center;"> <div style="text-align: center; margin-right: 5px;">↑</div> <div style="text-align: center; margin-right: 5px;">High</div> <div style="text-align: center; margin-right: 5px;">↓</div> <div style="text-align: center; margin-right: 5px;">Low</div> </div>	ON	—	—	—	—	—	—
IMAN	2		OFF	ON	—	—	—	—	—
TR	3		OFF	OFF	ON	—	—	—	—
ROUT	4		OFF	OFF	OFF	ON	—	—	—
RCAS	5		OFF	OFF	OFF	OFF	ON	—	—
MAN	6		OFF	OFF	OFF	OFF	OFF	OFF	—
AUTO	6		OFF	OFF	OFF	OFF	OFF	ON	OFF
CAS	7		OFF	OFF	OFF	OFF	OFF	ON	ON

Note: "—" in Table 3.1 means that the parameter can be either ON or OFF.

Taking into account the different levels of complexity between the function blocks, the working modes held are also slightly different. The following table shows the working modes supported by each function block in the control function block library.

Table 3.2 Working modes each function block supports

Function Block	Working Mode									
	OOS	IMAN	TRACK	ROUT	RCAS	MAN	AUTO	CAS	EM-MAN	OR
PID	√	√	√	√	√	√	√	√	–	–
PIDEP	√	√	–	√	√	–	√	–	–	–
PIDEX	√	√	√	–	–	√	√	√	√	–
EPID	√	–	–	–	–	–	√	–	–	–
LEPID	√	–	√	√	√	–	√	–	–	–
PID_TP	√	√	–	√	√	√	√	√	–	–
PI_PLS	√	√	√	–	–	√	√	√	–	–
PD_SI	√	√	√	–	–	√	√	√	–	–
PI_AE	√	√	√	–	–	√	√	√	–	–
RATIO	√	√	√	–	–	√	√	√	–	–
SPLIT	√	√	√	–	–	√	√	√	–	–
MANUAL	√	√	√	–	–	√	√	–	√	–
MANUAL_EP	√	√	√	–	–	√	√	–	–	√
ASH	√	√	–	–	–	–	√	–	–	–
ASL	√	√	–	–	–	–	√	–	–	–
FOUT	√	–	–	–	–	–	√	–	–	–

Refer to the parameter description of each function block for the parameter conditions corresponding to the different modes of each function block.

3.1.1 OOS

When the function block is in this status, the function block stops computing, and the output MV keeps the set value (the last cycle value MV or the safety value OOSVAL) unchanged, but the

data multicast, parameter validity check and redundancy processing continue as usual. When the function block is downloaded to the controller for the first time, it is recommended to use the OOS status.

3.1.2 Initial mode (IMAN)

When the function block enters the initial status, its output MV tracks the change of the feedback input value (BKIN) of the function block, and BKIN needs to be connected with the inversion calculation output value (BKOUT) of the downstream function block. At this time, the function block can only switch to OOS mode, and cannot enter other modes.

When the function block meets the following conditions, it enters the initial status:

- The upstream control function block connected to the AO function block enters the initial stage when the AO function block is in forced, tracking or AO tag failure.
- When two control function blocks form a cascade loop, if the downstream function block is in a non-cascade status, the upstream function block enters the initial status.
- For split-range control (SPLIT), only when BKINERR1=ON and BKINERR2=ON, the function block is in IMAN status.

3.1.3 Track (TR)

When not in OOS mode and IMAN mode, the tracking switch SWTR is equal to ON to enter the tracking mode. The SWTR status is set by the external contact input or the output signal of other function blocks.

- The output MV follows the change of the input value TV.
- MV still has a limiting effect. If the TV value exceeds the limiting range, it will be forced to the limiting value, that is, $MV=MVL$ when $TV<MVL$, and $MV=MVH$ when $TV>MVH$.

3.1.4 Manual (MAN) / Auto (AUTO)

When the OOS, IMAN and TR modes are not generated, the manual automatic selection switch SWAM=OFF enters manual mode, and SWAM=ON enters automatic mode.

- In manual mode, the output value MV can be directly set manually. $MV=MANMV$, output MV has a limiting effect.
- In automatic mode, the output value MV is calculated and output according to the control algorithm. BKOUTERR=OFF when in automatic mode, and BKOUTERR=ON in other modes.

3.1.5 Remote Cascade (RCAS)

When the high priority mode is not satisfied, when SWRCAS equals ON, it enters remote cascade mode and the setting value changes with the RSV value

3.1.6 Remote Out (ROUT)

When the high priority mode is not satisfied, and SWROUT equals ON, it enters remote manual mode and the output changes with the RMV value.

3.1.7 Cascade (CAS)

- When the function block is in automatic mode, the cascade switch SWSV=ON enters the cascade CAS mode, and SWSV=OFF returns to the automatic mode.
- In the cascade mode, the set value SV is equal to the cascade set value CSV, and the output value MV is calculated and output according to the control algorithm..

3.1.8 Force Manual (EMMAN)

In the MANUAL function block of the Communicator, when OOS, IMAN and TR modes do not occur, the force manual switch EMMAN=ON enters the force manual mode.

The force manual mode is based on safety considerations, and only allows the switching of the upper-level tracking mode, which can effectively avoid the manual to automatic switching caused by improper operation on the function block panel.

When force manual, the output value MV can be set manually by MANMV directly, $MV=MANMV$.

3.1.9 Override (OR)

In the MANUAL_EP function block of the power manual, when the OOS, IMAN and TR modes do not occur, the override input switch OS=ON enters the override mode.

In the override mode, the output value MV changes with the override input value OV.

3.2 Application Foundation of Control Function Block

Basic work flow of control function block is shown as Figure 3.1.

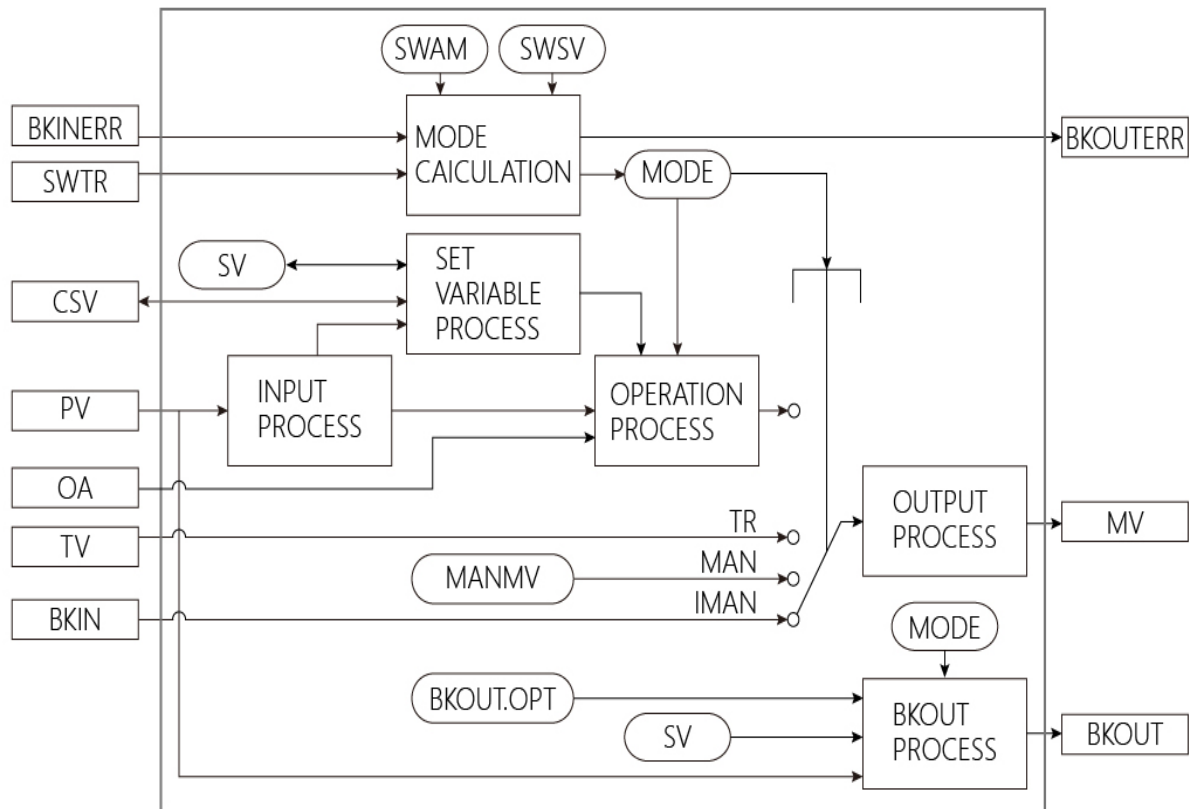


Figure 3.1 Basic work flow of control function block

The left parameter represents the input pin of the function block, the right parameter represents the output pin of the function block, and the middle represents the logic operation inside the function block. The above figure describes the basic workflow of the control function block, and the pin parameters of different function blocks may be slightly different.

3.2.1 Transition Process of Function Block Modes

The process of changing a function block from one working mode to another is called mode transition. The function block mode transition is divided into manual fallback and automatic fallback.

- Manual fallback refers to the function block falls back from the initial status IMAN mode or TR mode to manual MAN mode. By default, the fallback mode of the function block is manual fallback (ie, MODE_OPT=OFF). The manual fallback process of the control function block is shown in Figure 3.2.
- Automatic fallback is based on the priority of the function block working mode, that is, according to the mode calculation, starting from the OOS mode with the highest priority operation, the current function block is determined to meet the working mode, and then back to the working mode.

The standby working mode IMODE (the last working mode the function block is in) corresponding to each working MODE can provide a reference for operators in field.

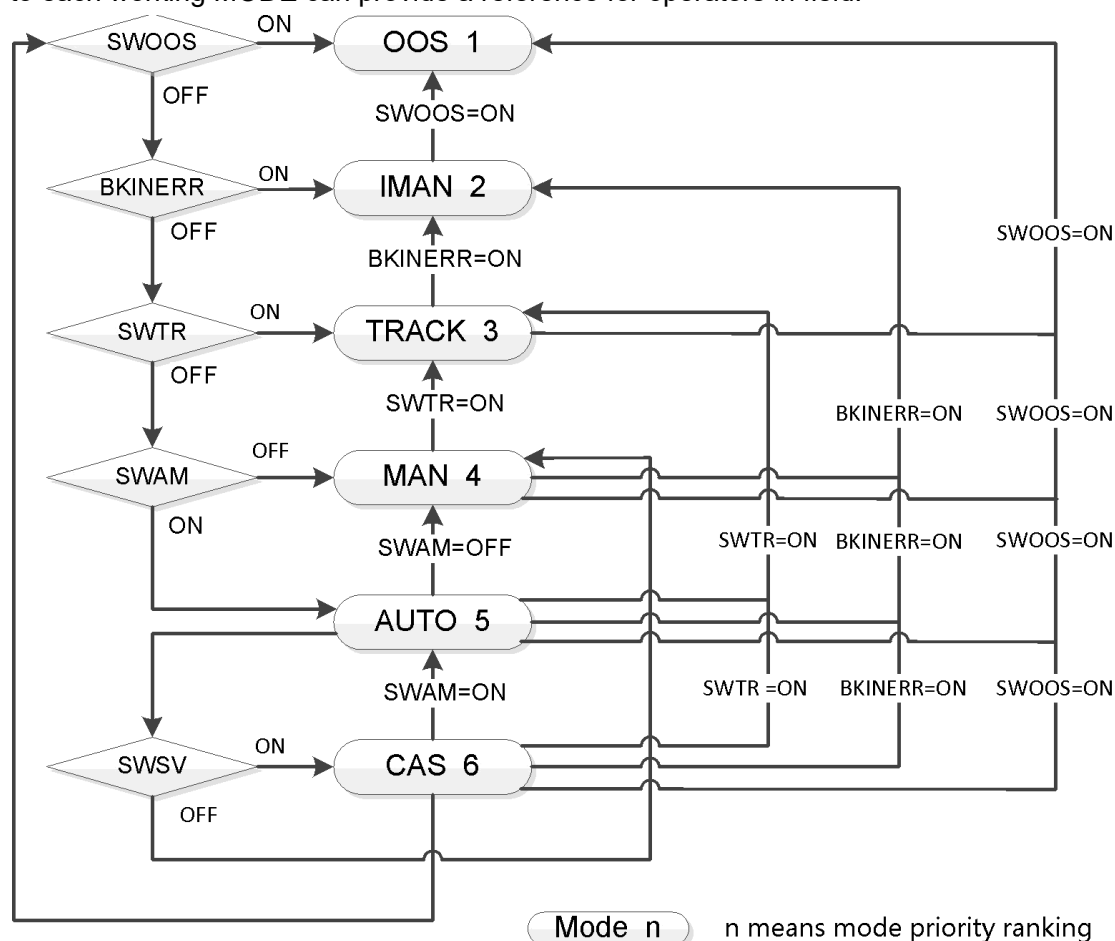


Figure 3.2 Manual fallback mode of control function block

3.2.2 Input Process

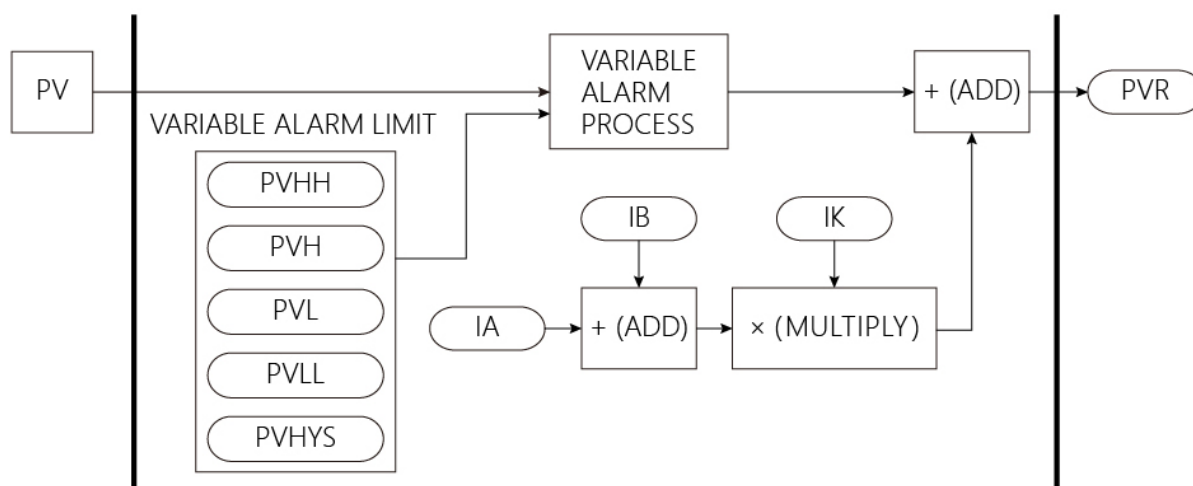


Figure 3.3 input process of control function block

1. Process variable alarm

There are four limit alarm for process input variables: HH limit alarm (PVHH), high limit alarm (PVH), low limit alarm (PVL) and LL limit alarm (PVLL), which are hysteresis. When PV is greater than or equal to PVHH, HH limit alarm and high limit alarm are generated; When PV is greater than or equal to PVH, high limit alarm is generated; When PV is less than PVL, low limit alarm is generated; When PV is less than or equal to PVLL, LL limit alarm and low limit alarm are generated.

Following conditions should be reached for these four values: $PVHH - PVHYS \geq PVH$, $PVH - PVHYS > PVL + PVHYS$, $PVL \geq PVLL + PVHYS$. PVHYS is PV alarm hysteresis value.

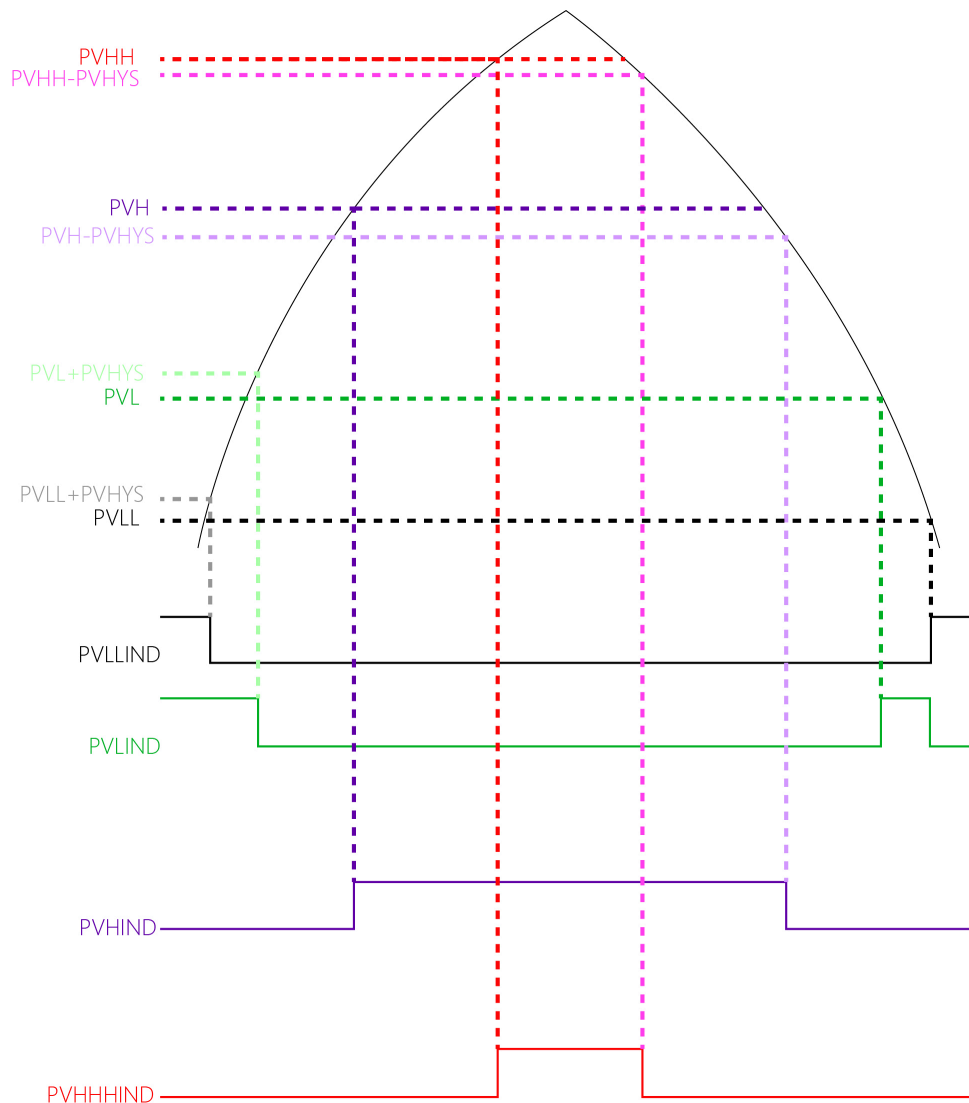


Figure 3.4 Alarm process of control function block

2. Input compensation

Input compensation is used to add compensation value derived outside to input signal PV operated by control function block. Mainly used to improve the controllability of process control with long dead zone value. The expression is:

$$PVR = PV + IK(IA + IB)$$

Input compensation is used to improve controllability of process with long deadband.

3. Check Validity

Note: Only function blocks PID, PIDEK and PIDEK have the function.

Check the validity of PV after input compensation, which can exclude the PV noise signal caused by transducer disturbance and signal transmission interference.

Enable the function via SWPV. That is, the validity check is enabled when SWPV=ON. If PV exceeds the check limit PVLMT after compensation of this and last periods, and it happens for the first time continuously, this period is applied for holding PV in PID calculation. There will be no filter after exceeding once continuously because the signal may change quickly.

3.2.3 Set Variable Process

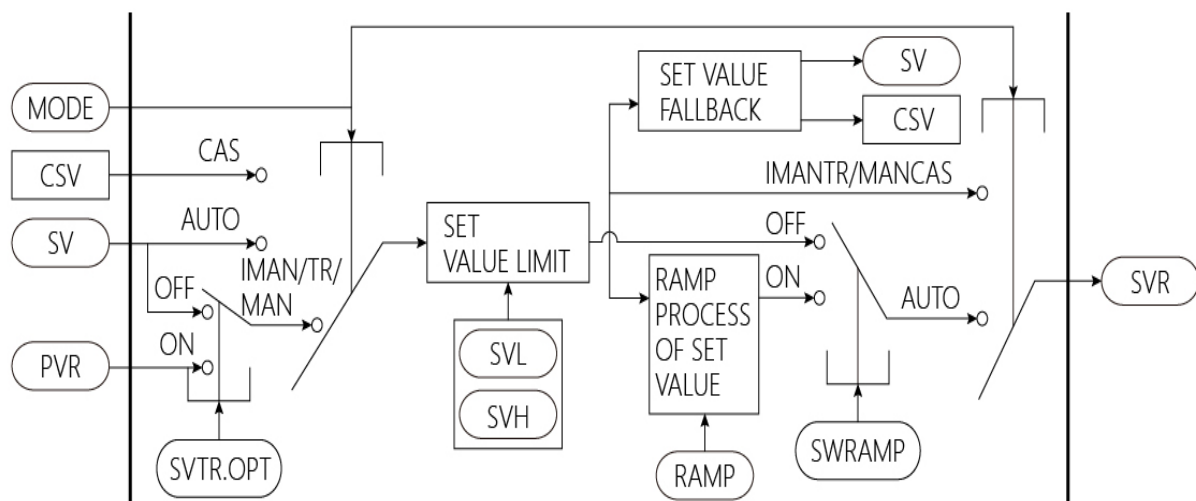


Figure 3.5 Set variable process of control function block

1. Set value limit and alarm

When the control mode is transferred from manual mode to auto mode or from track mode to auto mode, there may be huge error, which cause MV fluctuate to bump. Therefore, in manual or track mode, forced SV tracks change of PV after output compensation (PVR), which can avoid bumping when the control mode is transferred from manual mode to auto mode and from track mode to auto mode.

In the cascade control loop, the master loop can run in auto or cascade mode. If the slave loop is transferred from cascade mode to auto mode, the cascaded loop is open, the master loop is in IMAN mode and the slave loop can be controlled separately. In this case, SV of the master loop can be consistent with PV by tracking PV.

Whether process value is tracked by set value can be selected by SVTR_OPT: When SVTR_OPT is ON, track; When SVTR_OPT is OFF, not track. When it is in not track mode, there is slight bump, transferring from manual to auto.

If PVR is over SVH and SVL, SV is equal to range limit and not equal to PVR.

2. Set value limit and alarm

High limit of set value (SVH) must be greater than or equal to low limit of set value (SVL).

Otherwise, limit will not be processed and configuration error alarm (CFGERR) will be generated.

Set $SVL \leq SV \leq SVH$, when the set value exceeds the range specified by SVH and SVL, it will be limited to the high and low limits of the set value and alarm. Similarly, if it is in the external given status, if CSV is between SVH and SVL, $SV = CSV$, if $CSV > SVH$, then $SV = SVH$, if $CSV < SVL$, then $SV = SVL$.

3. SV and CSV

There are two set values in the control function block, SV and CSV. When one is used, the other will be consistent with this.

4. Ramp action of set value

Ramp action of set value indicates that in auto or cascade mode, when the set value is changed, the set value inclines to SV according to the set ramp RAMP and RAMP is in unit of second. Ramp action of set value is enabled or disabled by switch SWRAMP. When SWRAMP is ON, ramp action of set value is enabled; When SWRAMP is OFF, ramp action of set value is disabled.

Note: PIDEX function block's set value has two modes, which are set in parameter PAMPMODE. For details, refer to "Parameter Illustration" of PIDEX function block.

3.2.4 Operation Process

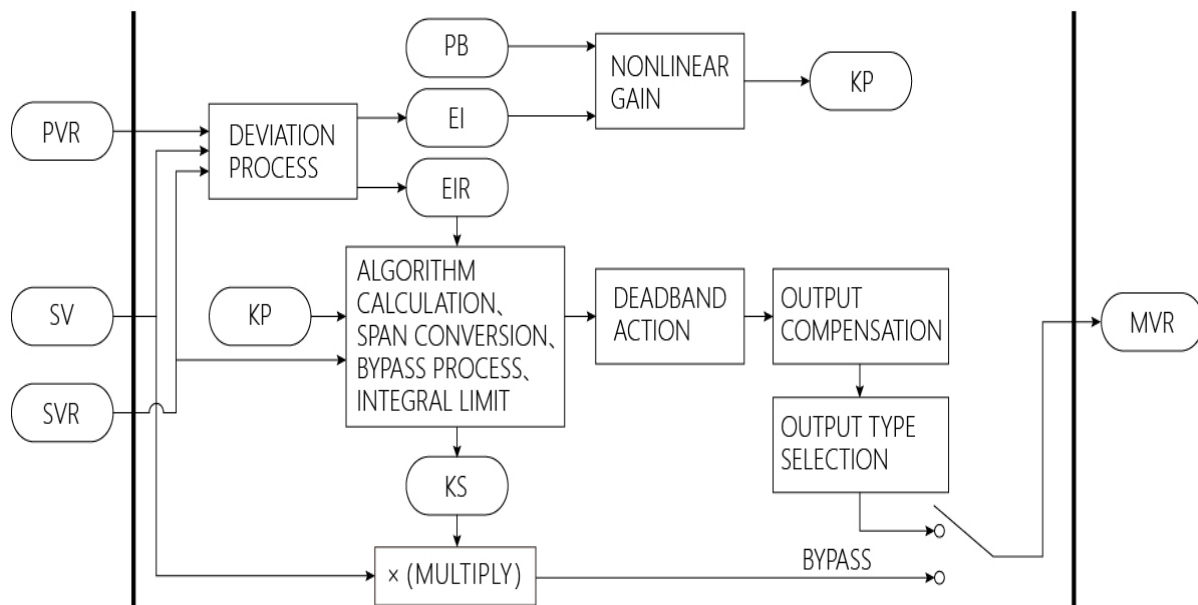


Figure 3.6 Operation process of control function block

1. Nonlinear gain

The function of nonlinear gain can process processes with nonlinear gain by providing a gain contrary to the process, for example, PH control, its process gain will become very big near the target value.

The actual proportion gain KP can be gained by revising proportion gain 100/PB nonlinearly (PB cannot be less than 0.1).

The function block provides two kinds of nonlinear gain, including gap action and EI square action.

- Gap action

When deviation EI is in the set nonlinear gain range GW, whose range is [SCSCL-SVSCH], the actual proportion gain KP is $100.0/PB \cdot KN$, KN is gain factor whose valid range is [0.0, 1.0].

When deviation EI is out of the nonlinear gain range GW, the actual proportion gain is

$$KP = [1 - (1 - KN) \cdot \frac{GW}{|EI|}] * 100.0 / PB$$

- EI square action

When deviation EI is in the set nonlinear gain range GW, the actual proportion gain is

$$KP = \frac{|EI|}{GW} * 100.0 / PB$$

When deviation EI is out nonlinear gain range GW, the actual proportion gain KP is 100.0/PB.

Gap action (NGN_OPT=ON) and EI square action (NGN_OPT=OFF) can be selected by the nonlinear gain option parameter NGN_OPT.

2. Deviation deadband action

Some process control system, such as tank level control system, is not required to control the tank level at the set value accurately and the tank level can change in the set range. In this case, deviation deadband action is introduced to avoid adjustment valve acting frequently and system oscillation.

When absolute value of deviation EI between SV and PV is less than deviation deadband DB minus hysteresis value DBHYS, dMV is set 1 (except PD_SI block, MV is set 0) and output value MV is not changed (if DB is equal to DBHYS, dMV is not 0 for the action of deviation deadband); When deviation EI is greater than DB, the deadband action is disabled and output value is added dMV, shown as Figure 3.7.

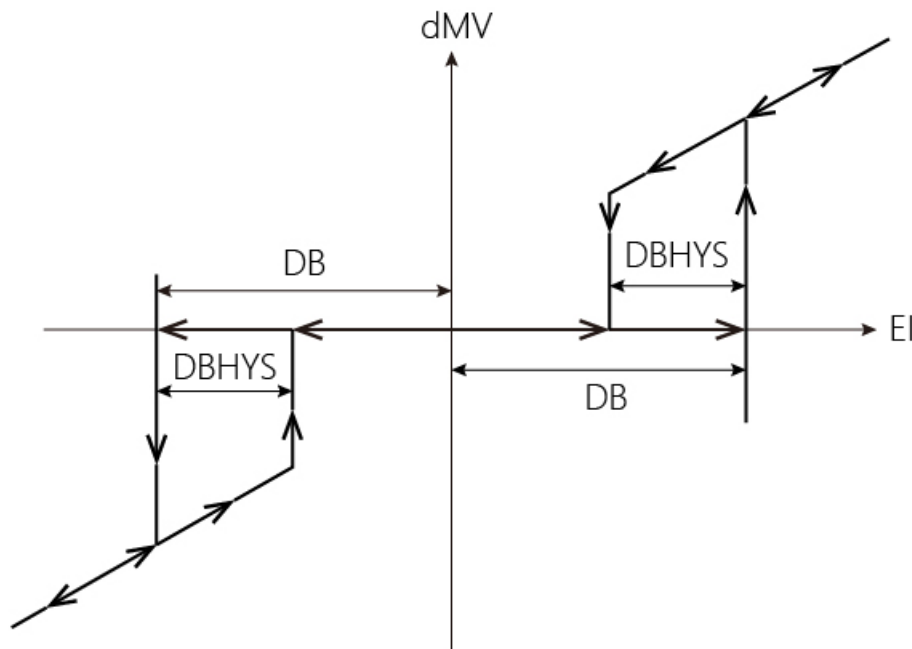


Figure 3.7 Deviation deadband action

When the deviation deadband action switch SWDB is ON, deviation deadband action is enabled. When SWDB is OFF, deviation deadband action is disabled.

3. Bypass action

Bypass action is available only in auto or cascade mode.

When STOPI is ON, integral action is unavailable. Only PID, PI_PLS and PI_AE function block have integral stop function.

When STOPP is ON, integral action is not available.

When bypass output is calculated (BYPASS=ON), output $MV = (SV - SVSCL) \cdot KS + MVSCL$.

SV—Set value

SVSCL—Low limit of set value range,

MVSCL—Low limit of output value range.

KS—Range conversion coefficient

4. PID single function stop

When STOPI=ON, the integral action is not executed, function blocks PID, PI_PLS, PI_AE, PIDEX, PID_TP, LEPID and PIDEP have the integral stop function.

When STOPP=ON, the proportional action is not executed.

When TD is 0, the derivative action is disabled.

Similarly, P, I action controlled in PI_PLS and PI_AE can be disabled. P, D action controlled in PD_SI can be disabled. Bypass action of function blocks is available only in the control calculation stage and does not affect these values in the holding stage.

5. Deviation process

- Direct or reverse action

When set value SV is fixed and direct action is available, increment of PV will cause MV value to increase; when reverse action is available, increment of PV will cause MV value to decrease. Direct action (SWPN=OFF) and reverse action (SWPN=ON).

$EI = SV - PV$;

When direct action is available:

$EI = PV - SV$;

When reverse action is available:

$EI = SV - PV$;

- Deviation alarm

When absolute value of deviation EI is greater than absolute value of set value of deviation DLp, deviation alarm is generated. When EI is greater than DL, positive deviation alarm (PEI) is generated. When EI is less than -DLp, negative deviation alarm (NEI) is generated. There is alarm deadband action (DLHYS) when deviation is recovered, shown as Figure 3.8.

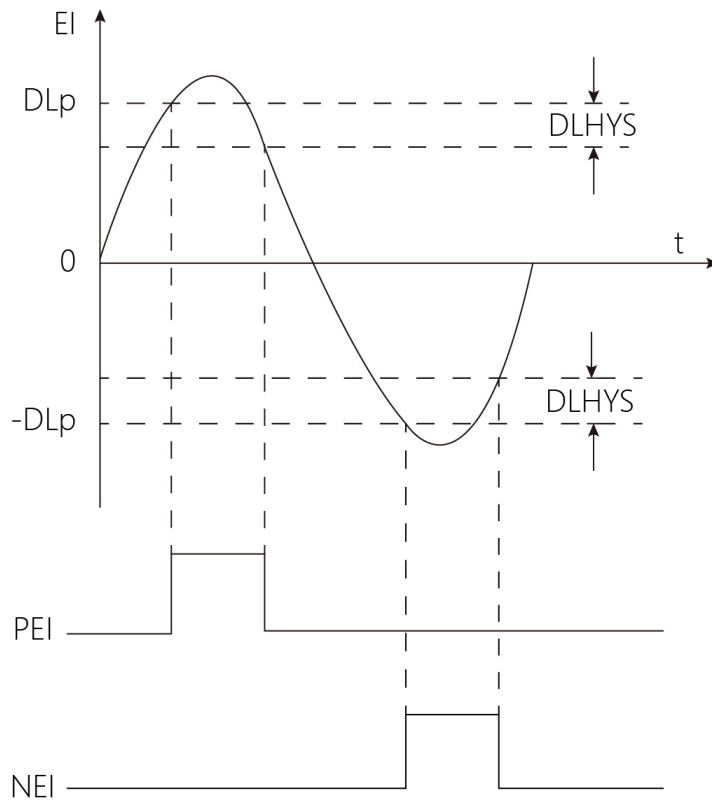


Figure 3.8 Error alarm process

In order to avoid deviation alarm caused by mutation of set value, the value r got by filtering the set value is used as compensation coefficient of deviation alarm set value (DL). Deviation set value compensated (DLp) is deviation alarm set value DL adding compensation coefficient r , shown as Figure 3.9.

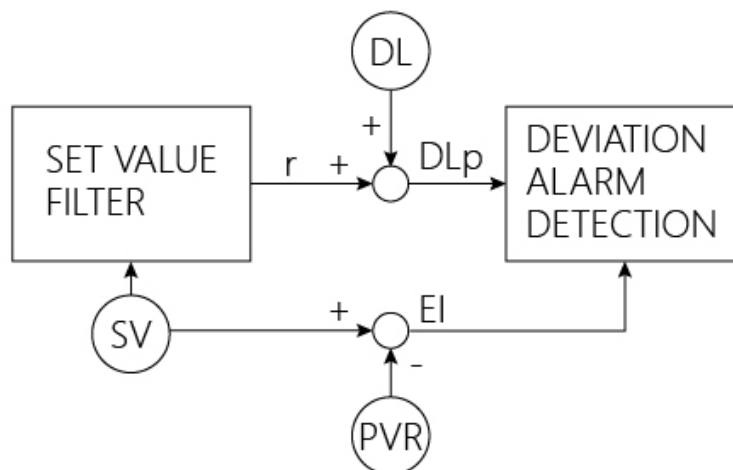


Figure 3.9 Diagram of deviation alarm

$$r(s) = \frac{K_{SV} * T_{SV} s}{1 + T_{SV} s} * SV(s)$$

Expression of set value filter:

$$r_n = \frac{K_{SV} * T_{SV} (SV_n - SV_{n-1}) + T_{SV} * r_{n-1}}{T_S + T_{SV}}$$

Expression after discretion:

6. Output compensation

Output compensation is used to add the compensation value got outside to the output signal MV calculated by the control block. Expression: $MV = MV_0 + OK(OA + OB)$.

Output compensation is mainly used to add feedforward signal to output signal to achieve feedforward function.

7. Control output

Increment dMV output in this period is got by PID calculation. dMV should be converted to the actual output value MV in this period. There are commonly two output modes: increment and position.

- Increment

New output value is got by adding increment dMV of the current output value to feedback input BKIN. Expression: $MV = dMV + BKIN$.

- Position

New output value MV is got by adding increment dMV of the current output value to output value LMV of last time. Expression: $MV = dMV + LMV$.

Output mode option OUT_OPT: when OUT_OPT is OFF, position output is selected.

When OUT_OPT is ON, increment output is selected.

8. Range conversion

For general control function block, set value commonly has the same range as process value and output value is in another range. Because range is inconsistent, the input range should be mapped to the output range. The mapping coefficient is called range conversion coefficient KS.

Expression:

$$Ks = \frac{MVSCH - MVSCL}{SVSCH - SVSCL}$$

If process value is PV, the PV is mapped to MV. The value is equal to:

$$MV = (PV - SVSCL) \times KS + MVSCL$$

For ratio function block, because SV is conversion coefficient, SV is not required to converse range. Only process value PV is converted range.

9. Integral limit action

In control calculation of PID, PI_PLS, PI_AE, PIDEX, PID_TP, LEPID and PIDEP, the integral item is the integral of deviation for time, the integral windup is easily caused, and the control results may cause overshoot and lead to unsteady process. The integral limit action is used to limit the integral item and prevented from the integral windup.

BKIN and RRL are used to updating calculation to dMV. When MV is limited to between MVH and MVL, integral limit action acts on integral item of MV' of before amplitude limiting.

$$dMV_n = dMV_{n0} + \frac{\Delta T}{T_I} (BKIN - RRL - MV'_{n-1})$$

dMV_{n0} : operating output gain value (before updating) in PID, PI_PLS, PI_AE calculation

MV'_{n-1} : operating output value (before output amplitude limiting) in last time calculation.

Note:

PIDES function block has two anti-integral windup modes, which are set in parameter IA_OPT.

When IA_OPT=0, MV needs to be corrected as the expression above;

When IA_OPT=1, MV needs to be corrected as the "Note 1 : Anti-integral windup correction function". For details, refer to the "Table 3.21" in PIDEEX.

3.2.5 Output Process

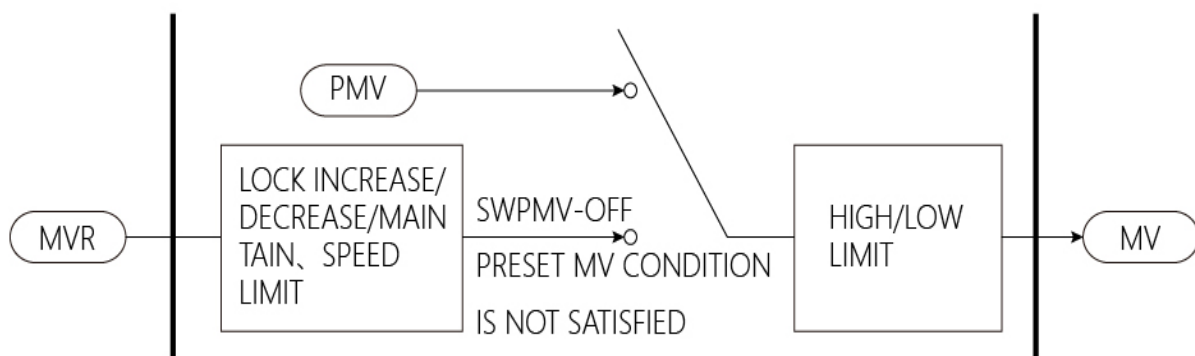


Figure 3.10 Output process of control function block

1. Preset MV process

If mode of last period is OOS, IMAN, TR, MAN and mode of this period is AUTO or CAS and SWPMV=ON, MV=PMV. In this case, MV velocity alarm, lock increase/decrease/maintain are unavailable.

If mode of last period is not MAN mode and mode of this period is MAN mode and SWMMV=ON, MV=MMV.

2. Output limit and alarm

When output value is over its limit, the output is limited, and alarm is generated. High limit of output limit (MVH) must be greater than or equal to low limit of output limit (MVL). Otherwise, output limit alarm is disabled and the configuration error alarm (CFGERR) is generated.

Output maximum MVH must be less than $HORLIM \cdot (MVSCH - MVSCL) / 100 + MVSCH$ and output minimum MVL must be greater than

$MVSCL - LORLIM \cdot (MVSCH - MVSCL) / 100$.

3. Output velocity limit and alarm

When change velocity of output is over change limit, the output is limited, and alarm is generated. Velocity limit is only available in mode of auto and cascade. In mode of auto and cascade, when change velocity of output MV is over velocity limit DMVLIM, an alarm is generated. When the velocity increased of MV is over DMVLIM, positive velocity alarm

is generated, i.e., DMVHIND=ON; When the velocity decreased of MV is over DMVLIM, negative velocity alarm is generated, i.e., DMVLIND=ON. When the velocity is over limit, output is increased or decreased according to the velocity limit.

4. Lock increase/decrease/maintain (invalid for RATIO and split control)

In the mode of auto and cascade, lock increase/decrease can be implemented for MV.

- Lock increase
When SWING=ON, lock increase. Output MV cannot be increased.
- Lock decrease
When SWDEC=ON, lock decrease. Output MV cannot be decreased.
- Output maintain
In the mode of auto and cascade, when HOLD is equal to ON, output is maintained.

3.2.6 Integral Cutting

The purpose of introducing integral in ordinary PID control is mainly to eliminate static errors and improve control accuracy. However, when the controlled object starts, stops, or greatly increases or decreases the set value, a large deviation of the system output in a short period of time will cause the accumulation of PID calculation points. Integral accumulation will cause data overflow, which will cause the control quantity to exceed the limit control quantity corresponding to the maximum operating range of the actuator, which will eventually cause a large overshoot of the system and even a large oscillation of the system.

The basic principle of integral separation is:

- When the deviation between the controlled quantity and the set value is large, the integral action is cancelled to avoid the decrease of the stability of the system due to the integral action and the increase of the overshoot, which will cause larger oscillations.
- When the controlled quantity is close to the given value, the integral action is introduced to eliminate the static error and improve the control accuracy.

The specific working process of integral separation is:

According to the actual situation, set the threshold EA. If $EA \neq 0$, integral separation works.

1. If $|\text{deviation}| > EA$, integral cut, only PD control is executed. At the same time, the proportional coefficient KP is corrected according to the set proportional correction value DK. After the correction, the proportional coefficient is $KP = KP + DK$.
2. If $|\text{deviation}| \leq EA$, add the integral link and execute PID control.

The flow of integral separation is shown in the figure below, where $|\text{deviation}|$ = the absolute value of the difference between the given value and the measured value.

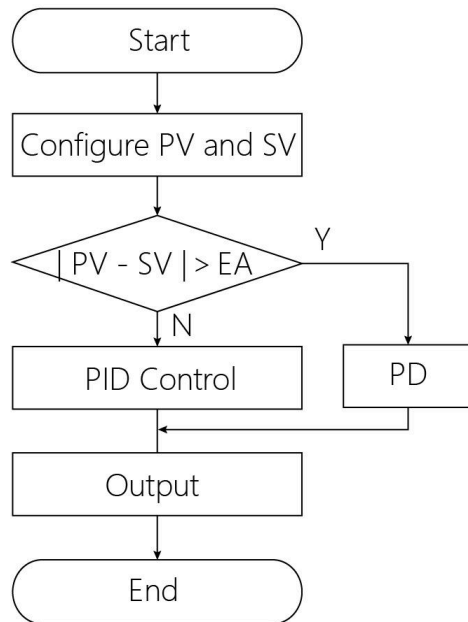


Figure 3.11 Integral separation process

3.2.7 Alarm

1. Alarm enabled and alarm

- Alarm enabled

Alarms can be enabled by ENALM. The type of ENALM is ALMTYPE. For example, PID function block can be set initial value of alarm enabled under "Function block properties/Alarm Enabled and Suppress", shown as Figure 3.12.

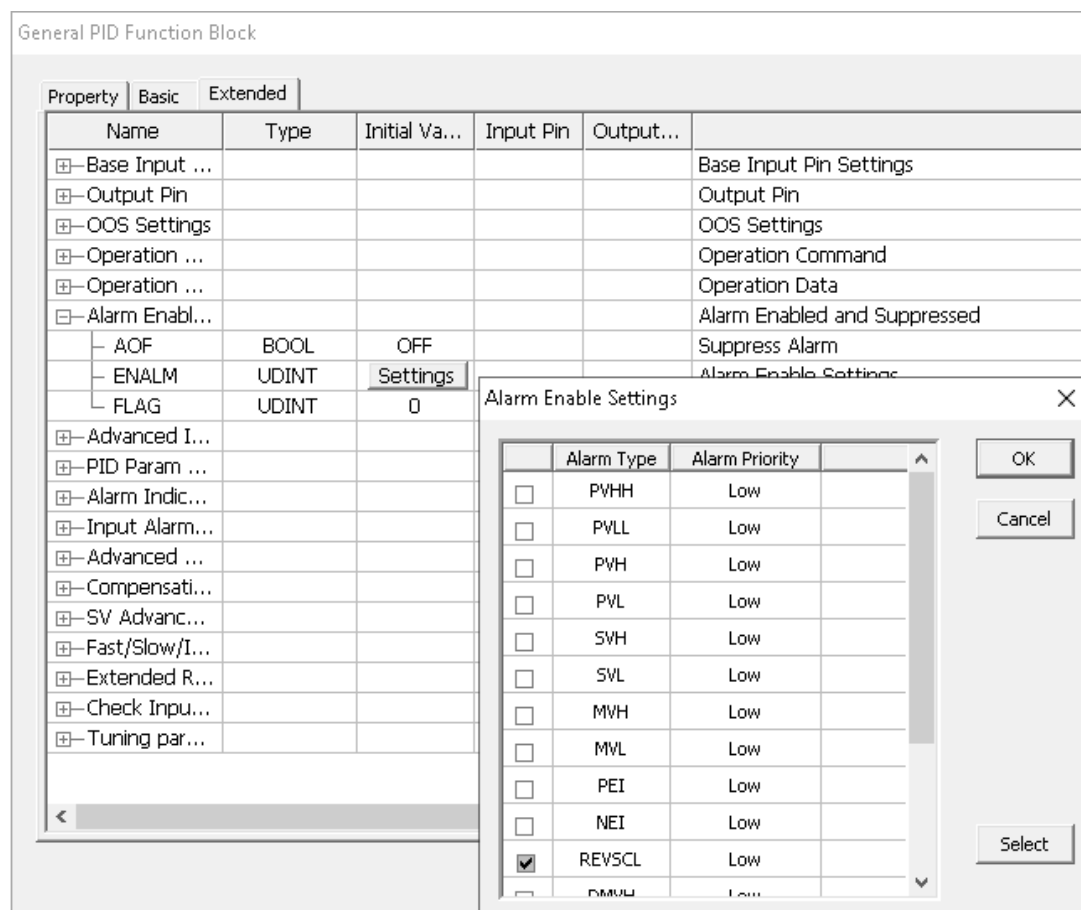


Figure 3.12 Alarm enable setting

When an alarm is selected, the alarm is enabled. The alarm not selected will be shielded.

When the function block is debugged, the alarm enabled option can be modified in real time under "Function Block Parameter Debug", shown as Figure 3.13.

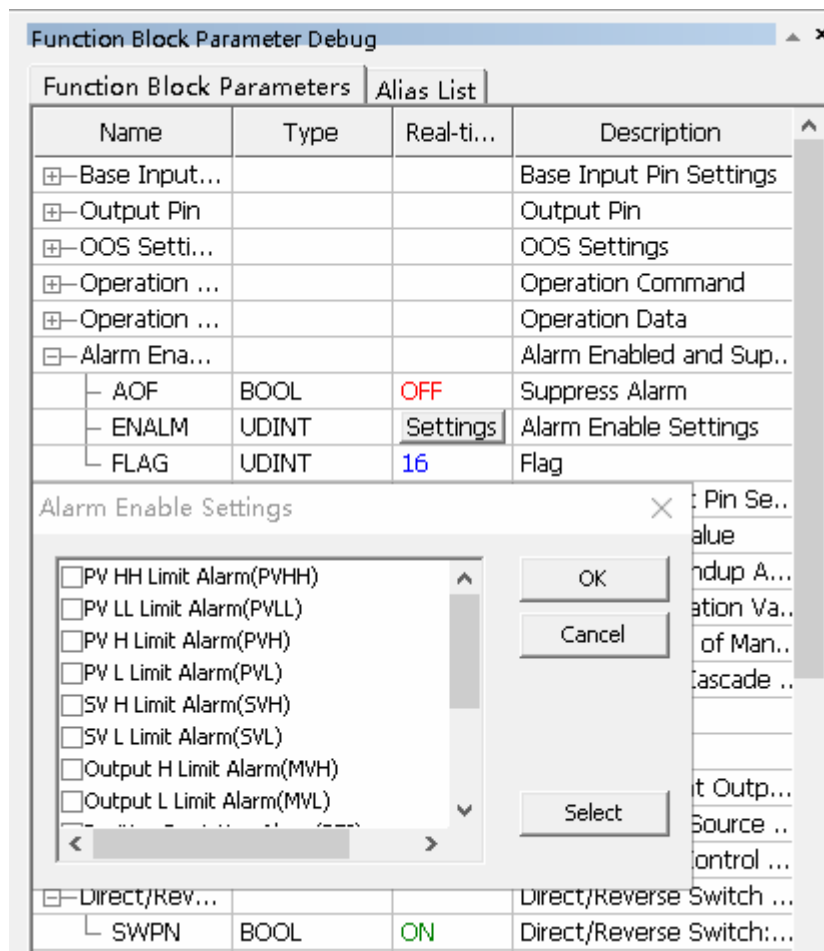


Figure 3.13 Modify alarm enable

- Alarm

The parameter Alarm in Extended Parameters can be data excerpt. Details of data excerpt refer to the *VFFBDBuilder User Manual*.

You can debug the alarm parameters in the debugging mode as shown as follows.

Name	Type	Real-ti...	Description
[-] PID Param...			PID Param Settings
[-] Alarm Indi...			Alarm Indication
[-] NMFIND	BOOL	OFF	Valve Position Negative..
[-] PMFIND	BOOL	OFF	Valve Position Positive ...
[-] PVHHIND	BOOL	OFF	PVHH Alarm Indication
[-] PVHIND	BOOL	OFF	PVH Alarm Indication
[-] PVLIND	BOOL	OFF	PVL Alarm Indication
[-] PVLIND	BOOL	OFF	PVLL Alarm Indication
[-] MVHIND	BOOL	OFF	MVH Alarm Indication
[-] MVLIND	BOOL	OFF	MVL Alarm Indication
[-] SVHIND	BOOL	OFF	SVH Alarm Indication
[-] SVLIND	BOOL	OFF	SVL Alarm Indication
[-] PEIIND	BOOL	OFF	Positive Deviation Alarm..
[-] NEIIND	BOOL	OFF	Negative Deviation Alar..
[-] DMVHIND	BOOL	OFF	MV Positive Rate Limit I..
[-] DMVLIND	BOOL	OFF	MV Negative Rate Limit..
[-] Input Alar...			Input Alarm Settings
[-] NMFLIM	REAL	100.00	Valve Position Negative..
[-] PMFLIM	REAL	100.00	Valve Position Positive ...
[-] TMFHYS	REAL	0.00	Alarm Hysteresis Time

Figure 3.14 Alarm Instructions

If the alarm is selected in the panel, when it occurs, it shows in the detail alarm area in the panel, and the real-time value in the function block parameter debug interface shows ON.

2. Flag code parse of general control function block list

Table 3.3 Flag code list

Name	symbols	skewing	PID	PI_PLS	PD_SI	PI_AE	RATIO	SPLIT
FB Disable	OOS	0	√	√	√	√	√	√
Manual Initialization	IMAN	1	√	√	√	√	√	√
Manual	MAN	2	√	√	√	√	√	√
Tracking	TR	3	√	√	√	√	√	√
Automatic	AUTO	4	√	√	√	√	√	√
Cascade	CAS	5	√	√	√	√	√	√

Table 3.3 Flag code list (continued)

Name	symbols	skewing	PID	PI_PLS	PD_SI	PI_AE	RATIO	SPLIT
High Limit Alarm of Output 1	MVH1	8	-	-	-	-	-	√
Low Limit Alarm of Output 1	MVL1	9	-	-	-	-	-	√
High Limit Alarm of Output 2	MVH2	10	-	-	-	-	-	√
Low Limit Alarm of Output 2	MVL2	11	-	-	-	-	-	√
PV HH Alarm	PVHH	8	√	√	√	√	√	-
PV LL Alarm	PVLL	9	√	√	√	√	√	-
PV High Limit Alarm	PVH	10	√	√	√	√	√	-
PV Low Limit Alarm	PVL	11	√	√	√	√	√	-
SV High Limit Alarm	SVH	12	√	√	√	√	√	√
SV Low Limit Alarm	SVL	13	√	√	√	√	√	√
MV High Limit Alarm	MVH	14	√	√	√	√	√	-
MV Low Limit Alarm	MVL	15	√	√	√	√	√	-
Positive Deviation Alarm	PEI	16	√	√	√	√		-
Minus Deviation Alarm	NEI	17	√	√	√	√		-
High/Low Limit Reversal Alarm for Alarm	REVS-CL	18	√	√	√	√	√	√
Alarm for Config Error	CFGERR	19	√	√	√	√	√	√
Alarm for Control Deviation is High	AEH	20	-	-	-	√	-	-

Table 3.3 Flag code list (continued)

Name	symbols	skewing	PID	PI_PLS	PD_SI	PI_AE	RATIO	SPLIT
Alarm for Control Deviation is Low	AEL	21	-	-	-	√	-	-
Alarm for MV Velocity High Limit	DMVH	22	√	√	√	√	√	-
Alarm for MV Velocity Amplitude Limiting is Low	DMVL	23	√	√	√	√	√	-
Valve Position Minus Deviation Alarm	NMF	27	√	√	√	√	-	-
Valve Position Positive Deviation Alarm	PMF	28	√	√	√	√	-	-

3. Alarm for range high/low limit reversal

When $SVSCH < SVSCL$ or $MVSCH < MVSCL$, alarm for range high/low limit reversal (REVSCL) is generated.

4. Alarm for Config Error

When alarm limit of SV or MV is reversed, configuration error (CFGERR) alarm will be generated, limit will not work.

5. Valve position deviation alarm

$DVLV = MV - MF$.

If $DVLV < 0$ and absolute value of DVLV is greater than NMFLIM in TMFHYS seconds, NMF alarm is generated.

If $DVLV > 0$ and absolute value of DVLV is greater than PMFLIM in TMFHYS seconds, PMF alarm is generated.

3.2.8 Others

1. BKOUT

When BK_OPT is ON, BKOUT tracks the process value. When BK_OPT is OFF, BKOUT tracks the set value.

2. Fast increase and fast decrease (invalid for RATIO and split control)

There are buttons of fast increase, fast decrease, slow increase and slow decrease on the panel, by which MV or SV can be modified.

- **MODE=MAN**

In this case, the four buttons on the panel are valid for MV. Value (engineering unit) of fast increase or decrease is equal to $(MVSCH-MVSCL) * FMV/100$ and value of slow increase or decrease is equal to $(MVSCH-MVSCL) * SMV/100$.

- **MODE=AUTO**

In this case, the four buttons are valid for SV. Value of fast increase or decrease is equal to $(SVSCH-SVSCL) * FSV/100$ and value of slow increase or decrease is equal to $(SVSCH-SVSCL) * SSV/100$.

The four buttons are invalid in other modes.

3. Select manual and auto signal source and auto and cascade signal source

Manual and auto signal source can be selected by parameter MAN_OPT. When MAN_OPT is ON, it is controlled by PSWAM. When MAN_OPT is OFF, it is controlled by SWAM.

Auto and cascade signal source can be selected by parameter SV_OPT. When SV_OPT is ON, it is controlled by PSWSV. When SV_OPT is OFF, it is controlled by SWSV.

4. Decimal digits

Decimal digits configuration of SVDLEN and MVDLEN referred in the control function block library is used to display data in the function block panel.

3.2.9 PID Parameter Tune

The proportional control is a basic control method and has the control effect corresponding to derivation. PB selection largely affects the control performance of the system. Decrease of PB can improve the control precision, shorten the respond time and speed up the respond action, while reduce the stability. Adjustment for PB should consider these two indexes.

The integral action weakens with the increase of TI. Adding integral control can eliminate the residual error which cannot be eliminated by pure proportional control, while reduce the system stability. PB should be added to keep the original attenuation ratio of system, which will reduce the other control indexes of system. Thus the proportional action should not be added if the attenuation ratio is not the main control index.

Adding differential control can suppress at the moment of fast variation interference for the system and increase its stability. The differential action is strengthened with the increase of the differential time TD. Proper differential action can improve the control quality, while overlarge differential will cause uncontrollable strict shock.

Integral and differential should be used with proportional action.

1. Experience Tune

It is an actually trial and error of experience. It needs no advance calculation and experiment, while determines a group of control parameter first according to the running experience (shown in Table 1), starts the system operation, through observing the transition process curve after adding man-made interference (changing the set value), to change the corresponding control parameter value according to the various effects of different control actions on the transition process, and to perform repeat trial and error till the satisfying control quality is obtained.

Table 3.4 Experience data for controller parameter

Controlled Variable	Rule Selection	Proportional Band PB (%)	Integral Time TI/s	Differential Time TD/s
Flow	Object time constant is small, parameter has variation, PB should be large; TI should be short; differential is not used	40~100	18~60	-
Temperature	Object volume lag is large, means the parameter variation becoming slow with interference, PB should be small; TI should be long; differential should be added generally	20~60	180~600	30~180
Pressure	Object volume lag is not rather large, differential	30~70	24~180	-

Table 3.4 Experience data for controller parameter (continued)

Controlled Variable	Rule Selection	Proportional Band PB (%)	Integral Time TI/s	Differential Time TD/s
	tial is not added generally			
Fluid Level	Object time constant range is large, the requirements are not high, PB can be selected in a range, differential is not used generally	20~80	-	-

As the proportional action is the basic control action, the experience tune meets the quality index mainly by adjusting proportional band PB. There are two ways to tune:

- 1) First use the pure proportional (P) action, means to find the proper proportional band PB, and change the transition process after adding man-made interference to the attenuation oscillation process of 4:1. Then add integral action (I), and take the integral time TI as a half of the attenuation oscillation cycle. As the integral action enhances the oscillation, the proportional action should be weakened before adding integral action, and enlarge 10%~20% of the proportional band generally. Adjust the integral time till the 4:1 attenuation oscillation occurs. Add differential (D) action if needed, means to start from 0 and enlarge the differential time TD gradually. As the differential action can suppress the oscillation, the proportional band can be adjusted to be less than pure proportional action before adding integral action, and shorten the integral time. The transition time can be adjusted to be shortest and the overshoot to be smallest via the trial and error of differential time.
- 2) Select integral time TI and differential time TD, take $TD = (1/3 \sim 1/4) TI$ generally. Perform repeat trial and error for the proportional band PB till the satisfying result is obtained. The satisfying curve may not be obtained if the setting of TI and TD are not proper at beginning. Then adjust TI and TD properly and perform trial and error again to meet the curve to the control requirements.

The experience tune method applies to various control system, especially the control system with frequent object interference and irregular transition process curve. However, it will cost more time for operator lacking of experience.

2. Critical Proportional Band

Critical proportional band refers to obtain critical oscillation data in the method of pure proportional control in the system closed loop, means the critical proportional band PB_k and the critical oscillation cycle T_k , and use some experience formulas to get the controller parameter meeting the 4:1 attenuation oscillation process. The formula are shown in Table 2. The steps are shown below.

- 1) Set the integral time of controller as maximum ($TI=\infty$), differential time as minimum ($TD=0$), proportional band PB behind a comparatively large value, and start system operation.
- 2) Reduce the proportional band gradually. Exert stage interference for the system via changing the set value once the PB value is modified, and observe the output of system till the continuous oscillation occurs to the transition process. The transition process here called critical oscillation process. PB_k is critical proportional band and T_k is critical oscillation cycle.
- 3) Use two testing data PB_k and T_k and by the corresponding formula in Table 2 to figure out various tune parameters of controller.

Table 3.5 Table 3-5 Controller parameter calculation in critical proportional band method (attenuation ratio 4:1)

Control Rule	Proportional Band PB (%)	Integral Time TI/s	Differential Time TD/s
P	$2PB_k$	-	-
PI	$2.2PB_k$	$51T_k$	-
PD	$1.8PB_k$	-	$6T_k$
PID	$1.7PB_k$	$30T_k$	$7.5T_k$

- 4) Change the proportional band of controller to the tuned value, and put the tune of integral time and differential time successively.

3. Attenuation Curve

It is a little like the tune process of critical proportional band method, means set the integral time as maximum in closed loop system, the differential time as minimum and the proportional time as comparatively large value, then input the change of set value as interference, decrease the proportional band PB value gradually, and observe the output response curve of the system. Change the PB value according to the attenuation of transition process till the 4:1 attenuation oscillation. Record the proportional band PB_s and

the attenuation oscillation cycle T_s , and figure out the tune parameter of controller via the corresponding experience formula in Table 3.6.

Table 3.6 Controller parameter calculation in attenuation curve (attenuation ratio 4:1)

Control Rule	Proportional Band PB (%)	Integral Time TI/s	Differential Time TD/s
P	PBs	-	-
PI	1.2PBs	30Ts	-
PID	0.8PBs	18Ts	6Ts

The attenuation curve method can apply to most systems. For its short test transition process oscillation time, and all are attenuation oscillation, it is acceptable for operator. Thus this kind of tune method is widely used.

3.2.10 Difference between Various PID Function Blocks

Table 3.7 Table 3-7 Difference of PID Function Blocks

Difference Item	PID	PIDEP	PIDEX	EPID	LEPID	PID_TP
Supported Operation Mode	OOS, IMAN, TR, MAN, AUTO, CAS	OOS, IMAN, AUTO	OOS, IMAN, TR, MAN, AUTO, CAS	OOS, AUTO, CAS	OOS, TR, AUTO	OOS, IMAN, MAN, AUTO, CAS
PID Algorithm Selection	PID, D_PI, PD_I	PID, D_PI, PD_I	PID, D_PI, PD_I	PID	PID	PID, D_PI, PD_I
SV Ramp Action	√	√	√	-	-	√
SV Track Action	√	√	√	-	-	√
Proportional Nonlinear Gain	√	√	√	-	-	√
Integral Cutting	√	√	√	-	-	√
Wind-up	√	√	√	-	-	√
PID Single Function Stop	Stop P, I, D Separately	Stop P, I, D Separately	Stop P, I, D Separately	-	-	Respectively stop P, I, or D
Bypass	√	√	√	-	-	√

Table 3.7 Table 3-7 Difference of PID Function Blocks (continued)

Difference Item	PID	PIDEP	PIDEX	EPID	LEPID	PID_TP
Lock Increase/Decrease and Maintain	√	√	√	-	√	√
MV Output Mode	Position type, Increment Type	Position Type	Position Type, Increment Type	Position Type	Position Type	position type, increment type
Recommended Industry	General	Electrical Power Industry	General (recommended)	Electrical Power Industry	Electrical Power Industry	general

Table 3.8 Function block input and set value function difference

Control Function Block	Input Process			Setting Value Process			
	Measurement value alarm	Input compensation	Validity check	Set variable track	Internal/external setting value	Set value limit amplitude and alarm	Ramp
PID	√	√	√	√	√	√	√
PIDEP	√	√	√	√	—	√	√
PIDEX	√	√	√	√	√	√	√
EPID	√	√	—	—	√	—	—
LEPID	—	√	—	—	—	—	—
PID_TP	√	√	—	√	√	√	√
PI_PLS	√	√	—	√	√	√	√
PD_SI	√	√	—	√	√	√	√
PI_AE	√	√	—	√	√	√	√
RATIO	√	—	—	√	√	√	√
SPLIT	—	—	—	—	√	√	—
MANUAL	√	—	—	—	—	—	—
MANUAL_EP	√	—	—	√	—	√	—
ASH	—	—	—	—	—	—	—
ASL	—	—	—	—	—	—	—
FOUT	—	—	—	—	√	—	—

Table 3.9 Operation process function difference of each function block

Control function block	Operation Process								
	Non-linear gain	Deviation dead zone	By-pass	PID single function stop function	Offset process	Output compensation	Control output	Range concentration	Integration amplitude limit
PID	√	√	√	√(P,I,D)	√	√	√	√	√
PIDEP	√	√	√	√(P,I,D)	√	√	√	√	—
PIDEX	√	√	√	√(P,I,D)	√	√	√	√	√
EPID	—	—	—	—	√	√	√	√	—
LEPID	—	—	—	√(P,I,D)	√	√	√	√	—
PID_TP	√	√	√	√(P,I,D)	√	√	√	√	√
PI_PLS	√	√	√	√(P,I,D)	√	√	√	√	√
PD_SI	√	√	√	√(P,D)	√	√	√	√	—
PI_AE	√	√	√	√(P,I,D)	√	√	√	√	√
RATIO	—	—	—	—	—	—	—	√	—
SPLIT	—	—	—	—	—	—	—	√	—
MANUAL	—	—	—	—	—	—	—	√	—
MANUAL_EP	—	—	—	—	—	—	—	√	—
ASH	—	—	—	—	—	—	—	√	—
ASL	—	—	—	—	—	—	—	√	—
FOUT	—	—	—	—	—	—	—	√	—

Table 3.10 Output process function difference of each function block

Control Function Block	Output Process			
	Preset MV process	Output amplitude limit and alarm	Output rate amplitude limit and alarm	Latch increase, decrease and output hold
PID	√	√	√	√
PIDEP	—	√	√	√
PIDEX	√	√	√	√
EPID	—	√	—	—
LEPID	—	√	√	√
PID_TP	√	√	√	√

Table 3.10 Output process function difference of each function block (continued)

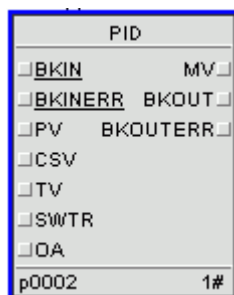
Control Function Block	Output Process			
	Preset MV process	Output amplitude limit and alarm	Output rate amplitude limit and alarm	Latch increase, decrease and output hold
PI_PLS	√	√	√	√
PD_SI	√	√	√	√
PI_AE	√	√	√	√
RATIO	√	√	√	—
SPLIT	—	√	—	—
MANUAL	√	√	—	√
MANUAL_EP	—	√	√	√
ASH	—	—	—	—
ASL	—	—	—	—
FOUT	—	—	—	—

3.3 General PID Function Block (PID)

The PID general function block can perform PID adjustment function based on the D-value of PV and SV, can provide three kinds of control modes PID, PV PD_I and PV D_PI via parameter setting, and provide output of increment type or position type for different control objects.

It is a complex function block and its running time is 120μs.

Please refer to the "Overview" and "Control Function Block Library" before using the function block.



3.3.1 Parameter Description

Details of various parameters setting refer to the Parameter Property and Parameter Setting Illustration.

The data type, initial value and default pin of function block parameter in Table 1 refer to the function properties setting interface.

When the parameter in Table 1 is uploaded as TRUE, it means the corresponding parameter can upload the data of controller and save to the configuration later. When offline download is performed next time, the saved data can be downloaded.

Table 3.11 Parameter instruction and application of PID Function Block

Name			Description	Upload	Properties	Application Reference
Basic Parameters	Range Setting	MVSCH	MV high scale	-	Configuration Parameter	The same as MV actual value H limit
		MVSCL	MV low scale	-	Configuration Parameter	The same as MV actual value L limit
		SVSCH	SV high scale	-	Configuration Parameter	The same as PV actual value H limit
		SVSCL	SV low scale	-	Configuration Parameter	The same as PV actual value L limit
		SVEU	SV engineer unit	-	Configuration Parameter	Set in the function block properties setting interface
		MVEU	MV engineer unit	-	Configuration Parameter	Set in the function block properties setting interface
		SVDLEN	SV decimal digits [0,5]	-	Configuration Parameter	Used for data displayed on function block panel (equal to 3 as default)
		MVDLEN	MV decimal digits [0,5]	-	Configuration Parameter	Used for data displayed on function block panel (equal to 3 as default)
	Limits	MVH	MV H limit value	TRUE	Operation Parameter	Value range [MVSCL,MVSCH]
		MVL	MV L limit value	TRUE	Operation Parameter	Value range [MVSCL,MVSCH]
		SVH	SV H limit value	TRUE	Operation Parameter	Value range [SVSCL,SVSCH]
		SVL	SV L limit value	TRUE	Operation Parameter	Value range [SVSCL,SVSCH]
		DMVLIM	MV output rate variety limit value. Used to prevent the MV from overlarge modifi-	TRUE	Operation Parameter	Refer to Output Process

Table 3.11 Parameter instruction and application of PID Function Block (continued)

Name			Description	Upload	Properties	Application Reference
			cation in a short time.			
	Direct/Reverse Switch Settings	SWPN	Direct/Reverse switch. SV is not changed, the MV increases with the increasing of PV in direct action, and decreases with the increasing of PV in reverse action.	TRUE	Operation Parameter	OFF=Direct action, ON=Reverse action
Extended Parameters	Base Input Pin Settings	BKIN	Feedback input	-	Input Pin	Connect to BKOUT of downstream block
		BKINERR	Feedback status input	-	Input Pin	Connect to BKOUTERR of downstream block
		PV	Process value of loop closed control process	-	Input Pin	Connect to measuring point AI
		CSV	Cascade	-	Input Pin	Connect to outer loop control value MV
		TV	Track input value (in track mode, MV=TV)	-	Input Pin	Connect to measuring point AI, Related parameter: SWTR
		SWTR	Track switch: OFF=not track, ON=track	-	Input Pin	Upstream interlock condition input, related parameter: TV
		OA	Output compensation, used for feedforward control	-	Input Pin	Connect to measuring point AI (feedforward signal), related parameters: OK, OB
	Advance Input Pin Settings	MF	Executor feedback value, used for monitoring	-	Input Pin	Connect to measuring point AI
		IA	Input compensation value, used to improve the controllability of process with long deadband time	-	Input Pin	Connect to measuring point AI, refer to Input ProcessRelated parameters: IK, IB
		PSWAM	Program manual and auto	-	Input Pin	Connect to upstream output, valid

Table 3.11 Parameter instruction and application of PID Function Block (continued)

Name		Description	Upload	Properties	Application Reference
		control switch, OFF=program manual control, ON=program au- to control			when MAN_OP- T=ON
	PSWSV	Program auto/ cascade control switch, OFF= SV, ON=CSV	-	Input Pin	Connect to up- stream output,valid when SV_OPT=ON
	MAN_OPT	Manual-auto- matic control source switch, ON= manual-au- tomatic selec- tion controlled by PSWAM, OFF= manual-automat- ic selection con- trolled by SWAM	-	Input Pin	Connect to up- stream output,re- lated parameters: PSWAM, SWAM
	SV_OPT	Auto/Cascade control source selection, ON= auto/cascade se- lection controlled by PSWSV, OFF= auto/cas- cade selection controlled by SWSV	-	Input Pin	Connect to up- stream output,re- lated parameters: PSWSV, SWSV
	SWROUT	Remote Manu- al Switch (ON=to Remote Manual)	-	Input Pin	-
	RMV	Remote Manual Value	-	Input Pin	-
	SWRCAS	Remote Cas- cade Switch (ON=to Remote Cascade)	-	Input Pin	-
	RSV	Remote Cas- cade Value	-	Input Pin	-
	SWINC	Lock increase for MV (MV cannot Increase), ON= lock increase	-	Input Pin	Connect to up- stream output,valid when function block is automatic or cas- cade
	RRL	Anti-integral windup input, used for control overshoot	-	Input Pin	Connect to measur- ing point AI,related parameters: BKIN-

Table 3.11 Parameter instruction and application of PID Function Block (continued)

Name			Description	Upload	Properties	Application Reference
						Refer to Operation Process
		SWDEC	Lock decrease for MV (MV cannot decrease), ON= Lock decrease	-	Input Pin	Connect to upstream output,valid when function block is automatic or cascade
		HOLD	Hold the current output value for MV, ON= hold the current output value	-	Input Pin	Connect to upstream output,valid when function block is automatic or cascade
	Output Pin	MV	Operation output value for PID	-	Output Pin	Connect to electric manual instrument.If there's a float abnormal happened to the MV value, the MV will be set as the value of previous period or lower limit.. Please refer to "Application" for details.
		BKOUT	Feedback output value	-	Output Pin	Connect to the BKIN of Upstream Block,Related Parameter: BK_OPT
		BKOUTERR	Feedback status value	-	Output Pin	Connect to the BKINERR of Upstream Block
		BK_OPT	BKOUT value switch (ON=track PV, OFF=track SV)	-	Configuration Parameter	Related parameter: BKOUT
	PID Param Setting	PB	Proportion band size	TRUE	Operation Parameter	Refer to PID Parameter Tune
		TI	Integral time (s)	TRUE	Operation Parameter	Refer to PID Parameter Tune
		TD	Derivative time (s)	TRUE	Operation Parameter	When TD=0, suppress derivation action Refer to PID Parameter Tune
		KD	Derivative filter coefficient	TRUE	Operation Parameter	Refer to ^{Note1,} ^{Note2,} ^{Note3,} ^{Note4}
	Operator	MODE	Work mode	-	Monitoring Parameter	Refer to Parameter Description

Table 3.11 Parameter instruction and application of PID Function Block (continued)

Name			Description	Upload	Properties	Application Reference
	com- mand	IMODE	Standby work mode	-	Monitoring Parameter	Refer to Parameter Description
		MODE_OPT	ON=auto return, OFF=manual return (default)	-	Configuration Parameter	Refer to Parameter Description
		SWAM	Manual and auto switch: OFF=manual, ON=auto	-	Operation Parameter	Valid when MAN_OPT=OFF
		SWSV	Auto/ cascade selection: OFF=auto, ON=cascade	-	Operation Parameter	Valid when SV_OPT=OFF
		SWMMV	Whether to equal to preset MV value when switch to manual status	TRUE	Operation Parameter	Related parameter: MMV
		MMV	Preset MV value (switch to manual)	TRUE	Operation Parameter	Valid parameter SWMMV=ON
		SWPMV	Whether to equal to preset MV value when switch to auto status. PMV enable switch. When SWPMV=ON, MV = PMV, MV velocity alarm, lock increase/decrease are disabled	TRUE	Operation Parameter	Related parameter: PMV
		PMV	Preset MV when switching from OOS/IMAN/TR/MAN modes to AUTO or CAS mode	TRUE	Operation Parameter	Valid when SWPMV=ON
		LOCK	Mode lock (OFF=unlock, ON=lock)	-	Operation Parameter	-
		RMT_OVRD	Override remote mode (ON=override)	-	Operation Parameter	-
	Operator Data	SV	SV for loop closed control	TRUE	Operation Parameter	Refer to Set Variable Process

Table 3.11 Parameter instruction and application of PID Function Block (continued)

Name			Description	Upload	Properties	Application Reference
		MANMV	Manual output value	-	Operation Parameter	MV = MANMV in manual mode
		EI	Deviation	-	Monitoring Parameter	Refer to Operation Process
	Input Alarm Settings	PVHH	PV HH limit alarm value	TRUE	Operation Parameter	Refer to "Input Process"
		PVH	PV H limit alarm value	TRUE	Operation Parameter	Refer to "Input Process"
		PVL	PV L limit alarm value	TRUE	Operation Parameter	Refer to "Input Process"
		PVLL	PV LL limit alarm value	TRUE	Operation Parameter	Refer to "Input Process"
		PVHYS	PV alarm hysteresis	TRUE	Operation Parameter	Refer to "Input Process"
		DL	Deviation alarm set value	TRUE	Operation Parameter	Refer to "Operation Process"
		DLHYS	Deviation alarm hysteresis value	TRUE	Operation Parameter	Refer to "Operation Process"
		KSV	Deviation filter coefficient	TRUE	Operation Parameter	Refer to "Operation Process"
		TSV	Deviation filter time constant (s)	TRUE	Operation Parameter	Refer to "Operation Process"
		NMFLIM	Valve position negative error thresholds	TRUE	Operation Parameter	Related parameter: NMF Refer to "Alarm"
		PMFLIM	Valve position positive error thresholds	TRUE	Operation Parameter	Related parameter: PMF Refer to "Alarm"
		TMFHYS	Valve position positive error Valve position error alarm hysteresis time	TRUE	Operation Parameter	Refer to "Alarm"
	Advance Calculation Settings	BYPASS	Bypass PID operation, when BYPASS=ON, excise PID calculation, switch SV to MV directly for output	TRUE	Operation Parameter	When cascade adjusting, used to excise inner loop when it fails Refer to "Operation Process"

Table 3.11 Parameter instruction and application of PID Function Block (continued)

Name		Description	Upload	Properties	Application Reference
	STOPP	Proportion suppress switch, when STOP-P=ON, stop integral action	TRUE	Operation Parameter	Refer to "Operation Process"
	STOPI	Integral suppress switch, when STOPI=ON, stop integral action	TRUE	Operation Parameter	Refer to "Operation Process"
	SWDB	Enable switch, when SWD-B=ON, dead-band enable	TRUE	Operation Parameter	Related parameter: DB
	DB	Deadband band size	TRUE	Operation Parameter	Valid when SWD-B=ON
	DBHYS	Deadband band hysteresis	TRUE	Operation Parameter	Refer to "Operation Process"
	GW	Non-linear gain range non-linear gain range	TRUE	Operation Parameter	Refer to "Operation Process"
	KN	Non-linear gain coefficient [0,1.0]	TRUE	Operation Parameter	Refer to "Operation Process"
	NGN_OPT	Non-linear gain selection switch, switch the relation between error and output change value to nonlinear. Used for control when proportional gain needs nonlinear change. OFF=Error square root function, ON=Gap action function	-	Configuration Parameter	Related parameters: GW, PB and KN When NGN_OPT = ON; GW and PB when NGN_OPT = OFF
	EA	Integral excise coefficient. when EI > EA, excise coefficient, when EI < EA, excising coefficient is disabled, used for prevent MV change from overlarge	TRUE	Operation Parameter	Related parameter: DK

Table 3.11 Parameter instruction and application of PID Function Block (continued)

Name			Description	Upload	Properties	Application Reference
		DK	Proportion modified value when integral excising- <small>Note5</small>	TRUE	Operation Parameter	Related parameter: EA
		OUT_OPT	Control output type: OFF=position type, ON=increment type	-	Configuration Parameter	Related parameter: MVRefer to "Operation Process"
		PID_OPT	PID type selection	-	Configuration Parameter	When PID_OPT = 0, use standard PID algorithm ^{Note2} ; when PID_OPT = 1, use PV D_P I algorithm ^{Note4} ; when PID_OPT = 2, use PV proportional PD_I algorithm ^{Note3}
		ATI_OPT	Anti-integral windup mode selection:0=Keep original mode1=No Resection2=Total Resection		Configuration Parameter	0 : Keep the original processing mode. When the derivative time is set to 0, the internally calculated MV will be limited by high and low limits. 1: Regardless of whether the differential time is 0 or not, the internally calculated MV will not be limited. 2: Regardless of whether the differential time is 0, limit the internally calculated MV.
	Alarm	PVHHIND	PVHH alarm indication	-	Monitoring Parameter	Refer to "Alarm"
		PVHIND	PV H Limit alarm indication	-	Monitoring Parameter	Refer to "Alarm"
		PVLIND	PV L limit alarm indication	-	Monitoring Parameter	Refer to "Alarm"
		PVLLIND	PV LL limit alarm indication	-	Monitoring Parameter	Refer to "Alarm"

Table 3.11 Parameter instruction and application of PID Function Block (continued)

Name			Description	Upload	Properties	Application Reference
		MVHIND	MV H limit alarm indication	-	Monitoring Parameter	Refer to "Alarm"
		MVLIND	MV L limit alarm indication	-	Monitoring Parameter	Refer to "Alarm"
		SVHIND	SV H limit alarm indication	-	Monitoring Parameter	Refer to "Alarm"
		SVLIND	SV L limit alarm indication	-	Monitoring Parameter	Refer to "Alarm"
		DMVHIND	MV positive rate limit indication	-	Monitoring Parameter	Refer to "Alarm"
		DMVLIND	MV negative rate limit indication	-	Monitoring Parameter	Refer to "Alarm"
		NMFIND	Valve position error negative alarm indication	-	Monitoring Parameter	Refer to "Alarm"
		PMFIND	Valve position error positive alarm indication	-	Monitoring Parameter	Refer to "Alarm"
	Compensation Setting	IK	Input compensation gain	TRUE	Operation Parameter	Refer to "Input Process" related parameter: IA
		IB	Input compensation bias value	TRUE	Operation Parameter	Refer to "Input Process" related parameter: IA
		OK	Output compensation gain	TRUE	Operation Parameter	Refer to "Operation Process" related parameter: OA
		OB	Output compensation bias value	TRUE	Operation Parameter	Refer to "Operation Process" related parameter: OA
	Fase/Slow/Increase/Decrease Setting	SMV	Manual slow increase/decrease value (%)	TRUE	Operation Parameter	Set MV manual slow increase/decrease percentage in function block properties setting

Table 3.11 Parameter instruction and application of PID Function Block (continued)

Name			Description	Upload	Properties	Application Reference
		FMV	Manual fast increase/decrease value (%)	TRUE	Operation Parameter	Set MV manual fast increase/decrease percentage in function block properties setting
		SSV	SV slow increase/decrease value (%)	TRUE	Operation Parameter	Set SV manual slow increase/decrease percentage in function block properties setting
		FSV	SV fast increase/decrease value (%)	TRUE	Operation Parameter	Set SV manual fast increase/decrease percentage in function block properties setting
		GMV	MV safety protection input increase or decrease value	TRUE	Operation Parameter	-
		GSV	SV safety protection input increase or decrease value	TRUE	Operation Parameter	-
	Extended Range Settings	HORLIM	Extended range maximum percentage	-	Configuration Parameter	Refer to "Output Process"
		LORLIM	Extended range minimum percentage	-	Configuration Parameter	Refer to "Output Process"
	SV Advance Settings	SWRAMP	SV ramp function switch. When changing SV, incline it to SV according to the set RAMP (s). OFF=SV ramp function off, ON=SV ramp function on	TRUE	Operation Parameter	Related parameter: RAMP, valid when in automatic or cascade mode
		RAMP	Ramp coefficient	TRUE	Operation Parameter	Related parameter: SWRAMP
		SVTR_OPT	SV track PV switch enable/disable: OFF=not track, ON=track. If PV> SVH/ SVL, SV= range limit. Used to prevent	-	Configuration Parameter	Refer to "Set Variable Process"

Table 3.11 Parameter instruction and application of PID Function Block (continued)

Name			Description	Upload	Properties	Application Reference
			the output MV from interference when changing the control mode.			
		SVRG_OPT	SV track convert option: 0=no convert, 1=convert by percent	-	Configuration Parameter	0 by default
	Alarm Enabled and Suppress	AOF	Suppress module alarm, on=prohibit to display alarm	TRUE	Operation Parameter	Refer to "Alarm"
		ENALM	Alarm enable	TRUE	Alarm Parameter	Refer to "Alarm"
		FLAG	Flag	-	Output Pin	Refer to "Flag"
	OOS Setting	SWOOS	Function block disable (ON=disable)	TRUE	Operation Parameter	Set as ON at the first time of function block downloading
		OOSVAL	Output value in OOS status	TRUE	Operation Parameter	Related parameter: OOS_OPT=ON
		OOS_OPT	Output value type in OOS status. when OOS_OPT =ON, MV=OOSVAL, when OOS_OPT =OFF, maintain the MV	-	Configuration Parameter	Refer to "OOS"
	Check Input Validity	SWPV	Enable switch for checking PV validity	TRUE	Operation Parameter	Refer to "Input Process"
		PVLMT	PV change limit (%)	TRUE	Operation Parameter	Refer to "Input Process"

Working modes of PID function block and parameter conditions of each corresponding mode are shown in Table 3.1.

3.3.2 Mode Illustration

This part introduces the modes of PID function block and the switching methods.

A variety of modes are available for PID function block, such as OOS, MAN, IMAN, AUTO, CAS, RCAS, ROUT, TR, and OR.

Mode Switching

- When SWOOS=ON, it enters OOS mode.
- When SWOOS=OFF and BKINERR=ON, if ENSAFEOP=OFF, it enters IMAN mode.
- When SWOOS=OFF, BKINERR=OFF, SWTR=ON,
 - If TVERR=OFF, enters TR mode.
 - If TVERR=ON, enters MAN mode.
- When SWOOS=OFF, BKINERR=OFF, SWTR=OFF,
 - If the mode lock is on (LOCK=ON),
 - You cannot switch modes by means of commands (SWROUT, SWRCAS, SWAM, SWSV, etc.).
 - If the mode lock is off (LOCK=OFF), and override switch is off (RMT_OVRD=OFF),
 - SWROUT=ON: enters ROUT mode.
 - SWROUT=OFF and SWRCAS=ON: enters RCAS mode.
 - SWROUT=OFF, SWRCAS=OFF, and SWAM=OFF: enters MAN mode.
 - SWROUT=OFF, SWRCAS=OFF, SWAM=ON, and SWSV=OFF: enters AUTO mode.
 - SWROUT=OFF, SWRCAS=OFF, SWAM=ON, and SWSV=ON: enters CAS mode.
 - If the mode lock is off (LOCK=OFF), and override switch is on (RMT_OVRD=ON),
 - SWAM=OFF, enters MAN mode.
 - SWAM=ON, SWSV=OFF: enters AUTO mode.
 - SWAM=ON, SWSV=ON: enters CAS mode.
- If the function block is in CAS or RCAS mode, when SVERR=ON, it switches to AUTO mode and override is OFF.
 - If MODE_OPT=OFF (manual fallback), mode lock is unlocked, and the function block remains in AUTO mode after the fault is resolved.
 - If MODE_OPT=ON (auto fallback), mode lock remains the previous status, and the function block switches to the original mode after the fault is resolved.
- If the function block is in AUTO, CAS or RCAS mode, when PVERR=ON, it switches to MAN mode and override is OFF.
 - If MODE_OPT=OFF (manual fallback), mode lock is unlocked, and the function block remains in MAN mode after the fault is resolved.
 - If MODE_OPT=ON (auto fallback), mode lock remains the previous status, and the function block switches to the original mode after the fault is resolved.

Mode Fallback

Mode fallback function allows a function block falling back automatically or manually (default). Work mode (MODE) and standby work mode (IMODE) of each function block are only for operators' reference.

- When MODE_OPT=OFF, manual fallback is applied. For manual fallback, the function block exits from IMAN or TR mode and goes back to MAN mode.
- When MODE_OPT=ON, auto fallback is applied. For auto fallback, the function block exits from IMAN or TR mode and goes back to its original target mode.
- If falling back from OOS mode, it enters MAN mode either way.
- If the system goes through a cold reset, it enters MAN mode either way.

Override and Mode Lock

- In OOS mode, RMT_OVRD=OFF, LOCK=OFF, SWTR=OFF, SWAM=OFF, and SWSV=OFF.
- In IMAN, or EMMAN mode, RMT_OVRD=OFF, SWTR=OFF, SWAM=OFF, and SWSV=OFF. When it is manually falling back, unlock the mode lock. Regarding auto fallback, the mode lock remain the previous status.
- In TR mode, except for SWTR is not reset, other parameters and settings are the same as in IMAN mode.

3.3.3 Algorithm Illustration

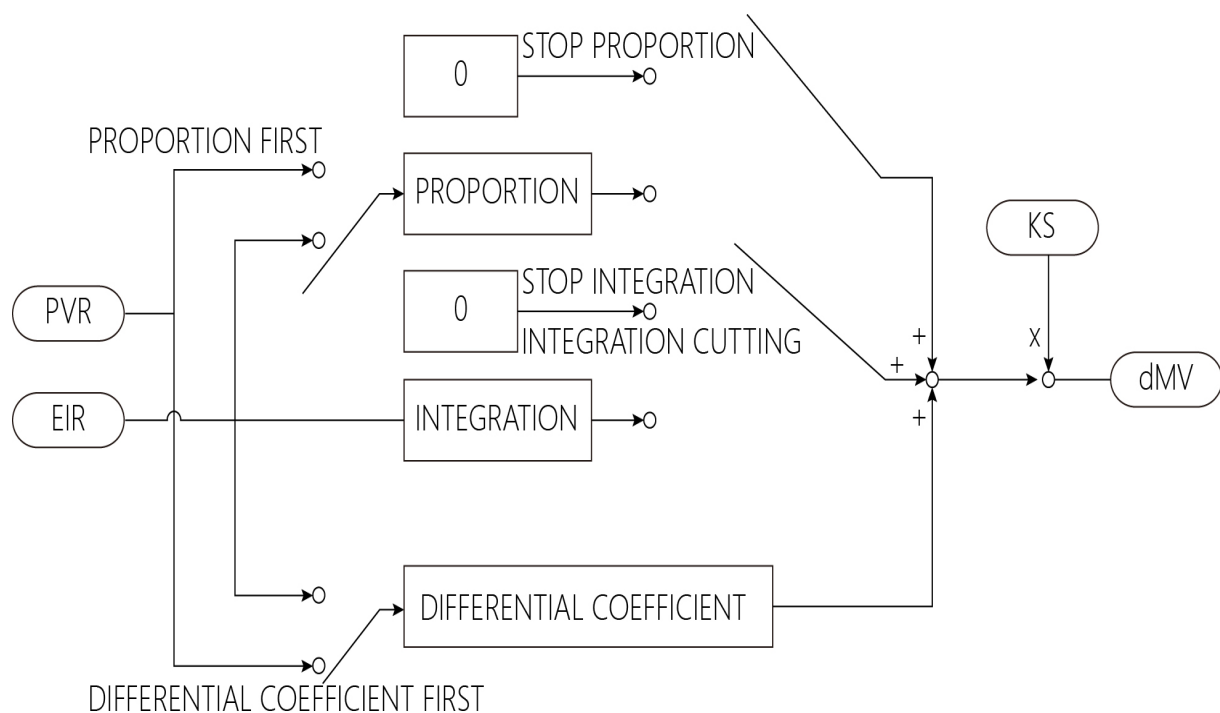


Figure 3.15 General PID function block algorithm

There are three control modes for the function block, including PID, PV PD_I and PV D_PI.

1. Standard PID control algorithm (PID)

The mode mainly applies to produce process with big time parameter and control of instantaneous response caused by change of set value.

Calculation expression:

$$\Delta MV_n = \frac{100}{PB} \left(\Delta E_n + \frac{T_S}{T_I} E_n + \Delta U_n \right)$$

In the above, $\Delta E_n = E_n - E_{n-1}$

$$\Delta U_n = U_n - U_{n-1}$$

$$U_n = \frac{T_D}{K_D T_S + T_D} [U_{n-1} + K_D (E_n - E_{n-1})]$$

T_S : control cycle

K_D : differential filter coefficient

2. PV PD_I (PD_I)

The mode is different from standard PID control algorithm. Change of set value does not influence action of proportion and differential coefficient even if mutation of set value cannot cause dramatic change of output by which stable control Properties can be obtained.

Calculation expression:

$$\Delta MV_n = \frac{100}{PB} \left(\Delta PV_n + \frac{T_S}{T_I} E_n + \Delta U_n \right)$$

In the above, $\Delta PV_n = PV_n - PV_{n-1}$

$$\Delta U_n = U_n - U_{n-1}$$

$$U_n = \frac{T_D}{K_D T_S + T_D} [U_{n-1} + K_D (PV_n - PV_{n-1})]$$

3. PV D_PI (D_PI)

Only proportion action and integral action are implemented in this mode when the set value is changed. The algorithm mainly applies to the field which needs to track set value, such as salve loop of cascade control loop.

Calculation expression:

$$\Delta MV_n = \frac{100}{PB} \left(\Delta E_n + \frac{T_S}{T_I} E_n + \Delta U_n \right)$$

In the above, $\Delta E_n = E_n - E_{n-1}$

$$\Delta U_n = U_n - U_{n-1}$$

$$U_n = \frac{T_D}{K_D T_S + T_D} [U_{n-1} + K_D (PV_n - PV_{n-1})]$$

4. Integral Cutting

In the PID control calculation, it will lead to system overshoot and oscillating when start, stop or SV go up and down by a large margin and appear large deviation in little time. For this reason, introduce integral cutting strategy. When the deviation less-than setting value EA, plunge into integral function. In order to keep stability of system, diminution proportion gain with plunge integral function, and add a gain factor DK to the proportional gain with integral cutting when error is reduced to beneath EA, perform integral action and restore the original proportional gain to achieve it.

To make sure the stability of system after performing integral action, the proportional gain should reduce. When cutting the integral action, the proportional gain should be KP+DK.

5. Incomplete differential action of PID

Computer control can help to achieve ideal differential control. However, the PID control result of ideal differential is not perfect, especially for the production process with high frequency interference. Over-sensitive differential action will generate process oscillation of the process. Thus, the real PID controller is often applied, which adds first order inertia link to the ideal differential link. The transmission function of the algorithm is:

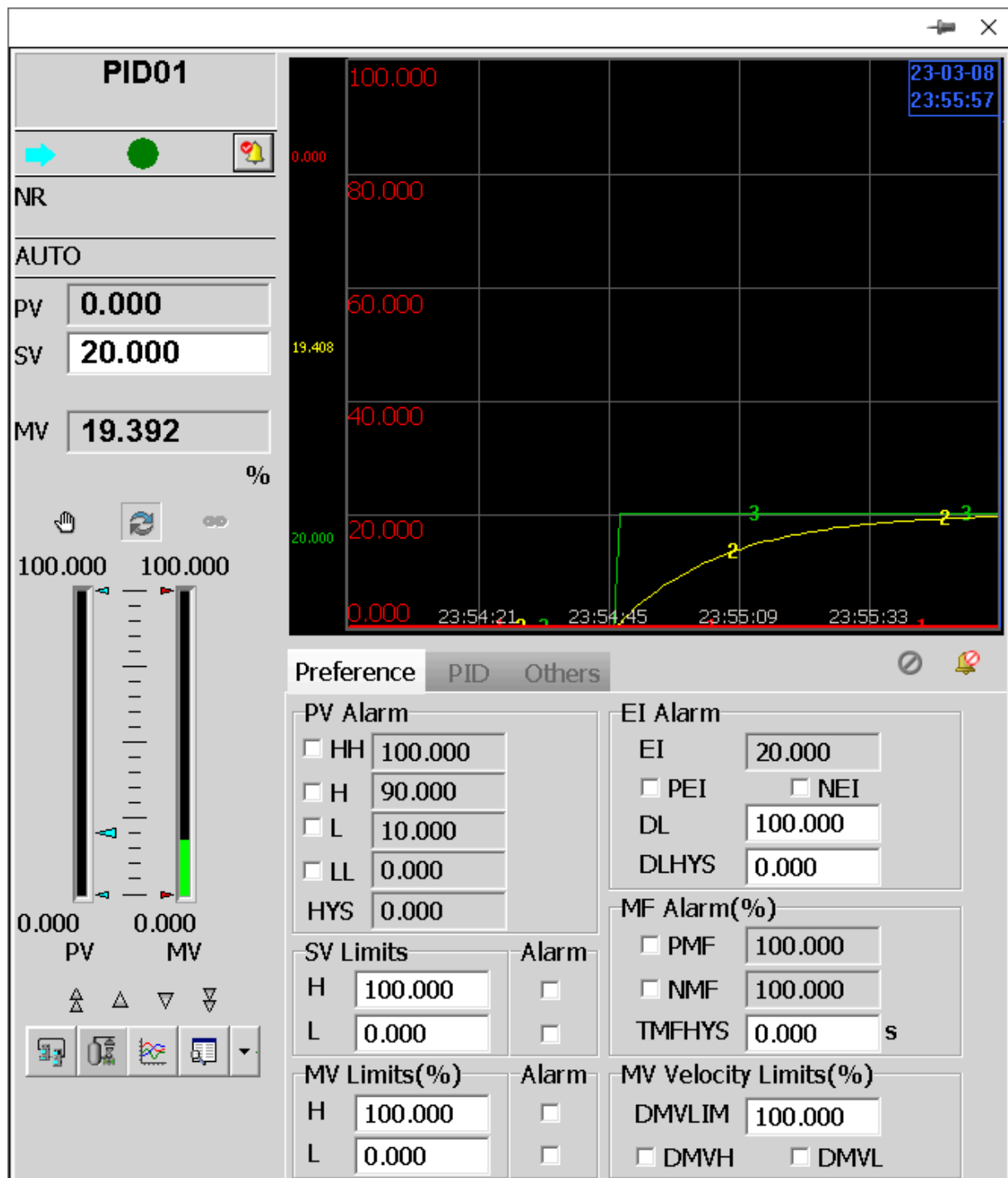
$$\frac{MV(s)}{E(s)} = \frac{100}{PB} \left(1 + \frac{1}{TI * s} + \frac{TD * s}{1 + \frac{TD}{KD} s} \right)$$

3.3.4 Application Illustration

The float abnormal of output values means that the output values are not float format, or a meaningless output value is produced in a calculation that performs a divide-by-zero operation. When float abnormal happened, the function block's output values shall conform to the following rules:

- If there's the normal value of previous period, MV outputs the value of previous period.
- If there's the abnormal value of previous period or no previous period value, MV outputs the lower range limit.

3.3.5 Panel Parameter



The figure displays two screenshots of the 'Function Block Panel Parameter' configuration window. The top screenshot shows the 'PID' tab, and the bottom screenshot shows the 'Others' tab.

PID Tab Parameters:

- PID Parameter:** PB (100.000 %), TI (20.000 s), TD (0.000 s)
- Non-linear Gain:** ☐ Gap Action, ☒ Square Root, GW (0.000), KN (1.000)
- Control Direction:** ☐ Direct, ☒ Reverse
- Proportional Action:** ☒ Run, ☐ Stop
- Incomplete Diff Coef.:** KD (10.000 s)
- Integral Separation:** EA (0.000), DK (0.000)
- Deadband:** ☐ Enable, ☒ Disable, DB (0.000), DBHYS (0.000)
- SV Ramp Action:** ☐ Enable, ☒ Disable, RAMP (100.000)
- Integral Action:** ☒ Run, ☐ Stop
- PID:** ☒ Run, ☐ Bypass

Others Tab Parameters:

- Input Compensation:** IA (0.000), IK (1.000), IB (0.000)
- BKOUT Track:** ☐ PV, ☒ SV
- SV Track:** ☒ Track, ☐ Untrack
- Change Limit of SV & MV:** GSV (0.000), GMV (0.000)
- Output Compensation(%):** OA (0.000), OK (1.000), OB (0.000)
- MAN_OPT:** ☒ Panel, ☐ Program
- SV_OPT:** ☐ Panel, ☒ Program
- Mode Lock:** ☐ Enable
- Override:** ☐ Enable
- EI Alarm Filter:** KSV (1.000), TSV (0.000 s)
- TR:** (0.000)
- Executive Feedback:** (0.000 %)

Figure 3.16 Function Block Panel Parameter

Table 3.12 Operation Instruction for Panel Parameter

Panel Parameter Name			Function Block Parameter Name	Initial Value	Value Range	Application Instruction
Preference	PVAlarm (%)	HH	PVHH	100.000	[SVS-CL,SVSCH]	HH alarm value setting of loop PV (select alarm enabled, or it is disabled).

Table 3.12 Operation Instruction for Panel Parameter (continued)

Panel Parameter Name			Function Block Parameter Name	Initial Value	Value Range	Application Instruction
		H	PVH	90.000	[SVS-CL,SVSCH]	H alarm value setting of loop PV(select alarm enabled, or it is disabled)
		L	PVL	10.000	[SVS-CL,SVSCH]	L alarm value setting of loop PV(select alarm enabled, or it is disabled)
		LL	PVLL	0.000	[SVS-CL,SVSCH]	LL alarm value setting of loop PV. (select alarm enabled, or it is disabled)
		HYS	PVHYS	0.000	-	PV Process value alarm hysteresis
	SV Limits (%)	H	SVH	40.000	[SVS-CL,SVSCH]	H value setting of loop SV (select alarm enabled, or it is disabled). Note: SV limit is not affected by selection.
		L	SVL	0.000	[SVS-CL,SVSCH]	L value setting of loop SV (select alarm enabled, or it is disabled). Note: SV limit is not affected by selection.
	MV Limits (%)	H	MVH	100.000	[MVS-CL,MVSCH]	H value setting of loop MV (select alarm enabled, or it is disabled). Note: MV limit is not affected by selection.
		L	MVL	0.000	[MVS-CL,MVSCH]	L value setting of loop MV (select alarm enabled, or it is disabled). Note: MV limit is not affected by selection.
	EI Alarm (%)	EI	EI	0.000	-	Read-only. EI=SV-PV (select alarm enabled, or it is disabled).
		PEI (selected)	-	-	-	Selecting the positive deviation alarm is enabled.
		NEI (selected)	-	-	-	Selecting the negative deviation alarm is enabled.
		DL	DL	100.000	± (Range H-Range L)	Deviation alarm SV
		DL-HYS	DLHYS	0.000	-	Deviation alarm hysteresis value

Table 3.12 Operation Instruction for Panel Parameter (continued)

Panel Parameter Name			Function Block Parameter Name	Initial Value	Value Range	Application Instruction
	MF Alarm (%)	PMF	PMFLIM	100.000	-	Selecting the positive deviation alarm is enabled.
		NMF	NMFLIM	100.000	-	Selecting the negative deviation alarm is enabled.
		TMFHYS	TMFHYS	0.000	-	Lag time SV
	MV Velocity Limits (%)	DMVH (selected)	-	-	-	Selecting positive velocity alarm is enabled.
		DMVL (selected)	-	-	-	Selecting negative velocity alarm is enabled.
		DMVLIM	DMVLIM	100.000	-	Loop MV velocity limit SV
PID	PID Parameter	PB (%)	PB	100.000	Not less than 0	Loop proportional parameter SV
		TI(s)	TI	20.000	Not less than 0	Loop integral time parameter SV
		TD(s)	TD	0.000	Not less than 0	Loop differential time parameter SV
	Incomplete differential Parameter	KD(s)	KD	10.000	Not less than 0	Incomplete integral filter coefficient
	Deadband (%)	Enable (selected)	SWDB	-	-	Selecting deadband parameter is enabled.
		Disable (selected)	SWDB	√	-	Selecting deadband parameter is disabled.
		DB	DB	0.000	-	Deadband band size
		DB-HYS	DBHYS	0.000	[0,DB]	Deadband band hysteresis

Table 3.12 Operation Instruction for Panel Parameter (continued)

Panel Parameter Name			Function Block Parameter Name	Initial Value	Value Range	Application Instruction
	Non-linear Gain (%)	Gap Action (selected)	NGN_-OPT	-	-	Read-only, non-linear gain selection switchON= Gap Action
		Square Root (selected)	NGN_-OPT	√	-	Read-only, non-linear gain selection switchOFF=Square Root Action
		GW	GW	0.000	[0,1.0]	Nonlinear gain action range
		KN	KN	1.000	-	Nonlinear gain coefficient
	Integral Separation (%)	EA	EA	0.000	-	Range parameter SV
		DK	DK	0.000	-	Integral excising coefficient. When EI>EA, integral excising enabled; when EI<EA, integral excising disabled.
	SV Ramp Action (%)	Enable (selected)	SWRAMP	-	-	Selecting SV ramp is enabled.
		Disable (selected)	SWRAMP	√	-	Selecting SV ramp is disabled.
		RAMP	RAMP	100.000	-	Coefficient parameter SV
	Control Direction	Direct (selected)	SWPN	-	-	Selecting direct action is enabled.
		Reverse (selected)	SWPN	√	-	Selecting reverse action is enabled.
	Proportional Action	Run (selected)	STOPP	√	-	Selecting proportional action is enabled.

Table 3.12 Operation Instruction for Panel Parameter (continued)

Panel Parameter Name			Function Block Parameter Name	Initial Value	Value Range	Application Instruction
		Stop	STOPP	-	-	Selecting proportional action is disabled.
	Integral Action	Run	STOPI	√	-	Selecting integral action is enabled.
		Stop	STOPI	-	-	Selecting integral action is disabled.
	PID	Run	BYPASS	√	-	The modification of function block panel is enabled for function block properties interface when debugging.
		By-pass	BYPASS	-	-	The modification of function block panel is disabled for function block properties interface when debugging.
Others	Input Compensation (%)	IA	IA	0.000	-	Read-only, can be set in configuration or program
		IK	IK	1.000	-	Input compensation gain
		IB	IB	0.000	-	Input compensation bias value
	Output Compensation (%)	OA	OA	0.000	-	Read-only, feedforward signal
		OK	OK	1.000	-	Output compensation gain
		OB	OB	0.000	-	Output compensation bias value
	Bias Alarm Filter Settings	KSV	KSV	1.000	0~100	Deviation filter coefficient
		TSV (s)	TSV	0.000	0~1000s filter time	Constant between errors (s)
	Feed-back Output Track	PV	BK_OPT	-	-	Read-only, can be set in configuration or program
		SV	BK_OPT	√	-	Read-only, can be set in configuration or program
	SV Track	Track	SVTR_OPT	√	-	Read-only, can be set in configuration or program
		Not Track	SVTR_OPT	-	-	Read-only, can be set in configuration or program
	MAN_-OPT Setting	Panel	MAN_-OPT	√	-	Read-only, can be set in configuration or program

Table 3.12 Operation Instruction for Panel Parameter (continued)

Panel Parameter Name			Function Block Parameter Name	Initial Value	Value Range	Application Instruction
		Program	MAN_-OPT	-	-	Read-only, can be set in configuration or program
	SV_-OPT Settings	Panel	SV_OPT	-	-	Read-only, can be set in configuration or program
		Program	SV_OPT	√	-	Read-only, can be set in configuration or program
	Mode Lock	Enable	LOCK	-	-	Selecting the mode lock will cause manual, auto, and cascade buttons on the panel become unavailable.
	Override	Enable	RTM_-OVRD	-	-	In RCAS and ROUT modes, if it is not in override status, manual, auto, and cascade buttons on the panel become unavailable.
	Change Limit of SV & MV	GSV	GSV	0.000	-	SV safety protection input increase or decrease value
		GMV	GMV	0.000	-	MV safety protection input increase or decrease value
	TV (%)		TV	0.000	-	Read-only, track input value
	Executive Feedback		MF	0.0	[MVL,MVH]	Writable, %

3.3.6 Flag

The table lists the corresponding relation between PID function block flag and alarm code. For details of quality code, refer to Flag.

Table 3.13 Flag

Flag	Alarm	Instruction
D0	OOS	Disable
D1	IMAN	Initialize Manually
D2	MAN	Manual
D3	TR	Track
D4	AUTO	Auto

Table 3.13 Flag (continued)

Flag	Alarm	Instruction
D5	CAS	Cascade
D8	PVHH	PV HH Limit Alarm
D9	PVLL	PV LL Limit Alarm
D10	PVH	PV H Limit Alarm
D11	PVL	PV L Limit Alarm
D12	SVH	SV H Limit Alarm
D13	SVL	SV L Limit Alarm
D14	MVH	Output H Limit Alarm
D15	MVL	Output L Limit Alarm
D16	PEI	Positive Deviation Alarm
D17	NEI	Negative Deviation Alarm
D18	REVSCL	Span H/L Limit Reverse or output value float abnormal
D19	CFGERR	Configuration Error
D22	DMVH	MV Positive Rate Limit Alarm
D23	DMVL	MV Negative Rate Limit Alarm
D25	AOF	Suppress Alarm
D27	NMF	Valve Negative Deviation Alarm
D28	PMF	Valve Positive Deviation Alarm

3.3.7 Application Example

Example 1: PID single loop control

Single loop, also known as simple control system, refers to a closed loop feedback control system composed of a controlled object, a detection transmitter, a controller and an actuator. It is often used in occasions where the lag time of the controlled object is small, the load and interference change little, and the control quality requirements are not very high. For example, in this example, the controlled object is a reactor, the detection transmitter is a temperature transmitter, the controller is a PID, and the actuator is a cooling water regulating valve.

[On-site requirements] As shown in Figure 3.17, in the continuously stirred reactor, the materials enter the reactor to cause an exothermic reaction, and the heat generated by the reaction is

taken away by the cooling water flowing through the jacket. It is required to adjust the flow of the cooling water to control realize the purpose of adjusting the temperature of the mixture.

[Project realization] Through the following on-site deployment and design, the purpose of controlling the temperature of the on-site reaction mixture can be achieved.

AI number TT001 collects the reaction mixture temperature TT.

After the PID function block receives the value of TT001, it performs PID calculation and outputs the execution signal to the AO tag FC001.

FC001 controls the valve to adjust the flow of cooling water so that the temperature of the reaction mixture reaches a given value.

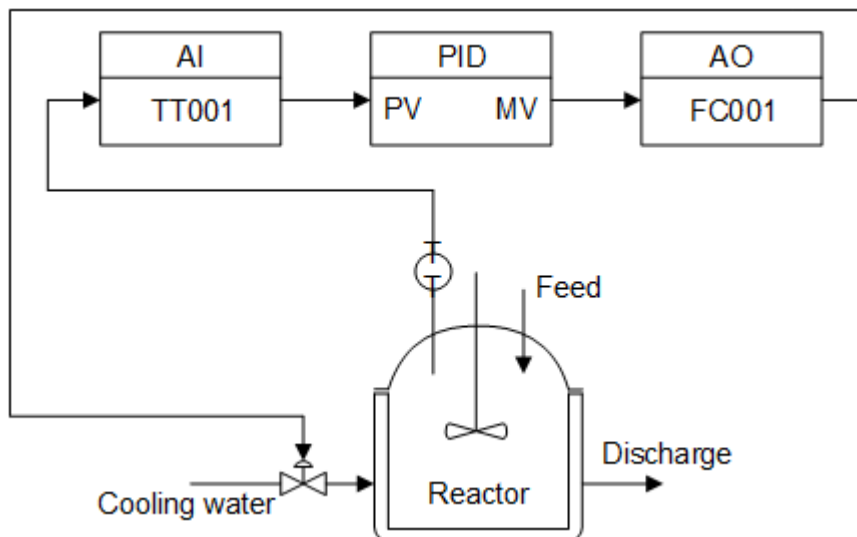


Figure 3.17 Compound temperature PID control

[PID configuration] In the PID control process shown in the figure above, PID can be configured as described below.

The FBD programming method is shown in Figure 3.19. When applying the PID function block, its input pins BKIN and BKINERR must be connected to the output pins BKOUT and BKOUTERR of the downstream block respectively (for this example, the downstream block is the AO tags).

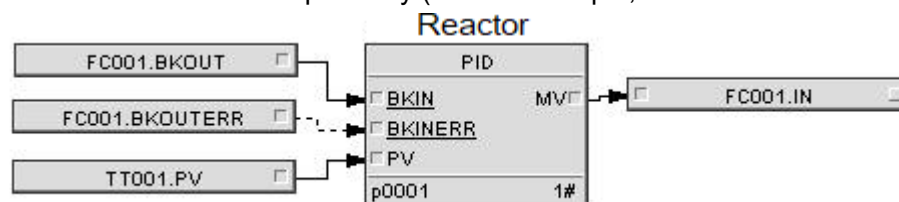


Figure 3.18 Single closed-loop control program

PID function block parameter setting (setting is completed in the function block attribute interface):

- PID_OPT: 0 (standard PID algorithm)
- SWPN: ON (select reaction)
- SVEU: °C

- SVSCH: (= High range value of tag TT001)
- SVSCL: (= low range value of tag TT001)
- MVEU: m³/s.
- Other parameters remain unchanged by default

When the program is debugged, run the monitoring software to call up the function block panel and expand the adjustment screen. If the function block is in the IMAN status at this time, check the FC001 tag information and adjust the FC001 status until FC001.BKOUTERR=OFF. At this time, the reactor is in the MAN status and can be automatically switched by hand.

Example2.Feedforward control

The adjustment method of the feedforward control is carried out in accordance with the interference effect, and the feedforward control will introduce the adjustment device to directly overcome the measured interference. In Example 1, the system adjusts only after a deviation between the measured value and the set value. If interference has occurred in the system without deviation, the system has no control effect, so the feedback control method lags behind the feedforward control. Therefore, in actual use, we often use feedforward + feedback control methods to achieve better control effects.

[Field requirements] In Example 1, if the supply of cooling water is reduced, the temperature of the reaction mixture in the reactor will be higher than the set temperature for a period of time. This disturbance can be detected before it is reflected to the temperature measuring point of the reaction mixture, and used as output compensation to participate in the PID calculation to eliminate its influence on the temperature of the reaction mixture.

[Engineering realization] As shown in Figure 3.19, the purpose of controlling the temperature of the on-site reaction mixture can be achieved.

AI tag FT001 measures the cooling water flow FT before the control valve and sends it to the PID function block as a feedforward signal.

- If the cooling water flow decreases, the function block increases the output signal to increase the opening of the control valve.
- If the cooling water flow increases, the function block reduces the output signal to reduce the opening of the control valve.

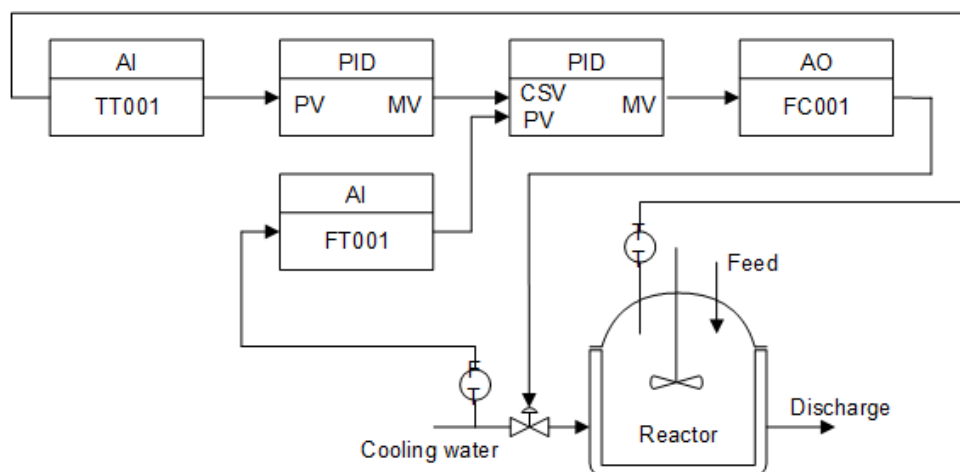


Figure 3.19 Feedforward control program

[PID configuration] FBD programming method is shown in Figure 3.21. The feedforward control is added to the system to improve the temperature response of the reaction mixture, the inlet cooling water flow measurement value is input to the AI block and connected to the OA of the PID block, and the parameters OK and OB are set through the function block panel.

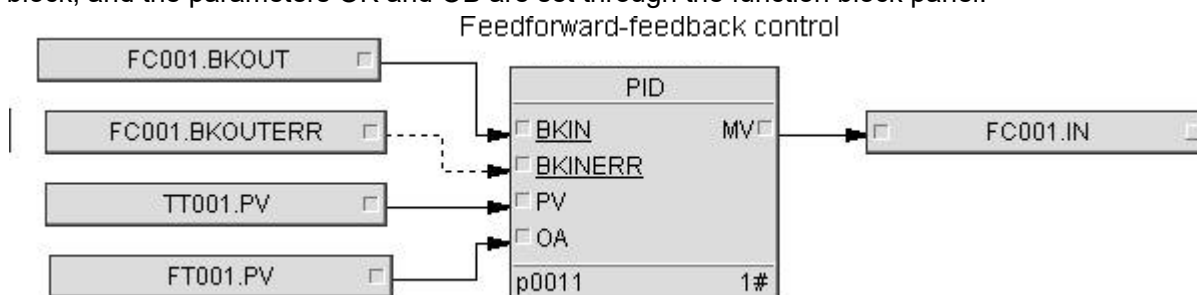


Figure 3.20 Feedforward-feedback control program

The PID function block parameter setting involved in the program is completed in the function block attribute interface. Among them, the setting methods of PID_OPT, SWPN, SVEU, SVSCH, SVSCL, MVEU, please refer to Example 1, the setting methods of OK, OB, PB refer to section Operation Process, and the setting methods of PB, TI, TD refer to section PID Parameter Tune.

Example 3: PID cascade control

[Field requirements] Cascade control refers to a closed loop composed of two PID single loops. In order to overcome the interference caused by the change of cooling water flow rate in Example 1, Example 2 adopts the feedforward-feedback control method, but this method requires that the amount of control valve opening adjustment caused by the change of cooling water flow rate be determined in advance, which depends on the amount of interference and the controlled amount. Associated mathematical model. Another way to solve this problem is to use cascade control. The cascade control refers to a closed loop composed of two PID single loops, in which the output MV of the main loop is used as the given CSV of the slave loop.

[Engineering realization] In the cascade loop, the output MV of the main loop (temperature loop) is used as the given CSV of the slave loop (cooling water flow loop). The control strategy is shown in Figure 3.21.

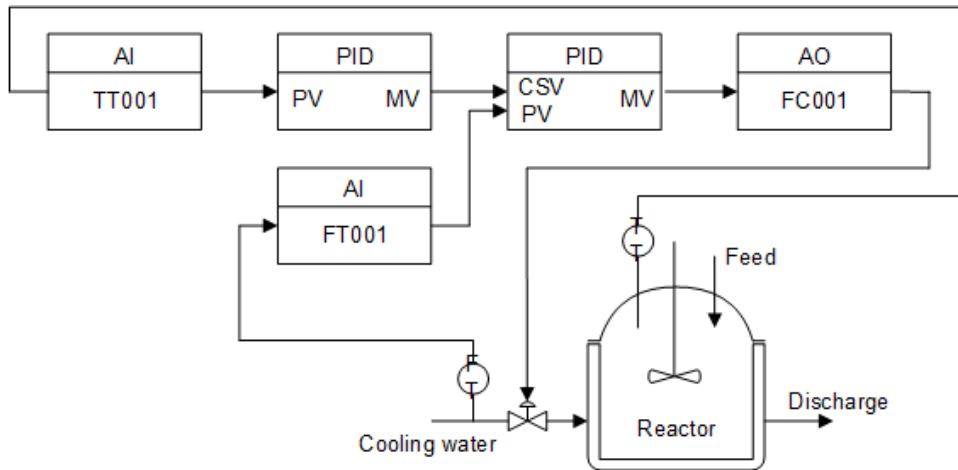


Figure 3.21 Cascade control diagram

[PID configuration] The FBD program is shown in Figure 3.22. Notice the function block number when programming (executing order).

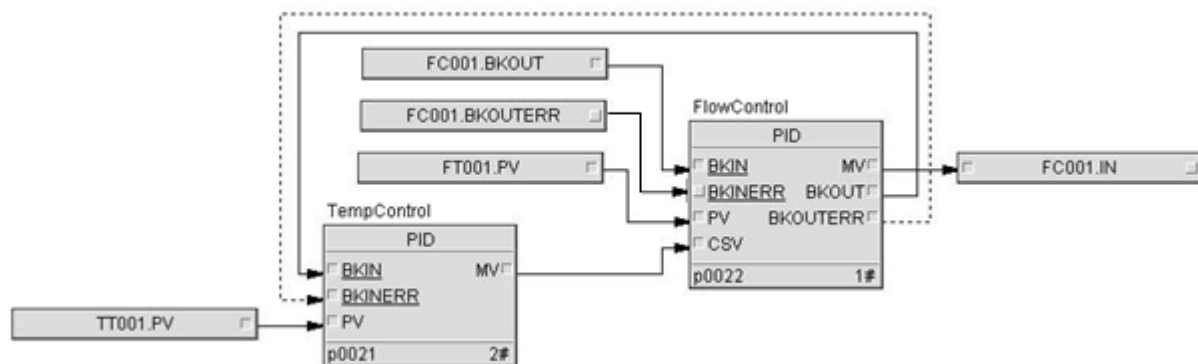


Figure 3.22 Cascade control program diagram

Function block TempControl parameter setting (set in the function block properties settings interface):

- PID_OPT: 0 (Standard PID algorithm)
- SWPN: ON(reverse action)
- SVEU: °C
- SVSCH: (= range H value of tag TT001)
- SVSCL: (= range L value of tag TT001)
- MVEU: m^3/s
- MVSCH: (= range H value of tag FT001)
- MVSCL: (= range L value of tag FT001)
- Default values of other parameters keep unchanged

Function block FlowControl parameter setting (set in the function block properties settings interface).

- PID_OPT: 0
- SWPN: ON(reverse action)
- SVEU: m^3/s
- SVSCH: (= range H value of tag FT001)
- SVSCL: (= range L value of tag FT001)
- MVEU: m^3/s
- Default values of other parameters keep unchanged.

When debugging program, first exit the FlowControl loop and TempControl loop from OOS mode, debug the FlowControl loop, which is the same as the single loop control, after it finished, switch to cascade and then debug TempControl.

Example 4: PD_I

It is different from standard PID control algorithm; the variation of set value will not affect the proportional and differential action. Even the sudden change of set value will not cause the rapid change of operation output, and can obtain the steady control features easily. It performs proportional, integral and differential control actions for the modification of controlled process features and the modification and interference of load, to achieve better control.

The program of FBD is the same as standard PID control. Refer to Figure 3.18 and Figure 3.22.

Parameter setting:

- PID_OPT: 2 (PV proportional differential control prior to PID)
- Other parameter settings are the same as standard PID control.

Example 5: D_PI

It only performs proportional control and integral control, but no differential control, when the set value changes, and is mainly used in filed needing better track feature for the change of set value, for example, the minor loop of cascade control loop.

Parameter setting:

- PID_OPT: 1 (PV Differential control prior to PID)
- Other parameter settings are the same as standard PID control.

Example 6: PID control with track function

The track action is usually used for the process control beyond normal running range.

In Figure 3.23, the liquid level of the water tank is controlled. The AI position number LI10401 collects the liquid level height LT (0~10m), and the AO position number LV10401 controls the valve. Requirements: When the liquid level is greater than 90%, the tracking starts and the valve is fully closed; when the liquid level is less than 90%, the tracking is closed, the PID regulator starts to work normally, and the valve position is controlled to adjust the output flow.

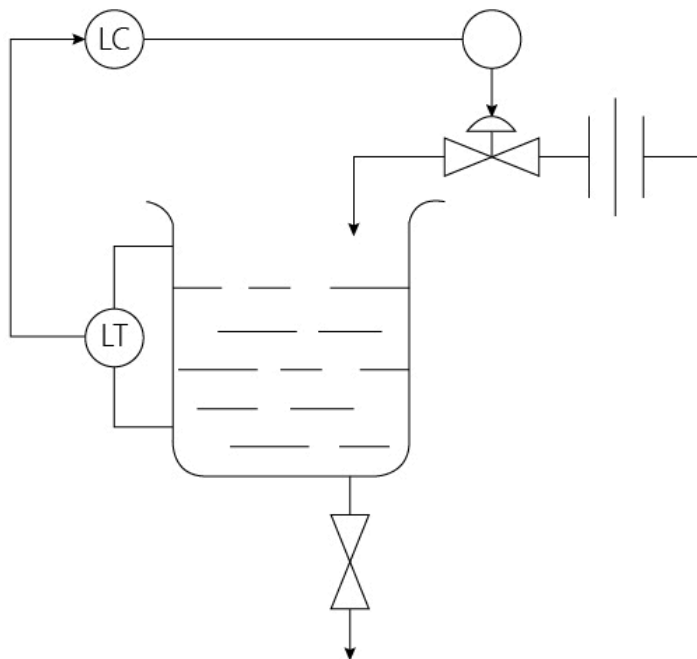


Figure 3.23 Track and PID control diagram

FBD program is shown in Figure 3.24.

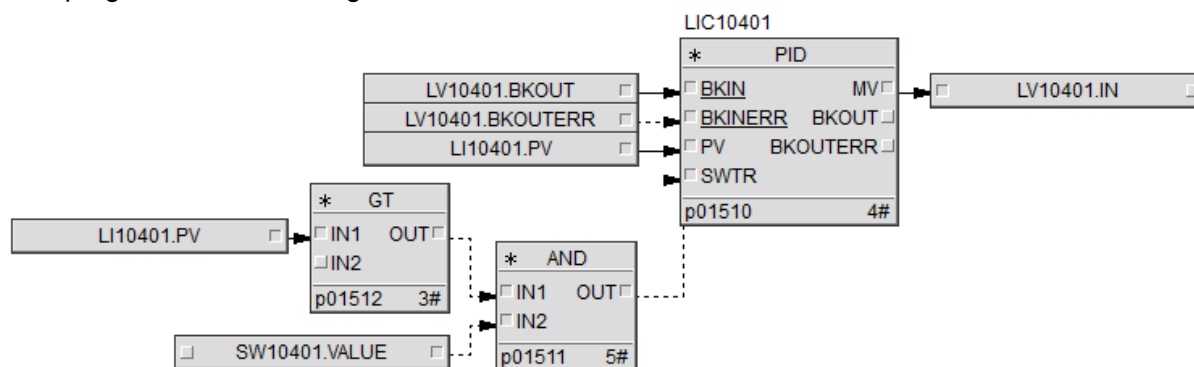


Figure 3.24 Track and PID control program

Function block illustration and corresponding instances are shown in the table below.

Table 3.14 Function block and corresponding instance illustration

No.	Instance	Type	Illustration
001	LI10401	AI input	Collect liquid level height LT
002	LV10401	AO output	Valve control liquid level height
003	SW10401	AI output	Interlock switch

Table 3.14 Function block and corresponding instance illustration (continued)

No.	Instance	Type	Illustration
004	LIC10401	Function block tag	PID function block tag

The parameter setting of the PID function block involved in the program is completed in the function block property interface. The specific parameter setting is as follows:

- The parameter IN2 in the GT function block is 9;
- TV in the PID function block is 0;
- The setting methods of PID_OPT, SWPN, SVEU, SVSCH, SVSCL, MVEU are shown in the PID single loop control in Example 1, and the setting methods of PB, TI and TD are shown in section 3.2.9.

3.4 PIDEF Function Block (PIDEF)

The control function of general PID is available in PIDEF. It has three work modes^{Note1} OOS, IMAN and AUTO, and applies to electric power industry.

It is a complex function block and its running time is 150μs.

Please refer to the Overview and Control Function Block Library before using the function block.



3.4.1 Parameter Description

Details of various parameters setting refer to Parameter Property and Parameter Setting Illustration.

The data type, initial value and default pin of function block parameter in the table below refer to the function properties setting interface.

When the parameter in the table below is uploaded as TRUE, it means the corresponding parameter can upload the data of controller and save to the configuration later. When offline download is performed next time, the saved data can be downloaded to the controller.

Table 3.15 Parameter instruction and application of PIDEF Function Block

Name			Description	Upload	Properties	Application Reference
Basic Parameters	Range Settings	MVSCH	MV high scale	-	Configuration Parameter	The same as MV actual value H limit.

Table 3.15 Parameter instruction and application of PIDEF Function Block (continued)

Name			Description	Upload	Properties	Application Reference
		MVSCL	MV low scale	-	Configuration Parameter	The same as MV actual value L limit.
		SVSCH	SV high scale	-	Configuration Parameter	The same as PV actual value H limit.
		SVSCL	SV low scale	-	Configuration Parameter	The same as PV actual value L limit.
		SVEU	SV engineer unit	-	Configuration Parameter	Set in the function block properties settings interface.
		MVEU	MV engineer unit	-	Configuration Parameter	Set in the function block properties settings interface.
		SVDLEN	SV decimal digits [0,5]	-	Configuration Parameter	Used for data displayed on function block panel (equal to 3 as default).
		MVDLEN	MV decimal digits [0,5]	-	Configuration Parameter	Used for data displayed on function block panel (equal to 3 as default).
	Limits	MVH	MV H limit value	TRUE	Operation Parameter	Value range [MVSCL,MVSCH]
		MVL	MV L limit value	TRUE	Operation Parameter	Value range [MVSCL,MVSCH]
		SVH	SV H limit value	TRUE	Operation Parameter	Value range [SVSCL,SVSCH]
		SVL	SV L limit value	TRUE	Operation Parameter	Value range [SVSCL,SVSCH]
		DMVLIM	MV output rate variety limit value. Used to prevent the MV from overlarge modification in a short time.	TRUE	Operation Parameter	Refer to Output Process
	Direct/Reverse Switch Settings	SWPN	Direct/Reverse switch. SV is not changed, the MV increases with the increasing of PV in direct action, and decreases with the	TRUE	Operation Parameter	OFF=Direct action, ON=Reverse action

Table 3.15 Parameter instruction and application of PIDEF Function Block (continued)

Name			Description	Upload	Properties	Application Reference
			increasing of PV in reverse action.			
Extended Parameter	Base Input Pin Settings	BKIN	Feedback input	-	Input Pin	Connect to BKOUT of downstream block
		BKIN-ERR	Feedback status input	-	Input Pin	Connect to BKOUTERR of downstream block
		BKINSTA	Multi-status feedback input ^{Note4}	-	Input Pin	Connect to BKOUTSTA of downstream block
		PV	Process value of loop closed control process	-	Input Pin	Connect to measuring point AI
		SV	Setpoint value of loop closed control process	-	Input Pin	Connect to measuring point AI
		OA	Output compensation, used for feedforward control	-	Input Pin	Connect to measuring point AI (feedforward signal), related parameters: OK, OB
	Advance Input Pin	IA	Input compensation value, used to improve the controllability of process with long deadband time	-	Input Pin	Connect to measuring point AI , refer to Input Process. Related parameters: IK, IB
		SWINC	MV lock increase (MV cannot increase), ON= lock increase	-	Input Pin	Connect to upstream output, valid when function block is automatic
		SWDEC	MV lock decrease (MV cannot decrease), ON= Lock decrease	-	Input Pin	Connect to upstream output, valid when function block is automatic.
		HOLD	MV hold the current output value, ON= hold the current output value	-	Input Pin	Connect to upstream output,
		BYPASS	PID bypass operation, when BYPASS=ON, excise PID calculation, switch SV	TRUE	Operation Parameter	Bypass action is performed only in auto mode ^{Note2} .

Table 3.15 Parameter instruction and application of PIDEF Function Block (continued)

Name			Description	Upload	Properties	Application Reference
			to MV directly for output.			
		STOPP	Proportion shield switch, stop proportion action when STOPP=ON	TRUE	Operation Parameter	Refer to Operation Process
		STOPI	Integral shield switch, stop integral action when STOPP=ON	TRUE	Operation Parameter	Refer to Operation Process
	Output Pin	MV	PID operation output value	-	Output Pin	Connect to electric manual instrument-The MV changes only when accumulated modification of dMV is more than output deadband. Otherwise, it holds. If set the deadband as 1, the MV will change only when the accumulated modification is more than deadband (it is 1 when changing from 30 to 31).If there's a float abnormal happened to the MV value, the MV will be set as the value of previous period or the lower limit. Please refer to "Application Illustration" for details.
		BKOUT	Feedback output value	-	Output Pin	Connect to the BKIN of Upstream Block, related Parameter: BK_OPT
		BKOUTERR	Feedback status value	-	Output Pin	Connect to the BKINERR of Upstream Block
		BKOUTS-TA	Multi-status feedback output ^{Note5}	-	Output Pin	Connect to the BKINSTA of Upstream Block
		BK_OPT	BKOUT value switch (ON=track PV, OFF=track SV)	-	Configuration Parameter	Related parameter: BKOUT

Table 3.15 Parameter instruction and application of PIDEF Function Block (continued)

Name			Description	Upload	Properties	Application Reference
	Status	IMANIND	IMAN Status	-	Monitoring Parameter	-
		AUTOIND	Auto status indication	-	Monitoring Parameter	-
	PID Param Settings	PB	Proportion band size	TRUE	Operation Parameter	Refer to PID Parameter Tune
		TI	Integral time (s)	TRUE	Operation Parameter	Refer to PID Parameter Tune
		TD	Derivative time (s)	TRUE	Operation Parameter	When TD=0, suppress derivation action, Refer to PID Parameter Tune
		KD	Derivative filter coefficient	TRUE	Operation Parameter	Refer to Parameter Description ^{Note1, Note2, Note3, Note4}
	Error Indication	EI	Deviation	-	Monitoring Parameter	Refer to Operation Process
	Input Alarm Settings	PVHH	PV HH limit alarm value	TRUE	Operation Parameter	Refer to Input Process
		PVH	PV H limit alarm value	TRUE	Operation Parameter	Refer to Input Process
		PVL	PV L limit alarm value	TRUE	Operation Parameter	Refer to Input Process
		PVLL	PV LL limit alarm value	TRUE	Operation Parameter	Refer to Input Process
		PVHYS	Process value alarm hysteresis	TRUE	Operation Parameter	Refer to Input Process
		DL	Deviation alarm set value	TRUE	Operation Parameter	Refer to Operation Process
		DLHYS	Deviation alarm hysteresis value	TRUE	Operation Parameter	Refer to Operation Process
		KSV	Deviation filter coefficient	TRUE	Operation Parameter	Refer to Operation Process
		TSV	Deviation filter time constant(s)	TRUE	Operation Parameter	Refer to Operation Process
	Advanced Calcul-	SWDB	Enable switch, when SWD-	TRUE	Operation Parameter	Related parameter: DB

Table 3.15 Parameter instruction and application of PIDEF Function Block (continued)

Name			Description	Upload	Properties	Application Reference
	lational Settings		B=ON, deadband enable			
		DB	Dead band size	TRUE	Operation Parameter	Enable when SWD-B=ON
		DBHYS	Dead band hysteresis	TRUE	Operation Parameter	Refer to Operation Process
		MDB	Precise controlled zone range	TRUE	Operation Parameter	Refer to ^{Note1}
		MK	Precise controlled zone coefficient [0,1.0]	TRUE	Operation Parameter	Refer to ^{Note1}
		GW	Non-linear Gain Range	TRUE	Operation Parameter	Refer to Operation Process
		KN	Non-linear Gain Coefficient[0, 1.0]	TRUE	Operation Parameter	Refer to Operation Process
		NGN_-OPT	Non-linear Gain Selection: OFF=Deviation Square Root Function, ON=Gap Action Function	TRUE	Operation Parameter	When OPT=ON, the related parameters include GW, PB and KN. When NGN_-OPT = OFF, the related parameters include GW and PB.
		EA	Integral excise coefficient. when EI > EA, excise coefficient, when EI < EA, excising coefficient is disabled, used for prevent MV change from overlarge	TRUE	Operation Parameter	Related parameter: DK
		DK	Proportion modified value when integral excising	TRUE	Operation Parameter	Related parameter: EA
		PID_-OPT	PID type selection	-	Configuration Parameter	Refer to Parameter Description ^{Note1, Note2, Note3}
	Alarm	PVH-HIND	PVHH alarm indication	-	Monitoring Parameter	Refer to Integral Cutting
		PVHIND	PV H Limit alarm indication	-	Monitoring Parameter	Refer to Integral Cutting

Table 3.15 Parameter instruction and application of PIDEF Function Block (continued)

Name			Description	Upload	Properties	Application Reference
		PVLIND	PV L limit alarm indication	-	Monitoring Parameter	Refer to Integral Cutting
		PVLLIND	PV LL limit alarm indication	-	Monitoring Parameter	Refer to Integral Cutting
		MVHIND	MV H limit alarm indication	-	Monitoring Parameter	Refer to Integral Cutting
		MVLIND	MV L limit alarm indication	-	Monitoring Parameter	Refer to Integral Cutting
		SVHIND	SV H limit alarm indication	-	Monitoring Parameter	Refer to Integral Cutting
		SVLIND	SV L limit alarm indication	-	Monitoring Parameter	Refer to Integral Cutting
		PEIIND	Positive deviation alarm indication	-	Monitoring Parameter	Refer to Integral Cutting
		NEIIND	Negative deviation alarm indication	-	Monitoring Parameter	Refer to Integral Cutting
		DMVHIND	MV positive rate limit indication	-	Monitoring Parameter	Refer to Integral Cutting
		DMVLIND	MV negative rate limit indication	-	Monitoring Parameter	Refer to Integral Cutting
	Compensation Settings	IK	Input compensation gain	TRUE	Operation Parameter	Refer to Input Process.Related parameter: IA
		IB	Input compensation bias value	TRUE	Operation Parameter	Refer to Input Process.Related parameter: IA
		OK	Output compensation gain	TRUE	Operation Parameter	Refer to Operation Process.Related parameter: OA
		OB	Output compensation bias value	TRUE	Operation Parameter	Refer to Operation Process.Related parameter: OA
	Extended Range Settings	HORLIM	Extended range maximum percentage	-	Configuration Parameter	Refer to Output Process
		LORLIM	Extended range minimum percentage	-	Configuration Parameter	Refer to Output Process

Table 3.15 Parameter instruction and application of PIDEF Function Block (continued)

Name			Description	Upload	Properties	Application Reference
	SV Advance Settings	SWRAMP	SV ramp function switch. When changing set value, incline it to SV according to the set RAMP (s). OFF=SV ramp function off, ON=SV ramp function on	TRUE	Operation Parameter	Related parameter: RAMPEnable when in automatic mode
		RAMP	Ramp coefficient	TRUE	Operation Parameter	Related parameter: SWRAMP
		SVTR_OPT	Track PV switch enable/disable: OFF=not track, ON=track. If PV> SVH/ SVL, SV= range limit. Used to prevent the output MV from interference when changing the control mode.	-	Configuration Parameter	When it is in track mode, SV tracks the PVR change of PV after input compensation. Refer to Set Variable Process
	Alarm Enabled and Suppress	AOF	Suppress module alarm, On=prohibit to display alarm	TRUE	Operation Parameter	Refer to Integral Cutting
		ENALM	Alarm enable	TRUE	Alarm Parameter	Refer to Integral Cutting
		FLAG	Flag	-	Output Pin	Refer to Integral Cutting
	OOS Settings	SWOOS	OOS mode setting switch (ON= OOS mode)	TRUE	Operation Parameter	Set as ON at the first time of function block downloading
		OOSVAL	OOS mode output value	TRUE	Operation Parameter	Related parameter: OOS_OPT=ON
		OOS_OPT	OOS mode output value type. when OOS_OPT =ON, MV=OOSVAL, when OOS_OPT =OFF, maintain the MV	-	Configuration Parameter	Refer to Transition Process of Function Block Modes
	Check Input Validity	SWPV	Enable switch for checking PV validity	TRUE	Operation Parameter	Refer to Input Process

Table 3.15 Parameter instruction and application of PIDEF Function Block (continued)

Name			Description	Upload	Properties	Application Reference
		PVLMT	PV change limit (%)	TRUE	Operation Parameter	Refer to Input Process
	Fast/ Slow/In- crease/De- crease Settings	GMV	MV safety protection input increase or decrease value	TRUE	Operation Parameter	-
		GSV	SV safety protection input increase or decrease value	TRUE	Operation Parameter	-

“-“ in the table above means parameters can be any conditions of ON or OFF.

Some of its functions are like PID, and the setting can refer to PID function block, except followings.

Note 1: Precise control processing

When $Mdb > 0$ and the absolute value of bias after compensation is within precise control zone ($-MDB$, MDB), ratio coefficient KP will be corrected as $KP = KP \times MK$. The specific instructions please refer to PID function block.

Note 2: Bypass action

It works only in AUTO mode. When $BYPASS = ON$, output as follows:

$$MV = (SV - SVSCL) \times KS + MVSCL$$

Note 3: Other

The fallback function should be achieved by users when the function block is connected with manual operation but not AO tag.

Note 4:

Input pin $BKINSTA$ and output pin $BKOUTSTA$, data type is USINT. Its meaning is defined by bit, as shown below.

Table 3.16 BKINSTA and BKOUTSTA bit definition

	Data High 2 Bits	Data Middle 2 Bits	Data Low 2 Bits
Example	XX.....	..XXXX..XX
Instruction	11*****: High 2 bits generally have no special meaning, and are set as 1.	**0000**: Middle 4 bits setting as 0 means OK.	*****00: Not limited
			*****01: Low limited
		1111*: Middle 4 bits setting as 1 means Track.	***10: High limited
			*****11: Constant(low+high)

Status values of BKINSTA and BKOUTSTA combined by definition are shown below, please don't use other status values undefined.

Table 3.17 Instruction for status values

BKINSTA/BKOUTSTA	Status Instruction (If high 2 bits of system are always 1, it is cascaded master status.)	Process
11111100(0xFC)	Track if middle 4 bits are 1.	Track (Highest priority)
11111101(0xFD)		
11111110(0xFE)		
11111111(0xFF)		
11000000(0xC0)	Good	Good
11000001(0xC1)	Low limited	Low limited
11000010(0xC2)	High limited	High limited
11000011(0xC3)	Low limited + High limited	Low limited + High limited

Note 5:

Output influence of BKINSTA for PID are shown below. MVLT refers to MV of last period, and dMV refers to MV increment calculated by PID of current period.

Table 3.18 Feedback pin status process of PIDEF function block

Input	Output Response	
BKINSTA	MV	BKOUTSTA
GOOD(BKINSTA=0xC0)	Calculate output MV by current mode	High 2 bits are set as 1
		Middle 4 bits of BKOUTSTA are decided by MODE: MODE != AUTO, middle 4 bits are set as Track. MODE = AUTO, middle 4 bits are set as Good.
		Low 2 bits of BKOUTSTA are set by following rules: MV limit MV H limit: If PID is positive action, low 2 bits of BKOUTSTA are set as Low limited. If PID is negative action, low 2 bits of BKOUTSTA are set as High limited. MV L limit: If PID is positive action, low 2 bits of BKOUTSTA are set as High limited. If PID is negative action, low 2 bits of BKOUTSTA are set as Low limited. SV limit SV H limit: No matter positive or negative action for PID, low 2 bits of BKOUTSTA are set as High limited. SV L limit: No matter positive or negative action for PID, low 2 bits of BKOUTSTA are set as Low limited.

Table 3.18 Feedback pin status process of PIDEF function block (continued)

Input	Output Response	
Track (BKINS-TA=0XFC\0xFD\0xFE\0xFF)	MV = BKIN	High 2 bits are set as 1. Middle 4 bits of BKOUTSTA are set as Track.
Low limited (BKINS-TA=0xC1)	MV lock decrease, i.e. only enable increase and disable decrease (output hold if lock increase signal is existing too).	High 2 bits are set as 1.
		Middle 4 bits of BKOUTSTA are decided by MODE value: MODE != AUTO, middle 4 bits are set as Track. MODE = AUTO, middle 4 bits are set as Good.
Low limited (BKINS-TA=0xC1)	MV lock decrease, i.e. only enable increase and disable decrease (output hold if lock increase signal is existing too).	Low 2 bits of BKOUTSTA are set by following rules: MV limit MV H limit: If PID is positive action, low 2 bits of BKOUTSTA are set as Low limited. If PID is negative action, low 2 bits of BKOUTSTA are set as High limited. MV L limit: If PID is positive action, low 2 bits of BKOUTSTA are set as High limited. If PID is negative action, low 2 bits of BKOUTSTA are set as Low limited. SV limit SV H limit: No matter positive or negative action for PID, low 2 bits of BKOUTSTA are set as High limited. SV L limit: No matter positive or negative action for PID, low 2 bits of BKOUTSTA are set as Low limited.
		High 2 bits are set as 1.
High limited (BKINS-TA=0xC2)	MV lock increase, i.e. only enable decrease and disable increase (output hold if lock decrease signal is existing too).	Middle 4 bits of BKOUTSTA are decided by MODE value: MODE != AUTO, middle 4 bits are set as Track. MODE = AUTO, middle 4 bits are set as Good.
		Low 2 bits of BKOUTSTA are set by following rules: MV limit MV H limit: If PID is positive action, low 2 bits of BKOUTSTA are set as Low limited. If PID is negative action, low 2 bits of BKOUTSTA are set as High limited. MV L limit: If PID is positive action, low 2 bits of BKOUTSTA are set as High limited. If PID is negative action, low 2 bits of BKOUTSTA are set as Low limited. SV limit SV H limit: No matter positive or negative action for PID, low 2 bits of BKOUTSTA are set as High limited. SV L limit: No matter positive or negative action for PID, low 2 bits of BKOUTSTA are set as Low limited. BKINSTA process If PIDEF is positive action, low 2 bits of BKOUTSTA are set as Low limited. If PIDEF is negative action, low 2 bits of BKOUTSTA are set as High limited.

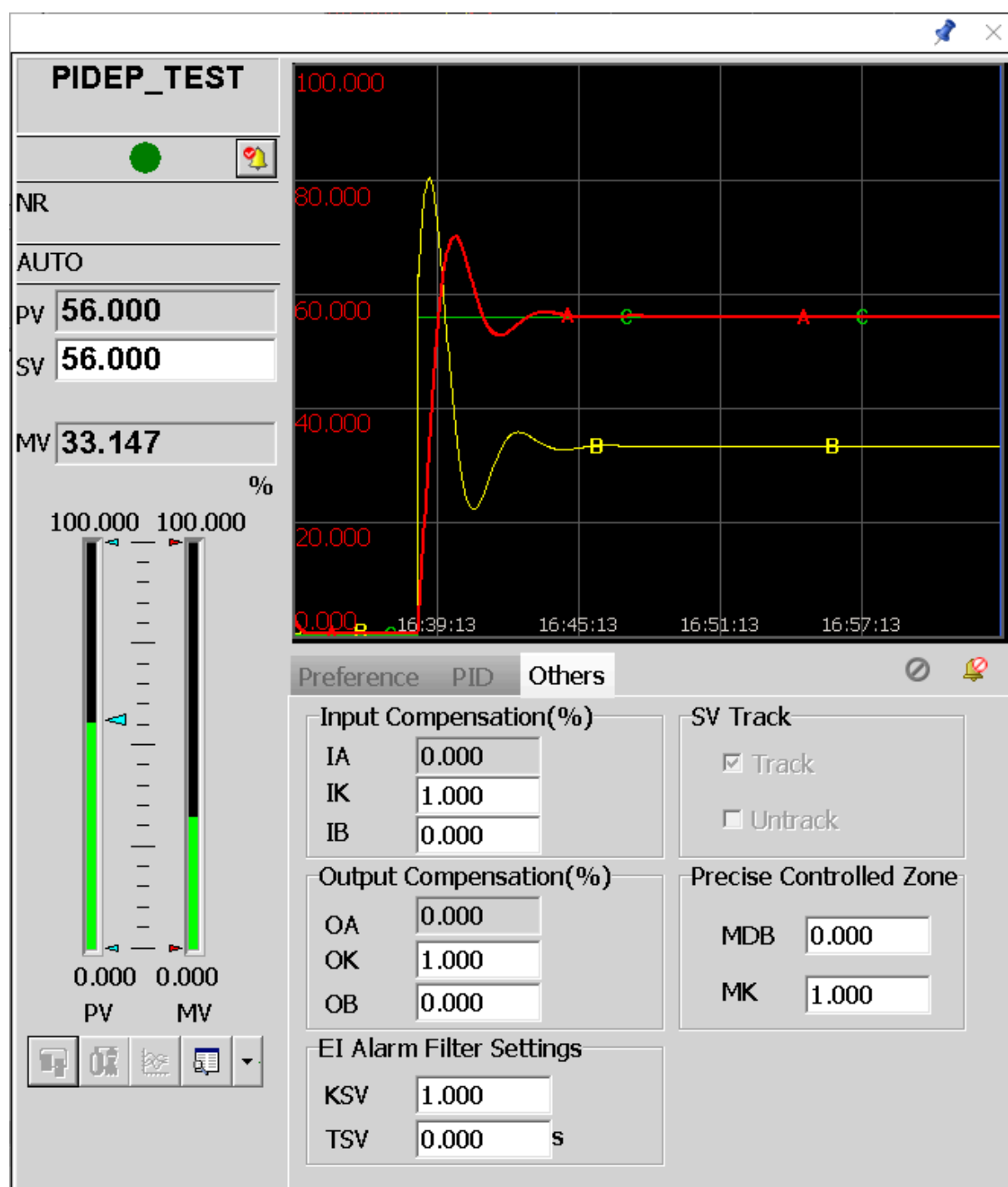
- When calculating BKOUTSTA: if BKINSTA has limit information, and MV or SV is limited, it superimposes the influence of outputting BKOUTSTA, i.e. same priority. The High limited and Low limited of BKOUTSTA may exist together, i.e. set as Constant.
- When processing BKINSTA, Track has the highest priority. The limit information of BKINSTA may be invalid only if middle 4 bits are set as Track.
- If High limited and Low limited exist together, output lock increase and decrease are valid together, output MV hold.
- Lock increase obtained by BKINSTA, will be locked as positive dMV, i.e. including proportion, integral items. If high limit occurs to MV calculated, only exclude the positive integral action.

3.4.2 Application Illustration

The float abnormal of output values means that the output values are not float format, or a meaningless output value is produced in a calculation that performs a divide-by-zero operation. When float abnormal happened, the function block's output values shall conform to the following rules:

- If there's the normal value of previous period, MV outputs the value of previous period.
- If there's the abnormal value of previous period or no previous period value, MV outputs the lower range limit.

3.4.3 Panel Parameter



Preference PID Others

PID Parameter

PB 88.000 %

TI 22.000 s

TD 5.000 s

Nonlinear Gain

☐ Gap Action

☒ Square Root

GW 0.000

KN 1.000

D/R Action

☐ Direct

☒ Reverse

Scale Action

☒ Run

☐ Stop

Incomplete Diff Coef.

KD 10.000 s

Integral Separation Coef.

EA 0.000 DK 0.000

Deadzone Parameter

☐ Efficiency ☒ Invalid

DB 0.000

DBHYS 0.000

Value Ramp

☐ Efficiency

☒ Invalid

RAMP 100.000

Integral Action

☒ Run

☐ Stop

PID Operation

☒ Run

☐ Bypass

Preference PID Others

Input Compensation(%)

IA 0.000

IK 1.000

IB 0.000

Output Compensation(%)

OA 0.000

OK 1.000

OB 0.000

SV Track

☒ Track

☐ Untrack

Precise Controlled Zone

MDB 0.000

MK 1.000

EI Alarm Filter Settings

KSV 1.000

TSV 0.000 s

Table 3.19 Operation Instruction for Panel Parameter

Panel Parameter Name			Function Block Parameter Name	Initial Value	Value Range	Application Instruction
Preference	PV Alarm (s)	HH	PVHH	100.000	[SVS-CL,SVSCH]	HH alarm value setting of loop PV (select alarm enabled, or it is disabled).
		H	PVH	90.000	[SVS-CL,SVSCH]	H alarm value setting of loop PV(se-

Table 3.19 Operation Instruction for Panel Parameter (continued)

Panel Parameter Name			Function Block Parameter Name	Initial Value	Value Range	Application Instruction
						lect alarm enabled, or it is disabled)
		L	PVL	10.000	[SVS-CL,SVSCH]	L alarm value setting of loop PV(select alarm enabled, or it is disabled)
		LL	PVLL	0.000	[SVS-CL,SVSCH]	LL alarm value setting of loop PV. (select alarm enabled, or it is disabled)
		HYS	PVHYS	0.000	-	PVProcess value alarm hysteresis
	SV Limits (s)	H	SVH	40.000	[SVS-CL,SVSCH]	H value setting of loop SV (select alarm enabled, or it is disabled). Note: SV limit is not affected by selection.
		L	SVL	0.000	[SVS-CL,SVSCH]	L value setting of loop SV (select alarm enabled, or it is disabled). Note: SV limit is not affected by selection.
	MV Limits (%)	H	MVH	100.000	[MVS-CL,MVSCH]	H value setting of loop MV (select alarm enabled, or it is disabled). Note: MV limit is not affected by selection.
		L	MVL	0.000	[MVS-CL,MVSCH]	L value setting of loop MV (select alarm enabled, or it is disabled). Note: MV limit is not affected by selection.
	Set DL (s)	EI	EI	0.000	-	Read-only. EI=PV - SV(select alarm enabled, or it is disabled).
		PEI (selected)	-	-	-	Selecting the positive deviation alarm is enabled.
		NEI (selected)	-	-	-	Selecting the negative deviation alarm is enabled.

Table 3.19 Operation Instruction for Panel Parameter (continued)

Panel Parameter Name			Function Block Parameter Name	Initial Value	Value Range	Application Instruction
		DL	DL	100.000	± (Range H-Range L)	Deviation alarm SV
		DL-HYS	DLHYS	0.000	-	Deviation alarm hysteresis value
	Change Limit of SV & MV	GSV	GSV	0.000	-	SV safety protection input increase or decrease value
		GMV	GMV	0.000	-	MV safety protection input increase or decrease value
	MV Limits (%)	DMVH (selected)	-	-	-	Selecting positive velocity alarm is enabled.
		DMVL (selected)	-	-	-	Selecting negative velocity alarm is enabled.
DMVLIM		DMVLIM	100.000	-	Loop MV velocity limit SV	
PID	PID Co-efficient	PB(%)	PB	100.000	Not less than 0	Loop proportional band parameter SV
		TI(s)	TI	20.000	Not less than 0	Loop integral time parameter SV
		TD(s)	TD	0.000	Not less than 0	Loop differential time parameter SV
	Incomplete Diff Co-ef	KD(s)	KD	10.000	Not less than 0	Incomplete integral filter coefficient
	Dead band Coefficient	Efficiency (selected)	SWDB	-	-	Selecting deadband parameter is enabled.
		Invalid (selected)	SWDB	√	-	Selecting deadband parameter is disabled.
		DB	DB	0.000	-	Deadband band size
		DB-HYS	DBHYS	0.000	[0,DB]	Deadband band hysteresis
Precise Controlled	MDB	MDB	0.000	[0,1.0]	Precision settings range	

Table 3.19 Operation Instruction for Panel Parameter (continued)

Panel Parameter Name			Function Block Parameter Name	Initial Value	Value Range	Application Instruction
	Zone Setting	MK	MK	1.000	-	Precision settings coefficient
	Integral separation coefficient	EA	EA	0.000	-	Range parameter SV
		DK	DK	0.000	-	Coefficient parameter SV
	Set Value Ramp	Efficiency (selected)	SWRAMP	-	-	Selecting SV ramp is enabled.
		Invalid (selected)	SWRAMP	√	-	Selecting SV ramp is disabled.
		RAMP	RAMP	100.000	-	Coefficient parameter SV
	Direct/Reverse	Direct (selected)	SWPN	-	-	Selecting direct action is enabled.
		Reverse (selected)	SWPN	√	-	Selecting reverse action is enabled.
	Scale Action	Run (selected)	STOPP	√	-	Selecting proportional action is enabled.
		Stop	STOPP	-	-	Selecting proportional action is disabled.
	Integral Action	Run	STOPI	√	-	Selecting integral action is enabled.
		Stop	STOPI	-	-	Selecting integral action is disabled.
	PID Operation	Run	BYPASS	√	-	-
		Bypass	BYPASS	-	-	-
Others	Input Compensation (%)	IA	IA	0.000	-	Read-only, can be set in configuration or program
		IK	IK	1.000	-	Input compensation gain

Table 3.19 Operation Instruction for Panel Parameter (continued)

Panel Parameter Name			Function Block Parameter Name	Initial Value	Value Range	Application Instruction
		IB	IB	0.000	-	Input compensation bias value
	Output compensation (%)	OA	OA	0.000	-	Read-only, can be set in configuration or program
		OK	OK	1.000	-	Output compensation gain
		DB	DB	0.000	-	Output compensation bias value
	Set EI alarm filter	KSV	KSV	1.000	0~100	Deviation filter coefficient
		TSV (s)	TSV (s)	0.000	0~1000s	Deviation filter time constant(s) (s)
	SV Track	Track	SVTR_OPT	√	-	Read-only, can be set in configuration or program
		Un-track	SVTR_OPT	-	-	Read-only, can be set in configuration or program

3.4.4 Flag

Table 3.20 Flag

Flag	Alarm	Instruction
D0	OOS	Disable
D1	IMAN	Initialize Manually
D2	MAN	Manual
D3	TR	Track
D4	AUTO	Auto
D5	CAS	Cascade
D8	PVHH	PV HH Limit Alarm
D9	PVLL	PV LL Limit Alarm
D10	PVH	PV H Limit Alarm
D11	PVL	PV L Limit Alarm

Table 3.20 Flag (continued)

Flag	Alarm	Instruction
D12	SVH	SV H Limit Alarm
D13	SVL	SV L Limit Alarm
D14	MVH	Output H Limit Alarm
D15	MVL	Output L Limit Alarm
D16	PEI	Positive Deviation Alarm
D17	NEI	Negative Deviation Alarm
D18	REVSCL	Span H/L Limit Reverse or output value float abnormal
D19	CFGERR	Configuration Error
D22	DMVH	MV Positive Rate Limit Alarm
D23	DMVL	MV Negative Rate Limit Alarm
D25	AOF	Suppress Alarm

3.4.5 Application Example

Continuous flash tank water level adjustment: to change the flow rate by adjusting the water level adjusting valve of continuous flash tank, then to control the water level of continuous flash tank. If the water level tag is WT001, adjusting valve opening feedback is LT001, adjusting valve command is LT002.

When the control strategy is PIDEP function block, the water level of continuous flash tank is PV, the set value input of manual instrument is SV, output it to the manual instrument function block, then output to AO block and adjust the adjusting valve.

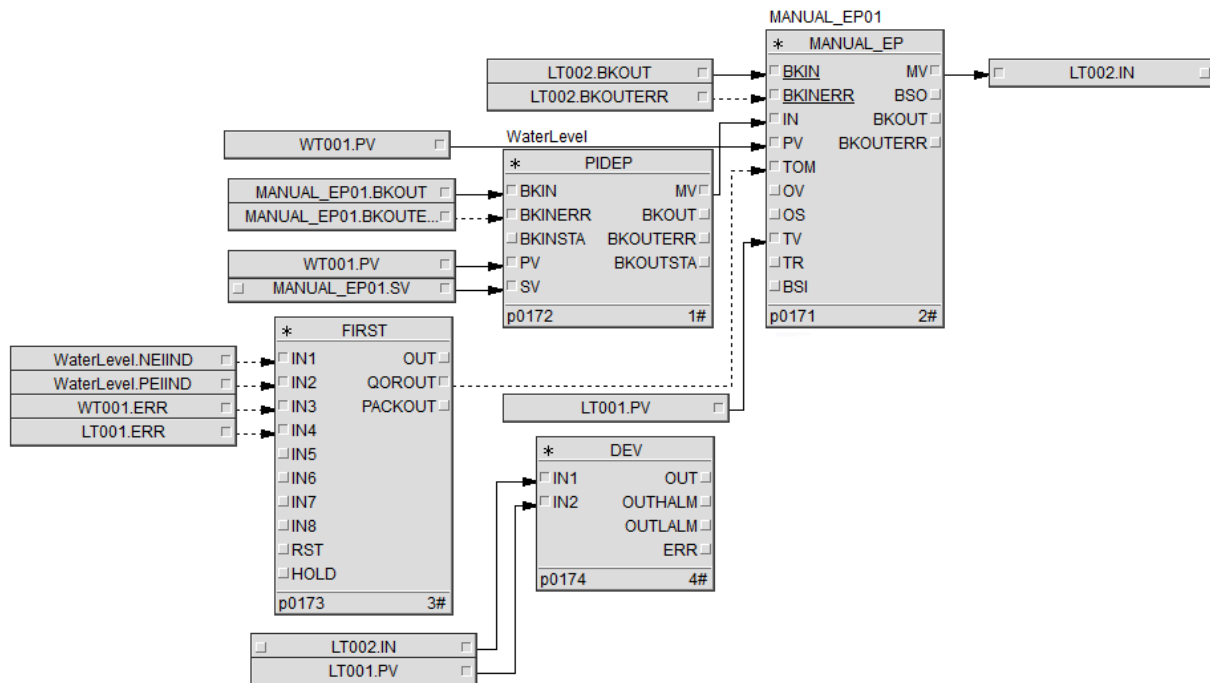


Figure 3.25 Single loop control program

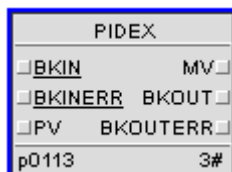
3.5 Extended PID Control Function Block (PIDEX)

Functions of PIDEX are same as PID function block, except the following items.

1. Limit process: In MAN and IMAN modes, output is not limited by MVH and MVL but it must be in the range of extended range.
2. Mode process
 - In track mode, if TVERR=ON, PIDEX is transferred to manual mode.
 - In auto mode, if PVERR=ON or OAERR=ON, PIDEX is transferred to manual mode.
 - In cascade mode, if PVERR=ON or OAERR=ON, PIDEX is transferred to manual mode. If PVERR=OFF, OAERR=OFF and SVERR=ON, PIDEX is transferred to auto mode.

It is a complex function block and its running time is 150μs.

Please refer to the Overview and Control Function Block Library before using the function block.



3.5.1 Parameter Description

For details of various parameters setting, refer to the Parameter Property and Parameter Setting Illustration.

For the data type, initial value and default pin of function block parameters in the table below, refer to the function block properties setting window.

When the "Upload" column in the table below shows "TRUE", it means the corresponding parameter can upload the data from the controller and save it to the configuration later. When offline download is performed next time, the saved data can be downloaded to the controller.

Table 3.21 Parameter description and application of PIDEX Function Block

Name			Description	Upload	Properties	Application Reference
Basic Parameters	Range Settings	MVSCH	MV high scale	-	Configuration Parameter	The same as MV actual value H limit.
		MVSCL	MV low scale	-	Configuration Parameter	The same as MV actual value L limit.
		SVSCH	SV high scale	-	Configuration Parameter	The same as PV actual value H limit.
		SVSCL	SV low scale	-	Configuration Parameter	The same as PV actual value L limit.
		SVEU	SV engineer unit	-	Configuration Parameter	Set in the function block properties settings interface.
		MVEU	MV engineer unit	-	Configuration Parameter	Set in the function block properties settings interface.
		SVDLEN	SV decimal digits [0,5]	-	Configuration Parameter	Used for data displayed on function block panel (equal to 3 as default).
		MVDLEN	MV decimal digits [0,5]	-	Configuration Parameter	Used for data displayed on function block panel (equal to 3 as default).

Table 3.21 Parameter description and application of PIDEX Function Block (continued)

Name			Description	Upload	Properties	Application Reference
	Limits	MVH	MV H limit value	TRUE	Operation Parameter	Value range [MVS-CL,MVSCH]
		MVL	MV L limit value	TRUE	Operation Parameter	Value range [MVS-CL,MVSCH]
		SVH	SV H limit value	TRUE	Operation Parameter	Value range [SVS-CL,SVSCH]
		SVL	SV L limit value	TRUE	Operation Parameter	Value range [SVS-CL,SVSCH]
		DMVLIM	MV output rate variety limit value. Used to prevent the MV from over-large modification in a short time.	TRUE	Operation Parameter	Refer to Integral Cutting
	Direct/Reverse Switch Settings	SWPN	Direct/Reverse switch. SV is not changed, the MV increases with the increasing of PV in direct action, and decreases with the increasing of PV in reverse action.	TRUE	Operation Parameter	OFF=Direct action, ON=Reverse action
Extended Parameters	Base Input Pin Settings	BKIN	Feedback input	-	Input Pin	Connect to BKOUT of downstream block
		BKINERR	Feedback status input	-	Input Pin	Connect to BKOUT of downstream block ERR
		PV	Process value of loop closed control process	-	Input Pin	Connect to measuring point AI
		CSV	Cascade	-	Input Pin	Connect to outer loop control value MV

Table 3.21 Parameter description and application of PIDEX Function Block (continued)

Name			Description	Upload	Properties	Application Reference
		TV	Track input value	-	Input Pin	Connect to measuring point AI. Related parameter: SWTR
		SWTR	Track switch: OFF=not track, ON=track	-	Input Pin	Upstream interlock condition input, Related parameter: TV, TVERR
		OA	Output compensation, used for feed-forward control	-	Input Pin	Connect to measuring point AI (feedforward signal), Related parameter: OK, OB
	Advance Input Pin Settings	PVERR	PV is in fault or not, ON=Abnormal, OFF=normal	-	Input Pin	Connect the tag AI.ERR
		SVERR	SV is in fault or not, ON=Abnormal, OFF (default)=normal	-	Input Pin	Connect the upstream output
		TVERR	TV is in fault or not, ON=Abnormal, OFF=normal	-	Input Pin	Connect the tag AI.ERR
		OAERR	OA is in fault or not, ON=Abnormal, OFF=normal	-	Input Pin	Connect the upstream output
		MVA	Separated Anti-integral Windup Feedback Input	-	Input Pin	Refer to "Note1"
		MF	PID executor feedback value, used for monitoring	-	Input Pin	Connect to measuring point AI
		IA	Input compensation value, used to improve the controllability of	-	Input Pin	Connect to measuring point AI, Refer to Input Process, Re-

Table 3.21 Parameter description and application of PIDEX Function Block (continued)

Name		Description	Upload	Properties	Application Reference
		process with long deadband time			lated parameters: IK, IB
	PSWAM	Program manual and auto control switch, OFF=program manual control, ON=program auto control	-	Input Pin	Connect the upstream outputEnabled when MAN_ - OPT=ON
	PSWSV	Program auto/ cascade control switch, OFF= SV, ON=CSV	-	Input Pin	Connect the upstream output enabled when SV_ - OPT=ON
	MAN_OPT	Manual-automatic control source switch, ON= manual-automatic selection controlled by PSWAM, OFF= manual-automatic selection controlled by SWAM	-	Input Pin	Connect the upstream outputRelated parameter: PSWAM, SWAM
	SV_OPT	Auto/Cascade control source selection, ON= auto/cascade selection controlled by PSWSV, OFF= auto/cascade selection controlled by SWSV	-	Input Pin	Connect the upstream outputRelated parameter: PSWSV, SWSV
	SWROUT	Remote Manual Switch (ON=to Remote Manual)	-	Input Pin	-
	RMV	Remote Manual Value	-	Input Pin	-
	SWRCAS	Remote Cascade Switch (ON=to Re-	-	Input Pin	-

Table 3.21 Parameter description and application of PIDEX Function Block (continued)

Name			Description	Upload	Properties	Application Reference
			mote Cascade)			
		RSV	Remote Cascade Value	-	Input Pin	-
		SWINC	MV lock increase (MV cannot Increase), ON= lock increase	-	Input Pin	Connect the upstream output. enabled when function block is automatic or cascade
		RRL	Anti-integral windup input, used for control overshoot	-	Input Pin	Connect to measuring point AI, Related parameter: BKIN Refer to Operation Process
		SWDEC	MV lock decrease (MV cannot decrease), ON= Lock decrease	-	Input Pin	Connect the upstream output. enabled when function block is automatic or cascade
		HOLD	MV holds the current output value, ON= hold the current output value	-	Input Pin	Connect to upstream output,
	Output Pin	MV	PID operation output value	-	Output Pin	Connect to electric manual instrument.If there's a float abnormal happened to the MV value, the MV will be set as the value of previous period or the lower limit.
		BKOUT	Feedback output value	-	Output Pin	Connect to the BKIN of Upstream Block, Relat-

Table 3.21 Parameter description and application of PIDEX Function Block (continued)

Name			Description	Upload	Properties	Application Reference
						ed parameter: BK_OPT
		BKOUTERR	Feedback status value	-	Output Pin	Connect to the BKINERR of Upstream Block
		BK_OPT	BKOUT value switch (ON=track PV, OFF=track SV)	-	Configuration Parameter	Related parameter: BKOUT
	PID Program-Settings	PB	Proportion band size	TRUE	Operation Parameter	Refer to PID Parameter Tune
		TI	Integral time (s)	TRUE	Operation Parameter	Refer to PID Parameter Tune
		TD	Derivative time (s)	TRUE	Operation Parameter	When TD=0, suppress derivation action, Refer to PID Parameter Tune
		KD	Derivative filter coefficient	TRUE	Operation Parameter	Refer to Alorithm Illustration
	Operator Command	MODE	Work mode	-	Monitoring Parameter	Refer to Transition Process of Function Block Modes
		IMODE	Standby work mode	-	Monitoring Parameter	Refer to Transition Process of Function Block Modes
		MODE_OPT	ON=auto return, OFF=manual return (default)	-	Configuration Parameter	Refer to Transition Process of Function Block Modes
		SWAM	Manual and auto switch: OFF=manual, ON=auto	-	Operation Parameter	Enabled when MAN_OPT=OFF

Table 3.21 Parameter description and application of PIDEX Function Block (continued)

Name		Description	Upload	Properties	Application Reference	
		SWSV	Auto/ cascade selection: OFF=auto, ON=cascade	-	Operation Parameter	Enabled when SV_OPT=OFF
		SWMMV	Whether to equal to preset MV value when switch to manual status	TRUE	Operation Parameter	Related parameter: MMV
		MMV	Preset MV value (switch to manual)	TRUE	Operation Parameter	Enabled when SWMMV=ON
		SWPMV	Whether to equal to preset MV value when switch to auto status. PMV enable switch. When SWPMV=ON, MV = PMV, MV velocity alarm, lock increase/decrease are disabled	TRUE	Operation Parameter	Related parameter: PMV
		PMV	Preset MV when switching from OOS/IMAN/TR/MAN modes to AUTO or CAS mode	TRUE	Operation Parameter	Enabled when SWPMV=ON
		LOCK	Mode lock-OFF=unlock-ON=lock	-	Operation Parameter	-
		RMT_OVRD	Override remote mode (ON=override)	-	Operation Parameter	-
	Operator Data	SV	SV for loop closed control	TRUE	Operation Parameter	Refer to Set Variable Process
		MANMV	Manual output value	-	Operation Parameter	MV= MANMV in manual mode

Table 3.21 Parameter description and application of PIDEX Function Block (continued)

Name			Description	Upload	Properties	Application Reference
	Input Alarm Settings	EI	Deviation	-	Monitoring Parameter	Refer to Operation Process
		PVHH	PV HH limit alarm value	TRUE	Operation Parameter	Refer to Input Process
		PVH	PV H limit alarm value	TRUE	Operation Parameter	Refer to Input Process
		PVL	PV L limit alarm value	TRUE	Operation Parameter	Refer to Input Process
		PVLL	PV LL limit alarm value	TRUE	Operation Parameter	Refer to Input Process
		PVHYS	PV alarm hysteresis	TRUE	Operation Parameter	Refer to Input Process
		DL	Deviation alarm set value	TRUE	Operation Parameter	Refer to Operation Process
		DLHYS	Deviation alarm hysteresis value	TRUE	Operation Parameter	Refer to Operation Process
		KSV	Deviation filter coefficient	TRUE	Operation Parameter	Refer to Operation Process
		TSV	Deviation filter time constant(s)	TRUE	Operation Parameter	Refer to Operation Process
		NMFLIM	Valve position negative error thresholds	TRUE	Operation Parameter	Related parameter: NMF Refer to Integral Cutting
		PMFLIM	Valve position positive error thresholds	TRUE	Operation Parameter	Related parameter: PMF Refer to Integral Cutting
		TMFHYS	Valve position error alarm hysteresis time	TRUE	Operation Parameter	Refer to Integral Cutting
	Advanced Calculation Settings	BYPASS	Bypass PID operation, when BY-PASS=ON, excise PID calculation, switch SV to	TRUE	Operation Parameter	When cascade adjusting, used to excise inner loop when it failsRefer

Table 3.21 Parameter description and application of PIDEX Function Block (continued)

Name			Description	Upload	Properties	Application Reference
			MV directly for output			to Operation Process
		STOPP	Proportion suppress switch, when STOPP=ON, stop integral action	TRUE	Operation Parameter	Refer to Operation Process
		STOPI	Integral suppress switch, when STOPI=ON, stop integral action	TRUE	Operation Parameter	Refer to Operation Process
		SWDB	Enable switch, when SWDB=ON, dead-band enable	TRUE	Operation Parameter	Related parameter: DB
		DB	Deadband band size	TRUE	Operation Parameter	Enable when SWDB=ON
		DBHYS	Deadband band hysteresis	TRUE	Operation Parameter	
		GW	Non-linear gain range non-linear gain range	TRUE	Operation Parameter	Refer to Operation Process
		KN	Nonlinear gain coefficient[0,1.0]	TRUE	Operation Parameter	Refer to Operation Process
		NGN_OPT	Non-linear gain selection switch, switch the relation between error and output change value to nonlinear. Used for control when proportional gain needs nonlinear change. OFF=Error square root function, ON=Gap action function	-	Configuration Parameter	Related parameters: GW, PB and KN When NGN_OPT = ON; GW and PB when NGN_OPT = OFF

Table 3.21 Parameter description and application of PIDEX Function Block (continued)

Name		Description	Upload	Properties	Application Reference
	EA	Integral excise coefficient. when EI > EA, excise coefficient, when EI < EA, excising coefficient is disabled, used for prevent MV change from overlarge	TRUE	Operation Parameter	Related parameter: DK
	DK	Proportion modified value when integral excising	TRUE	Operation Parameter	Related parameter: EA
	KIA	Separated Anti-integral Windup Gain Coefficient	TRUE	Operation Parameter	Refer to "Note1"
	IA_OPT	Anti-integral Anti Correction Mode(0=Integrated(BKIN), 1=Separated(BKIN+MVA))	-	Configuration Parameter	When IA_OPT=0, MV is set in accordance with "Integral amplitude function" in 3.2.4 section; when IA_OPT=1, MV is set in accordance with "Anti-integral windup correction function".
	OUT_OPT	Control output type: OFF=position type, ON=increment type	-	Configuration Parameter	Related parameter: MV
	ENSAFEOP	Output enable of force manual status ON: enable OFF: disable	-	Configuration Parameter	Refer to Note 3
	PID_OPT	PID type selection	-	Configuration Parameter	Refer to Parameter Description, Note2, Note3, Note4

Table 3.21 Parameter description and application of PIDEX Function Block (continued)

Name		Description	Upload	Properties	Application Reference	
		MVLIM_M	Manual mode (IMAN/EM-MAN/MAN) MV limit setting: 0: extended range limit 1: output H/L limit	-	Configuration Parameter	-
		MVLIM_TR	Track mode MV limit setting ^{Note 4} 0=output H/L limit, 1=extended range limit	-	Configuration Parameter	-
		ATI_OPT	Anti-integral windup cutting mode selection:0=half cut1=No Resection2=Total Resection	-	Configuration Parameter	0=hold original solution. Perform high and low amplitude limit on internally calculated MV.1: no matter whether differential time is 0, there is no amplitude limiting on internally calculated MV.2: No matter whether differential time is 0, there is amplitude limit on internally calculated MV.
		BYPS_OPT	Tracking selection of bypass switching valve: 0: not track 1: track	-	Configuration Parameter	-
	Alarm	PVHHIND	PVHH alarm indication	-	Monitoring Parameter	Refer to Alarm

Table 3.21 Parameter description and application of PIDEX Function Block (continued)

Name		Description	Upload	Properties	Application Reference
	PVHIND	PV H Limit alarm indication	-	Monitoring Parameter	Refer to Alarm
	PVLIND	PV L limit alarm indication	-	Monitoring Parameter	Refer to Alarm
	PVLLIND	PV LL limit alarm indication	-	Monitoring Parameter	Refer to Alarm
	MVHIND	MV H limit alarm indication	-	Monitoring Parameter	Refer to Alarm
	MVLIND	MV L limit alarm indication	-	Monitoring Parameter	Refer to Alarm
	SVHIND	SV H limit alarm indication	-	Monitoring Parameter	Refer to Alarm
	SVLIND	SV L limit alarm indication	-	Monitoring Parameter	Refer to Alarm
	PEIIND	Positive deviation alarm indication	-	Monitoring Parameter	Refer to Alarm
	NEIIND	Negative deviation alarm indication	-	Monitoring Parameter	Refer to Alarm
	DMVHIND	MV positive rate limit indication	-	Monitoring Parameter	Refer to Alarm
	DMVLIND	MV negative rate limit indication	-	Monitoring Parameter	Refer to Alarm
	NMFIND	Valve position error negative alarm indication	-	Monitoring Parameter	Refer to Alarm
	PMFIND	Valve position error positive alarm indication	-	Monitoring Parameter	Refer to Alarm
	Compen- IK	Input compensation gain	TRUE	Operation Parameter	Refer to Input Process Re-

Table 3.21 Parameter description and application of PIDEX Function Block (continued)

Name			Description	Upload	Properties	Application Reference
	sation Set-tings					lated parameter: IA
		IB	Input compensation bias value	TRUE	Operation Parameter	Refer to Input Process Related parameter: IA
		OK	Output compensation gain	TRUE	Operation Parameter	Refer to Operation Process Related parameter: OA
		OB	Output compensation bias value	TRUE	Operation Parameter	Refer to Operation Process Related parameter: OA
	Fast/Slow/Increase/Decrease Set-tings	SMV	MV manual slow increase/decrease value (%)	TRUE	Operation Parameter	Set MV manual slow increase/decrease percentage in function block properties setting, $SMV \leq FMV$ Related parameter: MVSCH
		FMV	MV manual fast increase/decrease value (%)	TRUE	Operation Parameter	Set MV manual fast increase/decrease percentage in function block properties setting Related parameter: MVSCL
		SSV	SV slow increase/decrease value (%)	TRUE	Operation Parameter	Set SV manual slow increase/decrease percentage in function block properties setting- $SSV \leq FSV$, Related parameter: SVSCH
		FSV	SV fast increase/de-	TRUE	Operation Parameter	Set SV manual fast in-

Table 3.21 Parameter description and application of PIDEX Function Block (continued)

Name			Description	Upload	Properties	Application Reference
			crease value (%)			crease/decrease percentage in function block properties settingRelated parameter: SVSCL
		GSV	SV safety protection input increase or decrease value	TRUE	Operation Parameter	-
		GMV	MV safety protection input increase or decrease value	TRUE	Operation Parameter	-
	Extended Range Settings	HORLIM	Extended range maximum percentage	-	Configuration Parameter	Refer to Output Process
		LORLIM	Extended range minimum percentage	-	Configuration Parameter	Refer to Output Process
	SV Advance Settings	SWRAMP	SV ramp function switch. When changing set value, incline it to SV according to the set RAMP (s). OFF=SV ramp function off, ON=SV ramp function on	TRUE	Operation Parameter	Related parameter: RAMP. Enable when in automatic or cascade mode.
		RAMP	Ramp coefficient	TRUE	Operation Parameter	Related parameter: SWRAMP
		SVTR_OPT	Track PV switch enable/disable: OFF=not track, ON=track. If PV> SVH/ SVL, SV= range limit. Used to prevent the output MV from inter-	-	Configuration Parameter	Refer to Set Variable Process

Table 3.21 Parameter description and application of PIDEX Function Block (continued)

Name		Description	Upload	Properties	Application Reference
					ference when changing the control mode.
		SVRG_OPT		-	SV range convert option: 0=no convert, 1=convert by percent
		RAMPMODE	TRUE	Configuration Parameter	Operation Parameter
		RAMPACT	TRUE	Operation Parameter	Refer to "Note2".
		RAMP_SV	TRUE	Operation Parameter	Refer to "Note2".
		RAMP_OPT	TRUE	Operation Parameter	Refer to "Note2".
		TRAMP	TRUE	Operation Parameter	Refer to "Note2".
		TRAMP_EU	TRUE	Operation Parameter	Refer to "Note2".
		RAMP_EU	TRUE	Operation Parameter	Refer to "Note2".
	Alarm Enabled and Suppress	AOF	TRUE	Operation Parameter	Refer to Alarm
		ENALM	TRUE	Alarm Parameter	Refer to Alarm
		FLAG	-	Output Pin	Refer to Flag
	OOS Settings	SWOOS	TRUE	Operation Parameter	Set as ON at the first time of function block downloading
		OOSVAL	TRUE	Operation Parameter	Related parameter:

Table 3.21 Parameter description and application of PIDEX Function Block (continued)

Name			Description	Upload	Properties	Application Reference
						OOS_OPT=ON
		OOS_OPT	OOS mode output value type. when OOS_OPT =ON, MV=OOSVAL, when OOS_OPT =OFF, maintain the MV	-	Configuration Parameter	Refer to OOS
	Check Input Validity	SWPV	Enable switch for checking PV validity	TRUE	Operation Parameter	Refer to Input Process
		PVLMT	PV change limit (%)	TRUE	Operation Parameter	Refer to Input Process

The working mode of the PIDEX function block and the corresponding parameter conditions in each mode are shown in Table 3.1.

In addition, the PIDEX function block supports the anti-integral windup correction function and the ramping function in automatic mode.

Note 1 : Anti-integral windup correction function

When KIA (anti-integral windup correction coefficient) ≤ 0, no correction is made.

When KIA>0, make corrections.

λ BKINERR=ON, MV=BKIN, the mode is equal to IMAN.

λ BKINERR=OFF, if in automatic or cascade mode:

- If STOPP=OFF, then

$$MV = MVPID + \frac{100 / PB * KIA}{TI * s} * (MVA - MV_LT - RRL)$$
- If STOPP=ON, then

$$MV = MVPID + \frac{100 / PB}{TI * s} * (MVA - MV_LT - RRL)$$

Among them: MVPID is the internally calculated MV ; PB is the proportional coefficient; TI is the integration time; s is the Laplace operator; MV_LT is the last period MV output; RRL is the original anti-integral windup input parameter.

Note 2 : Ramping function

When RAMPMODE (Ramping Mode Selection Switch) = 0, SV supports slope ramping in auto or cascade mode;

When RAMPMODE=1, in automatic mode, SV supports ramping by time or slope, and the start switch of RAMPACT (setting value ramping switch) controls whether to ramp.

- When RAMP_OPT=0, ramping according to time, and ramping from the current setting value to the target setting value RAMP_SV (ramping setting value) at a constant speed within the time of TRAMP (setting ramping time).
- When RAMP_OPT=1, ramping according to the slope, and ramping from the current setting value to the target setting value RAMP_SV at a constant speed with RAMP (ramp coefficient) slope.
- When the ramp target value RAMP_SV is reached, the ramp switch RAMPACT=OFF.
- The time unit and slope unit can be set, TRAMP_EU is used to set the ramping time unit, supporting s, min, h; RAMP_EU is used to set the ramping slope unit, supporting RAMP/s, RAMP/min.
- In other modes, RAMPACT=OFF.
- During the ramping process, RAMPACT can be set to OFF to stop the ramping process.

Note 3: ENSAFEOP function

- When ENSAFEOP=ON (enabled)
 - If BKINERR=ON, enter EMMAN mode.
Priority: OOS>IMAN=EMMAN>TR>MAN=AUTO=CAS
In EMMAN mode, you can manually modify the MV value but you cannot switch it to MAN, AUTO, CAS, or TR mode.
 - If BKINERR=OFF and the block is set as manual fallback, enter MAN mode. If it is set to auto fallback, enter the mode before the fault occurs.
- When ENSAFEOP=OFF (disabled), the output process mode after the function block tag enters the fail-safe state is consistent with the configuration setting.

Note 4: Bypass Switching without Disturbance

For the user program configuration of a cascade loop, please refer to "Figure 3.28". When the slave loop is bypassed, the master loop will output MV according to the value of BYPS_OPT.

- If BYPS_OPT=0, during bypass switching, the current loop's MV will maintain its original conversion characteristics as specified in Note 6.
- If BYPS_OPT=1, during bypass switching, the current loop's MV will track the downstream valve output of the slave loop. The specific processing method is as follows:

- When the slave loop switches to bypass mode for the first time, the current loop's MV will maintain the output of the previous cycle, BKOUT will track the MV as specified in note 5, BKOUTERR will be ON, the upstream master loop will enter IMAN mode, and MV will be BKIN.
- When the slave loop is in bypass mode:
 - In non-cascade mode, the current loop's MV will maintain the output of the previous cycle, BKOUT will track the MV, BKOUTERR will be OFF, and the upstream master loop will exit the IMAN mode. The function block will fall back to the target mode based on the manual or automatic fallback selection (when MODE_OPT=OFF, it falls back to MAN mode; when MODE_OPT=ON, it falls back to the previous mode).
 - In cascade mode, the current loop's MV is directly converted from SV and outputted.

Note 5: BKOUT tracks MV

- SVRG_OPT=0 (no conversion), $BKOUT = (MV - MVSCL) / KS + SVSCL$
- SVRG_OPT=1 (convert by percent), $BKOUT = (MV - MVSCL) / (MVSCH - MVSCL) \times 100$

Note 6: SV to MV conversion during bypass

$$MV = (SV - SVSCL) \times KS + MVSCL$$

$$KS = (MVSCH - MVSCL) / (SVSCH - SVSCL)$$

3.5.2 Mode Illustration

This part introduces the modes of PIDEX function block and the switching methods.

A variety of modes are available for PID function block, such as OOS, EMMAN, MAN, IMAN, AUTO, CAS, RCAS, ROUT, TR, and OR.

Mode Switching

- When SWOOS=ON, it enters OOS mode.
- When SWOOS=OFF and BKINERR=ON,
 - If ENSAFEOP=OFF, it enters IMAN mode.
 - If ENSAFEOP=ON, it enters EMMAN mode.
- When SWOOS=OFF, BKINERR=OFF, SWTR=ON,
 - If TVERR=OFF, enters TR mode.
 - If TVERR=ON, enters MAN mode.
- When SWOOS=OFF, BKINERR=OFF, SWTR=OFF,

If the mode lock is on (LOCK=ON), you cannot switch modes by means of commands (SWROUT, SWRCAS, SWAM, SWSV, etc.).

- If the mode lock is off (LOCK=OFF), and override switch is off (RMT_OVRD=OFF),
 - SWROUT=ON: enters ROUT mode.
 - SWROUT=OFF and SWRCAS=ON: enters RCAS mode.
 - SWROUT=OFF, SWRCAS=OFF, and SWAM=OFF: enters MAN mode.
 - SWROUT=OFF, SWRCAS=OFF, SWAM=ON, and SWSV=OFF: enters AUTO mode.
 - SWROUT=OFF, SWRCAS=OFF, SWAM=ON, and SWSV=ON: enters CAS mode.
- If the mode lock is off (LOCK=OFF), and override switch is on (RMT_OVRD=ON),
 - SWAM=OFF, enters MAN mode.
 - SWAM=ON, SWSV=OFF: enters AUTO mode.
 - SWAM=ON, SWSV=ON: enters CAS mode.
- If the function block is in CAS or RCAS mode, when SVERR=ON, it switches to AUTO mode and override is OFF. If MODE_OPT=OFF (manual fallback), mode lock is unlocked, and the function block remains in AUTO mode after the fault is resolved. If MODE_OPT=ON (auto fallback), mode lock remains the previous status, and the function block switches to the original mode after the fault is resolved.
- If the function block is in AUTO, CAS or RCAS mode, when PVERR=ON, it switches to MAN mode and override is OFF. If MODE_OPT=OFF (manual fallback), mode lock is unlocked, and the function block remains in MAN mode after the fault is resolved. If MODE_OPT=ON (auto fallback), mode lock remains the previous status, and the function block switches to the original mode after the fault is resolved.

Mode Fallback

Mode fallback function allows a function block falling back automatically or manually (default). Work mode (MODE) and standby work mode (IMODE) of each function block are only for operators' reference.

- When MODE_OPT=OFF, manual fallback is applied. For manual fallback, the function block exits from IMAN, EMMAN, or TR mode and goes back to MAN mode.
- When MODE_OPT=ON, auto fallback is applied. For auto fallback, the function block exits from IMAN, EMMAN, or TR mode and goes back to its original target mode.
- If falling back from OOS mode, it enters MAN mode either way.
- If the system goes through a cold reset, it enters MAN mode either way.

Override and Mode Lock

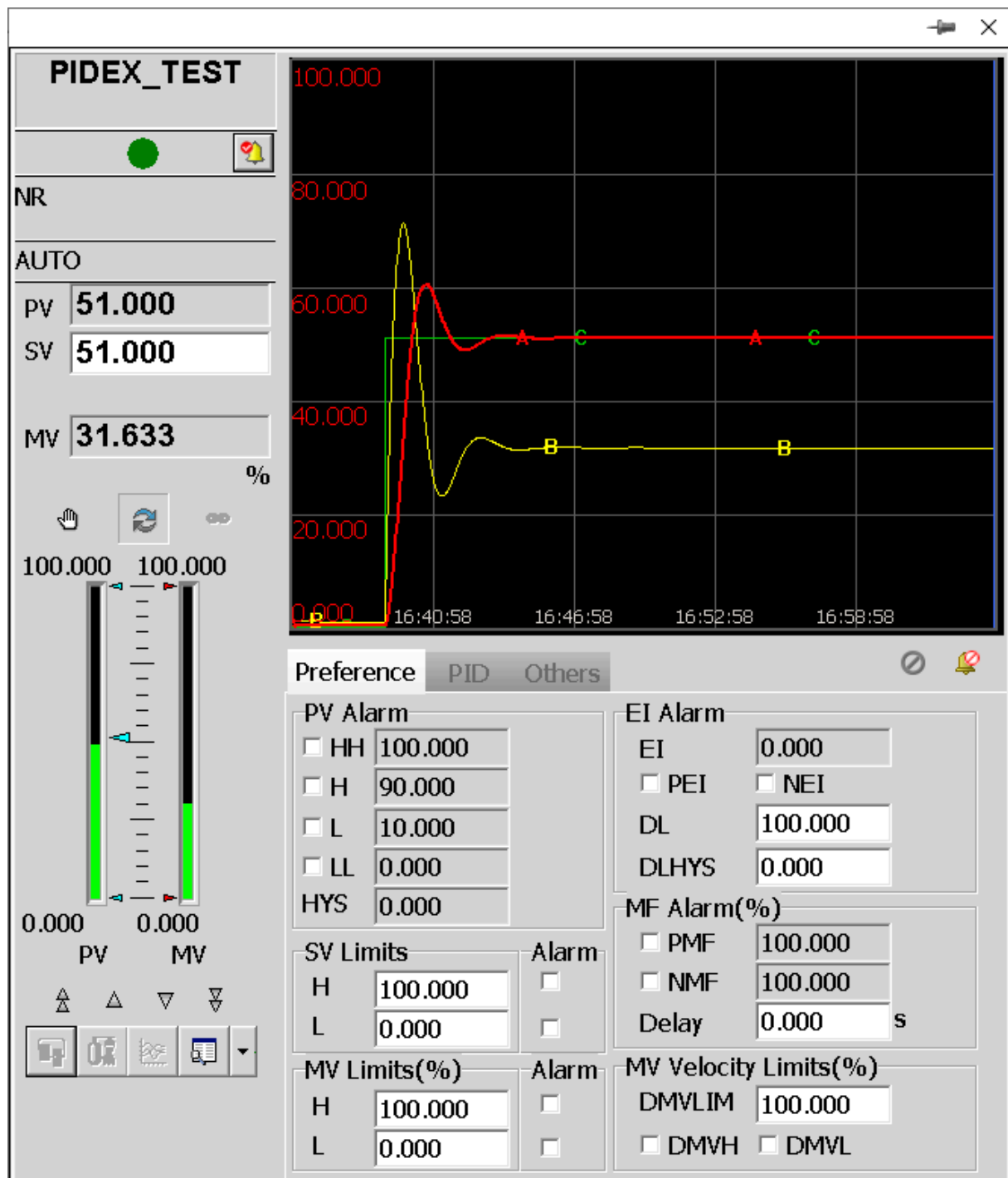
- In OOS mode, RMT_OVRD=OFF, LOCK=OFF, SWTR=OFF, SWAM=OFF, and SWSV=OFF.
- In IMAN, or EMMAN mode, RMT_OVRD=OFF, SWTR=OFF, SWAM=OFF, and SWSV=OFF. When it is manually falling back, unlock the mode lock. Regarding auto fallback, the mode lock remain the previous status.
- In TR mode, except for SWTR is not reset, other parameters and settings are the same as in IMAN mode.

3.5.3 Application Illustration

The float abnormal of output values means that the output values are not float format, or a meaningless output value is produced in a calculation that performs a divide-by-zero operation. When float abnormal happened, the function block's output values shall conform to the following rules:

- If there's the normal value of previous period, MV outputs the value of previous period.
- If there's the abnormal value of previous period or no previous period value, MV outputs the lower range limit.

3.5.4 Panel Parameter



Preference PID Others

PID Parameter

PB 100.000 %

TI 20.000 s

TD 0.000 s

Non-linear Gain

☐ Gap Action

☒ Square Root

Range(GW) 0.000

Coefficient(KN) 1.000

D/R Action

☐ Direct

☒ Reverse

Scale Action

☒ Run

☐ Stop

Incomplete Diff Coef.

KD 10.000 s

Integral Separation

EA 0.000 DK 0.000

Deadband

☐ Valid ☒ Invalid

Deadzone(DB) 0.000

Hysteresis (DBHYS) 0.000

SV Ramp Action

☐ Valid ☒ Invalid

Coefficient (RAMP) 100.000

Integral Action

☒ Run

☐ Stop

PID Operation

☒ Run

☐ Bypass

Preference PID Others

Input Compensation

IA 0.000

IK 1.000

IB 0.000

BKOUT Track

☐ PV ☒ SV

SV Track

☒ Track ☐ Untrack

Change Limit of SV & MV

GSV 0.000 GMV 0.000

Output Compensation(%)

OA 0.000

OK 1.000

OB 0.000

MAN_OPT

☒ Panel

☐ Program

SV_OPT

☐ Panel

☒ Program

Mode Lock

☐ Enable

Override

☐ Enable

EI Alarm Filter

KSV 1.000

TSV 0.000 s

TR

0.000

Executive Feedback

0.000 %

Table 3.22 Operation Instruction for Panel Parameter

Panel Parameter Name			Function Block Parameter Name	Initial Value	Value Range	Application Instruction
Preference	PV Alarm (%)	HH	PVHH	100.000	[SVS-CL,SVSCH]	HH alarm value setting of loop PV (select alarm enabled, or it is disabled).
		H	PVH	90.000	[SVS-CL,SVSCH]	H alarm value setting of loop PV(se-

Table 3.22 Operation Instruction for Panel Parameter (continued)

Panel Parameter Name			Function Block Parameter Name	Initial Value	Value Range	Application Instruction
						lect alarm enabled, or it is disabled)
		L	PVL	10.000	[SVS-CL,SVSCH]	L alarm value setting of loop PV(select alarm enabled, or it is disabled)
		LL	PVLL	0.000	[SVS-CL,SVSCH]	LL alarm value setting of loop PV. (select alarm enabled, or it is disabled)
		Hysteresis	PVHYS	0.000	-	PV Process value alarm hysteresis
	SV Limits (%)	H	SVH	40.000	[SVS-CL,SVSCH]	H value setting of loop SV (select alarm enabled, or it is disabled). Note: SV limit is not affected by selection.
		L	SVL	0.000	[SVS-CL,SVSCH]	L value setting of loop SV (select alarm enabled, or it is disabled). Note: SV limit is not affected by selection.
	MV Limits (%)	H	MVH	100.000	[MVS-CL,MVSCH]	H value setting of loop MV (select alarm enabled, or it is disabled). Note: MV limit is not affected by selection.
		L	MVL	0.000	[MVS-CL,MVSCH]	L value setting of loop MV (select alarm enabled, or it is disabled). Note: MV limit is not affected by selection.
	EI Alarm (%)	Error (EI)	EI	0.000	-	Read-only. EI=PV - SV(select alarm enabled, or it is disabled).
		PEI (selected)	-	-	-	Selecting the positive deviation alarm is enabled.
		NEI (selected)	-	-	-	Selecting the negative deviation alarm is enabled.

Table 3.22 Operation Instruction for Panel Parameter (continued)

Panel Parameter Name			Function Block Parameter Name	Initial Value	Value Range	Application Instruction
		DL	DL	100.000	± (Range H- Range L)	Deviation alarm SV
		DLHYS	DLHYS	0.000	-	Deviation alarm hysteresis value
	MF Alarm (%)	PMF	PMFLIM	100.000	-	Selecting the positive deviation alarm is enabled.
		NMF	NMFLIM	100.000	-	Selecting the negative deviation alarm is enabled.
		Delay (s)	Delay (s)	0.000	-	Lag time SV
	MV Velocity Limits (%)	DMVH (selected)	-	-	-	Selecting positive velocity alarm is enabled.
		DMVL (selected)	-	-	-	Selecting negative velocity alarm is enabled.
		DMVLIM	DMVLIM	100.000	-	Loop MV velocity limit SV
PID	PIDParameter	PB(%)	PB	100.000	Not less than 0	Loop proportional parameter SV
		TI(s)	TI	20.000	Not less than 0	Loop integral time parameter SV
		TD(s)	TD	0.000	Not less than 0	Loop differential time parameter SV
	Incomplete Differential Coefficient	KD(s)	KD	10.000	Not less than 0	Incomplete integral filter coefficient
	Deadband (%)	Efficiency (selected)	SWDB	-	-	Selecting deadband parameter is enabled.
		Invalid (selected)	SWDB	√	-	Selecting deadband parameter is disabled.
		Deadzone (DB)	DB	0.000	-	Deadband band size
		Hysteresis (DBHYS)	DBHYS	0.000	[0,DB]	Deadband band hysteresis

Table 3.22 Operation Instruction for Panel Parameter (continued)

Panel Parameter Name			Function Block Parameter Name	Initial Value	Value Range	Application Instruction
	Non-linear Gain (%)	Gap Action (selected)	NGN_OPT	-	-	Read-only, non-linear gain selection switchON= Gap Action
		Square Root (selected)	NGN_OPT	√	-	Read-only, non-linear gain selection switchOFF=Square Root Action
		Range (GW)	GW	0.000	[0, 1.0]	Nonlinear gain action range
		Coefficient (KN)	KN	1.000	-	Nonlinear gain coefficient
	Integral Separation (%)	EA	EA	0.000	-	Range parameter SV
		DK	DK	0.000	-	Coefficient parameter SV
	SV Ramp Action (%)	Efficiency (selected)	SWRAMP	-	-	Selecting SV ramp is enabled.
		Invalid (selected)	SWRAMP	√	-	Selecting SV ramp is disabled.
		Coefficient (RAMP)	RAMP	100.000	-	Coefficient parameter SV
	Direct/Reverse	Direct (selected)	SWPN	-	-	Selecting direct action is enabled.
		Reverse (selected)	SWPN	√	-	Selecting reverse action is enabled.
	Scale Action	Run (selected)	STOPP	√	-	Selecting proportional action is enabled.
		Stop	STOPP	-	-	Selecting proportional action is disabled.
	Integral Action	Run	STOPI	√	-	Selecting integral action is enabled.
		Stop	STOPI	-	-	Selecting integral action is disabled.
		BYPASS	BYPASS	√	-	The modification of function block panel is enabled for function block properties

Table 3.22 Operation Instruction for Panel Parameter (continued)

Panel Parameter Name			Function Block Parameter Name	Initial Value	Value Range	Application Instruction
						interface when debugging.
		Bypass	BYPASS	-	-	The modification of function block panel is disabled for function block properties interface when debugging.
Others	Input Compensation (%)	IA	IA	0.000	-	Read-only, can be set in configuration or program
		IK	IK	1.000	-	Input compensation gain
		IB	IB	0.000	-	Input compensation bias value
	Output Compensation (%)	OA	OA	0.000	-	Read-only, can be set in configuration or program
		OK	OK	1.000	-	Output compensation gain
		DB	DB	0.000	-	Output compensation bias value
	Set EI alarm filter	KSV	KSV	1.000	0~100	Deviation filter coefficient
		TSV (s)	TSV (s)	0.000	0~1000s	Deviation filter time constant(s)
	Feedback Output Track	PV	BK_OPT	-	-	Read-only, can be set in configuration or program
		SV	BK_OPT	√	-	Read-only, can be set in configuration or program
	SV Track	Track	SVTR_OPT	√	-	Read-only, can be set in configuration or program
		Untrack	SVTR_OPT	-	-	Read-only, can be set in configuration or program
	Manual and Auto Control Source	Panel	MAN_OPT	√	-	Read-only, can be set in configuration or program

Table 3.22 Operation Instruction for Panel Parameter (continued)

Panel Parameter Name			Function Block Parameter Name	Initial Value	Value Range	Application Instruction
		Program	MAN_OPT	-	-	Read-only, can be set in configuration or program
	Auto/Cascade Control Source	Panel	SV_OPT	-	-	Read-only, can be set in configuration or program
		Program	SV_OPT	√	-	Read-only, can be set in configuration or program
	Change Limit of SV & MV	GSV	GSV	0.000	-	SV safety protection input increase or decrease value
		GMV	GMV	0.000	-	MV safety protection input increase or decrease value
	TV		TV	0.000	-	Read-only, track input value(%)
	Executive Feedback		MF	0.0	[MVH,MVL]	Writable

3.5.5 Flag

This table lists the relation between the extended PID function block flag and alarm code.

Table 3.23 Flag list

Flag	Alarm	Instruction
D0	OOS	Disable
D1	IMAN	Initialize Manually
D2	MAN	Manual
D3	TR	Track
D4	AUTO	Auto
D5	CAS	Cascade
D6	RCAS	Remote Cascade
D7	ROUT	Remote Output
D8	PVHH	PV HH Limit Alarm

Table 3.23 Flag list (continued)

Flag	Alarm	Instruction
D9	PVLL	PV LL Limit Alarm
D10	PVH	PV H Limit Alarm
D11	PVL	PV L Limit Alarm
D12	SVH	SV H Limit Alarm
D13	SVL	SV L Limit Alarm
D14	MVH	Output H Limit Alarm
D15	MVL	Output L Limit Alarm
D16	PEI	Positive Deviation Alarm
D17	NEI	Negative Deviation Alarm
D18	REVSCL	Span H/L Limit Reverse or output value float abnormal
D19	CFGERR	Configuration Error
D20	TVERR	Trace Value Fault
D21	OAERR	Output Compensation Value Fault
D22	DMVH	MV Positive Rate Limit Alarm
D23	DMVL	MV Negative Rate Limit Alarm
D24	EMMAN	Force Manual Alarm
D25	AOF	Suppress Alarm
D27	NMF	Valve Negative Deviation Alarm
D28	PMF	Valve Positive Deviation Alarm
D29	PVERR	PV Fault
D30	SVERR	SV Fault

3.5.6 Application Example

Example 1

To adjust the water level of LT-1001 in the figure below and realize automatic control for water level. It is described in the diagram and can be applied.

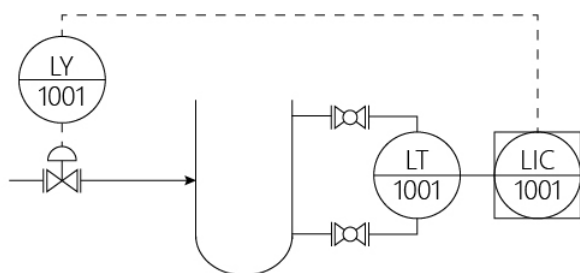


Figure 3.26 Single loop diagram

The single loop, which consists into a closed-loop feedback control system with a control target, a detect transmitter and a performer, also can be called as simple control system. It is often applied for fields with short lag time of the control target, small change of load and interference and general requirements for control quality.

Its programming is shown below, which can be realized via PIDEEX, the interface of host computer can be invoked by the tag of function block to monitor and control the loop in the diagram.

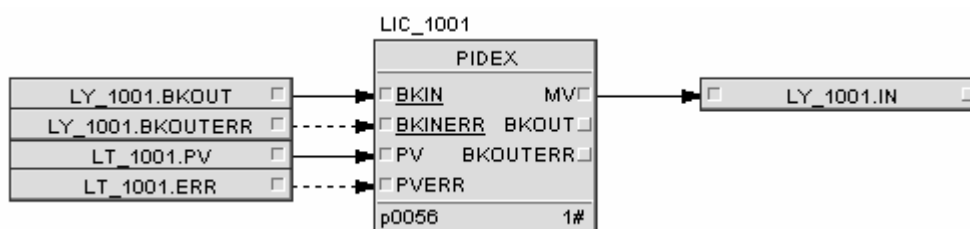


Figure 3.27 Programming of single loop

The function block instruction and examples are shown in the table below:

Table 3.24 Function Block Instruction and Examples

NO.	Example	Type	Instruction
001	LIC_1001	Tag of Function Block	Tag of PID
002	LY_1001	AO (Output)	Water Level Adjusting Valve
003	LT_1001	AI (Input)	Water Detecting Signal

Parameter settings of PIDEEX:

- SVSCL: the same with the unit of PV range
- SVSCH: the same with the unit of PV range
- SVEU: the same with the unit of PV range
- MVSCL: 0~100% in default
- MVSCH: 0~100% in default
- MVEU: 0~100% in default
- SVL: should be the same as the range of SV when SV limit is not required
- SVH: should be the same as the range of SV when SV limit is not required

- MODE_OPT: OFF
- SV_OPT: ON
- Set the alarm enabled and limit of alarm functions of PIDEX according to the requirements.
- BKIN should connect with the BKOUT of downstream function block, BKINERR should connect with the BKOUTERR of downstream function block. AO tag can be the downstream function block for single loop.

Note: the operation parameters SV_OPT, PSWSV (OFF in default) are set to prevent from wrong operation to “CAS” mode by the operator on the panel.

Notice:

The control panel can invoke the name of function block from HMI directly.

Example 2

To achieve the control for the water level of field craft tank, as shown in the figure below, by setting the in-tank water level adjustment as the outer loop and the entrance flow adjustment as the inner loop, and it can be shown and operated in the diagram.

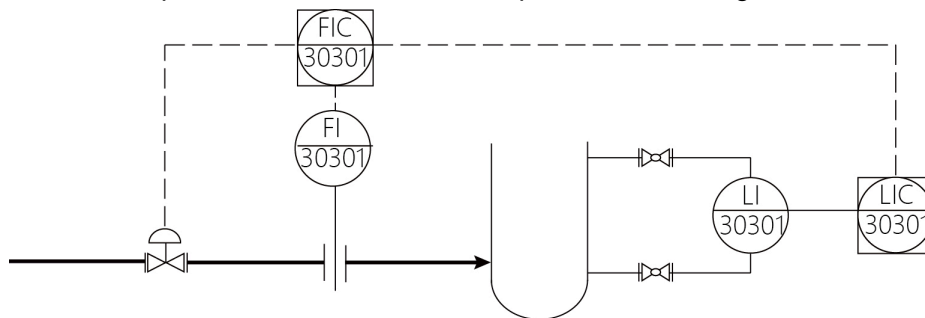


Figure 3.28 Diagram of cascade loop control

Its programming is shown below, which can be achieved by PIDEX. And the data monitoring can be realized by the control panel of the control module via the host computer display and operation data.

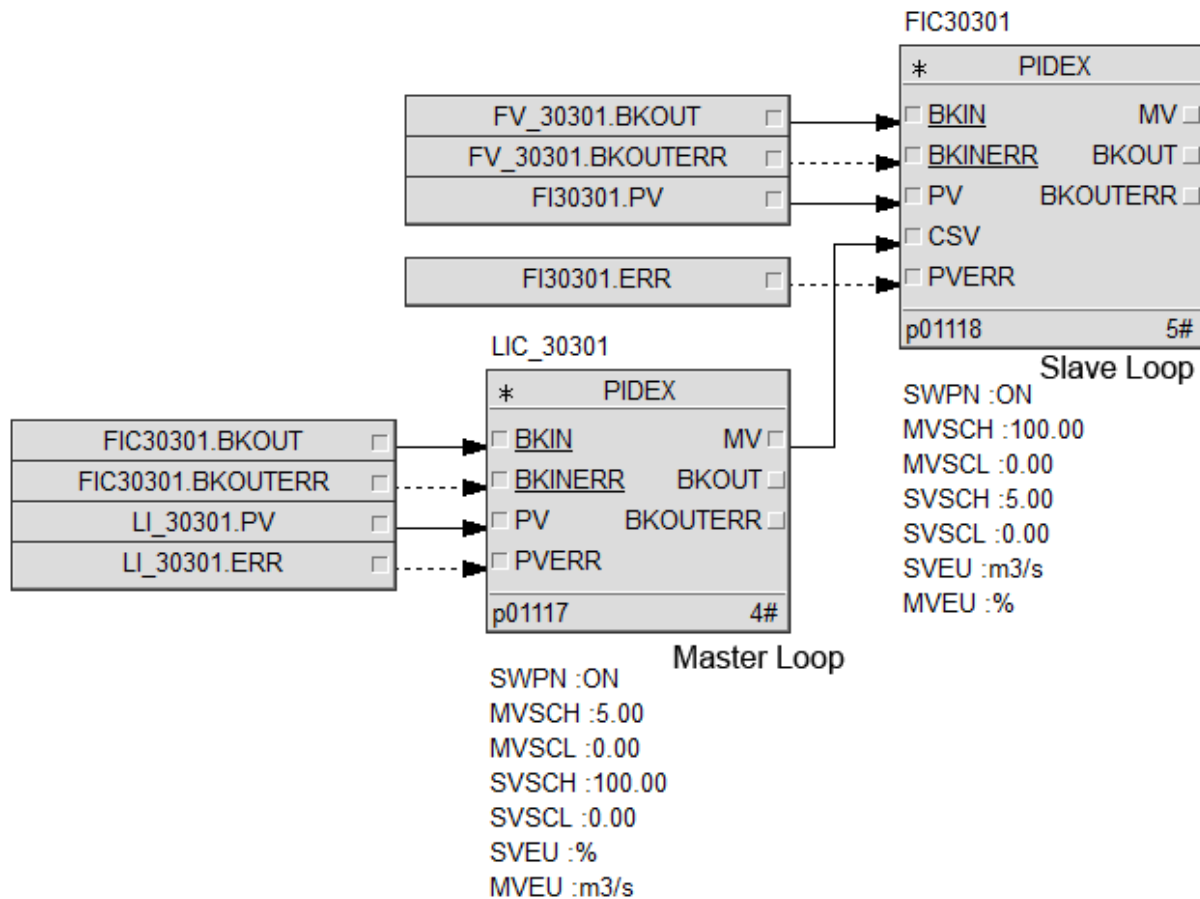


Figure 3.29 Programming of cascade control

The function block instruction and examples are shown below.

Table 3.25 Function Block Instruction and Examples

NO.	Example	Type	Instruction
001	LIC_30301	Tag of Function Block	Outer Loop
002	FIC_30301	Tag of Function Block	Inner Loop
003	FV_30301	AO (Output)	Control Target
004	LI_30301	AI (Input)	PV of Outer Loop
005	FI30301	AI (Input)	PV of Inner Loop

Parameter settings of PIDE:

- The SVSCL, SVSCH and SVEU of SV range of major/minor loops should be the same as its input PV range unit.
- The MVSCCL, MVSCH and MVEU of output MV range of major loop should be the same as the input PV range unit of minor loop. And its MVL, MVH should be the same as MVSCCL and MVSCH when the output limit of MV output is not required, or the MV output will be limited in 0~100.

- The MVSCL, MVSCH and MVEU of output MV range of minor loop use default value 0~100%, and the MVL and MVH use default value 0~100.
- The SVL and SVH of SV range of major/minor loops should be the same as the SV range when the SV limit function is not required, or the SV range will be limited in 0~100.
- When the SV_OPT of major loop is set as ON, the SV_OPT of minor loop should be set as OFF, or the cascade operation cannot be performed manually on the panel.
- Set the MODE_OPT of major/minor loops as OFF.
- Set the alarm enabled and limit of alarm functions of PIDEX according to the requirements.

BKIN of the upstream function block should connect with the BKOUT of downstream function block, BKINERR should connect with the BKOUTERR of downstream function block. The downstream function block can be minor loop for cascade major loop, and the AO tag can be the downstream function block for minor loop.

Notice:

The control panel can invoke the name of function block from HMI directly.

Example 3

To achieve the feedforward control, as shown in the figure below, and it can be operated in the diagram.

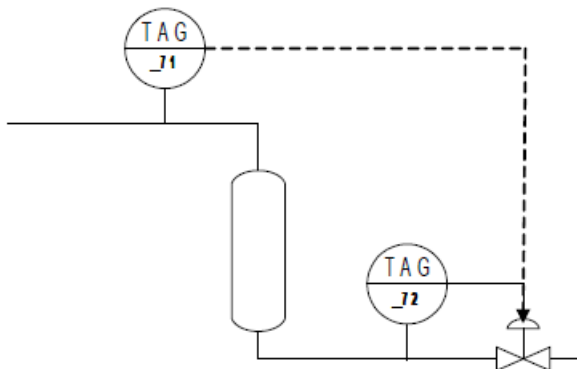


Figure 3.30 Diagram of feedforward control

Pure feedforward control is an open-loop control system, and is not often applied because of its complexity of input or interference in application. In fact, the feedforward-feedback control system is often used to improve the control performance. It means to reduce lag and improve the control precision by the feedforward compensation for the major interference and feedback control correction for other interference.

Its programming is shown below, which can be achieved by PIDEX. And the data monitoring can be realized by the control panel of the control module via the host computer display and operation data.

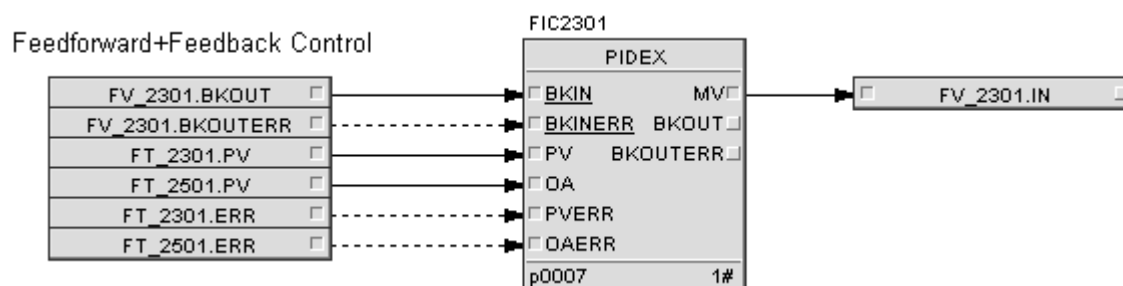


Figure 3.31 Programming of feedforward control

The function block instruction and examples are shown below.

Table 3.26 Function Block Instruction and Examples

NO.	Example	Type	Instruction
001	FIC2301	Tag of Function Block	Loop PID Tag
002	FV_2301	AO (Output)	Control Target
003	FT_2301	AI (Input)	PV
004	FT_2501	AI (Input)	Feedforward Signal

Parameter settings of PIDEX:

- SVSCL, SVSCH, SVEU: the same as PV range unit
- MVSCL, MVSCH, MVEU: default value 0~100%
- MODE_OPT: OFF
- SV_OPT: ON
- BKIN should connect with the BKOUT of downstream function block, BKINERR should connect with the BKOUTERR of downstream function block. AO tag can be the downstream function block for single loop.
- SVL and SVH should be the same as the range of SV when SV limit is not required
- Set OK and OB according to the turning result.
- When input PV error occurs, the PID loop enters into PVERR status. The loop enters into manual status automatically, and PID output MV holds.
- When AO is compelled, PID loop enters into IMAN status. The loop MV tracks the compel value of AO.
- Set the alarm enabled and limit of alarm functions of PIDEX according to the requirements.

Notice:

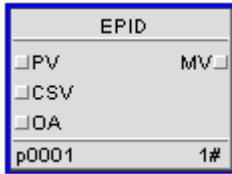
The control panel can invoke the name of function block from HMI directly.

3.6 EPID Control Function Block (EPID)

General PID control functions can be achieved by EPID function block. It has two work modes OOS and AUTO, and applies to electric power industry.

It is a complex function block and its running time is 150 μ s.

Please refer to the Overview and Control Function Block Library before using the function block.



3.6.1 Parameter Description

Table 3.27 Parameter description and application of EPID Function Block

Name			Description	Upload	Properties	Application Reference
Basic Parameters	Range Settings	SVSCH	SV high scale	-	Configuration Parameter	The same as PV actual value H limit. When SV>SVSCH, it is limited by the maximum of Range.
		SVS-CL	SV low scale	-	Configuration Parameter	The same as PV actual value L limit. When SV<SVSCH, it is limited by the minimum of Range.
		MVSCH	MV high scale	-	Configuration Parameter	The same as MV actual value H limit.
		MVS-CL	MV low scale	-	Configuration Parameter	The same as MV actual value L limit.
		SVEU	SV engineer unit	-	Configuration Parameter	Set in the function block properties settings interface.
		MVEU	MV engineer unit	-	Configuration Parameter	Set in the function block properties settings interface.
		SVDLEN	SV decimal digits [0,5]	-	Configuration Parameter	Used for data displayed on function block panel (equal to 3 as default).

Table 3.27 Parameter description and application of EPID Function Block (continued)

Name			Description	Upload	Properties	Application Reference
	Output Limits	MVDLEN	MV decimal digits [0,5]	-	Configuration Parameter	Used for data displayed on function block panel (equal to 3 as default).
		MVH	MV H limit value	TRUE	Operation Parameter	Value range [MVSC, MVSCH].
		MVL	MV L limit value	TRUE	Operation Parameter	Value range [MVSC, MVSCH].
	Direct/Reverse Switch Settings	SWPN	Direct/Reverse switch. SV is not changed, the MV increases with the increasing of PV in direct action, and decreases with the increasing of PV in reverse action.	TRUE	Operation Parameter	OFF=Direct action, ON=Reverse action
Extended Parameters	Input Pin	PV	Process value of loop closed control process	-	Input Pin	Connect to measuring point AI
		CSV	Cascade	-	Input Pin	Connect to outer loop control value MV. When select cascade, SV comes from CSV.
		OA	Output compensation, used for feedforward control	-	Input Pin	Connect to measuring point AI (feedforward signal), MV=MV0+OA
		IA	Input compensation value, used to improve the controllability of process with long deadband time	-	Input Pin	Connect to measuring point AIRefer to Input Process"" Related parameter: IK, IBPV=PV +IA
		SWSV	Auto/ cascade selection: OFF=auto, ON=cascade	TRUE	Input Pin	-
	Output Pin	MV	PID operation output value	-	Output Pin	Connect to electric manual instru-

Table 3.27 Parameter description and application of EPID Function Block (continued)

Name			Description	Upload	Properties	Application Reference
						<p>ment Control output MV=last period output LT_-MV (before Limits)+current period control increment dMV.</p> <p>If there's a float abnormal happened to the MV value, the MV will be set as the value of previous period or the lower limit. Please refer to "Application Illustration" for details.</p>
	PID Param Settings	PB	Proportion band size	TRUE	Operation Parameter	Refer to "PID Parameter Tune"
		TI	Integral time (s)	TRUE	Operation Parameter	Refer to "PID Parameter Tune"
		TD	Derivative time (s)	TRUE	Operation Parameter	When TD=0, suppress derivation action Refer to "PID Parameter Tune"
		KD	Derivative filter coefficient	TRUE	Operation Parameter	Refer to "Algorithm Illustration"
	Alarm	PVHH	PV HH limit alarm value	TRUE	Operation Parameter	Refer to "Operation Process"
		PVH	PV H limit alarm value	TRUE	Operation Parameter	Refer to "Input Process"
		PVL	PV L limit alarm value	TRUE	Operation Parameter	Refer to "Input Process"
		PVLL	PV LL limit alarm value	TRUE	Operation Parameter	Refer to "Input Process"
		PVHYS	Process value alarm hysteresis	TRUE	Operation Parameter	Refer to "Input Process"
		DL	Deviation alarm set value	TRUE	Operation Parameter	Refer to "Input Process"

Table 3.27 Parameter description and application of EPID Function Block (continued)

Name			Description	Upload	Properties	Application Reference
		DL-HYS	Deviation alarm hysteresis value	TRUE	Operation Parameter	Refer to "Operation Process"
	Error Indication	EI	Error	-	Monitoring Parameter	Refer to "Operation Process"
	SV	SV	SV for loop closed control	TRUE	Operation Parameter	Refer to "Set Variable Process" When select SV, set value comes from SV.
		SVRG_OPT	SV range convert option:0=no convert,1=convert by percent	-	Configuration Parameter	0 by default.
	Extended Range Settings	HOR-LIM	Extended range maximum percentage	-	Configuration Parameter	-
		LOR-LIM	Extended range minimum percentage	-	Configuration Parameter	-
	Alarm Enabled and Suppress	AOF	Suppress module alarm, On=prohibit to display alarm	TRUE	Operation Parameter	Refer to "Alarm"
		ENALM	Alarm enable	TRUE	Alarm Parameter	Refer to "Alarm"
	OOS Settings	SWOOS	OOS mode setting switch(ON=OOS mode)	TRUE	Operation Parameter	Set as ON at the first time of function block downloading

Working mode

Table 3.28 EPID function block's working modes and parameter conditions

Mode	Serial number	Parameter conditions	
		SWOOS	SWSV
OOS	1	ON	—
AUTO	5	OFF	OFF
CAS	6	OFF	ON

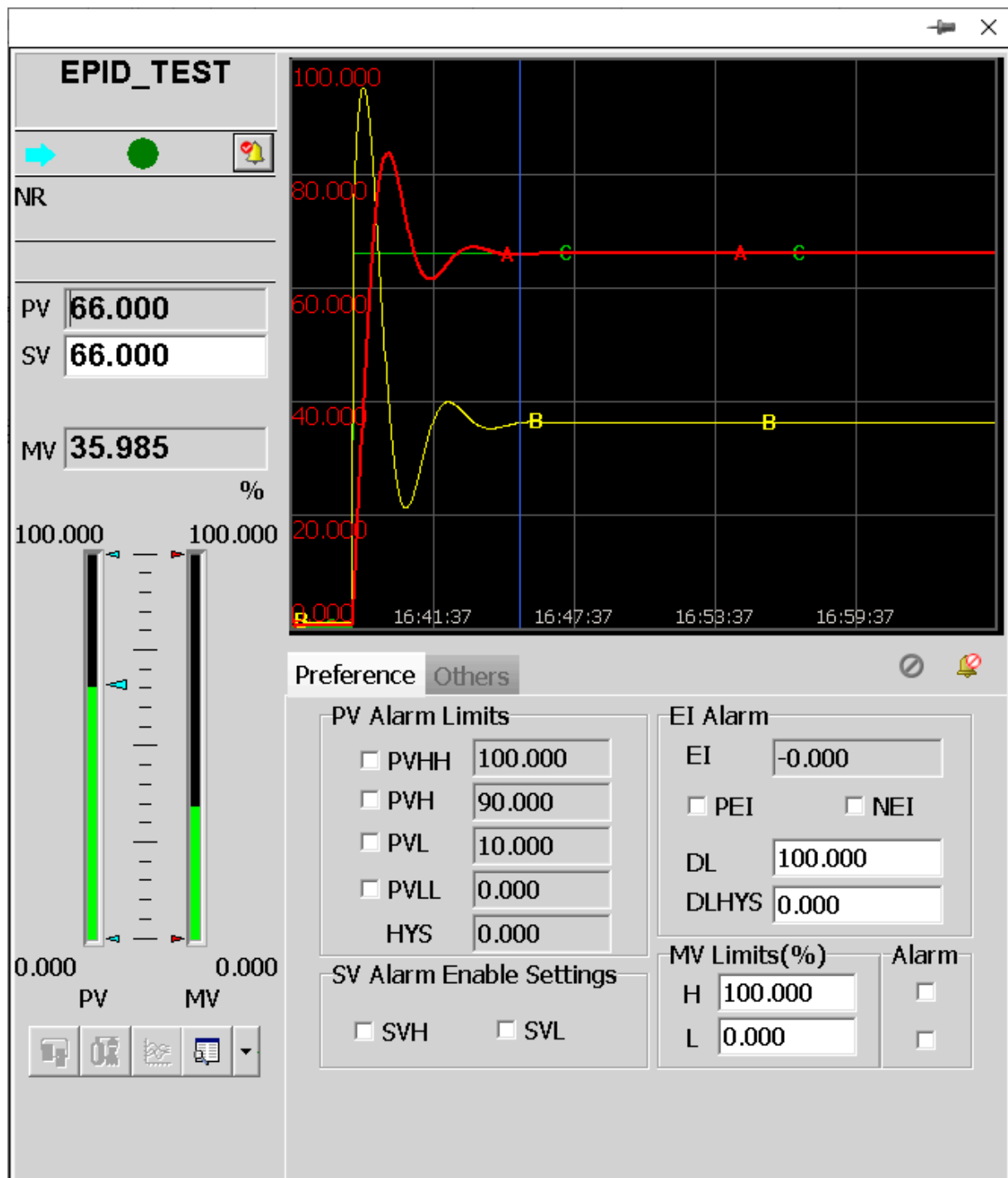
“-” means parameters can be any condition of ON or OFF.

3.6.2 Application Illustration

The float abnormal of output values means that the output values are not float format, or a meaningless output value is produced in a calculation that performs a divide-by-zero operation. When float abnormal happened, the function block's output values shall conform to the following rules:

- If there's the normal value of previous period, MV outputs the value of previous period.
- If there's the abnormal value of previous period or no previous period value, MV outputs the lower range limit.

3.6.3 Panel Parameter



The screenshot shows a software window titled 'Preference Others' with a close button and a help icon. It contains several parameter settings:

- PID Parameter:**
 - PB: 100.000 %
 - TI: 20.000 s
 - TD: 0.000 s
- Input Compensation:**
 - IA: 0.000
- Output Compensation(%):**
 - OA: 0.000
- Differential Filter Coefficient:**
 - KD: 10.000 s
- Control Direction:**
 - ☐ Direct ☒ Reverse

Table 3.29 Operation Instruction for Panel Parameter

Panel Parameter Name			Function Block Parameter Name	Initial Value	Value Range	Application Instruction
Preference	PV Alarm (%)	HH	PVHH	100.000	[SVS-CL,SVSCH]	HH alarm value setting of loop PV (select alarm enabled, or it is disabled).
		H	PVH	90.000	[SVS-CL,SVSCH]	H alarm value setting of loop PV(select alarm enabled, or it is disabled)
		L	PVL	10.000	[SVS-CL,SVSCH]	L alarm value setting of loop PV(select alarm enabled, or it is disabled)
		LL	PVLL	0.000	[SVS-CL,SVSCH]	LL alarm value setting of loop PV. (select alarm enabled, or it is disabled)
		HYS	PVHYS	0.000	-	PV Process value alarm hysteresis
	SV Limits (%)	SVH	-	-	-	SV H alarm enable
		SVL	-	-	-	SV L alarm enable
	MV Limits (%)	SVH	MVH	100.000	[MVS-CL,MVSCH]	H value setting of loop MV (select alarm enabled, or it is disabled). Note: MV limit is

Table 3.29 Operation Instruction for Panel Parameter (continued)

Panel Parameter Name			Function Block Parameter Name	Initial Value	Value Range	Application In-struction
						not affected by selection.
		SVL	MVL	0.000	[MVS-CL,MVSCH]	L value setting of loop MV (select alarm enabled, or it is disabled). Note: MV limit is not affected by selection.
	EI Alarm (%)	EI	EI	0.000	-	Read-only. EI=PV - SV(select alarm enabled, or it is disabled).
		PEI (se-lected)	-	-	-	Selecting the positive deviation alarm is enabled.
		NEI (se-lected)	-	-	-	Selecting the negative deviation alarm is enabled.
		DL	DL	100.000	DL	Deviation alarm SV
		DLHYS	DLHYS	0.000	-	Deviation alarm hystersis value
Others	PID Pa-rameter	PB(%)	PB	100.000	Not less than 0	Loop proportional parameter SV
		TI(s)	TI	20.000	Not less than 0	Loop integral time parameter SV
		TD(s)	TD	0.000	Not less than 0	Loop differential time parameter SV
	Differ-ential Filter Coeffi-cient	KD(S)	KD	10.000	Not less than 0	Incomplete inte-gral filter coeffi-cient
	Control Direc-tion	Direct (se-lected)	SWPN	-	-	Selecting direct action is enabled.
		Reverse (selected)	SWPN	√	-	Selecting reverse action is enabled.
	Input Com-pensa-tion (%)	IA	IA	0.000	-	Read-only, can be set in configura-tion or program

Table 3.29 Operation Instruction for Panel Parameter (continued)

Panel Parameter Name			Function Block Parameter Name	Initial Value	Value Range	Application Instruction
	Output Compensation (%)	OA	OA	0.000	-	Read-only, can be set in configuration or program

3.6.4 Flag

Flag	Alarm	Instruction
D0	OOS	Disable
D1	PVHH	PV HH Limit Alarm
D2	PVH	PV H Limit Alarm
D3	PVL	PV L Limit Alarm
D4	PVLL	PV LL Limit Alarm
D5	PEI	Positive Deviation Alarm
D6	NEI	Negative Deviation Alarm
D7	MVH	Output H Limit Alarm
D8	MVL	Output L Limit Alarm
D9	SVH	SV H Limit Alarm
D10	SVL	SV L Limit Alarm
D11	CFGERR	Configuration Error
D12	REVSCL	Span H/L Limit Reverse or output value float abnormal
D13	AOF	Suppress Alarm

3.6.5 Application Example

Refer to Application Example.

3.7 LEPID Function Block (LEPID)

The input of LEPID is bias. The function block provides three modes which are OOS, TR and AUTO. It connects with electric power manual instrument but not AO, and is special for electric power project.

It is a complex function block and its running time is 100μs.

Please refer to the Overview and Control Function Block Library before using the function block.



3.7.1 Parameter Description

Table 3.30 Parameter description and application of LEPID function block

Name			Description	Upload	Properties	Application Reference
Basic Parameters	Range Settings	MVSCH	MV high scale	-	ConfigurationParameter	The same as MV actual value H limit.
		MVSCL	MV low scale	-	Configuration Parameter	The same as MV actual value L limit.
		EISCH	EI high value	-	Configuration Parameter	The same as the actual value of EI H.
		EISCL	EI low value	-	Configuration Parameter	The same as the actual value of EI L.
		EIEU	EI actual value unit	-	Configuration Parameter	Set in the function block properties settings interface.
		MVEU	MV engineer unit	-	Configuration Parameter	Set in the function block properties settings interface.
		EIDLEN	EI decimal digits [0,5]	-	Configuration Parameter	Used for data displayed on function block panel (equal to 3 as default).

Table 3.30 Parameter description and application of LEPID function block (continued)

Name			Description	Upload	Properties	Application Reference
	Output Limits	MVDLEN	MV decimal digits [0,5]	-	Configuration Parameter	Used for data displayed on function block panel (equal to 3 as default).
		MVH	MV H limit value	TRUE	Operation Parameter	Value range [MVS-CL,MVSCH]
		MVL	MV L limit value	TRUE	Operation Parameter	Value range [MVS-CL,MVSCH]
		DMVLIM	MVoutput rate variety limit value. Used to prevent the MV from overlarge modification in a short time.	TRUE	Operation Parameter	Refer to Integral Cutting
Extended Parameters	Input Pin	EI	Bias input	-	Input Pin	Refer to Operation Process
		TV	Track input value (In track mode, MV=TV)	-	Input Pin	Connect to measuring point AI Related parameter: SWTR
		SWTR	Track switch: OFF= not track ,ON= track	-	Input Pin	Upstream interlock condition input,Related parameter: TV
		OA	Output compensation, used for feedforward control	-	Input Pin	Connect to measuring point AI (feedforward signal),Related parameter: OK, OBCompensate for PID calculated result, MV= MV of last period + PID output variable+OA increment

Table 3.30 Parameter description and application of LEPID function block (continued)

Name			Description	Upload	Properties	Application Reference
		IA	Input compensation value, used to improve the controllability of process with long deadband time	-	Input Pin	Connect to measuring point AI, Refer to Input Process Related to: IK, perform input compensation from I to EI, after compensation, $EIR = EI + IA$.
		SWINC	MV lock increase (MV cannot increase), ON= lock increase	-	Input Pin	Upstream output, enabled when function block is automatic or cascade when lock increase conflicts with MV Limits, MV Limits has the priority.
		SWDEC	MV lock decrease (MV cannot decrease), ON= Lock decrease	-	Input Pin	Connect the upstream output. enabled when function block is automatic or cascade
	Output Pin	Output pin	PID operation output value	-	Output Pin	Connect to electric manual instrument In track and auto modes, it must be in the range of MVH and MVL.If there's a float abnormal happened to the MV value, the MV will be set as the value of previous period or the lower

Table 3.30 Parameter description and application of LEPID function block (continued)

Name			Description	Upload	Properties	Application Reference
						limit. Please refer to Application Illustration for details.
		MVHIND	MV H limit alarm indication	-	Output Pin	Refer to Integral Cutting
		MVLIND	MV L limit alarm indication	-	Output Pin	Refer to Integral Cutting
	PID Param Settings	PB	Proportion band size	TRUE	Operation Parameter	Refer to PID Parameter Tune
		TI	Integral time (s)	TRUE	Operation Parameter	Refer to PID Parameter Tune
		TD	Derivative time (s)	TRUE	Operation Parameter	TD =0, Suppress deviation Action
		KD	Derivative filter coefficient	TRUE	Operation Parameter	Refer to general PID function block ^{Note1} , ^{Note2} , ^{Note3} , ^{Note4}
	Advanced Param Setting	EA	Integral excise coefficient. when EI > EA, excise coefficient, when EI < EA, excising coefficient is disabled, used for prevent MV change from overlarge	TRUE	Operation Parameter	Related parameter: DK
		DK	Proportion modified value when integral excising	TRUE	Operation Parameter	Related parameter: EA Refer to ^{Note2}
		MDB	Precise controlled zone range	TRUE	Operation Parameter	Refer to ^{Note1}
		MK	Precise controlled zone coefficient	TRUE	Operation Parameter	Refer to ^{Note1}

Table 3.30 Parameter description and application of LEPID function block (continued)

Name			Description	Upload	Properties	Application Reference
		EDB	Input EI Dead-band	TRUE	Operation Parameter	Refer to Note3
		MVDB	Output EI Dead-band	TRUE	Operation Parameter	Refer to Note3, can be modified in supervision
		STOPI	Integral suppress switch, when STOPI=ON, stop integral action	TRUE	Operation Parameter	Refer to Operation Process
		STOPP	Proportion suppress switch, when STOPP=ON, stop integral action	TRUE	Operation Parameter	Refer to Operation Process
	Alarm	DMVHIND	MV positive rate limit indication	-	Monitoring Parameter	Refer to Integral Cutting
		DMVLIND	MV negative rate limit indication	-	Monitoring Parameter	Refer to Integral Cutting
	ExtendedRange-Settings	HORLIM	Extended range maximum percentage	-	Configuration Parameter	Refer to Output Process
		LORLIM	Extended range minimum percentage	-	Configuration Parameter	Refer to Output Process
	Alarm-Enable and Suppress	AOF	Suppress module alarm, On=prohibit to display alarm	TRUE	Operation Parameter	Refer to Integral Cutting
		ENALM	Alarm enable	TRUE	Alarm Parameter	Refer to Integral Cutting
		FLAG	Flag	-	Output Pin	Refer to Integral Cutting
	OOS Settings	SWOOS	OOS mode setting switch (ON=OOS mode)	TRUE	Operation Parameter	Set as ON at the first time of function block downloading

Working mode

Table 3.31 LEPID function block's working modes and parameter conditions

Mode	Serial number	Parameter conditions	
		SWOOS	SWTR
OOS	1	ON	—
TR	3	OFF	ON
AUTO	5	OFF	OFF

Note 1: Precise control processing

When $Mdb > 0$ and the absolute value of bias after compensation is within precise control zone ($-MDB, MDB$), ratio coefficient KP will be corrected as $KP = KP * MK$.

Note 2: Integral isolation processing

Integral will not work if the absolute value of bias after compensation is greater than integral-separated coefficient. Ratio coefficient KP will be corrected according to set ratio correction, which will be $KP = KP + DK$.

Note 3:

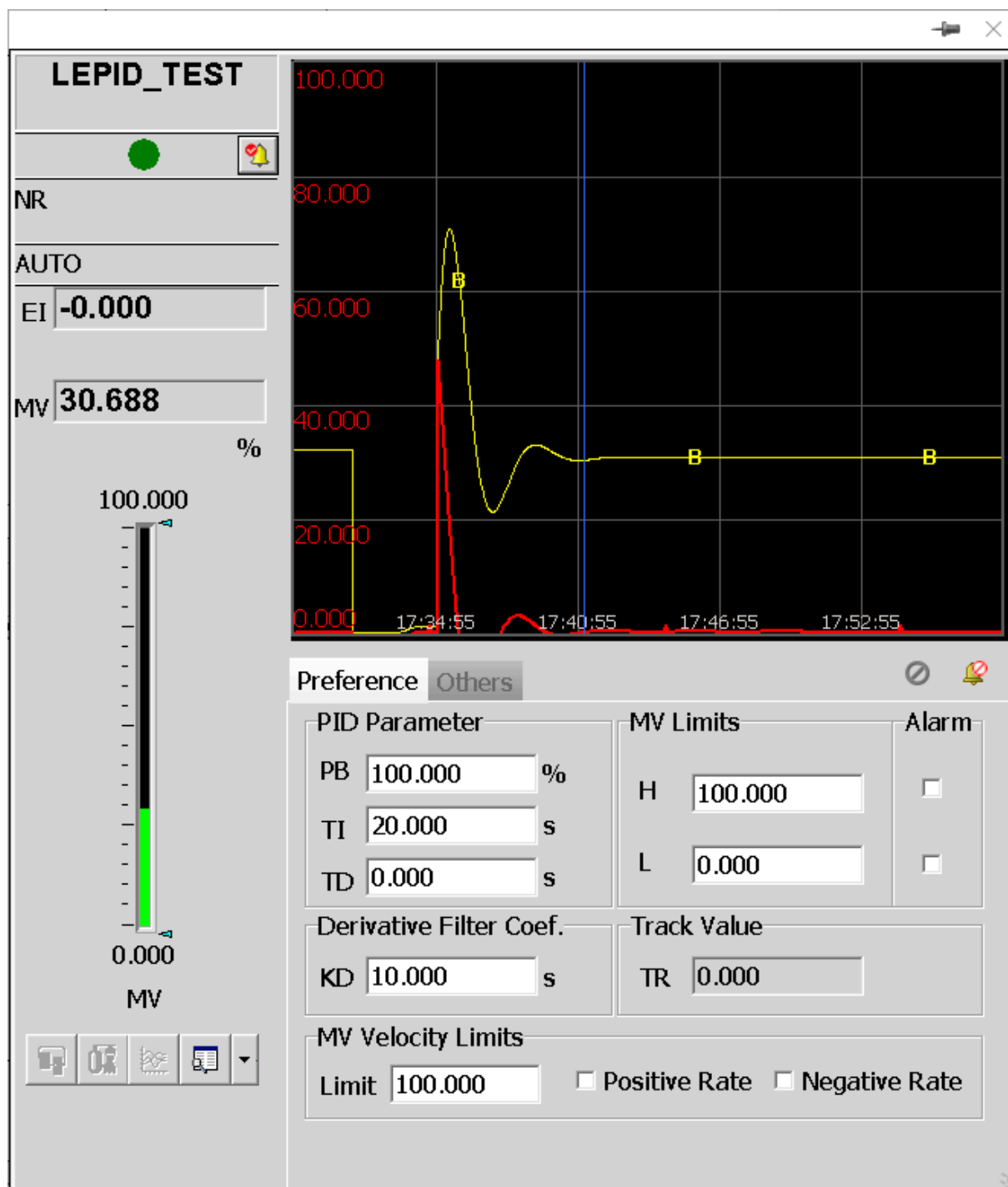
- Input deadband
When $fabs(EI) < EDB$, dMV (the variation of MV) = 0, stop the change of MV . When $EI > DB$, output the PID operation result.
- Output deadband
Only when cumulative variation of dMV is over output deadband, will MV changes. Otherwise it will maintain. For example, if deadband is set "1", only when the cumulative variation of dMV is over "1" (eg: change from 30 to 31), will MV changes.

3.7.2 Application Illustration

The float abnormal of output values means that the output values are not float format, or a meaningless output value is produced in a calculation that performs a divide-by-zero operation. When float abnormal happened, the function block's output values shall conform to the following rules:

- If there's the normal value of previous period, MV outputs the value of previous period.
- If there's the abnormal value of previous period or no previous period value, MV outputs the lower range limit.

3.7.3 Panel Parameter



The screenshot shows a software window titled 'Preference Others' with a close button and a help icon. It contains several sections for configuring control parameters:

- Input Deviation Deadzone:** EDB set to 0.000.
- Output Deviation Deadzone:** MVDB set to 0.000.
- Integral Isolation Coef.:** EA set to 0.000, DK set to 0.000.
- Precise Controlled Zone:** MDB set to 0.000, MK set to 0.000.
- Proportional Action:** ☒ Run, ☐ Stop.
- Integral Action:** ☒ Run, ☐ Stop.
- Input Compensation:** Value(IA) set to 0.000.
- Output Compensation:** Value(OA) set to 0.000.

Table 3.32 Operation Instruction for Panel Parameter

Name			Panel Parameter Name	Initial Value	Value Range	Application Instruction
Preference	MV Limit Settings	H	MVH	100.000	[MVS-CL,MVSCH]	H value setting of loop MV (select alarm enabled, or it is disabled). Note: MV limit is not affected by selection.
		L	MVL	0.000	[MVS-CL,MVSCH]	L value setting of loop MV (select alarm enabled, or it is disabled). Note: MV limit is not affected by selection.
	MV Speed Limit Settings	Positive Rate (selected)	-	-	-	Selecting positive velocity alarm is enabled.
		Negative Rate (selected)	-	-	-	Selecting negative velocity alarm is enabled.
		Limit	DMVLIM	100.000	-	Loop MV velocity limit SV
	PID Parameterization	PB(%)	PB	100.000	Not less than 0	Loop proportional parameter SV
		TI(s)	TI	20.000	Not less than 0	Loop integral time parameter SV

Table 3.32 Operation Instruction for Panel Parameter (continued)

Name			Panel Parameter Name	Initial Value	Value Range	Application Instruction
		TD(s)	TD	0.000	Not less than 0	Loop differential time parameter SV
	Derivation Filter Coef	KD(s)	KD(s)	10.000	-	Differential filter coefficient (s)
	Track Value	TV	TV	0.000	-	Read-only, track input value(%)
Others	Input Error Deadzone	EDB	EDB	0.000	-	When the absolute value of EI is less than error dead zone band EDB, dMV (MV variable)= 0, stop the operation MV modification. When EI is larger than DB, output based on calculation result.
	Integral Isolation Coefficient	EA	EA	0.000	-	Range parameter SV
		DK	DK	0.000	-	Coefficient parameter SV
	Proportional Action	Run (selected)	STOPP	√	-	Selecting proportional action is enabled.
		Stop	STOPP	-	-	Selecting proportional action is disabled.
	Input Compensation	Value (IA)	IA	0.000	-	Read-only, can be set in configuration or program
	Output Error Deadband	MVDB	MVDB	0.000	-	can be modified in supervisionRefer to "Alarm"
	Precise Controlled Zone Settings	MDB	MDB		-	can be modified in supervision
		MK	MK		-	can be modified in supervision
	Integral Action	Run	STOPI	√	-	Selecting integral action is enabled.
		Stop	STOPI	-	-	Selecting integral action is disabled.
	Output Compensation (%)	Value (OA)	OA	0.000	-	Read-only, can be set in configuration or program

3.7.4 Flag

Table 3.33 Flag

Flag	Alarm	Instruction
D0	OOS	Disable
D3	TR	Track
D4	AUTO	Auto
D14	MVH	Output H Limit Alarm
D15	MVL	Output L Limit Alarm
D18	REVSCL	Span H/L Limit Reverse or output value float abnormal
D19	CFGERR	Configuration Error
D22	DMVH	MV Positive Rate Limit Alarm
D23	DMVL	MV Negative Rate Limit Alarm
D25	AOF	Suppress Alarm

3.7.5 Application Example

Refer to Application Example.

3.8 PID for Pulse Output Function Block (PID_TP)

The functions are the same with those of PID function block except the followings ones:

- Track is not available.
- There is no need to connect BKIN.

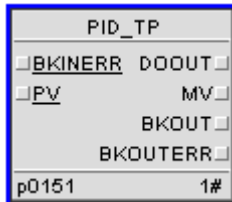
For there is no BKIN, it is like BKIN=MV of PID function block in the program, means PID_TP can only be the most downstream block of the control but not the upstream block. Connect the DOOUT with DO at last to control duty ratio of output.

- A more output BOOL whose duty ratio be calculated by current MV and pulse period.

This function block can be used in the condition in which temperature object is controlled by duty ratio.

It is a complex function block and its running time is 150μs.

Please refer to the Overview and Control Function Block Library before using the function block.



3.8.1 Parameter Description

Table 3.34 Parameter description and application of PID_TP Function Block

Name			Description	Upload	Properties	Application Reference
Basic Parameters	Range Setting	MVSCH	MV high scale	-	Configuration Parameter	The same as MV actual value H limit.
		MVSCL	MV low scale	-	Configuration Parameter	The same as MV actual value L limit.
		SVSCH	SV high scale	-	Configuration Parameter	The same as PV actual value H limit.
		SVSCL	SV low scale	-	Configuration Parameter	The same as PV actual value L limit.
		SVEU	SV engineer unit	-	Configuration Parameter	Set in the function block properties settings interface.
		MVEU	MV engineer unit	-	Configuration Parameter	Set in the function block properties settings interface.
		SVDLEN	SV decimal digits [0,5]	-	Configuration Parameter	Used for data displayed on function block panel (equal to 3 as default).
		MVDLEN	MV decimal digits [0,5]	-	Configuration Parameter	Used for data displayed on function block panel (equal to 3 as default).

Table 3.34 Parameter description and application of PID_TP Function Block (continued)

Name			Description	Upload	Properties	Application Reference
	Limits	MVH	MV H limit value	TRUE	Operation Parameter	Value range [MVS-CL,MV SCH]
		MVL	MV L limit value	TRUE	Operation Parameter	Value range [MVS-CL,MV SCH]
		SVH	SV H limit value	TRUE	Operation Parameter	Value range [SVS-CL,SV SCH]
		SVL	SV L limit value	TRUE	Operation Parameter	Value range [SVS-CL,SV SCH]
		DMVLIM	MV output rate variety limits value. Used to prevent the MV from overlarge modification in a short time.	TRUE	Operation Parameter	Refer to Integral Cutting
	Direct/Reverse Switch Settings	SWPN	Direct/Reverse for. SV is not changed, the MV increases with the increasing of PV in direct action, and decreases with the increasing of PV in reverse action.	TRUE	Operation Parameter	OFF=Direct action, ON=Reverse action
Extended Parameters	Base Input Pin Settings	BKIN-ERR	Feedback input	-	Input Pin	Connect to BKOUT of downstream block ERR
		PV	Process value of loop closed control process	-	Input Pin	Connect to measuring point AI
		CSV	Cascade	-	Input Pin	Connect to outer loop control value MV
		OA	Output compensation, used for feedforward control	-	Input Pin	Connect to measuring point AI (feedforward signal), Related parameter: OK, OB

Table 3.34 Parameter description and application of PID_TP Function Block (continued)

Name			Description	Upload	Properties	Application Reference
	Advance Input Pin Settings	MF	PID executor feedback value , used for monitoring	-	Input Pin	Connect to measuring point AI
		IA	Input compensation value, used to improve the controllability of process with long deadband time	-	Input Pin	Connect to measuring point AI, Refer to Input Process Related parameter: IK, IB
		PSWAM	Program manual and auto control switch, OFF=program manual control, ON=program auto control	-	Input Pin	Connect the upstream outputEnabled when MAN_-OPT=ON
		PSWSV	Program auto/cascade control switch, OFF=SV, ON=CSV	-	Input Pin	Connect the upstream output enabled when SV_-OPT=ON
		MAN_-OPT	Manual-automatic control source switch, ON= manual-automatic selection controlled by PSWAM, OFF= manual-automatic selection controlled by SWAM	-	Input Pin	Connect the upstream outputRelated parameter: PSWAM, SWAM
		SV_OPT	Auto/Cascade control source selection, ON= auto/cascade selection controlled by PSWSV, OFF= auto/cascade selection controlled by SWSV	-	Input Pin	Connect the upstream outputRelated parameter: PSWSV, SWSV
		SWINC	MV lock increase (MV cannot Increase), ON= lock increase	-	Input Pin	Connect the upstream output. Enabled when the function block is auto or cascade.

Table 3.34 Parameter description and application of PID_TP Function Block (continued)

Name			Description	Upload	Properties	Application Reference
		RRL	Anti-integral windup input, used for control overshoot	-	Input Pin	Connect to measuring point AI, Refer to Operation Process Related parameter: BKIN; Integral Limits Action
		SWDEC	MV lock decrease (MV cannot decrease), ON= Lock decrease	-	Input Pin	Connect the upstream output. enabled when function block is automatic or cascade
		HOLD	MV holds the current output value, ON= hold the current output value	-	Input Pin	Connect to upstream output,
	Output Pin	DOOUT	Pulse output	-	Output Pin	BOOL, Connect the tag DO
		MV	PID operation output value	-	Output Pin	Connect to AO tag Refer to Note 1
		BKOUT	Feedback output value	-	Output Pin	Connect to the BKIN of Upstream Block, Related parameter: BK_OPT
		BKOUTERR	Feedback status value	-	Output Pin	Connect to the BKINERR of Upstream Block
		BK_OPT	BKOUT value switch (ON=track PV, OFF=track SV)	-	Configuration Parameter	Related parameter: BKOUT
	PID Param Settings	PB	Proportion band size	TRUE	Operation Parameter	Refer to PID Parameter Tune
		TI	Integral time (s)	TRUE	Operation Parameter	Refer to PID Parameter Tune

Table 3.34 Parameter description and application of PID_TP Function Block (continued)

Name			Description	Upload	Properties	Application Reference
		TD	Derivative time (s)	TRUE	Operation Parameter	When TD=0, suppress derivation action Refer to PID Parameter Tune
		KD	Derivative filter coefficient	TRUE	Operation Parameter	Refer to Application Illustration
		TP	Pulse Circle (s)	TRUE	Operation Parameter	Refer to ^{Note1}
	Operator Command	MODE	Work mode	-	Monitoring Parameter	Refer to Transition Process of Function Block Modes
		IMODE	Standby work mode	-	Monitoring Parameter	Refer to Transition Process of Function Block Modes
		MODE_-OPT	ON=auto return, OFF=manual return	-	Configuration Parameter	Refer to Transition Process of Function Block Modes
		SWAM	Manual and auto switch: OFF=manual, ON=auto	-	Operation Parameter	Enabled when MAN_-OPT=OFF
		SWSV	Auto/ cascade selection: OFF=auto, ON=cascade	-	Operation Parameter	Enabled when SV_-OPT=OFF
		SWMMV	Whether to equal to preset MV value when switch to manual status	TRUE	Operation Parameter	Related parameter: MMV
		MMV	Preset MV value (switch to manual)	TRUE	Operation Parameter	Enabled when SWMMV=ON
		SWPMV	Whether to equal to present MV value when switch to auto status	TRUE	Operation Parameter	Related parameter: PMV

Table 3.34 Parameter description and application of PID_TP Function Block (continued)

Name			Description	Upload	Properties	Application Reference
	Operator Command	PMV	Preset MV	TRUE	Operation Parameter	Enabled when SWP-MV=ON
		SV	SV for loop closed control	TRUE	Operation Parameter	Refer to Set Variable Process
		MANMV	Manual output value	-	Operation Parameter	Output value= MAN-MV in manual mode
		EI	Error	-	Monitoring Parameter	Refer to Operation Process
	Input Alarm Settings	PVHH	PV HH limit alarm value	TRUE	Operation Parameter	Refer to Input Process
		PVH	PV H limit alarm value	TRUE	Operation Parameter	Refer to Input Process
		PVL	PV L limit alarm value	TRUE	Operation Parameter	Refer to Input Process
		PVLL	PV LL limit alarm value	TRUE	Operation Parameter	Refer to Input Process
		PVHYS	Process value alarm hysteresis	TRUE	Operation Parameter	Refer to Input Process
		DL	Deviation alarm set value	TRUE	Operation Parameter	Refer to Operation Process
		DLHYS	Deviation alarm hysteresis value	TRUE	Operation Parameter	Refer to Operation Process
		KSV	Deviation filter coefficient	TRUE	Operation Parameter	Refer to Operation Process
		TSV	Deviation filter time constant(s)	TRUE	Operation Parameter	Refer to Operation Process
		NMFLIM	Valve position negative error thresholds	TRUE	Operation Parameter	Refer to Integral Cutting
		PMFLIM	Valve position positive error thresholds	TRUE	Operation Parameter	Refer to Integral Cutting

Table 3.34 Parameter description and application of PID_TP Function Block (continued)

Name			Description	Upload	Properties	Application Reference
		TMFHYS	Valve position error alarm hysteresis time	TRUE	Operation Parameter	Refer to Integral Cutting
	Advance Calculation Settings	BYPASS	Bypass PID operation, when BYPASS=ON, excise PID calculation, switch SV to MV directly for output	TRUE	Operation Parameter	When cascade adjusting, used to excise inner loop when it fails Refer to Operation Process
		STOPP	Proportion suppress switch, when STOP-P=ON, stop integral action	TRUE	Operation Parameter	Refer to Operation Process
		STOPI	Integral suppress switch, when STOPI=ON, stop integral action	TRUE	Operation Parameter	Refer to Operation Process
		SWDB	Enable switch, when SWD-B=ON, dead-band enable	TRUE	Operation Parameter	Related parameter: DB
		DB	Deadband band size	TRUE	Operation Parameter	Enable when SWDB=ON
		DBHYS	Deadband band hysteresis	TRUE	Operation Parameter	-
		GW	Non-linear gain range non-linear gain range	TRUE	Operation Parameter	Refer to Operation Process
		KN	Nonlinear gain coefficient[0,1.0]	TRUE	Operation Parameter	Refer to Operation Process
		NGN_-OPT	Non-linear gain selection switch, switch the relation between error and output change value to nonlinear. Used for control when proportional gain needs nonlinear change. OFF=Error square root function,	-	Configuration Parameter	Related parameters: GW, PB and KN When NGN_-OPT = ON; GW and PB when NGN_-OPT = OFF

Table 3.34 Parameter description and application of PID_TP Function Block (continued)

Name			Description	Upload	Properties	Application Reference
			ON=Gap action function			
		EA	Integral excise coefficient. when EI > EA, excise coefficient, when EI < EA, excising coefficient is disabled, used for prevent MV change from overlarge	TRUE	Operation Parameter	Related parameter: DK
		DK	Proportion modified value when integral excising	TRUE	Operation Parameter	Related parameter: EA
		OUT_-OPT	Control output type: OFF=position, ON=increment	-	Configuration Parameter	Associated parameter: MV
		PID_-OPT	PID type selection: 0=PID, 1=D_ PI, 2=PD_I	-	Configuration Parameter	Refer to Parameter Description-Note2, Note3, Note4
	Alarm	PVH-HIND	PVHH alarm indication	-	Monitoring Parameter	Refer to Integral Cutting
		PVHIND	PV H Limit alarm indication	-	Monitoring Parameter	Refer to Integral Cutting
		PVLIND	PV L limit alarm indication	-	Monitoring Parameter	Refer to Integral Cutting
		PVL-LIND	PV LL limit alarm indication	-	Monitoring Parameter	Refer to Integral Cutting
		MVHIND	MV H limit alarm indication	-	Monitoring Parameter	Refer to Integral Cutting
		MVLIND	MV L limit alarm indication	-	Monitoring Parameter	Refer to Integral Cutting
		SVHIND	SV H limit alarm indication	-	Monitoring Parameter	Refer to Integral Cutting
		SVLIND	SV L limit alarm indication	-	Monitoring Parameter	Refer to Integral Cutting
		PEIIND	Positive deviation alarm indication	-	Monitoring Parameter	Refer to Integral Cutting

Table 3.34 Parameter description and application of PID_TP Function Block (continued)

Name			Description	Upload	Properties	Application Reference
		NEIIND	Negative deviation alarm indication	-	Monitoring Parameter	Refer to Integral Cutting
		DMVHIND	MV positive rate limit indication	-	Monitoring Parameter	Refer to Integral Cutting
		DMVLIND	MV negative rate limit indication	-	Monitoring Parameter	Refer to Integral Cutting
		NMFIND	Valve position error negative alarm indication	-	Monitoring Parameter	Refer to Integral Cutting
		PMFIND	Valve position error positive alarm indication	-	Monitoring Parameter	Refer to Integral Cutting
	Compensation Settings	IK	Input compensation gain	TRUE	Operation Parameter	Refer to Input Process Related parameter: IA
		IB	Input compensation bias value	TRUE	Operation Parameter	Refer to Input Process Related parameter: IA
		OK	Output compensation gain	TRUE	Operation Parameter	Refer to Operation Process Related parameter: OA
		OB	Output compensation bias value	TRUE	Operation Parameter	Refer to Operation Process Related parameter: OA
	Fase/Slow/Increase/Decrease Settings	SMV	MV manual slow increase/decrease value (%)	TRUE	Operation Parameter	Set MV manual slow increase/decrease percentage in function block properties setting, $SMV \leq FMV$ Related parameter: MVSCH
		FMV	MV manual fast increase/decrease value (%)	TRUE	Operation Parameter	Set MV manual fast increase/decrease percentage in

Table 3.34 Parameter description and application of PID_TP Function Block (continued)

Name			Description	Upload	Properties	Application Reference
						function block properties settingRelated parameter: MVSCL
		SSV	SV slow increase/decrease value (%)	TRUE	Operation Parameter	Set SV manual slow increase/decrease percentage in function block properties setting-SSV≤FSV, Related parameter: SVSCH
		FSV	SV fast increase/decrease value (%)	TRUE	Operation Parameter	Set SV manual fast increase/decrease percentage in function block properties settingRelated parameter: SVSCL
	Extended Range Settings	HORLIM	Extended range maximum percentage	-	Configuration Parameter	Refer to Output Process
		LORLIM	Extended range minimum percentage	-	Configuration Parameter	Refer to Output Process
	SV Advance Settings	SWRAMP	SV ramp function switch. When changing set value, incline it to SV according to the set RAMP (s). OFF=SV ramp function off, ON=SV ramp function on	TRUE	Operation Parameter	Related parameter: RAMP.Enable when in automatic or cascade mode.
		RAMP	Ramp coefficient	TRUE	Operation Parameter	Related parameter: SWRAMP
		SVTR_OPT	Track PV switch enable/disable: OFF=not track, ON=track. If PV> SVH/ SVL,	-	Configuration Parameter	Refer to Set Variable Process

Table 3.34 Parameter description and application of PID_TP Function Block (continued)

Name			Description	Upload	Properties	Application Reference
			SV= range limit. Used to prevent the output MV from interference when changing the control mode.			
		SVRG_OPT	SV range convert option:0=no convert,1=convert by percent	-	Configuration Parameter	0 by default.
	Alarm Enable and Suppress	AOF	Suppress module alarm,, On=prohibit to display alarm	TRUE	Operation Parameter	Refer to Integral Cutting
		ENALM	Alarm enable	TRUE	Alarm Parameter	Refer to Integral Cutting
		FLAG	Flag	-	Output Pin	Refer to Integral Cutting
	OOS Settings	SWOOS	OOS mode setting switch (ON= OOS mode)	TRUE	Operation Parameter	Set as ON at the first time of function block downloading
		OOSVAL	OOS mode output value	TRUE	Operation Parameter	Related parameter: OOS_OPT=ON
		OOS_OPT	OOS mode output value type. when OOS_OPT =ON, MV=OOSVAL, when OOS_OPT =OFF, maintain the MV	-	Configuration Parameter	Refer to About

Note. Duty ratio output

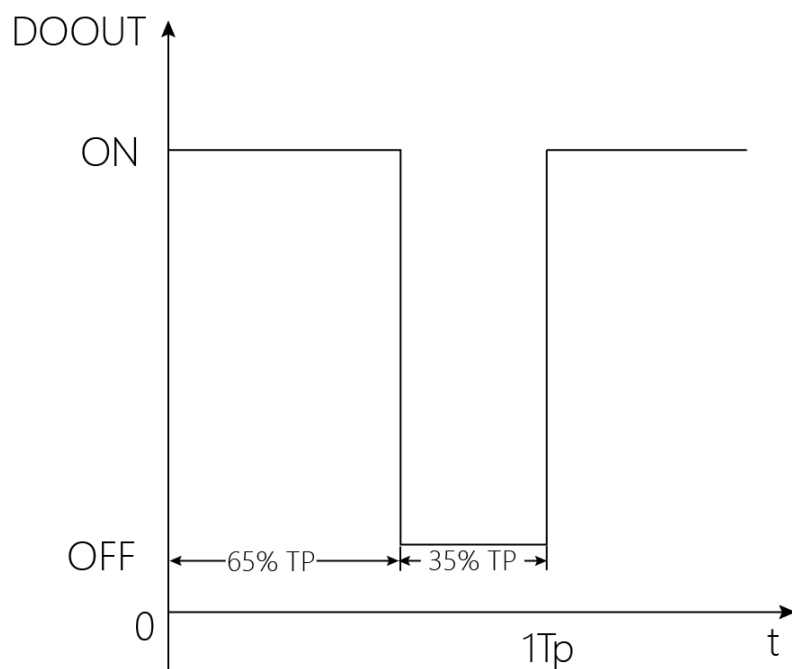
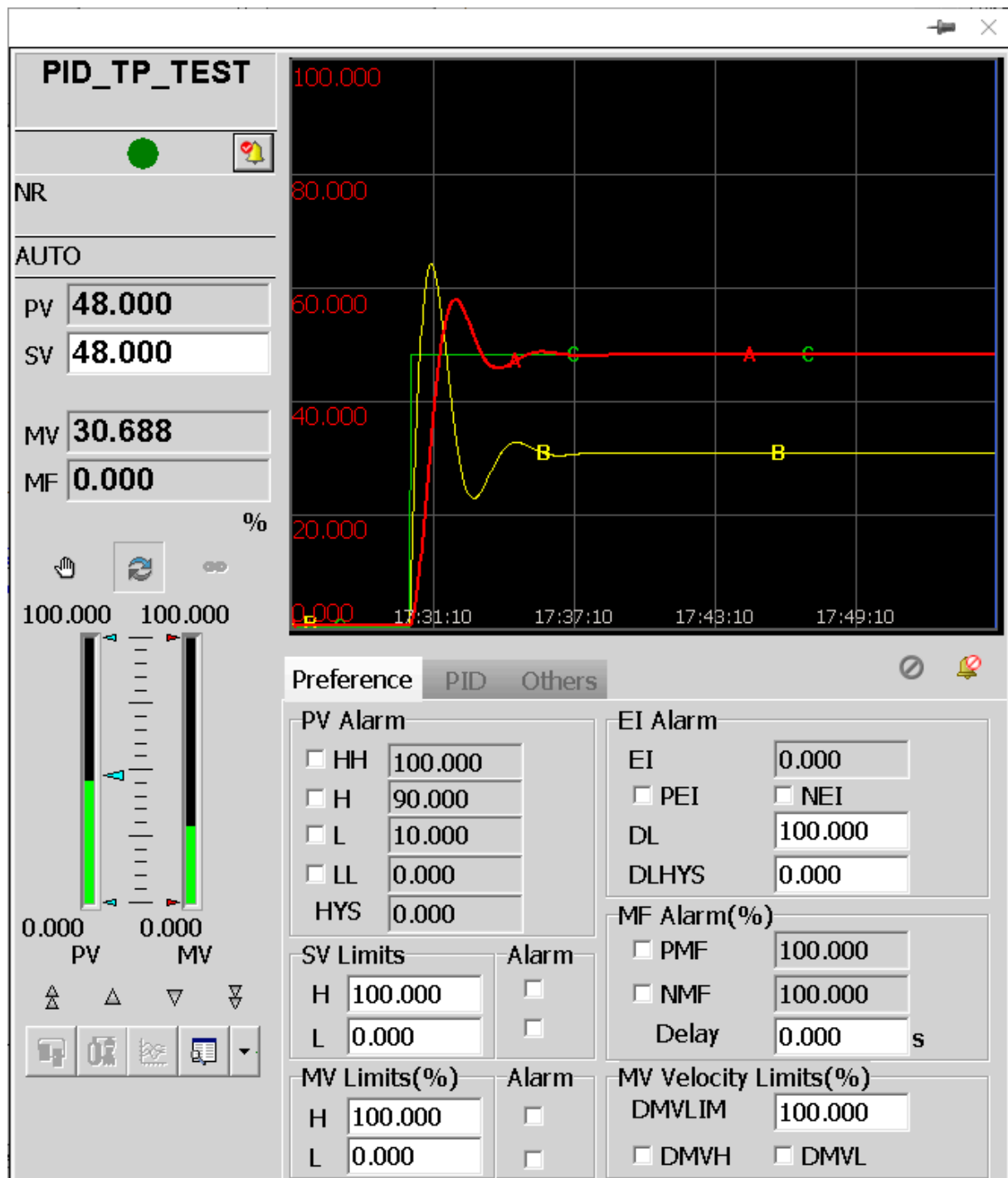


Figure 3.32 Duty Ratio Output Sketch Figure

Duty ratio is calculated from the percentage of current MV according to pulse period TP. For example, if $MV=65$, $MVSCH=100$, $MVSCL=0$, then $MV\%=65\%$. The ON time of DOOUT is $65\% \cdot TP$, while OFF time is $(1-65\%) \cdot TP$.

3.8.2 Panel Parameter



Preference PID Others

PID Parameter

PB 100.000 %

TI 20.000 s

TD 0.000 s

Non-linear Gain

☐ Gap Action

☒ Error Square

Range(GW) 0.000

KN 1.000

Direct/Reverse

☐ Direct

☒ Reverse

Scale Action

☒ Run

☐ Stop

Incomplete Diff Coef.

KD 10.000 s

Integral Separation

EA 0.000 Coefficient 0.000

Deadband

☐ Efficiency ☒ Invalid

DB 0.000

DBHYS 0.000

SV Ramp Action

☒ Invalid ☐ Efficiency

RAMP 100.000

Integral Action

☒ Run

☐ Stop

PID Action

☒ Run

☐ Bypass

Preference PID Others

Input Compensation

IA 0.000

IK 1.000

IB 0.000

Feedback Output Track

☐ Process Value ☒ Set Value

Set Value Track

☒ Track ☐ Untrack

Output Compensation(%)MAN_OPT

OA 0.000

OK 1.000

OB 0.000

SV_OPT

☒ Panel ☐ Program

☐ Panel ☒ Program

EI Alarm Filter

KSV 1.000

TSV 0.000 s

Output Pulse Cycle 10.000 s

Table 3.35 Operation Instruction for Panel Parameter

Panel Parameter Name			Function Block Parameter Name	Initial Value	Value Range	Application Instruction
Preference	PV Alarm (%)	HH	PVHH	100.000	[SVSCL,SVSCH]	HH alarm value setting of loop PV (select alarm enabled, or it is disabled).
		H	PVH	90.000	[SVSCL,SVSCH]	H alarm value setting of loop PV(se-

Table 3.35 Operation Instruction for Panel Parameter (continued)

Panel Parameter Name			Function Block Parameter Name	Initial Value	Value Range	Application Instruction
						lect alarm enabled, or it is disabled)
		L	PVL	10.000	[SVSCL,SVSCH]	L alarm value setting of loop PV(select alarm enabled, or it is disabled)
		LL	PVLL	0.000	[SVSCL,SVSCH]	LL alarm value setting of loop PV. (select alarm enabled, or it is disabled)
		Hysteresis	PVHYS	0.000	-	PV Process value alarm hysteresis
	SV Limits (%)	H	SVH	40.000	[SVSCL,SVSCH]	H value setting of loop SV (select alarm enabled, or it is disabled). Note: SV limit is not affected by selection.
		L	SVL	0.000	[SVSCL,SVSCH]	L value setting of loop SV (select alarm enabled, or it is disabled). Note: SV limit is not affected by selection.
	MV Limits (%)	H	MVH	100.000	[MVS-CL,MVSCH]	H value setting of loop MV (select alarm enabled, or it is disabled). Note: MV limit is not affected by selection.
		L	MVL	0.000	[MVS-CL,MVSCH]	L value setting of loop MV (select alarm enabled, or it is disabled). Note: MV limit is not affected by selection.
	EI Alarm (%)	Deviation (EI)	EI	0.000	-	Read-only. EI=PV - SV(select alarm enabled, or it is disabled).
		PEI (selected)	-	-	-	Selecting the positive deviation alarm is enabled.
		NEI (selected)	-	-	-	Selecting the negative deviation alarm is enabled.

Table 3.35 Operation Instruction for Panel Parameter (continued)

Panel Parameter Name			Function Block Parameter Name	Initial Value	Value Range	Application Instruction
		DL	DL	100.000	± (Range H-Range L)	Deviation alarm SV
		DLHYS	DLHYS	0.000	-	Deviation alarm hysteresis value
	MF Alarm (%)	PMF	PMFLIM	100.000	-	Selecting the positive deviation alarm is enabled.
		NMF	NMFLIM	100.000	-	Selecting the negative deviation alarm is enabled.
		Delay (s)	TMFHYS	0.000	-	Lag time SV
	MV Velocity Limits (%)	DMVH (selected)	-	-	-	Selecting positive velocity alarm is enabled.
		DMVL (selected)	-	-	-	Selecting negative velocity alarm is enabled.
		DMVLIM	DMVLIM	100.000	-	Loop MV velocity limit SV
PID	PID Coefficient	PB(%)	PB	100.000	Not less than 0	Loop proportional parameter SV
		TI(s)	TI	20.000	Not less than 0	Loop integral time parameter SV
		TD(s)	TD	0.000	Not less than 0	Loop differential time parameter SV
	Incomplete Differential coefficient	KD(s)	KD	10.000	Not less than 0	Incomplete integral filter coefficient
	Deadband (%)	Efficiency (selected)	SWDB	-	-	Selecting deadband parameter is enabled.
		Invalid (selected)	SWDB	√	-	Selecting deadband parameter is disabled.
		DB	DB	0.000	-	Deadband band size
		DBHYS	DBHYS	0.000	[0,DB]	Deadband band hysteresis

Table 3.35 Operation Instruction for Panel Parameter (continued)

Panel Parameter Name			Function Block Parameter Name	Initial Value	Value Range	Application Instruction
	Non-linear Gain (%)	Gap Action (selected)	NGN_OPT	-	-	Read-only, non-linear gain selection switchON= Gap Action
		Error Square (selected)	NGN_OPT	√	-	Read-only, non-linear gain selection switchOFF=Square Root Action
		Range (GW)	GW	0.000	[0,1.0]	Nonlinear gain action range
		KN	KN	1.000	-	Nonlinear gain coefficient
	Integral Separation (%)	EA	EA	0.000	-	Range parameter SV
		Coefficient	DK	0.000	-	Coefficient parameter SV
	SV Ramp Action (%)	Efficiency (selected)	SWRAMP	-	-	Selecting SV ramp is enabled.
		Invalid (selected)	SWRAMP	√	-	Selecting SV ramp is disabled.
		RAMP	RAMP	100.000	-	Coefficient parameter SV
	Direct/Reverse	Direct (selected)	SWPN	-	-	Selecting direct action is enabled.
		Reverse (selected)	SWPN	√	-	Selecting reverse action is enabled.
	Scale Action	Run (selected)	STOPP	√	-	Selecting proportional action is enabled.
		Stop	STOPP	-	-	Selecting proportional action is disabled.
	Integral Action	Run	STOPI	√	-	Selecting integral action is enabled.
		Stop	STOPI	-	-	Selecting integral action is disabled.

Table 3.35 Operation Instruction for Panel Parameter (continued)

Panel Parameter Name			Function Block Parameter Name	Initial Value	Value Range	Application Instruction
	PID Operation	Run	BYPASS	√	-	The modification of function block panel is enabled for function block properties interface when debugging.
		Bypass	BYPASS	-	-	The modification of function block panel is disabled for function block properties interface when debugging.
Others	Input Compensation (%)	IA	IA	0.000	-	Read-only, can be set in configuration or program
		IK	IK	1.000	-	Input compensation gain
		IB	IB	0.000	-	Input compensation bias value
	Output Compensation (%)	OA	OA	0.000	-	Read-only, can be set in configuration or program
		OK	OK	1.000	-	Output compensation gain
		DB	DB	0.000	-	Output compensation bias value
	Set EI Alarm Filter	KSV	KSV	1.000	0~100	Deviation filter coefficient
		TSV (s)	TSV	0.000	0~1000s	Deviation filter time constant(s)
	Feedback Output Track	Process Value	BK_OPT	-	-	Read-only, can be set in configuration or program
		Set Value	BK_OPT	√	-	Read-only, can be set in configuration or program
	Set Value Track	Track	SVTR_OPT	√	-	Read-only, can be set in configuration or program
		Untrack	SVTR_OPT	-	-	Read-only, can be set in configuration or program

Table 3.35 Operation Instruction for Panel Parameter (continued)

Panel Parameter Name			Function Block Parameter Name	Initial Value	Value Range	Application Instruction
	Man Auto Cntrl Src	Panel	MAN_OPT	√	-	Read-only, can be set in configuration or program
		Program	MAN_OPT	-	-	Read-only, can be set in configuration or program
	Cas-cade Cntrl Src	Panel	SV_OPT	-	-	Read-only, can be set in configuration or program
		Program	SV_OPT	√	-	Read-only, can be set in configuration or program
	Output (s)	Output (s)	TP	10.000	-	Read-only

3.8.3 Flag

Table 3.36 Flag List

Flag	Alarm	Instruction
D0	OOS	Disable
D1	IMAN	Initialize Manually
D2	MAN	Manual
D4	AUTO	Auto
D5	CAS	Cascade
D8	PVHH	PV HH Limit Alarm
D9	PVLL	PV LL Limit Alarm
D10	PVH	PV H Limit Alarm
D11	PVL	PV L Limit Alarm
D12	SVH	SV H Limit Alarm
D13	SVL	SV L Limit Alarm
D14	MVH	Output H Limit Alarm
D15	MVL	Output L Limit Alarm
D16	PEI	Positive Deviation Alarm

Table 3.36 Flag List (continued)

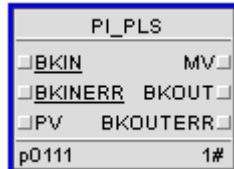
Flag	Alarm	Instruction
D17	NEI	Negative Deviation Alarm
D18	REVSCL	Span H/L Limit Reverse or output value float abnormal
D19	CFGERR	Configuration Error
D22	DMVH	MV Positive Rate Limit Alarm
D23	DMVL	MV Negative Rate Limit Alarm
D25	AOF	Suppress Alarm
D27	NMF	Valve Negative Deviation Alarm
D28	PMF	Valve Positive Deviation Alarm

3.9 Pulse PI Control Function Block (PI_PLS)

Pulse PI control function block adopts the "Control-Maintain-Control" mode, which is mainly used to fields with long deadband or control fields according to sampling data of analyzer unit.

It is a complex function block and its running time is 120μs.

Please refer to the Overview and Control Function Block Library before using the function block.



3.9.1 Parameter Description

Table 3.37 Parameter instruction and application of PID_PLS Function Block

Name			Description	Upload	Properties	Application Reference
Basic Parameters	Range Settings	MVSCH	MV high scale	-	Configuration Parameter	The same as MV actual value H limit.
		MVSCL	MV low scale	-	Configuration Parameter	The same as MV actual value L limit.
		SVSCH	SV high scale	-	Configuration Parameter	The same as PV actual value H limit.

Table 3.37 Parameter instruction and application of PID_PLS Function Block (continued)

Name			Description	Upload	Properties	Application Reference
		SVSCL	SV low scale	-	Configuration Parameter	The same as PV actual value L limit.
		SVEU	SV engineer unit	-	Configuration Parameter	Set in the function block properties settings interface.
		MVEU	MV engineer unit	-	Configuration Parameter	Set in the function block properties settings interface.
		SVDLEN	SV decimal digits [0,5]	-	Configuration Parameter	Used for data displayed on function block panel (equal to 3 as default).
		MVDLEN	MV decimal digits [0,5]	-	Configuration Parameter	Used for data displayed on function block panel (equal to 3 as default).
	Limits	MVH	MV H limit value	TRUE	Operation Parameter	Value range [MVS-CL,MVSCH]
		MVL	MV L limit value	TRUE	Operation Parameter	Value range [MVS-CL,MVSCH]
		SVH	SV H limit value	TRUE	Operation Parameter	Value range [SVS-CL,SVSCH]
		SVL	SV L limit value	TRUE	Operation Parameter	Value range [SVS-CL,SVSCH]
		DMVLIM	MV output rate variety limit value. Used to prevent the MV from over-large modification in a short time.	TRUE	Operation Parameter	Refer to Integral Cutting
	Direct/Reverse Switch Settings	SWPN	Direct/Reverse switch. SV is not changed, the MV increases with the increasing of PV in direct action, and decreases with the increasing	TRUE	Operation Parameter	OFF=Direct action, ON=Reverse action

Table 3.37 Parameter instruction and application of PID_PLS Function Block (continued)

Name			Description	Upload	Properties	Application Reference
Extended Parameters	Base Input Pin Settings		of PV in reverse action.			
		BKIN	Feedback input	-	Input Pin	Connect to BKOUT of downstream block
		BKINERR	Feedback status input	-	Input Pin	Connect to BKOUT of downstream block ERR
		PV	Process value of loop closed control process	-	Input Pin	Connect to measuring point AI
		CSV	Cascade	-	Input Pin	Connect to outer loop control value MV
		TV	Track input value (In track mode, MV=TV)	-	Input Pin	Connect to measuring point AIRelated parameter: SWTR
		SWTR	Track switch: OFF=not track, ON=track	-	Input Pin	Upstream interlock condition input,Related parameter: TV
		OA	Output compensation, used for feedforward control	-	Input Pin	Connect to measuring point AI (feed-forward signal),Related parameter: OK, OB
	Advance Input Pin Settings	CSW	Redundancy is required in the case of control period TP used to control sampling PI and TP is less than 0.	-	Input Pin	Connect the upstream output.Note: when up jumping occurs to CSW, if it is in external startup mode, control and count the TC time, after TC time, set CSW as OFF, and the output will be maintained.

Table 3.37 Parameter instruction and application of PID_PLS Function Block (continued)

Name		Description	Upload	Properties	Application Reference
	MF	PID executor feedback value , used for monitoring	-	Input Pin	Connect to measuring point AI
	IA	Input compensation value, used to improve the controllability of process with long deadband time	-	Input Pin	Connect to measuring point AI, Refer to Input ProcessRelated parameter: IK, IB
	PSWAM	Program manual and auto control switch, OFF=program manual control, ON=program auto control	-	Input Pin	Connect to upstream outputEnabled when MAN _ OPT=ON
	PSWSV	Program auto/cascade control switch, OFF= SV, ON=CSV	-	Input Pin	Connect the upstream outputenabled when SV_OPT=ON
	MAN _ OPT	Manual-automatic control source switch, ON= manual-automatic selection controlled by PSWAM, OFF= manual-automatic selection controlled by SWAM	-	Input Pin	Connect the upstream outputRelated parameter: PSWAM, SWAM
	SV_OPT	Auto/Cascade control source selection, ON= auto/cascade selection controlled by PSWSV, OFF= auto/cascade selection controlled by SWSV	-	Input Pin	Connect the upstream outputRelated parameter: PSWSV, SWSV
	SWINC	MV lock increase (MV cannot Increase), ON= lock increase	-	Input Pin	Connect the upstream output. enabled when function block is automatic or cascade
	RRL	Anti-integral windup input,	-	Input Pin	Connect to measuring point AI, Re-

Table 3.37 Parameter instruction and application of PID_PLS Function Block (continued)

Name			Description	Upload	Properties	Application Reference
			used for control overshoot			lated parameter: BKIN;Refer to Operation Process Integral Limits Action
		SWDEC	MV lock decrease (MV cannot decrease), ON= Lock decrease	-	Input Pin	Connect the upstream output. enabled when function block is automatic or cascade
		HOLD	MV holds the current output value, ON= hold the current output value	-	Input Pin	Connect to upstream output,
	Output Pin	MV	PID operation output value	-	Output Pin	Connect to electric manual instrument.If there's a float abnormal happened to the MV value, the MV will be set as the value of previous period or the lower limit. Please refer to Application Illustration for details.
		BKOUT	Feedback output value	-	Output Pin	Connect to the BKIN of Upstream Block, Related parameter: BK_OPT
		BKOUTERR	Feedback status value	-	Output Pin	Connect to the BKINERR of Upstream Block
		BK_OPT	BKOUT value switch (ON=track PV, OFF=track SV)	-	Configuration Parameter	Related parameter: BKOUT
	PID Param Settings	PB	Proportion band size	TRUE	Operation Parameter	Refer to PID Parameter Tune

Table 3.37 Parameter instruction and application of PID_PLS Function Block (continued)

Name			Description	Upload	Properties	Application Reference
		TI	Integral time (s)	TRUE	Operation Parameter	Refer to PID Parameter Tune
		TC	Control Time(s)	TRUE	Operation Parameter	Refer to ^{Note1}
		TP	Control Cycle(s)	TRUE	Operation Parameter	Refer to ^{Note1}
	Operator Command	MODE	Work mode	-	Monitoring Parameter	Refer to Transition Process of Function Block Modes
		IMODE	Standby work mode	-	Monitoring Parameter	Refer to Transition Process of Function Block Modes
		MODE_-OPT	ON=auto return, OFF>manual return (default)	-	Configuration Parameter	Refer To Transition Process of Function Block Modes
		SWAM	Manual and auto switch: OFF>manual, ON=auto	-	Operation Parameter	Enabled when MAN_OPT=OFF
		SWSV	Auto/ cascade selection: OFF=auto, ON=cascade	-	Operation Parameter	Enabled when SV_OPT=OFF
		SWMMV	Whether to equal to preset MV value when switch to manual status	TRUE	Operation Parameter	Related parameter: MMV
		MMV	Preset MV value (switch to manual)	TRUE	Operation Parameter	Enabled when SWMMV=ON
		CSWI	CSWI control input	TRUE	Operation Parameter	When up-jump occurs to CSWI, CSW=ON.
		SWPMV	Whether to equal to preset MV value when switch to auto status. PMV enable switch. When SWP-MV=ON, MV = PMV, MV velocity alarm, lock in-	TRUE	Operation Parameter	Related parameter: PMV

Table 3.37 Parameter instruction and application of PID_PLS Function Block (continued)

Name			Description	Upload	Properties	Application Reference
			crease/decrease are disabled			
		PMV	Preset MV when switching from OOS/IMAN/TR/MAN modes to AUTO or CAS mode	TRUE	Operation Parameter	Enabled when SWPMV=ON
	Operator Data	SV	SV	TRUE	Operation parameter	Refer to Set Variable Process
		MANMV	Manual output value	-	Operation parameter	Output value= MANMV in manual mode
		EI	Error	-	Monitoring parameter	Refer to Operation Process
	Input Alarm Settings	PVHH	PV HH limit alarm value	TRUE	Operation Parameter	Refer to Input Process
		PVH	PV H limit alarm value	TRUE	Operation Parameter	Refer to Input Process
		PVL	PV L limit alarm value	TRUE	Operation Parameter	Refer to Input Process
		PVLL	PV LL limit alarm value	TRUE	Operation Parameter	Refer to Input Process
		PVHYS	Process value alarm hysteresis	TRUE	Operation Parameter	Refer to Input Process
		DL	Deviation alarm set value	TRUE	Operation Parameter	Refer to Operation Process
		DLHYS	Deviation alarm hysteresis value	TRUE	Operation Parameter	Refer to Operation Process
		KSV	Deviation filter coefficient	TRUE	Operation Parameter	Refer to Operation Process
		TSV	Deviation filter time constant(s)	TRUE	Operation Parameter	Refer to Operation Process
		NMFLIM	Valve position negative error thresholds	TRUE	Operation Parameter	Refer to Integral Cutting
		PMFLIM	Valve position positive error thresholds	TRUE	Operation Parameter	Refer to Integral Cutting

Table 3.37 Parameter instruction and application of PID_PLS Function Block (continued)

Name			Description	Upload	Properties	Application Reference
	Advance Calculation Settings	TMFHYS	Valve position error alarm hysteresis time	TRUE	Operation Parameter	Refer to Integral Cutting
		BYPASS	Bypass PID operation, when BY-PASS=ON, excise PID calculation, switch SV to MV directly for output	TRUE	Operation Parameter	When cascade adjusting, used to excise inner loop when it fails Refer to Operation Process
		STOPP	Proportion suppress switch, when STOP-P=ON, stop integral action	TRUE	Operation Parameter	Refer to Operation Process
		STOPI	Integral suppress switch, when STOPI=ON, stop integral action	TRUE	Operation Parameter	Refer to Operation Process
		SWDB	Enable switch, when SWDB=ON, deadband enable	TRUE	Operation Parameter	Related parameter: DB
		DB	Deadband band size	TRUE	Operation Parameter	Enable when SWDB=ON
		DBHYS	Deadband band hysteresis	TRUE	Operation Parameter	Refer to Operation Process
		GW	Non-linear gain range non-linear gain range	TRUE	Operation Parameter	Refer to Operation Process
		KN	Nonlinear gain coefficient[0,1.0]	TRUE	Operation Parameter	Refer to Operation Process
		NGN_-OPT	Non-linear gain selection switch, switch the relation between error and output change value to nonlinear. Used for control when proportional gain needs nonlinear change. OFF=Error square root function, ON=Gap action function	-	Configuration Parameter	Related parameters: GW, PB and KN When NGN_-OPT = ON; GW and PB when NGN_-OPT = OFF

Table 3.37 Parameter instruction and application of PID_PLS Function Block (continued)

Name			Description	Upload	Properties	Application Reference
	Alarm	OUT_OPT	Output type selection switch. When OUT_OPT = OFF, output position type MV; OUT_OPT	-	Configuration Parameter	Related parameter: MV
		PVHHIND	PVHH alarm indication	-	Monitoring Parameter	Refer to Integral Cutting
		PVHIND	PV H Limit alarm indication	-	Monitoring Parameter	Refer to Operation Process
		PVLIND	PV L limit alarm indication	-	Monitoring Parameter	Refer to Operation Process
		PVLLIND	PV LL limit alarm indication	-	Monitoring Parameter	Refer to Operation Process
		MVHIND	MV H limit alarm indication	-	Monitoring Parameter	Refer to Operation Process
		MVLIND	MV L limit alarm indication	-	Monitoring Parameter	Refer to Operation Process
		SVHIND	SV H limit alarm indication	-	Monitoring Parameter	Refer to Operation Process
		SVLIND	SV L limit alarm indication	-	Monitoring Parameter	Refer to Operation Process
		PEIIND	Positive deviation alarm indication	-	Monitoring Parameter	Refer to Operation Process
		NEIIND	Negative deviation alarm indication	-	Monitoring Parameter	Refer to Operation Process
		DMVHIND	MV positive rate limit indication	-	Monitoring Parameter	Refer to Operation Process
		DMVLIND	MV negative rate limit indication	-	Monitoring Parameter	Refer to Operation Process
		NMFIND	Valve position error negative alarm indication	-	Monitoring Parameter	Refer to Operation Process
		PMFIND	Valve position error positive alarm indication	-	Monitoring Parameter	Refer to Operation Process
	Compensation Settings	IK	Input compensation gain	TRUE	Operation Parameter	Refer to Input Process Related parameter: IA

Table 3.37 Parameter instruction and application of PID_PLS Function Block (continued)

Name			Description	Upload	Properties	Application Reference
		IB	Input compensa- tion bias value	TRUE	Operation Parameter	Refer to Input Process Relat- ed parameter: IA
		OK	Output compensa- tion gain	TRUE	Operation Parameter	Refer to Oper- ation Process Related para- meter: OA
		OB	Output compensa- tion bias value	TRUE	Operation Parameter	Refer to Oper- ation Process Related para- meter: OA
	Fase/ Slow/In- crease/De- crease Settings	SMV	MV manual slow increase/decrease value (%)	TRUE	Operation Parameter	Set MV man- ual slow in- crease/de- crease per- centage in function block proper- ties setting, SMV≤FMVRe- lated param- eter: MVSCH
		FMV	MV manual fast increase/decrease value (%)	TRUE	Operation Parameter	Set MV man- ual fast in- crease/de- crease per- centage in function block properties set- tingRelated parameter: MVSCL
		SSV	SV slow in- crease/decrease value (%)	TRUE	Operation Parameter	Set SV man- ual slow in- crease/de- crease per- centage in function block properties set- tingSSV≤FSV, Related para- meter: SVSCH
		FSV	SV fast in- crease/decrease value (%)	TRUE	Operation Parameter	Set SV man- ual fast in- crease/de- crease per- centage in function block properties set- tingRelated

Table 3.37 Parameter instruction and application of PID_PLS Function Block (continued)

Name			Description	Upload	Properties	Application Reference
	Ex- tended Range Settings					parameter: SVSCL
		HORLIM	Extended range maximum percentage	-	Configura- tion Parame- ter	Refer to Out- put Process
		LORLIM	Extended range minimum percentage	-	Configura- tion Parame- ter	Refer to Out- put Process
	SV Ad- vance Settings	SWRAMP	SV ramp func- tion switch. When changing set val- ue, incline it to SV according to the set RAMP (s). OF- F=SV ramp func- tion off, ON=SV ramp function on	TRUE	Operation Parameter	Related para- meter: RAMP. Enable when in automat- ic or cascade mode.
		RAMP	Ramp coefficient	TRUE	Operation Parameter	Related pa- rameter: SWRAMP
		SVTR_ OPT	Track PV switch enable/disable: OFF=not track, ON=track. If PV> SVH/ SVL, SV= range limit. Used to prevent the out- put MV from in- terference when changing the con- trol mode.	-	Configura- tion Parame- ter	Refer to Set Variable Process
		SVRG_ OPT	SV range convert option:0=no con- vert,1=convert by percent	-	Configura- tion Parame- ter	0 by default.
	Alarm Enabled and Sup- press	AOF	Suppress module alarm, On=prohibit to display alarm.	TRUE	Operation Parameter	Refer to Inte- gral Cutting
		ENALM	Alarm enable	TRUE	Alarm Para- meter	Refer to Inte- gral Cutting
		FLAG	Flag	-	Output Pin	Refer to Inte- gral Cutting
	OOS Settings	SWOOS	OOS mode setting switch (ON= OOS mode)	TRUE	Operation Parameter	Set as ON at the first time of function block downloading

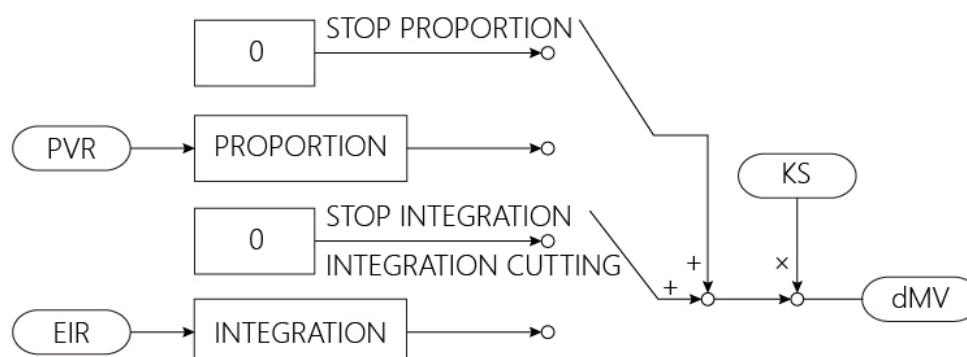
Table 3.37 Parameter instruction and application of PID_PLS Function Block (continued)

Name			Description	Upload	Properties	Application Reference
		OOSVAL	OOS mode output value	TRUE	Operation Parameter	Related parameter: OOS_OPT=ON
		OOS_-OPT	OOS mode output value type. when OOS_OPT=ON, MV=OOSVAL, when OOS_OPT=OFF, maintain the MV	-	Configuration Parameter	Refer to OOS

PI_PLS function block's working mode and corresponding parameters in each mode are shown in Table 3.1.

Note1

Other instruction refer to Control Function Block Library except followings.

**Figure 3.33 Algorithm of pulse PI control function block**

PI calculation with hold function is control algorithm of pulse PI controller function block, by which PI control calculation is implemented to get output value MV and output change value dMV. In the mode of auto run (AUT, CAS), PI control with hold function will be implemented only in the control time TC of each pulse time TP. Output value will be maintained in the left time (TP-TC).

Control time and sampling period (TS) must be set according to principles as follows:

Pulse period: $TP = \text{Deadband time of control objects} + \text{lag time constant} * (\text{from 2 to 3})$ of control objects

Control time: $TC = TP/10$

The unit of time is second.

Pulse period value is the time of process variable PV reaching stable after the output value acting on the whole process. The shortest period of the main bump which influences the process is T_n .

If T_n is shorter than sampling period, it is not available. Sampling period longer than T_n can be tuned according to the following expression:

$TP \leq Tn/5$

Sampling action:

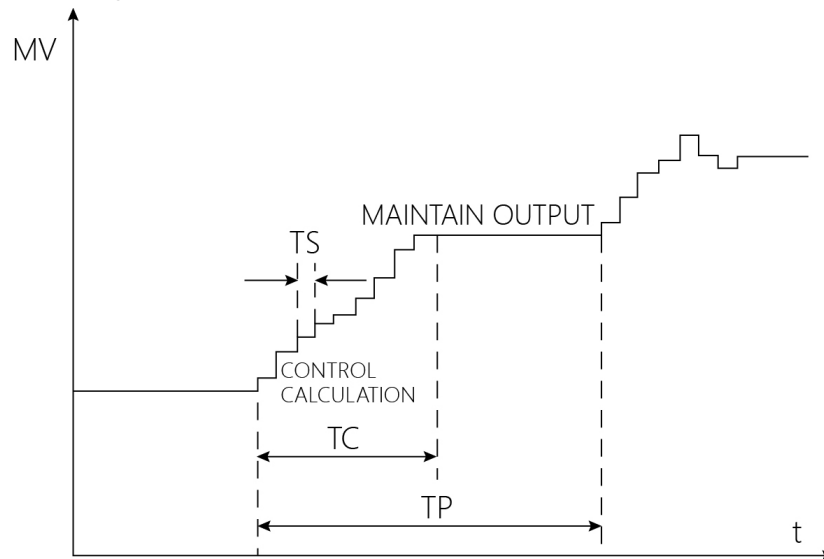


Figure 3.34 Principle figure of Pulse PI control

Pulse PI control calculation expression (P_I control)

$$\Delta MV = K_p * K_s * \left(\Delta PV_n + \frac{\Delta T}{TI} E_n \right)$$

$$EI_n = PV_n - SV_n$$

$$K_p = \frac{100}{PB}$$

$$K_s = \frac{MVSCH - MVSCL}{SVSCH - SVSCL}$$

KP is proportional coefficient and KS is range transition coefficient.

When TP is set 0, pulse PI control can be started from outside. PI control started from outside is achieved when the control switch (CSW) is set ON by other function blocks. Once PI control is started, PI control will run in the control time (TC). The control switch will be set OFF after TC. If the control switch is set OFF forcibly by outside function blocks, output values must be maintained, shown as follows.

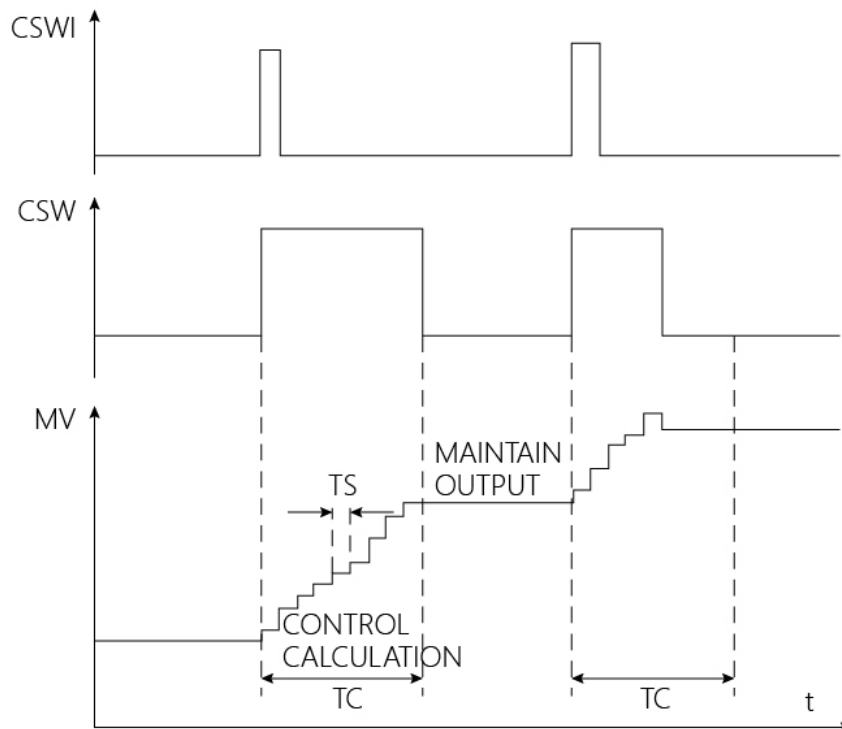


Figure 3.35 Principle figure of pulse PI control started from outside

3.9.2 Application Illustration

The float abnormal of output values means that the output values are not float format, or a meaningless output value is produced in a calculation that performs a divide-by-zero operation. When float abnormal happened, the function block's output values shall conform to the following rules:

- If there's the normal value of previous period, MV outputs the value of previous period.
- If there's the abnormal value of previous period or no previous period value, MV outputs the lower range limit.

3.9.3 Panel Parameter



The figure displays two screenshots of the PI_PLS Function Block Panel Parameter Graph. The top screenshot shows the 'PID' tab, and the bottom screenshot shows the 'Others' tab.

PID Tab Parameters:

- PID Parameter:** PB 100.000 %, TI 20.000 s
- Sampling Time:** TC 1.000 s, TP 1.000 s
- Deadband:** ☐ Enable, ☒ Disable, DB 0.000, DBHYS 0.000
- Non-linear Gain:** ☐ Gap Action, ☒ Square Root, GW 0.000, KN 1.000
- Control Direction:** ☐ Direct, ☒ Reverse
- Proportional Action:** ☒ Run, ☐ Stop
- Integral Action:** ☒ Run, ☐ Stop
- PID Action:** ☒ Run, ☐ Bypass
- SV Ramp Action:** ☒ Disable, ☐ Enable, RAMP 100.000

Others Tab Parameters:

- Input Compensation:** IA 0.000, IK 1.000, IB 0.000
- Feedback Output Track:** ☐ PV, ☒ SV
- SV Track:** ☒ Track, ☐ Not Track
- Output Compensation(%):** OA 0.000, OK 1.000, OB 0.000
- MAN_OPT:** ☒ Panel, ☐ Program
- SV_OPT:** ☐ Panel, ☒ Program
- EI Alarm Filter:** KSV 1.000, TSV 0.000 s
- TR:** 0.000 %

Figure 3.36 PI_PLS Function Block Panel Parameter Graph

Table 3.38 Operation Instruction for Panel Parameter

Panel Parameter Name			Function Block Parameter Name	Initial Value	Value Range	Application Instruction
Preference	PV Alarm (%)	HH	PVHH	100.000	[SVSCL,SVSCH]	HH alarm value setting of loop PV (select alarm en-

Table 3.38 Operation Instruction for Panel Parameter (continued)

Panel Parameter Name			Function Block Parameter Name	Initial Value	Value Range	Application Instruction
						abled, or it is disabled).
		H	PVH	90.000	[SVSCL,SVSCH]	H alarm value setting of loop PV(select alarm enabled, or it is disabled)
		L	PVL	10.000	[SVSCL,SVSCH]	L alarm value setting of loop PV(select alarm enabled, or it is disabled)
		LL	PVLL	0.000	[SVSCL,SVSCH]	LL alarm value setting of loop PV. (select alarm enabled, or it is disabled)
		HYS	PVHYS	0.000	-	PV Process value alarm hysteresis
		H	SVH	40.000	[SVSCL,SVSCH]	H value setting of loop SV (select alarm enabled, or it is disabled). Note: SV limit is not affected by selection.
		L	SVL	0.000	[SVSCL,SVSCH]	L value setting of loop SV (select alarm enabled, or it is disabled). Note: SV limit is not affected by selection.
	SV Limits (%)					
	MV Limits (%)	H	MVH	100.000	[MVS-CL,MVSCH]	H value setting of loop MV (select alarm enabled, or it is disabled). Note: MV limit is not affected by selection.
		L	MVL	0.000	[MVS-CL,MVSCH]	L value setting of loop MV (select alarm enabled, or it is disabled). Note: MV limit is not affected by selection.
	EI Alarm (%)	EI	EI	0.000	-	Read-only. EI=PV - SV(select alarm enabled, or it is disabled).

Table 3.38 Operation Instruction for Panel Parameter (continued)

Panel Parameter Name			Function Block Parameter Name	Initial Value	Value Range	Application Instruction
		PEI (selected)	-	-	-	Selecting the positive deviation alarm is enabled.
		NEI (selected)	-	-	-	Selecting the negative deviation alarm is enabled.
		DL	DL	100.000	± (Range H-Range L)	Deviation alarm SV
		DL-HYS	DLHYS	0.000	-	Deviation alarm hysteresis value
	MF Alarm (%)	PMF	PMFLIM	100.000	-	Selecting the positive deviation alarm is enabled.
		NMF	NMFLIM	100.000	-	Selecting the negative deviation alarm is enabled.
		TMFHYS	TMFHYS	0.000	-	Lag time SV
	MV Velocity Limits (%)	DMVH (selected)	-	-	-	Selecting positive velocity alarm is enabled.
		DMVL (selected)	-	-	-	Selecting negative velocity alarm is enabled.
		DMVLIM	DMVLIM	100.000	-	Loop MV velocity limit SV
PID	PID Parameter	PB(%)	PB	100.000	Not less than 0	Loop proportional parameter SV
		TI (s)	TI	20.000	Not less than 0	Loop integral time parameter SV
	Sampling Time	TC (s)	TC	1.000	Not less than 0	Control time
		TP (s)	TP	1.000	Not less than 0	Control period
	Deadband (%)	Enable (selected)	SWDB	-	-	Selecting dead-band parameter is enabled.
		Disable (selected)	SWDB	√	-	Selecting dead-band parameter is disabled.

Table 3.38 Operation Instruction for Panel Parameter (continued)

Panel Parameter Name			Function Block Parameter Name	Initial Value	Value Range	Application Instruction
		DB	DB	0.000	-	Deadband band size
		DB-HYS	DBHYS	0.000	[0,DB]	Deadband band hysteresis
	Non-linear Gain (%)	Gap Action (selected)	NGN_OPT	-	-	Read-only, non-linear gain selection switch ON= Gap Action
		Square Root (selected)	NGN_OPT	√	-	Read-only, non-linear gain selection switch OFF=Square Root Action
		GW	GW	0.000	[0,1.0]	Nonlinear gain action range
		KN	KN	1.000	-	Nonlinear gain coefficient
	SV Ramp Action (%)	Enable (selected)	SWRAMP	-	-	Selecting SV ramp is enabled.
		Disable (selected)	SWRAMP	√	-	Selecting SV ramp is disabled.
		RAMP	RAMP	100.000	-	Coefficient parameter SV
	Control Direction	Direct (selected)	SWPN	-	-	Selecting direct action is enabled.
		Reverse (selected)	SWPN	√	-	Selecting reverse action is enabled.
	Proportional Action	Run (selected)	STOPP	√	-	Selecting proportional action is enabled.
		Stop	STOPP	-	-	Selecting proportional action is disabled.
	Integral Action	Run	STOPI	√	-	Selecting integral action is enabled.

Table 3.38 Operation Instruction for Panel Parameter (continued)

Panel Parameter Name			Function Block Parameter Name	Initial Value	Value Range	Application Instruction
	PID	Stop	STOPI	-	-	Selecting integral action is disabled.
		Run	BYPASS	√	-	The modification of function block panel is enabled for function block properties interface when debugging.
		By-pass	BYPASS	-	-	The modification of function block panel is disabled for function block properties interface when debugging.
Others	Input Compensation (%)	IA	IA	0.000	-	Read-only, can be set in configuration or program
		IK	IK	1.000	-	Input compensation gain
		IB	IB	0.000	-	Input compensation bias value
	Output Compensation (%)	OA	OA	0.000	-	Read-only, can be set in configuration or program
		OK	OK	1.000	-	Output compensation gain
		DB	DB	0.000	-	Output compensation bias value
	Bias Alarm Filter Settings	KSV	KSV	1.000	0~100	Deviation filter coefficient
		TSV (s)	TSV (s)	0.000	0~1000s	Deviation filter time constant(s)
	Feedback Output Track	PV	BK_OPT	-	-	Read-only, can be set in configuration or program
		SV	BK_OPT	√	-	Read-only, can be set in configuration or program
	SV Track	Track	SVTR_OPT	√	-	Read-only, can be set in configuration or program

Table 3.38 Operation Instruction for Panel Parameter (continued)

Panel Parameter Name			Function Block Parameter Name	Initial Value	Value Range	Application Instruction
		Not Track	SVTR_OPT	-	-	Read-only, can be set in configuration or program
	MAN_-OPT Settings	Panel	MAN_OPT	√	-	Read-only, can be set in configuration or program
		Program	MAN_OPT	-	-	Read-only, can be set in configuration or program
	SV_OPT Settings	Panel	SV_OPT	-	-	Read-only, can be set in configuration or program
		Program	SV_OPT	√	-	Read-only, can be set in configuration or program
	TV (%)	TV (%)	TV (%)	0.000	-	Read-only, track input value(%)

3.9.4 Flag

Table 3.39 Flag List

Flag	Alarm	Description
D0	OOS	Disable
D1	IMAN	Initialize Manually
D2	MAN	Manual
D3	TR	Track
D4	AUTO	Auto
D5	CAS	Cascade
D8	PVHH	PV HH Limit Alarm
D9	PVLL	PV LL Limit Alarm
D10	PVH	PV H Limit Alarm
D11	PVL	PV L Limit Alarm
D12	SVH	SV H Limit Alarm
D13	SVL	SV L Limit Alarm

Table 3.39 Flag List (continued)

Flag	Alarm	Description
D14	MVH	Output H Limit Alarm
D15	MVL	Output L Limit Alarm
D16	PEI	Positive Deviation Alarm
D17	NEI	Negative Deviation Alarm
D18	REVSCL	Span H/L Limit Reverse or output value float abnormal
D19	CFGERR	Configuration Error
D22	DMVH	MV Positive Rate Limit Alarm
D23	DMVL	MV Negative Rate Limit Alarm
D25	AOF	Suppress Alarm
D27	NMF	Valve Negative Deviation Alarm
D28	PMF	Valve Positive Deviation Alarm

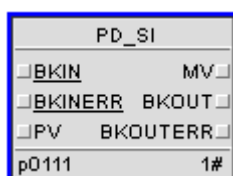
3.10 Integral of Manual Set PD Function Block (PD_SI)

PD function block with manual resetting implements PD control and integral action is control function set manually. In the process of programmable temperature control, operation conditions are not maintained.

For example, there is powerful instant heat liberation in the chemistry process. In this case, integral action will be weakened for a period of time. Just like these processes (deadband time is too long or process time constant is too big), big proportion band should be set. If integral action works, oscillation will be caused.

It is a complex function block and its running time is 120μs.

Please refer to the Overview and Control Function Block Library before using the function block.



3.10.1 Parameter Description

Table 3.40 Parameter description and application of PID_SI Function Block

Name			Description	Upload	Properties	Application Reference
Basic Parameters	Range Settings	MVSCH	MV high scale	-	Configuration Parameter	The same as MV actual value H limit.
		MVSCL	MV low scale	-	Configuration Parameter	The same as MV actual value L limit.
		SVSCH	SV high scale	-	Configuration Parameter	The same as PV actual value H limit.
		SVSCL	SV low scale	-	Configuration Parameter	The same as PV actual value L limit.
		SVEU	SV engineer unit	-	Configuration Parameter	Set in the function block properties settings interface.
		MVEU	MV engineer unit	-	Configuration Parameter	Set in the function block properties settings interface.
		SVDLEN	SV decimal digits [0,5]	-	Configuration Parameter	Used for data displayed on function block panel (equal to 3 as default).
		MVDLEN	MV decimal digits [0,5]	-	Configuration Parameter	Used for data displayed on function block panel (equal to 3 as default).
	Limits	MVH	MV H limit value	TRUE	Operation Parameter	Value range [MVS-CL,MVSCH]
		MVL	MV L limit value	TRUE	Operation Parameter	Value range [MVS-CL,MVSCH]
		SVH	SV H limit value	TRUE	Operation Parameter	Value range [SVS-CL,SVSCH]

Table 3.40 Parameter description and application of PID_SI Function Block (continued)

Name			Description	Upload	Properties	Application Reference
Extended Parameters		SVL	SV L limit value	TRUE	Operation Parameter	Value range [SVS-CL,SVSCH]
		DMVLIM	MVoutput rate variety limits value. Used to prevent the MV from overlarge modification in a short time.	TRUE	Operation Parameter	Refer to Integral Cutting
		SWPN	Direct/Reverse switch. SV is not changed, the MV increases with the increasing of PV in direct action, and decreases with the increasing of PV in reverse action.	TRUE	Operation Parameter	OFF=Direct action, ON=Reverse action
	Base Input Pin Settings	BKIN	Feedback input.BKIN does not act in the calculation. It outputs and tracks the modification of BKIN only in IMAN mode.	-	Input Pin	Connect to BKOUT of downstream block
		BKINERR	Feedback status input	-	Input Pin	Connect to BKOUT of downstream block ERR
		PV	PV, Refer to ^{Note1}	-	Input Pin	Connect to measuring point AI
		CSV	Cascade	-	Input Pin	Connect to outer loop control value MV
		TV	Track input value	-	Input Pin	Connect to measuring point AI.Related parameter: SWTR.
		SWTR	Track switch: OFF=not track, ON=track	-	Input Pin	Upstream interlock condition input,Related parameter: TV

Table 3.40 Parameter description and application of PID_SI Function Block (continued)

Name			Description	Upload	Properties	Application Reference
	Ad- vance Input Pin Set- tings	OA	Output compensa- tion, used for feed- forward control	-	Input Pin	Connect to measur- ing point AI (feedforward signal),Relat- ed paramete- r: OK, OB
		MF	PID executor feed- back value , used for monitoring	-	Input Pin	Connect to measuring point AI
		IA	Input compensation value, used to im- prove the controlla- bility of process with long deadband time	-	Input Pin	Connect to measuring point AI,Refer to Input Process Re- lated para- meter: IK, IB
		PSWAM	Program manual and auto control switch, OFF=pro- gram manual con- trol, ON=program auto control	-	Input Pin	Connect the upstream outputEn- abled when MAN_OP- T=ON
		PSWSV	Program auto/ cas- cade control switch, OFF= SV, ON=CSV	-	Input Pin	Connect the upstream outputen- abled when SV_OPT=ON
		MAN_OPT	Manual-automat- ic control source switch, ON= man- ual-automatic se- lection controlled by PSWAM, OFF= manual-automatic selection controlled by SWAM	-	Input Pin	Connect the upstream output Relat- ed paramete- r: PSWAM, SWAM
		SV_OPT	Auto/Cascade con- trol source selec- tion, ON= auto/cas- cade selection con- trolled by PSWSV, OFF= auto/cascade selection controlled by SWSV	-	Input Pin	Connect the upstream outputRelat- ed paramete- r: PSWSV, SWSV
		SWINC	MV lock increase (MV cannot In- crease), ON= lock increase	-	Input Pin	Connect the upstream output. en- abled when function

Table 3.40 Parameter description and application of PID_SI Function Block (continued)

Name			Description	Upload	Properties	Application Reference
						block is automatic or cascade
		SWDEC	Anti-integral windup input, used for control overshoot	-	Input Pin	Connect to measuring point AI, Related parameter: BKIN; Refer to Operation Process Integral Limits Action
		HOLD	MV lock decrease (MV cannot decrease), ON= Lock decrease	-	Input Pin	Connect the upstream output. enabled when function block is automatic or cascade
	Output Pin	MV	PID operation output value	-	Output Pin	Connect to electric manual instrument
		BKOUT	Feedback output value	-	Output Pin	Connect to the BKIN of Upstream Block, Related parameter: BK_OPT
		BKOUTERR	Feedback status value	-	Output Pin	Connect to the BKIN-ERR of Upstream Block
		BK_OPT	BKOUT value switch (ON=track PV, OFF=track SV)	-	Configuration Parameter	Related parameter: BKOUT
	PID Param Settings	PB	Proportion band size	TRUE	Operation Parameter	Refer to PID Parameter Tune
		TB	Balance time (s)	TRUE	Operation Parameter	Balance time without interference switch
		TD	Derivative time (s)	TRUE	Operation Parameter	TD =0, Suppress deviation Action

Table 3.40 Parameter description and application of PID_SI Function Block (continued)

Name			Description	Upload	Properties	Application Reference
	Operator Command	KD	Derivative filter coefficient	TRUE	Operation Parameter	Refer to Application Illustration
		MODE	Work mode	-	Monitoring Parameter	Refer to Transition Process of Function Block Modes
		IMODE	Standby work mode	-	Monitoring Parameter	Refer to Transition Process of Function Block Modes
		MODE_-OPT	ON=auto return, OFF=manual return (default)	-	Configuration Parameter	Refer to Transition Process of Function Block Modes
		SWAM	Manual and auto switch: OFF=manual, ON=auto	-	Operation Parameter	Enabled when MAN_-OPT=OFF
		SWSV	Auto/ cascade selection: OFF=auto, ON=cascade	-	Operation Parameter	Enabled when SV_-OPT=OFF
		SWMMV	Whether to equal to preset MV value when switch to manual status	TRUE	Operation Parameter	Related parameter : MMV
		MMV	Preset MV value (switch to manual)	TRUE	Operation Parameter	Enabled when SWM-MV=ON
	Operator Data	SV	SV for loop closed control	-	Operation Parameter	Refer to Set Variable Process
		MANMV	Manual output value	-	Operation Parameter	Output value= MAN-MV in manual mode
		EI	Error	-	Monitoring Parameter	Refer to Operation Process
		MR	Manual Set Value	-	Operation Parameter	Refer to Note2

Table 3.40 Parameter description and application of PID_SI Function Block (continued)

Name			Description	Upload	Properties	Application Reference
	Input Alarm Settings	PVHH	PV HH limit alarm value	TRUE	Operation Parameter	Refer to Input Process
		PVH	PV H limit alarm value	TRUE	Operation Parameter	Refer to Input Process
		PVL	PV L limit alarm value	TRUE	Operation Parameter	Refer to Input Process
		PVLL	PV LL limit alarm value	TRUE	Operation Parameter	Refer to Input Process
		PVHYS	Process value alarm hysteresis	TRUE	Operation Parameter	Refer to Input Process
		DL	Deviation alarm set value	TRUE	Operation Parameter	Refer to Operation Process
		DLHYS	Deviation alarm hysteresis value	TRUE	Operation Parameter	Refer to Operation Process
		KSV	Deviation filter coefficient	TRUE	Operation Parameter	Refer to Operation Process
		TSV	Deviation filter time constant(s)	TRUE	Operation Parameter	Refer to Operation Process
		NMFLIM	Valve position negative error thresholds	TRUE	Operation Parameter	Refer to Integral Cutting
		PMFLIM	Valve position positive error thresholds	TRUE	Operation Parameter	Refer to Integral Cutting
		TMFHYS	Valve position error alarm hysteresis time	TRUE	Operation Parameter	Refer to Integral Cutting
	Advanced Param Settings	BYPASS	Bypass PID operation, when BY-PASS=ON, excise PID calculation, switch SV to MV directly for output	TRUE	Operation Parameter	When cascade adjusting, used to excise inner loop when it failsRefer to Operation Process
		STOPP	Proportion suppress switch, when STOP-P=ON, stop integral action	TRUE	Operation Parameter	Refer to Operation Process

Table 3.40 Parameter description and application of PID_SI Function Block (continued)

Name			Description	Upload	Properties	Application Reference
		SWDB	Enable switch, when SWDB=ON, deadband enable	TRUE	Operation Parameter	Related parameter: DB
		DB	Deadband band size	TRUE	Operation Parameter	Enable when SWDB=ON
		DBHYS	Deadband band hysteresis	TRUE	Operation Parameter	Refer to Operation Process
		GW	Non-linear gain range non-linear gain range	TRUE	Operation Parameter	Refer to Operation Process
		KN	Nonlinear gain coefficient[0,1.0]	TRUE	Operation Parameter	Refer to Operation Process
		NGN_OPT	Non-linear gain selection switch, switch the relation between error and output change value to nonlinear. Used for control when proportional gain needs nonlinear change. OFF=Error square root function, ON=Gap action function	-	Configuration Parameter	Related parameters: GW, PB and KN When NGN_OPT = ON; GW and PB when NGN_OPT = OFF
	Alarm	PVHHIND	PVHH alarm indication	-	Monitoring Parameter	Refer to Integral Cutting
		PVHIND	PV H Limit alarm indication	-	Monitoring Parameter	Refer to Integral Cutting
		PVLIND	PV L limit alarm indication	-	Monitoring Parameter	Refer to Integral Cutting
		PVLLIND	PV LL limit alarm indication	-	Monitoring Parameter	Refer to Integral Cutting
		MVHIND	MV H limit alarm indication	-	Monitoring Parameter	Refer to Integral Cutting
		MVLIND	MV L limit alarm indication	-	Monitoring Parameter	Refer to Integral Cutting
		SVHIND	SV H limit alarm indication	-	Monitoring Parameter	Refer to Integral Cutting
		SVLIND	SV L limit alarm indication	-	Monitoring Parameter	Refer to Integral Cutting

Table 3.40 Parameter description and application of PID_SI Function Block (continued)

Name			Description	Upload	Properties	Application Reference
		PEIIND	Positive deviation alarm indication	-	Monitoring Parameter	Refer to Integral Cutting
		NEIIND	Negative deviation alarm indication	-	Monitoring Parameter	Refer to Integral Cutting
		DMVHIND	MV positive rate limit indication	-	Monitoring Parameter	Refer to Integral Cutting
		DMVLIND	MV negative rate limit indication	-	Monitoring Parameter	Refer to Integral Cutting
		NMFIND	Valve position error negative alarm indication	-	Monitoring Parameter	Refer to Integral Cutting
		PMFIND	Valve position error positive alarm indication	-	Monitoring Parameter	Refer to Integral Cutting
	Compensation Settings	IK	Input compensation gain	TRUE	Operation Parameter	Refer to Input Process Related parameter: IA
		IB	Input compensation bias value	TRUE	Operation Parameter	Refer to Input Process Related parameter: IA
		OK	Output compensation gain	TRUE	Operation Parameter	Refer to Operation Process Related parameter: OA
		OB	Output compensation bias value	TRUE	Operation Parameter	Refer to Operation Process Related parameter: OA
	Fase/Slow/Increase/Decrease Settings	SMV	MV manual slow increase/decrease value (%)	TRUE	Operation Parameter	Set MV manual slow increase/decrease percentage in function block properties setting, $SMV \leq FMV$ Related parameter: MVSCH

Table 3.40 Parameter description and application of PID_SI Function Block (continued)

Name			Description	Upload	Properties	Application Reference
		FMV	MV manual fast increase/decrease value (%)	TRUE	Operation Parameter	Set MV manual fast increase/decrease percentage in function block properties setting-Related parameter: MVS-CL
		SSV	SV slow increase/decrease value (%)	TRUE	Operation Parameter	Set SV manual slow increase/decrease percentage in function block properties setting-SSV≤FSV, Related parameter: SVSCH
		FSV	SV fast increase/decrease value (%)	TRUE	Operation Parameter	Set SV manual fast increase/decrease percentage in function block properties setting Related parameter: SVS-CL
	Extended Range Settings	HORLIM	Extended range maximum percentage	-	Configuration Parameter	Refer to Output Process
		LORLIM	Extended range minimum percentage	-	Configuration Parameter	Refer to Output Process
	SV Advance Settings	SWRAMP	SV ramp function switch. When changing set value, incline it to SV according to the set RAMP (s). OFF=SV ramp function off, ON=SV ramp function on	TRUE	Operation Parameter	Related parameter: RAMP. Enable when in automatic or cascade mode.

Table 3.40 Parameter description and application of PID_SI Function Block (continued)

Name			Description	Upload	Properties	Application Reference
		RAMP	Ramp coefficient	TRUE	Operation Parameter	Related parameter: SWRAMP
		SVTR_OPT	Track PV switch enable/disable: OFF=not track, ON=track. If PV>SVH/ SVL, SV= range limit. Used to prevent the output MV from interference when changing the control mode.	-	Configuration Parameter	Refer to Set Variable Process
		SVRG_OPT	SV range convert option:0=no convert,1=convert by percent	-	Configuration Parameter	0 by default.
	Alarm Enabled and Suppress	AOF	Suppress module alarm, On=prohibit to display alarm.	TRUE	Operation Parameter	Refer to Integral Cutting
		ENALM	Alarm enable	TRUE	Alarm Parameter	Refer to Integral Cutting
		FLAG	Flag	-	Output Pin	Refer to Integral Cutting
	OOS Settings	SWOOS	OOS mode setting switch (ON= OOS mode)	TRUE	Operation Parameter	Set as ON at the first time of function block downloading
		OOSVAL	OOS mode output value	TRUE	Operation Parameter	Related parameter: OOS_OPT=ON
		OOS_OPT	OOS mode output value type. when OOS_OPT =ON, MV=OOSVAL, when OOS_OPT =OFF, maintain the MV	-	Configuration Parameter	Refer to About

PD_SI function block' working mode and corresponding parameters of each mode are shown in Table 3.1.

Note 1: Principle Instruction

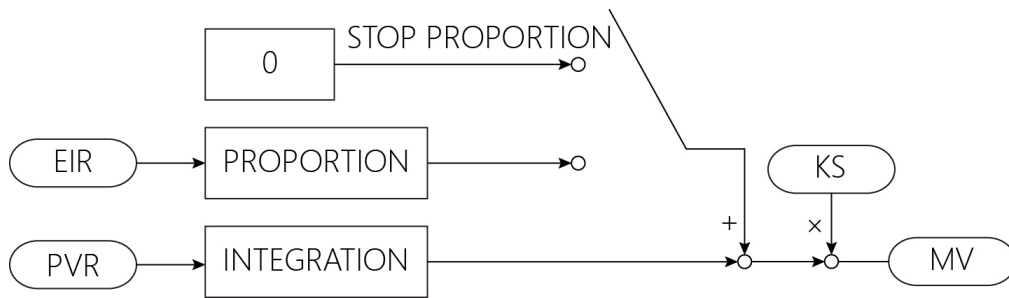


Figure 3.37 PD control FB algorithm process with manipulating set integral item

The proportional band can be set narrower via executing proportional differential control, and suppress overshoot via differential action to shift phase and achieve better control performance.

$$MV = K_p * K_s * (E_n + \frac{TD}{\Delta T} * \Delta PV_n) + MR + BL_n$$

Among them: the formulas of EI_n , KP and KS refer to "Note1" .

$$BL_n = (1 - \frac{\Delta T}{T_{bl}}) * BL_{n-1}$$

$$\Delta PV_n = PV_n - PV_{n-1}$$

BL_n is balance option, which is used to bumpless transfer revising variables from manual mode to auto mode. T_{bl} is balance time. K_s is range conversion coefficient. In the mode of AUT or CAS, $CALC_n$ is conversed to MV output by output process.

Note 2: Bumpless transfer

Bumpless transfer of PD_SI function block is based on balance movement. When function block is transferred from manual mode (MAN) to auto mode (AUTO), BL_{n0} as initial value of balance item is obtained by the following expression to achieve bumpless transfer.

$$BL_{n0} = MV - K_p * K_s * (E_n + \frac{TD}{\Delta T} * \Delta PV_n) - MR$$

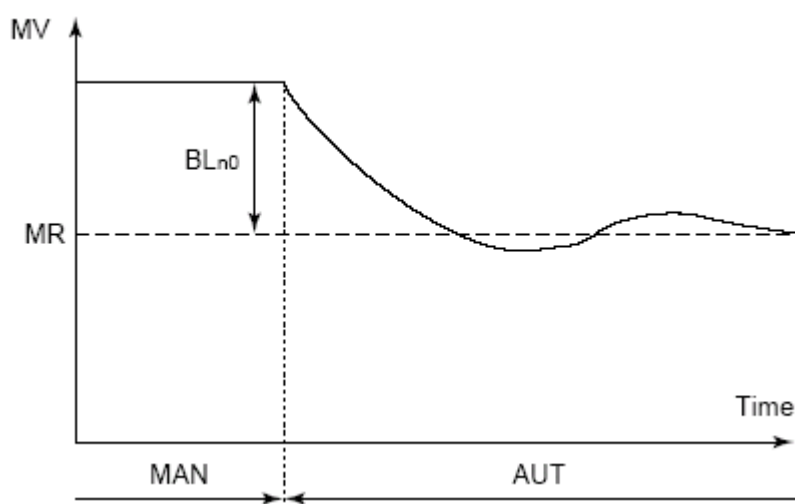


Figure 3.38 Bumpless transfer figure of balance movement of PD_SI function block

3.10.2 Panel Parameter



Preference **PID** Others

PID Parameter

PB 100.000 %

TD 0.000 s

Incomplete Diff Coef.

KD 10.000 s

Deadband

☐ Enable ☒ Disable

DB 0.000

DBHYS 0.000

Non-linear Gain

☐ Gap Action GW 0.000

☒ Square Root KN 1.000

D/R Direction

☐ Direct ☒ Reverse

Proportion Action

☒ Run ☐ Stop

Balance Switch Coef.

Balance Coefficient 0.000 s

SV Ramp Action

☐ Enable ☒ Disable

RAMP 100.000

PID Action

☒ Run ☐ Bypass

Preference **PID** Others

Input Compensation

IA 0.000

IK 1.000

IB 0.000

Output Compensation(%)

OA 0.000

OK 1.000

OB 0.000

EI Alarm Filter

KSV 1.000

TSV 0.000 s

SV Track

☒ Track ☐ Not Track

Feedback Output Track

☐ PV ☒ SV

MAN_OPT

☒ Panel ☐ Program

SV_OPT

☐ Panel ☒ Program

MR 0.000

TR 0.000 %

Table 3.41 Operation Instruction for Panel Parameter

Panel Parameter Name			Function Block Parameter Name	Initial Value	Value Range	Application Instruction
Preference	PV Alarm (%)	HH	PVHH	100.000	[SVS-CL,SVSCH]	HH alarm value setting of loop PV (select alarm enabled, or it is disabled).
		H	PVH	90.000	[SVS-CL,SVSCH]	H alarm value setting of loop PV(se-

Table 3.41 Operation Instruction for Panel Parameter (continued)

Panel Parameter Name			Function Block Parameter Name	Initial Value	Value Range	Application Instruction
						lect alarm enabled, or it is disabled)
		L	PVL	10.000	[SVS-CL,SVSCH]	L alarm value setting of loop PV(select alarm enabled, or it is disabled)
		LL	PVLL	0.000	[SVS-CL,SVSCH]	LL alarm value setting of loop PV. (select alarm enabled, or it is disabled)
		HYS	PVHYS	0.000	-	PV Process value alarm hysteresis
	SV Limits (%)	H	SVH	40.000	[SVS-CL,SVSCH]	H value setting of loop SV (select alarm enabled, or it is disabled). Note: SV limit is not affected by selection.
		L	SVL	0.000	[SVS-CL,SVSCH]	L value setting of loop SV (select alarm enabled, or it is disabled). Note: SV limit is not affected by selection.
	MV Limits (%)	H	MVH	100.000	[MVS-CL,MVSCH]	H value setting of loop MV (select alarm enabled, or it is disabled). Note: MV limit is not affected by selection.
		L	MVL	0.000	[MVS-CL,MVSCH]	L value setting of loop MV (select alarm enabled, or it is disabled). Note: MV limit is not affected by selection.
	EI Alarm (%)	Bias (EI)	EI	0.000	-	Read-only. EI=PV - SV(select alarm enabled, or it is disabled).
		PEI (selected)	-	-	-	Selecting the positive deviation alarm is enabled.

Table 3.41 Operation Instruction for Panel Parameter (continued)

Panel Parameter Name			Function Block Parameter Name	Initial Value	Value Range	Application Instruction
		NEI (selected)	-	-	-	Selecting the negative deviation alarm is enabled.
		DL	DL	100.000	± (Range H-Range L)	Deviation alarm SV
		DL-HYS	DLHYS	0.000	-	Deviation alarm hysteresis value
	MF Alarm (%)	PMF	PMFLIM	100.000	-	Selecting the positive deviation alarm is enabled.
		NMF	NMFLIM	100.000	-	Selecting the negative deviation alarm is enabled.
		TMFHYS (s)	TMFHYS	0.000	-	Lag time SV
	MV Velocity Limits (%)	DMVH (selected)	-	-	-	Selecting positive velocity alarm is enabled.
		DMVL (selected)	-	-	-	Selecting negative velocity alarm is enabled.
		DMVLIM	DMVLIM	100.000	-	Loop MV velocity limit SV
PID	PID Parameter	PB(%)	PB	100.000	-	Loop proportional parameter SV
		TD(s)	TD	0.000	-	Loop differential time parameter SV
	Incomplete Diff Coef	KD(s)	KD	10.000	-	Incomplete integral filter coefficient
	Deadband (%)	Enable (selected)	SWDB	-	-	Selecting dead-band parameter is enabled.
		Disable (selected)	SWDB	√	-	Selecting dead-band parameter is disabled.

Table 3.41 Operation Instruction for Panel Parameter (continued)

Panel Parameter Name			Function Block Parameter Name	Initial Value	Value Range	Application Instruction
		DB	DB	0.000	-	Deadband band size
		DB-HYS	DBHYS	0.000	[0,DB]	Deadband band hysteresis
	Non-linear Gain (%)	Gap Action (selected)	NGN_OPT	-	-	Read-only, non-linear gain selection switchON= Gap Action
		Square Root (selected)	NGN_OPT	√	-	Read-only, non-linear gain selection switchOFF=Square Root Action
		GW	GW	0.000	[0,1.0]	Nonlinear gain action range
		KN	KN	1.000	-	Nonlinear gain coefficient
	Balance Switch Coefficient	Balance (s)	TB	0.000	Not less than 0	Balance time without interference switch
	SV Ramp Action (%)	Enable (selected)	SWRAMP	-	-	Selecting SV ramp is enabled.
		Disable (selected)	SWRAMP	√	-	Selecting SV ramp is disabled.
		RAMP	RAMP	100.000	-	Coefficient parameter SV
	Control Direction	Direct (selected)	SWPN	-	-	Selecting direct action is enabled.
		Reverse (selected)	SWPN	√	-	Selecting reverse action is enabled.

Table 3.41 Operation Instruction for Panel Parameter (continued)

Panel Parameter Name			Function Block Parameter Name	Initial Value	Value Range	Application Instruction
	Proportional Action	Run (selected)	STOPP	√	-	Selecting proportional action is enabled.
		Stop	STOPP	-	-	Selecting proportional action is disabled.
	PID Action	Run	BYPASS	√	-	The modification of function block panel is enabled for function block properties interface when debugging.
		By-pass	BYPASS	-	-	The modification of function block panel is disabled for function block properties interface when debugging.
Others	Input Compensation (%)	IA	IA	0.000	-	Read-only, can be set in configuration or program
		IK	IK	1.000	-	Input compensation gain
		IB	IB	0.000	-	Input compensation bias value
	Output Compensation (%)	OA	OA	0.000	-	Read-only, can be set in configuration or program
		OK	OK	1.000	-	Output compensation gain
		DB	DB	0.000	-	Output compensation bias value
	Alarm Limit Settings	KSV	KSV	1.000	0~100	Deviation filter coefficient
		TSV(s)	TSV(s)	0.000	0~1000s	Deviation filter time constant(s)
	Feedback Output Track	PV	BK_OPT	-	-	Read-only, can be set in configuration or program

Table 3.41 Operation Instruction for Panel Parameter (continued)

Panel Parameter Name			Function Block Parameter Name	Initial Value	Value Range	Application Instruction
		SV	BK_OPT	√	-	Read-only, can be set in configuration or program
	Track	Track	SVTR_OPT	√	-	Read-only, can be set in configuration or program
		Not Track	SVTR_OPT	-	-	Read-only, can be set in configuration or program
	MAN_OPT Setting	Panel	MAN_OPT	√	-	Read-only, can be set in configuration or program
		Program	MAN_OPT	-	-	Read-only, can be set in configuration or program
	SV_OPT Settings	Panel	SV_OPT	-	-	Read-only, can be set in configuration or program
		Program	SV_OPT	√	-	Read-only, can be set in configuration or program
	MR (%)	MR (%)	MR	0.000	0~100	-
	TV (%)	TV (%)	TV	0.000	-	Read-only, track input value (%)

3.10.3 Flag

Table 3.42 Flag List

Flag	Alarm	Description
D0	OOS	Disable
D1	IMAN	Initialize Manually
D2	MAN	Manual
D3	TR	Track
D4	AUTO	Auto
D5	CAS	Cascade

Table 3.42 Flag List (continued)

Flag	Alarm	Description
D8	PVHH	PV HH Limit Alarm
D9	PVLL	PV LL Limit Alarm
D10	PVH	PV H Limit Alarm
D11	PVL	PV L Limit Alarm
D12	SVH	SV H Limit Alarm
D13	SVL	SV L Limit Alarm
D14	MVH	Output H Limit Alarm
D15	MVL	Output L Limit Alarm
D16	PEI	Positive Deviation Alarm
D17	NEI	Negative Deviation Alarm
D18	REVSCL	Span H/L Limit Reverse
D19	CFGERR	Configuration Error
D22	DMVH	MV Positive Rate Limit Alarm
D23	DMVL	MV Negative Rate Limit Alarm
D25	AOF	Suppress Alarm
D27	NMF	Valve Negative Deviation Alarm
D28	PMF	Valve Positive Deviation Alarm

3.11 Error Cumulation PI Control Function Block (PI_AE)

PI_AE is used for multivariate flow control to maintain total flux value, which is calculated according to certain proportion of flux of each part.

Proportional and integral control is implemented by PI_AE function block, based on accumulation deviation. Accumulation deviation value DV is obtained by summing the difference between process value PV and set value SV in each scan period. And the sum of difference is converted time range.

It is a complex function block and its running time is 120μs.

Please refer to the Overview and Control Function Block Library before using the function block.



3.11.1 Parameter Description

Table 3.43 Parameter instruction and application of PI_AE Function Block

Name			Description	Upload	Properties	Application Reference
Basic Parameters	Range Settings	MVSCH	MV high scale	-	Configuration Parameter	The same as MV actual value H limit.
		MVSCL	MV low scale	-	Configuration Parameter	The same as MV actual value L limit.
		SVSCH	SV high scale	-	Configuration Parameter	The same as PV actual value H limit.
		SVSCL	SV low scale	-	Configuration Parameter	The same as PV actual value L limit.
		SVEU	SV engineer unit	-	Configuration Parameter	Set in the function block properties settings interface.
		MVEU	MV engineer unit	-	Configuration Parameter	Set in the function block properties settings interface.
		SVDLEN	SV decimal digits [0,5]	-	Configuration Parameter	Used for data displayed on function block panel (equal to 3 as default).
		MVDLEN	MV decimal digits [0,5]	-	Configuration Parameter	Used for data displayed on function block panel (equal to 3 as default).
	Limits	MVH	MV H limit value	TRUE	Operation Parameter	Value range [MVSCL, MVSCH]
		MVL	MV L limit value	TRUE	Operation Parameter	Value range [MVSCL, MVSCH]

Table 3.43 Parameter instruction and application of PI_AE Function Block (continued)

Name		Description		Upload	Properties	Application Reference
		SVH	SV H limit value	TRUE	Operation Parameter	Value range [SVS-CL,SVSCH]
		SVL	SV L limit value	TRUE	Operation Parameter	Value range [SVS-CL,SVSCH]
		DMVLIM	MV output rate variety limit value. Used to prevent the MV from overlarge modification in a short time.	TRUE	Operation Parameter	Refer to Integral Cutting
		VL	Cumulation Error Limit	TRUE	Operation Parameter	Control Deviation alarm SV. Error alarm is performed for accumulation error value, not for the current error value. Refer to Note2
	Direct/Reverse Switch Settings	SWPN	Direct/Reverse switch. SV is not changed, the MV increases with the increasing of PV in direct action, and decreases with the increasing of PV in reverse action.	TRUE	Operation Parameter	OFF=Direct action, ON=Reverse action
Extended Parameters	Base input Pin Settings	BKIN	Feedback input	-	Input Pin	Connect to BKOUT of downstream block
		BKINERR	Feedback status input	-	Input Pin	Connect to BKOUT of downstream block ERR
		PV	Process value of loop closed control process	-	Input Pin	Connect to measuring point AI
		CSV	Cascade	-	Input Pin	Connect to outer loop control value MV

Table 3.43 Parameter instruction and application of PI_AE Function Block (continued)

Name			Description	Upload	Properties	Application Reference
		TV	Track input value (In track mode, MV=TV)	-	Input Pin	Connect to measuring point AI. Related parameter: SWTR.
		SWTR	Track switch: OFF=not track, ON=track	-	Input Pin	Upstream interlock condition input,Related parameter: TV
		OA	Output compensation, used for feedforward control	-	Input Pin	Connect to measuring point AI (feed-forward signal),Related parameter: OK, OB
	Advance Input Pin Settings	MF	PID executor feedback value , used for monitoring	-	Input Pin	Connect to measuring point AI
		IA	Input compensation value, used to improve the controllability of process with long dead-band time	-	Input Pin	Connect to measuring point AI, Refer to Input Process Related parameter: IK, IB
		PSWAM	Program manual and auto control switch, OFF=program manual control, ON=program auto control	-	Input Pin	Connect the upstream output Enabled when MAN_ - OPT=ON
		PSWSV	Program auto/ cascade control switch, OFF= SV, ON=CSV	-	Input Pin	Connect the upstream outputenabled when SV_OPT=ON
		MAN_ - OPT	Manual-automatic control source switch, ON= manual-automatic selection controlled by PSWAM, OFF= manual-automatic selection	-	Input Pin	Connect the upstream outputRelated parameter: PSWAM, SWAM

Table 3.43 Parameter instruction and application of PI_AE Function Block (continued)

Name		Description		Upload	Properties	Application Reference
			controlled by SWAM			
		SV_OPT	Auto/Cascade control source selection, ON= auto/cascade selection controlled by PSWSV, OFF= auto/cascade selection controlled by SWSV	-	Input Pin	Connect the upstream outputRelated parameter: PSWSV, SWSV
		SWINC	MV lock increase (MV cannot Increase), ON= lock increase	-	Input Pin	Connect the upstream output. enabled when function block is automatic or cascade
		RRL	Anti-integral windup input, used for control overshoot	-	Input Pin	Connect to measuring point AI, Related parameter: BKIN; Refer to Operation Process Integral Limits Action
		SWDEC	MV lock decrease (MV cannot decrease), ON= Lock decrease	-	Input Pin	Connect the upstream output. enabled when function block is automatic or cascade
		HOLD	MV holds the current output value, ON= hold the current output value	-	Input Pin	Connect to upstream output,
	Output Pin	MV	PID operation output value	-	Output Pin	Connect to electric manual instrument
		BKOUT	Feedback output value	-	Output Pin	Connect to the BKIN of Upstream Block, Related parameter: BK_ - OPT

Table 3.43 Parameter instruction and application of PI_AE Function Block (continued)

Name			Description	Upload	Properties	Application Reference
		BKOUTERR	Feedback status value	-	Output Pin	Connect to the BKINERR of Upstream Block
		BK_OPT	BKOUT value switch (ON=track PV, OFF=track SV)	-	Configuration Parameter	Related parameter: BKOUT
	PID Param Settings	PB	Proportion band size	TRUE	Operation Parameter	
		TB	Balance time (s)	TRUE	Operation Parameter	Balance time without interference switch
		TI	Integral time (s)	TRUE	Operation Parameter	
		TK	Time switching coefficient (No less than 0.05)	TRUE	Operation Parameter	Change the time unit into second.Refer to ^{Note1}
	Operator Command	MODE	Work mode	-	Monitoring Parameter	Refer to Transition Process of Function Block Modes
		IMODE	Standby work mode	-	Monitoring Parameter	Refer to Transition Process of Function Block Modes
		MODE_-OPT	ON=auto return, OFF=manual return (default)	-	Configuration Parameter	Refer to Transition Process of Function Block Modes
		SWAM	Manual and auto switch: OFF=manual, ON=auto	-	Operation Parameter	Enabled when MAN_OPT=OFF
		SWSV	Auto/ cascade selection: OFF=auto, ON=cascade	-	Operation Parameter	Enabled when SV_OPT=OFF
		SWMMV	Whether to equal to preset MV value when switch to manual status	TRUE	Operation Parameter	Related parameter: MMV

Table 3.43 Parameter instruction and application of PI_AE Function Block (continued)

Name			Description	Upload	Properties	Application Reference
		MMV	Preset MV value (switch to manual)	TRUE	Operation Parameter	Enabled when SWMMV=ON
		RST	Reset cumulation error	TRUE	Operation Parameter	
		SWPMV	Whether to equal to preset MV value when switch to auto status. PMV enable switch. When SWPMV=ON, MV = PMV, MV velocity alarm, lock increase/decrease are disabled	TRUE	Operation Parameter	Related parameter: PMV
		PMV	Preset MV when switching from OOS/IMAN/TR/MAN modes to AUTO or CAS mode	TRUE	Operation Parameter	Enabled when SWPMV=ON
	Operator Data	SV	SV for loop closed control	TRUE	Operation Parameter	Refer to Set Variable Process
		MANMV	Manual output value	-	Operation Parameter	Output value= MANMV in manual mode
		EI	Error	-	Monitoring Parameter	Refer to Operation Process
		DV	Control errorDV resets when:The cumulation error reset switch RST set as ON;Function block mode is manual;In the mode of process variable track	-	Monitoring Parameter	Cumulation error value, can be set in program
	Input Alarm Settings	PVHH	PV HH limit alarm value	TRUE	Operation Parameter	Refer to Input Process
		PVH	PV H limit alarm value	TRUE	Operation Parameter	Refer to Input Process

Table 3.43 Parameter instruction and application of PI_AE Function Block (continued)

Name		Description	Upload	Properties	Application Reference	
		PVL	PV L limit alarm value	TRUE	Operation Parameter	Refer to Input Process
		PVLL	PV LL limit alarm value	TRUE	Operation Parameter	Refer to Input Process
		PVHYS	Process value alarm hysteresis	TRUE	Operation Parameter	Refer to Input Process
		DL	Deviation alarm set value	TRUE	Operation Parameter	Refer to Operation Process
		DLHYS	Deviation alarm hysteresis value	TRUE	Operation Parameter	Refer to Operation Process
		KSV	Deviation filter coefficient	TRUE	Operation Parameter	Refer to Operation Process
		TSV	Deviation filter time constant(s)	TRUE	Operation Parameter	Refer to Operation Process
		NMFLIM	Valve position negative error thresholds	TRUE	Operation Parameter	Refer to Integral Cutting
		PMFLIM	Valve position positive error thresholds	TRUE	Operation Parameter	Refer to Integral Cutting
		TMFHYS	Valve position error alarm hysteresis time	TRUE	Operation Parameter	Refer to Integral Cutting
	Advanced Calculation Settings	BYPASS	Bypass PID operation, when BYPASS=ON, excise PID calculation, switch SV to MV directly for output	TRUE	Operation Parameter	When cascade adjusting, used to excise inner loop when it failsRefer to Operation Process
		STOPP	Proportion suppress switch, when STOPP=ON, stop integral action	TRUE	Operation Parameter	Refer to Operation Process
		STOPI	Integral suppress switch, when STOPI=ON, stop integral action	TRUE	Operation Parameter	Refer to Operation Process
		SWDB	Enable switch, when SWD-	TRUE	Operation Parameter	Related parameter: DB

Table 3.43 Parameter instruction and application of PI_AE Function Block (continued)

Name		Description	Upload	Properties	Application Reference
			B=ON, dead-band enable		
		DB	Deadband band size	TRUE	Operation Parameter Enable when SWDB=ON
		DBHYS	Deadband band hysteresis	TRUE	Operation Parameter Refer to Operation Process
		GW	Non-linear gain range non-linear gain range	TRUE	Operation Parameter Refer to Operation Process
		KN	Nonlinear gain coefficient[0,1.0]	TRUE	Operation Parameter Refer to Operation Process
		NGN_-OPT	Non-linear gain selection switch, switch the relation between error and output change value to nonlinear. Used for control when proportional gain needs nonlinear change. OFF=Error square root function, ON=Gap action function	-	Configuration Parameter Related parameters: GW, PB and KN When NGN_-OPT = ON; GW and PB when NGN_OPT = OFF
		OUT_OPT	Control output type: OFF=position type, ON=increment type	-	Configuration Parameter Related parameter: MV
	Alarm	PVHHIND	PVHH alarm indication	-	Monitoring Parameter Refer to Integral Cutting
		PVHIND	PV H Limit alarm indication	-	Monitoring Parameter Refer to Integral Cutting
		PVLIND	PV L limit alarm indication	-	Monitoring Parameter Refer to Integral Cutting
		PVLLIND	PV LL limit alarm indication	-	Monitoring Parameter Refer to Integral Cutting
		MVHIND	MV H limit alarm indication	-	Monitoring Parameter Refer to Integral Cutting
		MVLIND	MV L limit alarm indication	-	Monitoring Parameter Refer to Integral Cutting

Table 3.43 Parameter instruction and application of PI_AE Function Block (continued)

Name		Description	Upload	Properties	Application Reference	
		SVHIND	SV H limit alarm indication	-	Monitoring Parameter	Refer to Integral Cutting
		SVLIND	SV L limit alarm indication	-	Monitoring Parameter	Refer to Integral Cutting
		PEIIND	Positive deviation alarm indication	-	Monitoring Parameter	Refer to Integral Cutting
		NEIIND	Negative deviation alarm indication	-	Monitoring Parameter	Refer to Integral Cutting
		DMVHIND	MV positive rate limit indication	-	Monitoring Parameter	Refer to Integral Cutting
		DMVLIND	MV negative rate limit indication	-	Monitoring Parameter	Refer to Integral Cutting
		NMFIND	Valve position error negative alarm indication	-	Monitoring Parameter	Refer to Integral Cutting
		PMFIND	Valve position error positive alarm indication	-	Monitoring Parameter	Refer to Integral Cutting
		AEHIND	Control error H alarm	-	Monitoring Parameter	Refer to Integral Cutting
		AELIND	Control error L alarm	-	Monitoring Parameter	Refer to Integral Cutting
	Compensation Settings	IK	Input compensation gain	TRUE	Operation Parameter	Refer to Input Process Related parameter: IA
		IB	Input compensation bias value	TRUE	Operation Parameter	Refer to Input Process Related parameter: IA
		OK	Output compensation gain	TRUE	Operation Parameter	Refer to Operation Process Related parameter: OA
		OB	Output compensation bias value	TRUE	Operation Parameter	Refer to Operation Process Related parameter: OA

Table 3.43 Parameter instruction and application of PI_AE Function Block (continued)

Name		Description	Upload	Properties	Application Reference	
	Fase/ Slow/In- crease/De- crease Settings	SMV	MV manual slow increase/de- crease value (%)	TRUE	Operation Para- meter	Set MV man- ual slow in- crease/de- crease per- centage in function block proper- ties setting, SMV≤FMVRe- lated param- eter: MVSCH
		FMV	MV manual fast increase/de- crease value (%)	TRUE	Operation Para- meter	Set MV man- ual fast in- crease/de- crease per- centage in function block properties set- ting Related parameter: MVSCL
		SSV	SV slow in- crease/de- crease value (%)	TRUE	Operation Para- meter	Set SV man- ual slow in- crease/de- crease per- centage in function block properties set- tingSSV≤FSV, Related param- eter: SVSCH
		FSV	SV fast in- crease/de- crease value (%)	TRUE	Operation Para- meter	Set SV man- ual fast in- crease/de- crease per- centage in function block properties set- tingRelated pa- rameter: SVS- CL
	Extended Range Settings	HORLIM	Extended range maximum per- centage	-	Configuration Pa- rameter	Refer to Output Process
		LORLIM	Extended range minimum per- centage	-	Configuration Pa- rameter	Refer to Output Process
	SV Ad- vance Settings	SWRAMP	SV ramp func- tion switch. When chang- ing set value, in- cline it to SV ac-	TRUE	Operation Para- meter	Related para- meter: RAMP. Enable when in automatic or cascade mode

Table 3.43 Parameter instruction and application of PI_AE Function Block (continued)

Name		Description		Upload	Properties	Application Reference
			cording to the set RAMP (s). OFF=SV ramp function off, ON=SV ramp function on			
		RAMP	Ramp coefficient	TRUE	Operation Parameter	Related parameter: SWRAMP
		SVTR_-OPT	Track PV switch enable/disable: OFF=not track, ON=track. If PV> SVH/ SVL, SV= range limit. Used to prevent the output MV from interference when changing the control mode.	-	Configuration Parameter	Refer to Set Variable Process
		SVRG_-OPT	SV range convert option:0=no convert,1=convert by percent	-	Configuration Parameter	0 by default.
	Alarm Enabled and Suppress	AOF	Suppress module alarm, On=prohibit to display alarm.	TRUE	Operation Parameter	Refer to Integral Cutting
		ENALM	Alarm enable	TRUE	Alarm Parameter	Refer to Integral Cutting
		FLAG	Flag	-	Output Pin	Refer to Integral Cutting
	OOS Settings	SWOOS	OOS mode setting switch (ON= OOS mode)	TRUE	Operation Parameter	Set as ON at the first time of function block downloading
		OOSVAL	OOS mode output value	TRUE	Operation Parameter	Related parameter: OOS_-OPT=ON
		OOS_OPT	OOS mode output value type. when OOS_-OPT=ON,	-	Configuration Parameter	Refer to About

Table 3.43 Parameter instruction and application of PI_AE Function Block (continued)

Name	Description	Upload	Properties	Application Reference
	MV=OOS-VAL, when OOS_OPT=OFF, maintain the MV			

PI_AE function block' working modes and corresponding parameter conditions of each mode are shown in Table 3.1.

Note 1. PI control with cumulative departure

$$DVR_n = DVR_{n-1} + (SV_n - PV_n)$$

$$DV_n = \frac{DVR_n}{TK} * TS$$

DVR_n is original cumulative departure value;

DVR_{n-1} is original cumulative departure value of front cyclic

Time conversion coefficient converses original accumulation deviation value of flow unit (m³/h) to weight or volume unit (m³). Time conversion coefficient converses time unit of flow to second, for example, if unit of PV is m³/h, TK is set 3600.

Calculation expression of control algorithm of PI_AE function block:

$$\Delta MV_n = \frac{K_p * K_s}{8} * (\Delta T * E_n + \frac{\Delta T}{T_i} * ES_n) + BL_n$$

Instruction of EI_n , K_p and K_s refer to "Note1".

Control accumulation deviation value ES_n used for PI control calculation is equal to the value of accumulation deviation DV_n limited by set value of control deviation alarm VL.

When $DV_n \geq |VL|$, $ES_n = |VL| * TK$.

When $-|VL| < DV_n < |VL|$, $ES_n = DVR_n * TS$.

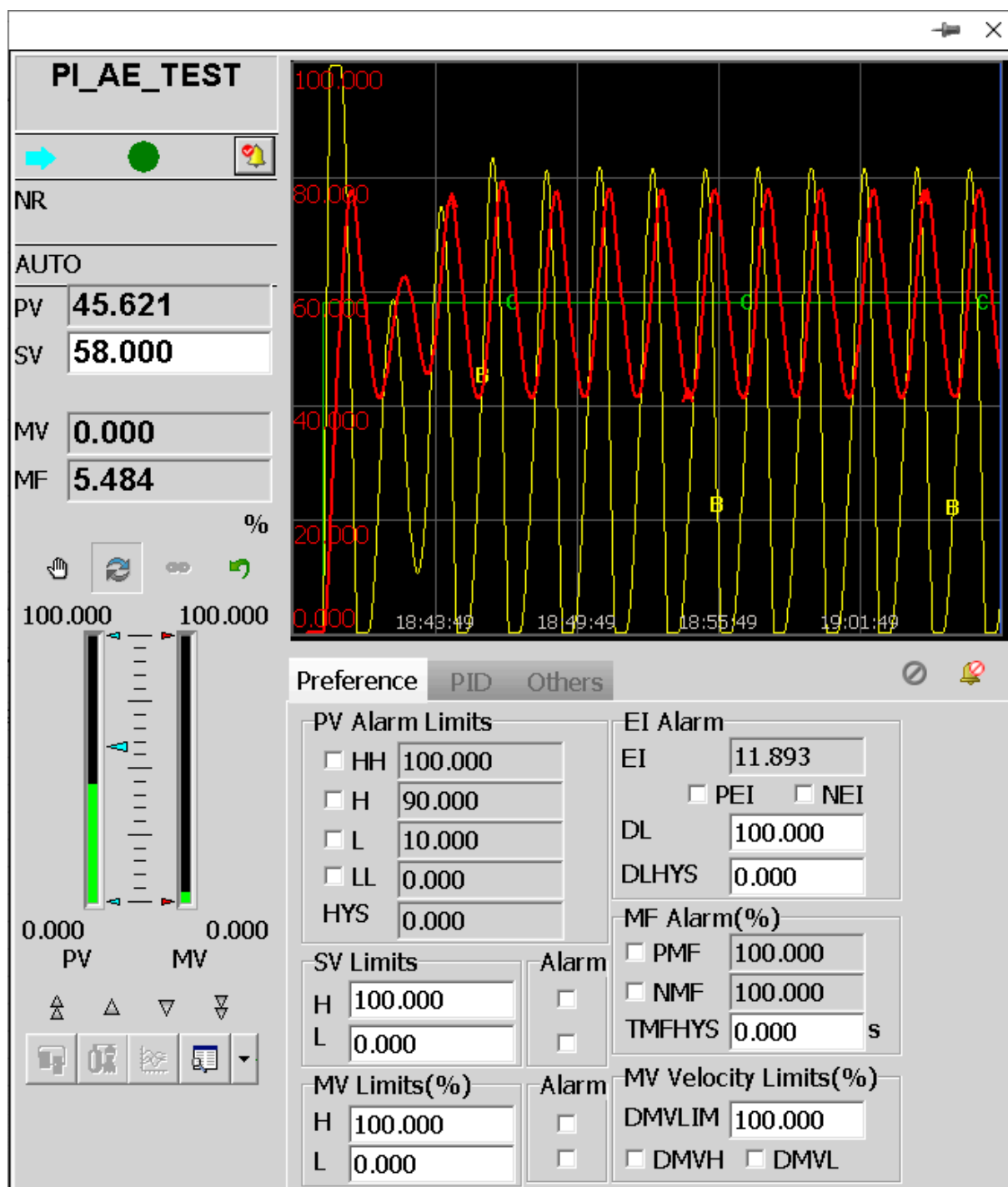
When $DV_n \leq -|VL|$, $ES_n = -|VL| * TK$

Note 2. Control deviation alarm

Control deviation alarm is used to check whether accumulation deviation value DV which continues to add after accumulation deviation alarm is over absolute value of set value of control deviation alarm VL. If exceeded, the control deviation alarm is generated.

If accumulation deviation value DV is over absolute value of set value of control deviation VL positively, positive alarm of control alarm AEH is generated; if accumulation deviation value DV is over set value of control deviation VL negatively, negative alarm of control deviation AEL is generated.

3.11.2 Panel Parameter



Preference PID Others

PID Parameter

PB 100.000 %

TI 20.000 s

Deadband

☐ Enable ☒ Disable

DB 0.000

DBHYS 0.000

Non-linear Gain

☐ Gap GW 0.000

☒ Square Root KN 1.000

D/R Direction

☐ Direct ☒ Reverse

Proportion Action

☒ Run ☐ Stop

SV Ramp Action

☐ Enable ☒ Disable

RAMP 100.000

Integral Action

☒ Run

☐ Stop

Balance Switch Coefficient

TB 0.000 s

TK 1.000

PID Action

☒ Run

☐ Bypass

Preference PID Others

Input Compensation(%)

IA 0.000

IK 1.000

IB 0.000

Output Compensation(%)

OA 0.000

OK 1.000

OB 0.000

EI Alarm Filter

KSV 1.000

TSV 0.000 s

Feedback Output Track

☐ PV ☒ SV

SV Track

☒ Track ☐ Not Track

MAN_OPT

☒ Panel ☐ Program

SV_OPT

☐ Panel ☒ Program

Control Bias Alarm

DV 0.000 ☐ AEH

VL 100.000 ☐ AEL

TR 0.000 %

Figure 3.39 PI_AE Function Block Panel Parameter Graph

Table 3.44 Operation Instruction for Panel Parameter

Panel Parameter Name			Function Block Parameter Name	Initial Value	Value Range	Application Instruction
Preference	PV Alarm (%)	HH	PVHH	100.000	[SVS-CL,SVSCH]	HH alarm value setting of loop PV (select alarm enabled, or it is disabled).

Table 3.44 Operation Instruction for Panel Parameter (continued)

Panel Parameter Name			Function Block Parameter Name	Initial Value	Value Range	Application Instruction
		H	PVH	90.000	[SVS-CL,SVSCH]	H alarm value setting of loop PV(select alarm enabled, or it is disabled)
		L	PVL	10.000	[SVS-CL,SVSCH]	L alarm value setting of loop PV(select alarm enabled, or it is disabled)
		LL	PVLL	0.000	[SVS-CL,SVSCH]	LL alarm value setting of loop PV. (select alarm enabled, or it is disabled)
		HYS	PVHYS	0.000	-	PV Process value alarm hysteresis
	SV Limits (%)	H	SVH	40.000	[SVS-CL,SVSCH]	H value setting of loop SV (select alarm enabled, or it is disabled). Note: SV limit is not affected by selection.
		L	SVL	0.000	[SVS-CL,SVSCH]	L value setting of loop SV (select alarm enabled, or it is disabled). Note: SV limit is not affected by selection.
	MV Limits (%)	H	MVH	100.000	[MVS-CL,MVSCH]	H value setting of loop MV (select alarm enabled, or it is disabled). Note: MV limit is not affected by selection.
		L	MVL	0.000	[MVS-CL,MVSCH]	L value setting of loop MV (select alarm enabled, or it is disabled). Note: MV limit is not affected by selection.
	EI Alarm (%)	EI	EI	0.000	-	Read-only. EI=PV - SV(select alarm enabled, or it is disabled).
		PEI (selected)	-	-	-	Selecting the positive deviation alarm is enabled.

Table 3.44 Operation Instruction for Panel Parameter (continued)

Panel Parameter Name			Function Block Parameter Name	Initial Value	Value Range	Application Instruction
		NEI (selected)	-	-	-	Selecting the negative deviation alarm is enabled.
		DL	DL	100.000	± (Range H-Range L)	Deviation alarm SV
		DLHYS	DLHYS	0.000	-	Deviation alarm hysteresis value
	MF Alarm (%)	PMF	PMFLIM	100.000	-	Selecting the positive deviation alarm is enabled.
		NMF	NMFLIM	100.000	-	Selecting the negative deviation alarm is enabled.
		TMFHYS	TMFHYS	0.000	-	Lag time SV
	MV Velocity Limits (%)	DMVH (selected)	-	-	-	Selecting positive velocity alarm is enabled.
		DMVL (selected)	-	-	-	Selecting negative velocity alarm is enabled.
		DMVLIM	DMVLIM	100.000	-	Loop MV velocity limit SV
PID	PID Parameter	PB(%)	PB	100.000	Not less than 0	Loop proportional parameter SV
		TI(s)	TI	20.000	Not less than 0	Loop integral time parameter SV
	Dead-band (%)	Enable (selected)	SWDB	-	-	Selecting dead-band parameter is enabled.
		Disable (selected)	SWDB	√	-	Selecting dead-band parameter is disabled.
		DB	DB	0.000	-	Deadband band size
		DBHYS	DBHYS	0.000	[0,DB]	Deadband band hysteresis
	Balance Switch Coefficient	TB	TB	0.000	Not less than 0	Balance time without interference switch

Table 3.44 Operation Instruction for Panel Parameter (continued)

Panel Parameter Name			Function Block Parameter Name	Initial Value	Value Range	Application Instruction
		TK	TK	1.000	-	Change the time unit into second.
	Non-linear Gain (%)	Gap (selected)	NGN_OPT	-	-	Read-only, non-linear gain selection switchON= Gap Action
		Square Root (selected)	NGN_OPT	√	-	Read-only, non-linear gain selection switchOFF=Square Root Action
		GW	GW	0.000	-	Nonlinear gain action range
		KN	KN	1.000	-	Nonlinear gain coefficient
	SV Ramp Action (%)	Enable (selected)	SWRAMP	-	-	Selecting SV ramp is enabled.
		Disable (selected)	SWRAMP	√	-	Selecting SV ramp is disabled.
		RAMP	RAMP	100.000	-	Coefficient parameter SV
	Control Direction	Direct (selected)	SWPN	-	-	Selecting direct action is enabled.
		Reverse (selected)	SWPN	√	-	Selecting reverse action is enabled.
	Proportional Action	Run (selected)	STOPP	√	-	Selecting proportional action is enabled.
		Stop	STOPP	-	-	Selecting proportional action is disabled.
	Integral Action	Run	STOPI	√	-	Selecting integral action is enabled.
		Stop	STOPI	-	-	Selecting integral action is disabled.
	PID Action	Run	BYPASS	√	-	The modification of function block panel is enabled for function block properties interface when debugging.

Table 3.44 Operation Instruction for Panel Parameter (continued)

Panel Parameter Name			Function Block Parameter Name	Initial Value	Value Range	Application Instruction
		Bypass	BYPASS	-	-	The modification of function block panel is disabled for function block properties interface when debugging.
Others	Input Compensation (%)	IA	IA	0.000	-	Read-only, can be set in configuration or program
		IK	IK	1.000	-	Input compensation gain
		IB	IB	0.000	-	Input compensation bias value
	Output Compensation (%)	OA	OA	0.000	-	Read-only, can be set in configuration or program
		OK	OK	1.000	-	Output compensation gain
		DB	DB	0.000	-	Output compensation bias value
	EI Alarm Settings	KSV	KSV	1.000	0~100	Deviation filter coefficient
		TSV(s)	TSV(s)	0.000	0~1000s	Deviation filter time constant(s)
	Feed-back Output Track	PV	BK_OPT	-	-	Read-only, can be set in configuration or program
		SV	BK_OPT	√	-	Read-only, can be set in configuration or program
	SV Track	Track	SVTR_OPT	√	-	Read-only, can be set in configuration or program
		Not Track	SVTR_OPT	-	-	Read-only, can be set in configuration or program
	MAN_-OPT Settings	Panel	MAN_OPT	√	-	Read-only, can be set in configuration or program

Table 3.44 Operation Instruction for Panel Parameter (continued)

Panel Parameter Name			Function Block Parameter Name	Initial Value	Value Range	Application Instruction
		Program	MAN_OPT	-	-	Read-only, can be set in configuration or program
	SV_OPT Settings	Panel	SV_OPT	-	-	Read-only, can be set in configuration or program
		Program	SV_OPT	√	-	Read-only, can be set in configuration or program
	Control Bias Alarm	DV	DV	0.000	-	Read-only, can be set in configuration or program
		AEH	AEH	-	-	Enabled when selected H alarm
		AEL	AEL	-	-	Enabled when selected L alarm
		VL	VL	100.000	Not less than 0	Control Bias Alarm SV
	TV (%)	TV (%)	TV (%)	0.000	-	Read-only, track input value(%)

3.11.3 Flag

Table 3.45 Flag List

Flag	Alarm	Description
D0	OOS	Disable
D1	IMAN	Initialize Manually
D2	MAN	Manual
D3	TR	Track
D4	AUTO	Auto
D5	CAS	Cascade
D8	PVHH	PV HH Limit Alarm
D9	PVLL	PV LL Limit Alarm
D10	PVH	PV H Limit Alarm

Table 3.45 Flag List (continued)

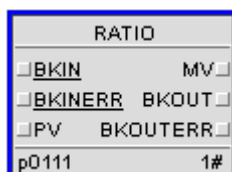
Flag	Alarm	Description
D11	PVL	PV L Limit Alarm
D12	SVH	SV H Limit Alarm
D13	SVL	SV L Limit Alarm
D14	MVH	Output H Limit Alarm
D15	MVL	Output L Limit Alarm
D16	PEI	Positive Deviation Alarm
D17	NEI	Negative Deviation Alarm
D18	REVSCL	Span H/L Limit Reverse
D19	CFGERR	Configuration Error
D20	AEH	Control Deviation High Alarm
D21	AEL	Control Deviation Low Alarm
D22	DMVH	MV Positive Rate Limit Alarm
D23	DMVL	MV Negative Rate Limit Alarm
D25	AOF	Suppress Alarm
D27	NMF	Valve Negative Deviation Alarm
D28	PMF	Valve Positive Deviation Alarm

3.12 Ratio Control Function Block (RATIO)

Output value of ratio setting function block (RATIO) is changed with the value of PV multiplied by set value of ratio. Ratio setting function block is used to control two variables at setting ratio.

It is a complex function block and its running time is 60μs.

Please refer to the "Overview" and "Application Foundation of Control Function Block" before using the function block.



3.12.1 Parameter Description

Table 3.46 Parameter description and application of RATIO Function Block

Name			Description	Upload	Properties	Application Reference
Basic Parameters	Range Settings	MVSCH	MV high scale	-	Configuration Parameter	The same as MV actual value H limit.
		MVSCL	MV low scale	-	Configuration Parameter	The same as MV actual value L limit.
		SVSCH	SV high scale	-	Configuration Parameter	The same as PV actual value H limit.
		SVSCL	SV low scale	-	Configuration Parameter	The same as PV actual value L limit.
		SVEU	SV engineer unit	-	Configuration Parameter	Set in the function block properties settings interface.
		MVEU	MV engineer unit	-	Configuration Parameter	Set in the function block properties settings interface.
		SVDLEN	SV decimal digits [0,5]	-	Configuration Parameter	Used for data displayed on function block panel (equal to 3 as default).
		MVDLEN	MV decimal digits [0,5]	-	Configuration Parameter	Used for data displayed on function block panel (equal to 3 as default).
	Limits	MVH	MV H limit value	TRUE	Operation Parameter	Value range [MVS-CL,MVSCH]
		MVL	MV L limit value	TRUE	Operation Parameter	Value range [MVS-CL,MVSCH]
		SVH	SV H limit value	TRUE	Operation Parameter	Value range [SVS-CL,SVSCH]
		SVL	SV L limit value	TRUE	Operation Parameter	Value range [SVS-CL,SVSCH]
		DMVLIM	MVoutput rate variety limits value.	TRUE	Operation Parameter	Refer to Integral Cutting

Table 3.46 Parameter description and application of RATIO Function Block (continued)

Name			Description	Upload	Properties	Application Reference
			Used to prevent the MV from over-large modification in a short time.			
ExtendParameter	Base Input Pin Settings	BKIN	Feedback input	-	Input Pin	Connect to BKOUT of downstream block
		BKINERR	Feedback status input	-	Input Pin	Connect to BKOUT of downstream block ERR
		PV	Process value of loop closed control process	-	Input Pin	Connect to measuring point AI
		CSV	Cascade	-	Input Pin	Connect to outer loop control value MV
		TV	Track input value (In track mode, MV=TV)	-	Input Pin	Connect to measuring point AI.Related parameter: SWTR.
		SWTR	Track switch: OFF=not track, ON=track	-	Input Pin	Upstream interlock condition input,Related parameter: TV
		PVF	PV reference value	-	Input Pin	-
	Advance Input Pin Settings	PSWAM	Program manual and auto control switch, OFF=program manual control, ON=program auto control	-	Input Pin	Connect the upstream output-Enabled when MAN_OPT=ON
		PSWSV	Program manual/ cascade control switch, OFF= SV, ON=CSV	-	Input Pin	Connect the upstream output-enabled when SV_OPT=ON

Table 3.46 Parameter description and application of RATIO Function Block (continued)

Name		Description	Upload	Properties	Application Reference	
		MAN_OPT	Manual-automatic control source switch, ON= manual-automatic selection controlled by PSWAM, OFF= manual-automatic selection controlled by SWAM	-	Input Pin	Connect the upstream outputRelated parameter: PSWAM, SWAM
		SV_OPT	Auto/Cascade control source selection, ON= auto/cascade selection controlled by PSWSV, OFF= auto/cascade selection controlled by SWSV	-	Input Pin	Connect the upstream outputRelated parameter: PSWSV, SWSV
	Output Pin	MV	PID operation output value	-	Output Pin	Connect to electric manual instrument
		BKOUT	Feedback output value	-	Output Pin	Connect to the BKIN of Upstream Block, Related parameter: BK_OPT
		BKOUTERR	Feedback status value	-	Output Pin	Connect to the BKINERR of Upstream Block
		BK_OPT	BKOUT value switch (ON=track PV, OFF=track SV)	-	Configuration Parameter	Related parameter: BKOUT
	Operation Command	MODE	Work mode	-	Monitoring Parameter	Refer to Transition Process of Function Block Modes
		IMODE	Standby work mode	-	Monitoring Parameter	Refer to Transition Process of

Table 3.46 Parameter description and application of RATIO Function Block (continued)

Name		Description	Upload	Properties	Application Reference	
					Function Block Modes	
		MODE_OPT	ON=auto return, OFF=manual return (default)	-	Configuration Parameter	Refer to Transition Process of Function Block Modes
		EQ_SVF	Ratio equation (0:SVF=PVF/PV, 1:SVF=PV/PVF)	TRUE	Configuration Parameter	-
		SWAM	Manual and auto switch: OFF=manual, ON=auto	-	Operation Parameter	Enabled when MAN_OPT=OFF
		SWSV	Auto/ cascade selection: OFF=auto, ON=cascade	-	Operation Parameter	Enabled when SV_OPT=OFF
		SWMMV	Whether to equal to preset MV value when switch to manual status	TRUE	Operation Parameter	Related parameter: MMV
		MMV	Preset MV value (switch to manual)	TRUE	Operation Parameter	Enabled when SWMMV=ON
	Operator Data	SV	SV for loop closed control	TRUE	Operation Parameter	Refer to Set Variable Process
		MANMV	Manual output value	-	Operation Parameter	Output value= MANMV in manual mode
	Input Alarm Settings	PVHH	PV HH limit alarm value	TRUE	Operation Parameter	Refer to Input Process
		PVH	PV H limit alarm value	TRUE	Operation Parameter	Refer to Input Process
		PVL	PV L limit alarm value	TRUE	Operation Parameter	Refer to Input Process

Table 3.46 Parameter description and application of RATIO Function Block (continued)

Name			Description	Upload	Properties	Application Reference
		PVLL	PV LL limit alarm value	TRUE	Operation Parameter	Refer to Input Process
		PVHYS	Process value alarm hysteresis	TRUE	Operation Parameter	Refer to Input Process
	Advance Calculation Settings	BIAS	Modify coefficient (compensation)	TRUE	Operation Parameter	Refer to ^{Note1}
		MV_OPT	MV calculate option.0=range convert,1=no range convert	-	Configuration Parameter	-
	Alarm	PVHHIND	PVHH alarm indication	-	Monitoring Parameter	Refer to Integral Cutting
		PVHIND	PV H Limit alarm indication	-	Monitoring Parameter	Refer to Integral Cutting
		PVLIND	PV L limit alarm indication	-	Monitoring Parameter	Refer to Integral Cutting
		PVLLIND	PV LL limit alarm indication	-	Monitoring Parameter	Refer to Integral Cutting
		MVHIND	MV H limit alarm indication	-	Monitoring Parameter	Refer to Integral Cutting
		MVLIND	MV L limit alarm indication	-	Monitoring Parameter	Refer to Integral Cutting
		SVHIND	SV H limit alarm indication	-	Monitoring Parameter	Refer to Integral Cutting
		SVLIND	SV L limit alarm indication	-	Monitoring Parameter	Refer to Integral Cutting
		DMVHIND	MV positive rate limit indication	-	Monitoring Parameter	Refer to Integral Cutting

Table 3.46 Parameter description and application of RATIO Function Block (continued)

Name			Description	Upload	Properties	Application Reference
	Ex- tended Range Settings	DMVLIND	MV negative rate limit indication	-	Monitoring Parameter	Refer to Integral Cutting
		HORLIM	Extended range maximum percentage	-	Configuration Parameter	Refer to Output Process
		LORLIM	Extended range minimum percentage	-	Configuration Parameter	Refer to Output Process
	SV Ad- vance Settings	RP	Ramp constant	TRUE	Operation Parameter	Related parameter: SWRAMP
		SVTR_OPT	Track PV switch enable/disable: OFF=not track, ON=track. If PV> SVH/SVL, SV=range limit. Used to prevent the output MV from interference when changing the control mode.	-	Configuration Parameter	Refer to Set Variable Process
		SVRG_OPT	SV range convert option:0=no convert,1=convert by percent	-	Configuration Parameter	0 by default.
	Alarm Enabled and Sup- press	AOF	Suppress module alarm, On=prohibit to display alarm.	TRUE	Operation Parameter	Refer to Integral Cutting
		ENALM	Alarm enable	TRUE	Alarm Parameter	Refer to Integral Cutting
		FLAG	Flag	-	Output Pin	Refer to Integral Cutting

Table 3.46 Parameter description and application of RATIO Function Block (continued)

Name			Description	Upload	Properties	Application Reference
	OOS Settings	SWOOS	OOS mode setting switch (ON=OOS mode)	TRUE	Operation Parameter	Set as ON at the first time of function block downloading
		OOSVAL	OOS mode output value	TRUE	Operation Parameter	Related parameter: OOS_OPT=ON
		OOS_OPT	OOS mode output value type. when OOS_OPT=ON, MV=OOSVAL, when OOS_OPT=OFF, maintain the MV	-	Configuration Parameter	Refer to Transition Process of Function Block Modes
	Panel display settings	SVF	Reference ratio	-	Monitoring Parameter	For details of the calculation method, refer to descriptions of "EQ_SVF"

RATIO function block's working modes and corresponding parameter conditions of each mode are shown in Table 3.1.

Note 1. Calculate ratio

Ratio is calculated according to the following expression:

$$MV_n = SV_e * (PV_n - SVSCL) * KS + BIAS + MVSCL$$

SV_e : Valid set value of ratio which is enabled set value of ratio after set value of ratio SV is implemented ramp process of set value. Ramp process of set value is used for bumpless transfer of function block mode.

As the PV and MV are the actual values, when the maximum and minimum ranges of PV and MV, the value of KS (range) changes. The engineering unit of BIAS is the same as MV.

Note 2. Bumpless transfer

Bumpless transfer indicates that output value will not be mutant in the mode of transfer function block. The movement of bumpless transfer which is selected automatically will be different with difference of output movement and control mode. There are two bumpless transfer modes for RATIO function block: ratio track and ramp movement of set value of ratio.

- Ratio track

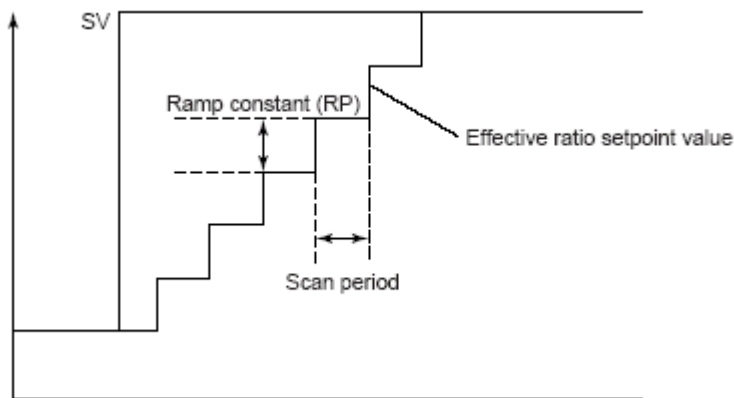
When ratio calculation is stopped, set value of ratio SV is calculated according to output value MV, by which bumpless transfer from manual mode to auto mode can be achieved.

$$SV = (MV - MV_{SCL} - BIAS) * \frac{1}{(PV - SV_{SCL}) * KS}$$

The function of ratio track can be implemented in manual mode (MAN). If $(PV - SV_{SCL}) * KS = 0$, $SV = SVH$.

- Ramp movement of set value of ratio

When set value of ratio SV is changed, change of set value of valid ratio SV_e in per second is limited to be less than or equal to ramp constant RP by ramp movement of set value of ratio. When function block mode is transferred from manual mode to auto mode, SV_e calculated according to MV is initial value of set value of valid ratio. And when set value SV is changed, ramp action of ratio set value works.



3.12.2 Panel Parameter

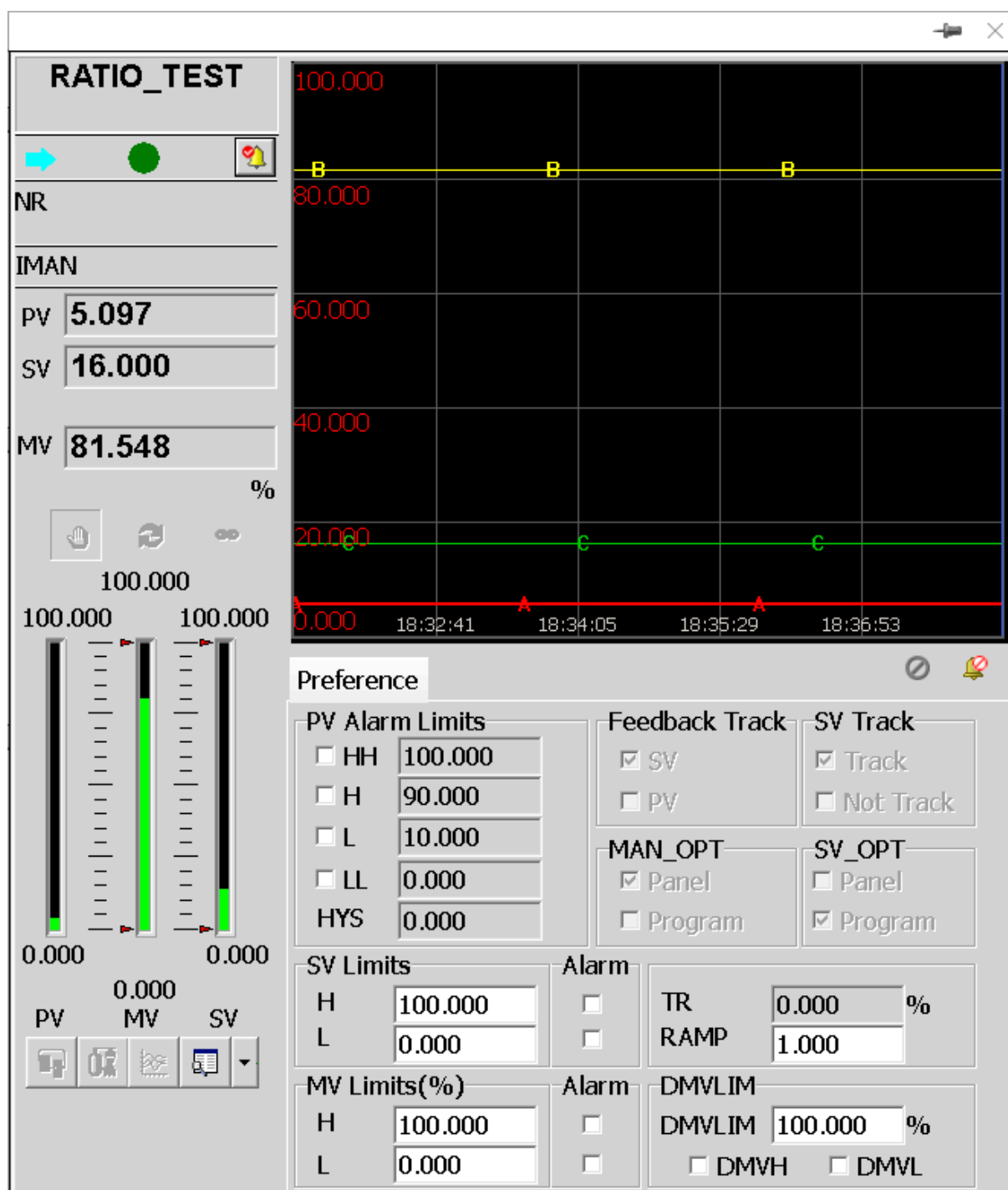


Table 3.47 Operation Instruction for Panel Parameter

Panel Parameter Name			Function Block Parameter Name	Initial Value	Value Range	Application Instruction
Preference	PV Alarm (%)	HH	PVHH	100.000	[SVSCL,SVSCH]	HH alarm value setting of loop PV (select alarm enabled, or it is disabled).

Table 3.47 Operation Instruction for Panel Parameter (continued)

Panel Parameter Name			Function Block Parameter Name	Initial Value	Value Range	Application Instruction
		H	PVH	90.000	[SVSCL,SVSCH]	H alarm value setting of loop PV(select alarm enabled, or it is disabled)
		L	PVL	10.000	[SVSCL,SVSCH]	L alarm value setting of loop PV(select alarm enabled, or it is disabled)
		LL	PVLL	0.000	[SVSCL,SVSCH]	LL alarm value setting of loop PV. (select alarm enabled, or it is disabled)
		HYS	PVHYS	0.000	-	PV Process value alarm hysteresis
	SV Limits (%)	H	SVH	40.000	[SVSCL,SVSCH]	H value setting of loop SV (select alarm enabled, or it is disabled). Note: SV limit is not affected by selection.
		L	SVL	0.000	[SVSCL,SVSCH]	L value setting of loop SV (select alarm enabled, or it is disabled). Note: SV limit is not affected by selection.
	MV Limits (%)	H	MVH	100.000	[MVS-CL,MVSCH]	H value setting of loop MV (select alarm enabled, or it is disabled). Note: MV limit is not affected by selection.
		L	MVL	0.000	[MVS-CL,MVSCH]	L value setting of loop MV (select alarm enabled, or it is disabled). Note: MV limit is not affected by selection.
	DMVLIM Settings	DMVH (selected)	-	-	-	Selecting positive velocity alarm is enabled.
		DMVL (selected)	-	-	-	Selecting negative velocity alarm is enabled.

Table 3.47 Operation Instruction for Panel Parameter (continued)

Panel Parameter Name			Function Block Parameter Name	Initial Value	Value Range	Application Instruction
		DMVLIM	DMVLIM	100.000	-	Loop MV velocity limit SV
	Feed-back Track	PV	BK_OPT	-	-	Read-only, can be set in configuration or program
		SV	BK_OPT	√	-	Read-only, can be set in configuration or program
	SV Track	Track	SVTR_OPT	√	-	Read-only, can be set in configuration or program
		Not Track	SVTR_OPT	-	-	Read-only, can be set in configuration or program
	MAN_-OPT Settings	Panel	MAN_OPT	√	-	Read-only, can be set in configuration or program
		Pro-gram	MAN_OPT	-	-	Read-only, can be set in configuration or program
	SV_OPT Settings	Panel	SV_OPT	-	-	Read-only, can be set in configuration or program
		Pro-gram	SV_OPT	√	-	Read-only, can be set in configuration or program
	TV	TV	TV	0.000	-	Read-only, track input value(%)
	RAMP	RAMP	RAMP	100.000	No less than 0	Related parameter: SWRAMP

3.12.3 Flag

Table 3.48 Flag List

Flag	Alarm	Description
D0	OOS	Disable
D1	IMAN	Initialize Manually
D2	MAN	Manual

Table 3.48 Flag List (continued)

Flag	Alarm	Description
D3	TR	Track
D4	AUTO	Auto
D5	CAS	Cascade
D8	PVHH	PV HH Limit Alarm
D9	PVLL	PV LL Limit Alarm
D10	PVH	PV H Limit Alarm
D11	PVL	PV L Limit Alarm
D12	SVH	SV H Limit Alarm
D13	SVL	SV L Limit Alarm
D14	MVH	Output H Limit Alarm
D15	MVL	Output L Limit Alarm
D18	REVSC	Span H/L Limit Reverse
D19	CFGERR	Configuration Error
D22	DMVH	MV Positive Rate Limit Alarm
D23	DMVL	MV Negative Rate Limit Alarm
D25	AOF	Suppress Alarm

3.12.4 Application Example

Two liquids should be mixed by a ratio of $F2/F1=1.4$ to produce a new product. Suppose the flow $F1$ is measured by tag FL001 and $F2$ is measured by tag FL002, the valve is controlled by FC001.

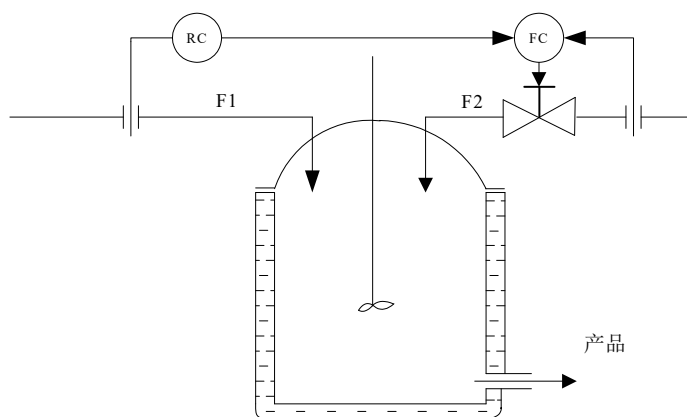


Figure 3.40 Ratio control diagram

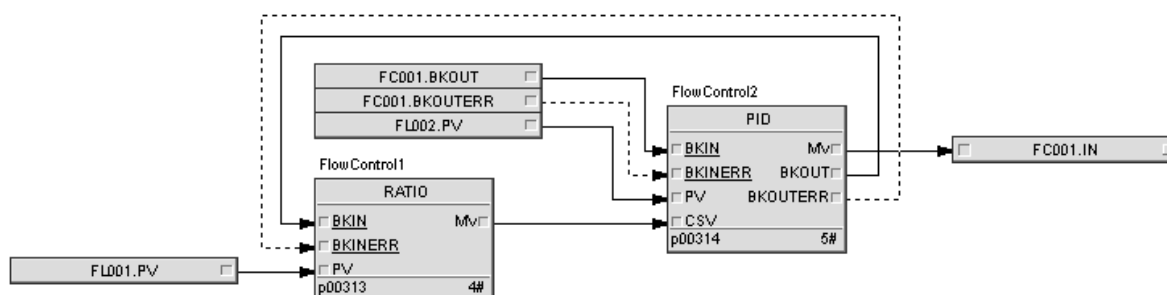


Figure 3.41 Ratio control program

RATIO function block parameter setting (set in the function block properties settings interface).

FlowControl1

- CSV: 1.4
- SVEU: m^3/s
- SVSCH: (= range H value of tag FL001)
- SVSCL: (= range L value of tag FL001)
- MVEU: m^3/s
- MVSCH: (= range H value of tag FL002)
- MVSCL: (= range L value of tag FL002)
- Function block parameter setting (set in the function block properties settings interface).

FlowControl2

- SWPN: ON(reverse action)
- SVEU: m^3/s
- SVSCH: (= range H value of tag FL002)
- SVSCL: (= range L value of tag FL002)
- MVEU: %
- Default values of other parameters keep unchanged.

When debugging program, first invoke the function block panel and open the adjusting interface. If the function block is in IMAN mode, review the tag information of FC001, and adjust the status of FC001 until FC001.BKOUTERR=OFF, and the FlowControl2 is in MAN mode.

It can be switched manually.

During industrial manufacture, technically there always have 2 or more materials mixed proportional, wrong proportion will influence manufacture or cause accident. The control system achieving the proportion for 2 or more parameters is ratio control system.

The master parameter (master momentum) G1 in ratio control system, is leading and not controlled by ratio control system. The subordinate and controlled material is slave parameter (slave momentum). Values are controlled to keep $G2 / G1 = K$, i.e. change slave parameter to reach the ratio with master parameter.

Ratio control system can be divided into single closed loop ratio control system and dual-closed loop ratio control system by whether the master parameter is adjustable, or divided into static ratio control system and change ratio control system by whether the ratio K is adjustable.

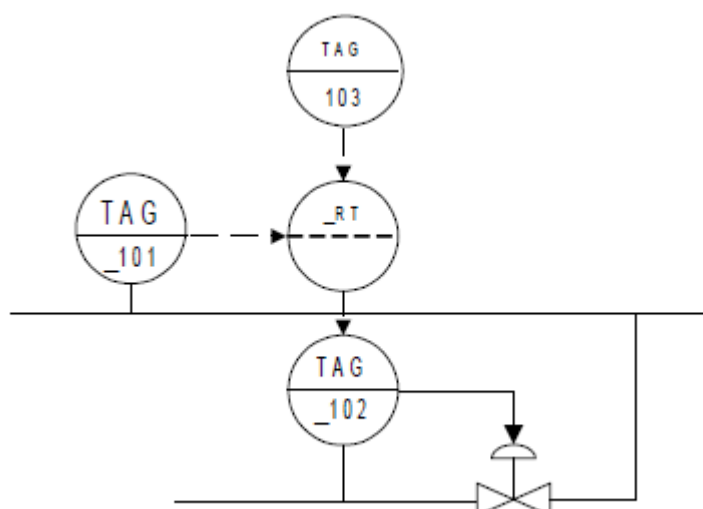


Figure 3.42 Ratio control

The program is shown in Figure 3.43, which can apply RATIO and PIDEX.

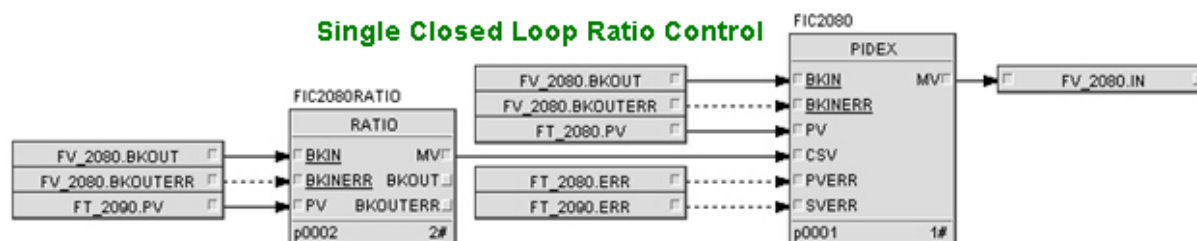


Figure 3.43 Building ratio control program

Function block instruction and example are shown below:

No.	Example	Type	Instruction	Remarks
001	FV_2080	AO output	Analog output tag	
002	FT_2080	AI input	Slave momentum analog input tag	
003	FT_2090	AI input	Master momentum analog input tag	
004	FIC2080RATIO	Function block tag	Proportion control function block tag	
005	FIC2080	Function block tag	PID control function block tag	Reference loop in graphics

Parameter settings for PIDEX function block:

- SVSCL, SVSCH, SVEU: same with other input PV range unit.
- SVL, SVH: same with SV range if no need SV limit function.
- MODE_OPT: OFF

Parameter settings for RATIO function block:

- SVSCL, SVSCH, SVEU: same (unit) with MVSCL, MVSCH, MVEU. Same input PV range and unit are recommended with PID function block.
- MVL, MVH: same range with MV.
- MODE_OPT: OFF
- MAN_OPT: ON
- PSWAM: ON

Alarm settings:

- When slave momentum (i.e. PID function block) input PV fault, the PID loop enters into PVERR status, and the loop enters into manual status automatically, PID output MV keeps the same.
- When master momentum (i.e. RATIO function block) input PV fault, the PID loop enters into SVERR status, and the loop will enter into auto status automatically if in cascade status, PID SV keeps the same.
- Input PV second level H/L alarm of master and slave momentums are set as required in RATIO and PID function blocks. Set the deviation alarm for PID loop as required if have valve position feedback. Disable other alarms.

BKIN should connect the down stream function block BKOUT, BKINERR should connect the down stream function block BKOUTERR. The down stream function block of proportion control function block RATIO is PID function block. The down stream function block of PID function block is AO tag.

Note:

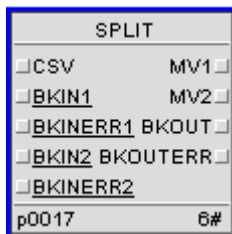
Control panel can call function block name in HMI directly.

3.13 Split Control Function Block (SPLIT)

The input signal is allocated by split control function block according to range of the two output. It only has the control output action of position type.

It is a complex function block and its running time is 50μs.

Please refer to the "Overview" and "Application Foundation of Control Function Block" before using the function block.



3.13.1 Parameter Description

Table 3.49 Parameter description and application of SPLIT Function Block

Name			Description	Upload	Properties	Application Reference
Basic Parameters	Range-Settings	SVSCH	SV high scale	-	Configuration Parameter	Make sure that SVSCH be greater than SVSCL.
		SVS-CL	SV low scale	-	Configuration Parameter	Make sure that SVSCH be greater than SVSCL.
		MVSCH1	MV1 high value	-	Configuration Parameter	The same as MV1 actual value H limit.
		MVS-CL1	MV1 low value	-	Configuration Parameter	The same as MV1 actual value L limit.
		MVSCH2	MV2 high value	-	Configuration Parameter	The same as MV2 actual value H limit.
		MVS-CL2	MV2 low value	-	Configuration Parameter	The same as MV2 actual value L limit.
		SVEU	SV engineer unit	-	Configuration Parameter	Set in the function block properties settings interface.
		MVEU1	MV1 actual value unit	-	Configuration Parameter	Set in the function block properties settings interface.

Table 3.49 Parameter description and application of SPLIT Function Block (continued)

Name			Description	Upload	Properties	Application Reference
		MVEU2	MV2 actual value unit	-	Configuration Parameter	Set in the function block properties settings interface.
		SVDLEN	SV decimal digits [0,5]	-	Configuration Parameter	Used for data displayed on function block panel (equal to 3 as default).
		MVDLEN1	MV1 decimal digits [0,5]	-	Configuration Parameter	Used for data displayed on function block panel (equal to 3 as default).
		MVDLEN2	MV2 decimal digits [0,5]	-	Configuration Parameter	Used for data displayed on function block panel (equal to 3 as default).
	Output Action Limit Setting	SRH1	Output1 action maximum	-	Configuration Parameter	Refer to ^{Note1, 3}
		SRL1	Output1 action minimum	-	Configuration Parameter	Refer to ^{Note1, 3}
		SRH2	Output2 action maximum	-	Configuration Parameter	Refer to ^{Note1, 3}
		SRL2	Output2 action minimum	-	Configuration Parameter	Refer to ^{Note1, 3}
	Limits	MVH1	MV1 H limit value	TRUE	Operation Parameter	Value range [MVS-CL,MVSCH]
		MVL1	MV1 L limit value	TRUE	Operation Parameter	Value range [MVS-CL,MVSCH]
		MVH2	MV2 H limit value	TRUE	Operation Parameter	Value range [MVS-CL,MVSCH]
		MVL2	MV2 L limit value	TRUE	Operation Parameter	Value range [MVS-CL,MVSCH]
		SVH	SV H limit value	TRUE	Operation Parameter	Value range [SVS-CL,SVSCH]
		SVL	SV L limit value	TRUE	Operation Parameter	Value range [SVS-CL,SVSCH]
	Direct/Reverse	SWPN1	Output 1Direct/Reverse switch. SV is not changed, the	TRUE	Operation Parameter	SWPN1 = OFF, direct, SWPN1 = ON, reverse.

Table 3.49 Parameter description and application of SPLIT Function Block (continued)

Name			Description	Upload	Properties	Application Reference
	Switch Settings		MV increases with the increasing of PV in direct action, and decreases with the increasing of PV in reverse action.			
		SW-PN2	Output 2Direct/Reverse switch. SV is not changed, the MV increases with the increasing of PV in direct action, and decreases with the increasing of PV in reverse action.	TRUE	Operation Parameter	SWPN2 = OFF, direct, SWPN2 = ON, reverse.
Extended Parameters	Base Input Pin Settings	CSV	Cascade	-	Input Pin	Connect to outer loop control value MV
		BKIN1	Feedback value1 input	-	Input Pin	Connect to downstream BKOUT
		BKIN-ERR1	Feedback status1 input	-	Input Pin	Connect to downstream BKOUTERR
		BKIN2	Feedback value2 input	-	Input Pin	Connect to downstream BKOUT
		BKIN-ERR2	Feedback status2 input	-	Input Pin	Connect to downstream BKOUTERR
		TV1	Track input value 1	-	Input Pin	Connect to measuring point AI
		TV2	Track input value 2	-	Input Pin	Connect to measuring point AI
		SWTR	Track switch: OFF=not track, ON=track	-	Input Pin	Upstream interlock condition input, Related parameter: TV
	Advance Input Pin Settings	PSWAM	Program manual and auto control switch, OFF=program manual control, ON=program auto control	-	Input Pin	Connect the upstream output Enabled when MAN_ - OPT=ON
		PSWSV	Program auto/ cascade control switch, OFF= SV, ON=CSV	-	Input Pin	Connect the upstream outputenabled when SV_ OPT=ON
		MAN_ - OPT	Manual-automatic control source	-	Input Pin	Connect the upstream outputRelated

Table 3.49 Parameter description and application of SPLIT Function Block (continued)

Name			Description	Upload	Properties	Application Reference
			switch, ON= manual-automatic selection controlled by PSWAM, OFF= manual-automatic selection controlled by SWAM			parameter: PSWAM, SWAM
		SV_-OPT	Auto/Cascade control source selection, ON= auto/cascade selection controlled by PSWSV, OFF= auto/cascade selection controlled by SWSV	-	Input Pin	Connect the upstream outputRelated parameter: PSWSV, SWSV
	Output Pin	MV1	PID operation output value 1	-	Output Pin	Connect to electric manual instrument-Refer to ^{Note1}
		MV2	PID operation output value 2	-	Output Pin	Connect to electric manual instrument-Refer to ^{Note1}
		BKOUT	Feedback output value	-	Output Pin	Connect to the BKIN of Upstream Block, Related parameter: BK_OPT
		BKOUTERR	Feedback status value	-	Output Pin	Connect to the BKIN-ERR of Upstream Block
	Operator Command	MODE	Work mode	-	Monitoring Parameter	Refer to Transition Process of Function Block Modes
		IMODE	Standby work mode	-	Monitoring Parameter	Refer to Transition Process of Function Block Modes
		MODE_-OPT	ON=auto return, OFF=manual return (default)	-	Configuration Parameter	Refer to Transition Process of Function Block Modes
		SWAM	Manual and auto switch: OFF=manual, ON=auto	-	Operation Parameter	Enabled when MAN_-OPT=OFF
		SWSV	Auto/ cascade selection: OFF=auto, ON=cascade	-	Operation Parameter	Enabled when SV_-OPT=OFF
	Operator Data	MAN-MV1	Manual output value1	-	Operation Parameter	Output value= MAN-MV in manual mode

Table 3.49 Parameter description and application of SPLIT Function Block (continued)

Name			Description	Upload	Properties	Application Reference
		MAN-MV2	Manual output value2	-	Operation Parameter	Refer to Note1
		SV	SV	TRUE	Operation Parameter	Value range [SVS-CL,SVSCH]
	Advance Calculation Settings	SW	Signal distribution switch	TRUE	Operation Parameter	Refer to Note2
		RP1	Balance ramp coefficient1	TRUE	Operation Parameter	Related parameter: SW
		RP2	Balance ramp coefficient2	TRUE	Operation Parameter	Related parameter: SW
		RP_-OPT	Balance ramp mode	TRUE	Operation Parameter	Refer to note 6
		SVRG_-OPT	SV range convert option:0=no convert,1=convert by percent	-	Configuration Parameter	0 by default.
		BK_-OPT	BKOUT value selection mode: 0=track and hold1=track the first cut	-	Configuration Parameter	Refer to Note 8.
	Alarm	SVHIND	SV H limit alarm indication	-	Monitoring Parameter	Refer to Integral Cutting
		SVLIND	SV L limit alarm indication	-	Monitoring Parameter	Refer to Integral Cutting
		MV1HINDMV1HAlarm		-	Monitoring Parameter	Refer to Integral Cutting
		MV1LIND MV1LAlarm		-	Monitoring Parameter	Refer to Integral Cutting
		MV2HINDMV2HAlarm		-	Monitoring Parameter	Refer to Integral Cutting
		MV2LIND MV2LAlarm		-	Monitoring Parameter	Refer to Integral Cutting
	Extended Range Settings	HOR-LIM1	Output 1Extended range maximum percentage	-	Configuration Parameter	Refer to Output Process
		LOR-LIM1	Output 1Extended range minimum percentage	-	Configuration Parameter	Refer to Output Process

Table 3.49 Parameter description and application of SPLIT Function Block (continued)

Name			Description	Upload	Properties	Application Reference
		HOR-LIM2	Output 2Extended range maximum percentage	-	Configuration Parameter	Refer to Output Process
		LOR-LIM2	Output 2Extended range minimum percentage	-	Configuration Parameter	Refer to Output Process
	Alarm Enabled and Suppress	AOF	Suppress module alarm,, On=prohibit to display alarm	TRUE	Operation Parameter	Refer to Integral Cutting
		ENALM	Alarm enable	TRUE	Alarm Parameter	Refer to Integral Cutting
		FLAG	Flag	-	Output Pin	Refer to Integral Cutting
	OOS Settings	SWOOS	Function block disabled	TRUE	Operation Parameter	Set as ON at the first time of function block downloadingRefer to Note5
		OOS-VAL1	OOS mode safe value 1	TRUE	Operation Parameter	Related parameter: OOS_OPT=ON
		OOS-VAL2	OOS mode safe value 2	TRUE	Operation Parameter	Related parameter: OOS_OPT=ON
		OOS_OPT	OOS mode output value type. when OOS_OPT =ON, MV=OOSVAL, when OOS_OPT =OFF, maintain the MV	-	Configuration Parameter	Refer to About

Note 1. Calculate output value

The two output values MV1 and MV are calculated by SPLIT function block according to SV. Users can preset range of the output value (SRH1, SRL1, SRH2, SRL2) according to SV. The range of output value must be in the range of SV and SRH1>SRL1, SRH2>SRL2, SRL1=SVSCL, SRH2=SVSCH.

MV1 and MV2 can be calculated by the following expression:

$$MV_i = CALC_i + BL_i(n)$$

When MV is increase output:

$$CALC_i = MVSCL_i + \frac{MVSCH_i - MVSCL_i}{SRH_i - SRL_i} * (SV - SRL_i)$$

When MV is decrease output:

$$CALC_i = MVSCH_i - \frac{MVSCH_i - MVSCL_i}{SRH_i - SRL_i} * (SV - SRL_i)$$

i=1 or 2, and $BL_i(n)$ is balance item.

Note 2. Selection Switch (Signal allocation switch)

The function block calculates output value of each output pin according to SV and allocates signals to output terminals. And output pin can be specified by signal allocation switch.

When SW=0, signal allocation is stopped;

When SW=1, only MV1 is allocated signal;

When SW=2, only MV2 is allocated signal;

When SW=3, the two output pin are allocated signal.

Output pin not selected by SW tracks TV value.

Note 3. Control movement direction

Direct movement: Output value MV changes in the same direction with set value SV.

Reverse movement: Output value MV changes in the reverse direction with set value SV.

Note 4. Limit set value

Set value SV is limited between high limit of set value SVH and low limit of set value SVL.

Low limit of output 1 movement is equal to low limit of set value range;

High limit of output 2 movement is equal to high limit of set value range;

High limit of output 1 movement is less than or equal to high limit of set value range;

Low limit of output 2 movement is less than or equal to low limit of set value range.

Note 5. SV fallback

SV fallback function is used to keep set values consistent for bumpless transfer. In auto and manual mode, CSV is equal to SV. In cascade mode, SV is equal to CSV.

When only one used to output, if it is in auto or manual mode, set value is reversely calculated by manual value.

When two channels used to output, if it is in the mode of manual or track, set value is reversely calculated by manual value of two channels. If differential value between reversely calculated SV and SV is smaller than 1% of the range, reversely calculated SV fallbacks, otherwise does not fallback.

When MV is direct output:

$$SV_i = \frac{(MV_i - MVSCL_i) * (SRH_i - SRL_i)}{(MVSCH_i - MVSCL_i)} + SRL_i$$

When MV is reverse output:

$$SV_i = \frac{(MVSCH_i - MV_i) * (SRH_i - SRL_i)}{(MVSCH_i - MVSCL_i)} + SRL_i$$

i=1 or 2.

Note 6 Balanced ramp mode selection

RP_OPT =0, normal mode, split function block switch from other modes to AUTO or Cascade mode, and the output ramps according to the set balanced ramp coefficient.

RP_OPT =1, apart from normal mode, the handoperator's working mode in the downstream switch from MANUAL to AUTO, and the output also ramps according to the set balanced ramp coefficient.

Note 7. Mode process

When SWOOS is OFF, if BKINERR1 and BKINERR2 are ON, the function block is in IMAN mode; if one of them is OFF, the function block will be change to other valid mode from IMAN. Output of the one with value OFF is in manual mode and output value of the one with value ON tracks corresponding BKIN value.

Note 8 BKOUT Selection

- BK_OPT=0, track and hold
When the cascaded tag of SPLIT function block changes from MAN to AUTO, SPLIT does not track its output value.
- BK_OPT=1, track its cascaded function block that first changes state to AUTO
When the two function blocks connected to 2 MV parameters are both in MAN status, SPLIT tracks the output vlaue of the function block that first changes to AUTO state. The logic of this selection is explained below:

1. Add a user program as shown in the figure below. Right-click SPLIT function block to set its properties.

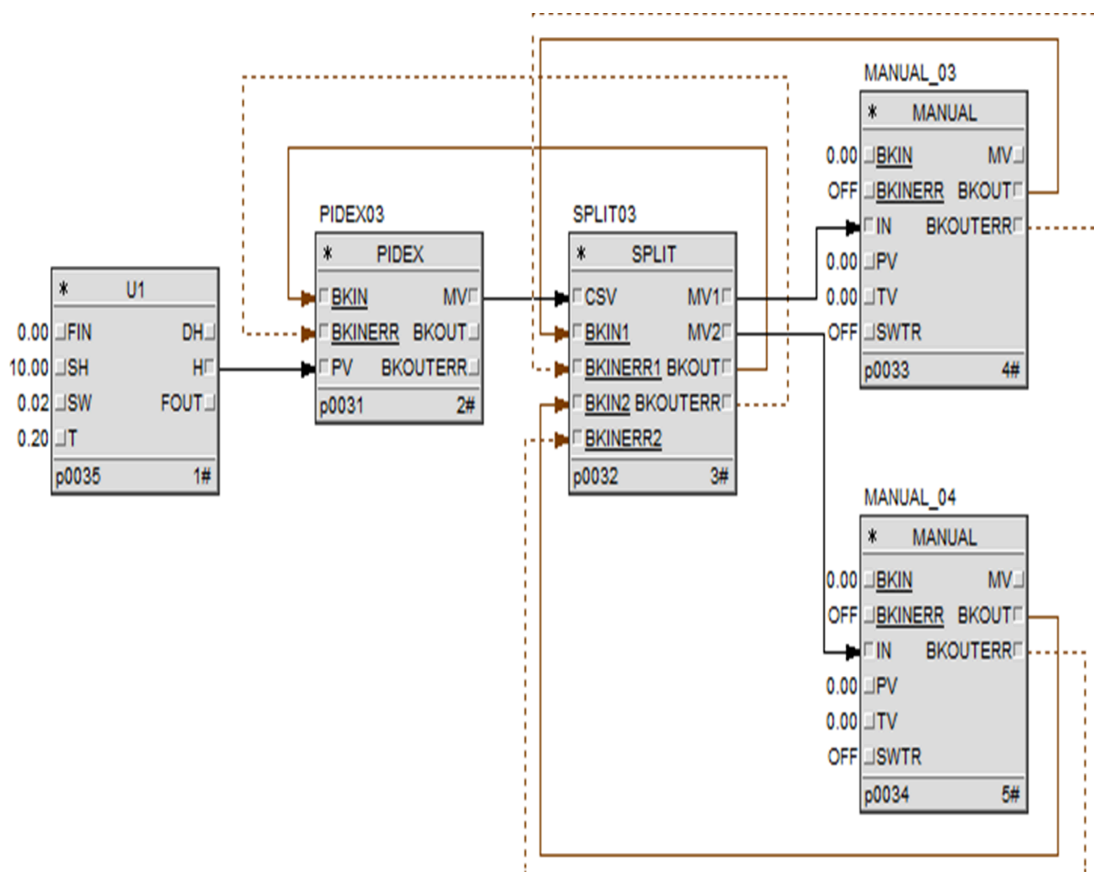


Figure 3.44 User program



2. Set the following parameters:
SRH1=50.0, SRL1=0.00, SRH2=100.00, SRL2=50.00, as well as set the range of MV1 and MV2 both as 0.00 to 100.00.
Set reverse action for MANUAL_03 and direct action for MANUAL_04.
3. In VFExplorer, click  on the toolbar. After download, open user program window.
4. Click  on the toolbar to adjust the status and parameters.

Table 3.50 Function block status and parameters (1)

Function Block Name	MODE	MV/CSV	MV1	MV2
PIDE03	AUTO	38.25	/	/
SPLIT03	CAS	38.25	23.5	0.00
MANUAL_03	AUTO	23.5	/	/
MANUAL_04	AUTO	0	/	/

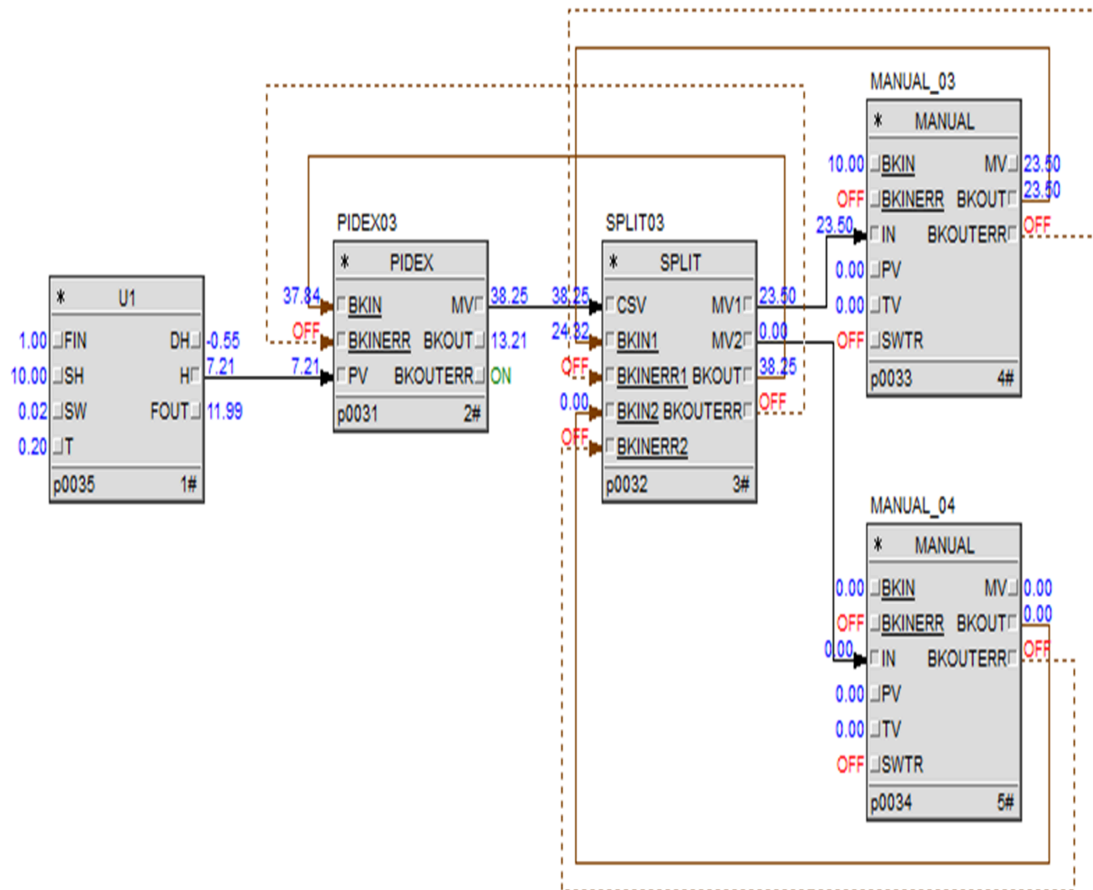


Figure 3.45 MANUAL function blocks are all in AUTO state

5. Modify MANUAL_03 tag to MAN status and MV to 20.00.

Table 3.51 Function block status and parameters (2)

Function Block Name	MODE	MV/CSV	MV1	MV2
PIDEX03	AUTO	73.24	/	/
SPLIT03	CAS	73.24	20.00	46.49
MANUAL_03	MAN	20.00	/	/
MANUAL_04	AUTO	46.49	/	/

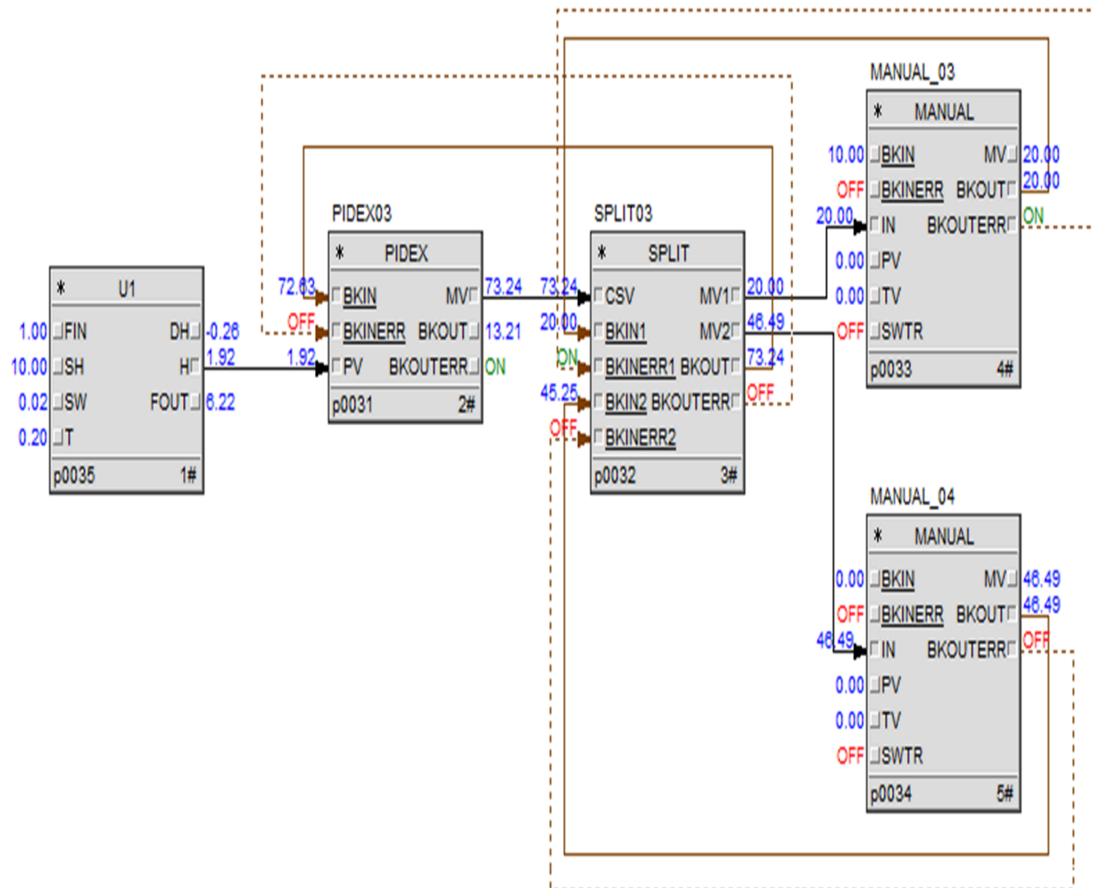


Figure 3.46 MANUAL_03 is in MAN state

- Modify MANUAL_04 to MAN status and SPLIT03 to IMAN status.

Table 3.52 Function block status and parameters (3)

Function Block Name	MODE	MV/CSV	MV1	MV2
PIDE03	IMAN	72.63	/	/
SPLIT03	IMAN	73.24	20.00	46.49
MANUAL_03	MAN	20.00	/	/
MANUAL_04	MAN	78.25	/	/

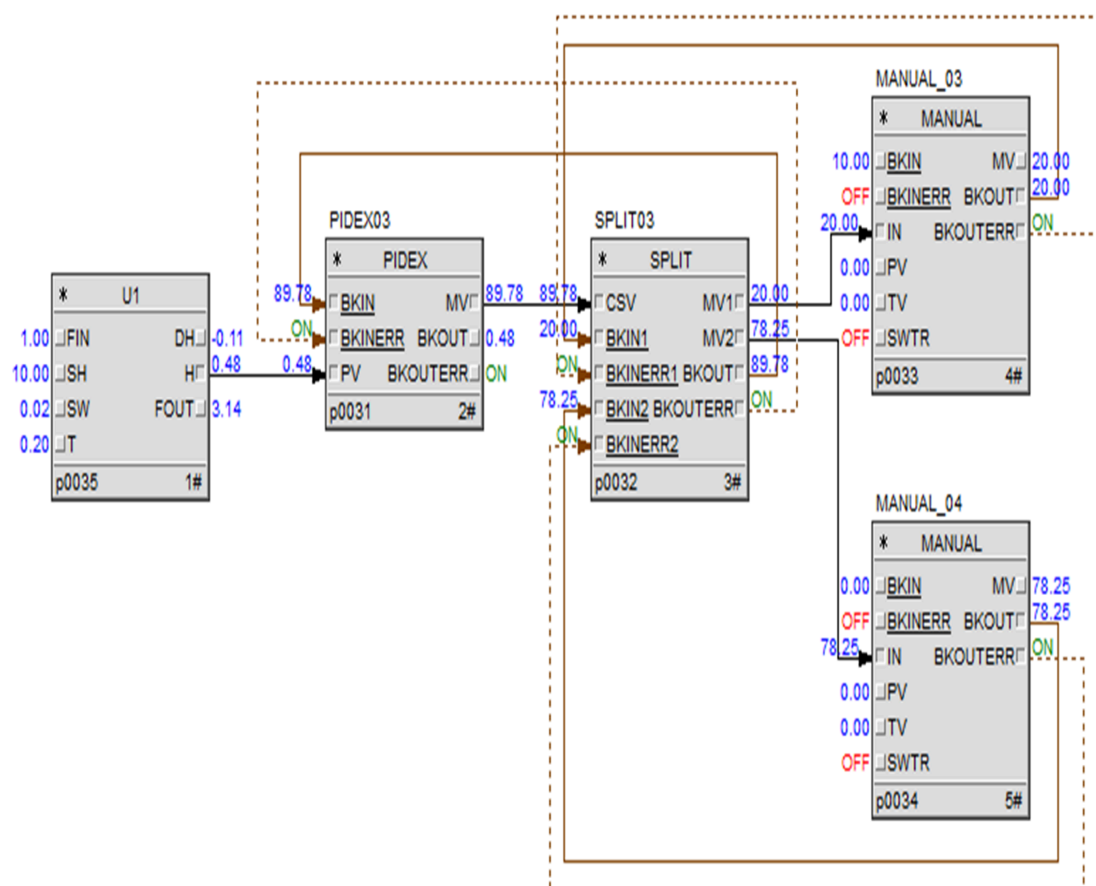


Figure 3.47 MANUAL_04 is in MAN state

- Set MANUAL_03 to AUTO status, SPLIT03 to CAS, PIDE03 to AUTO.

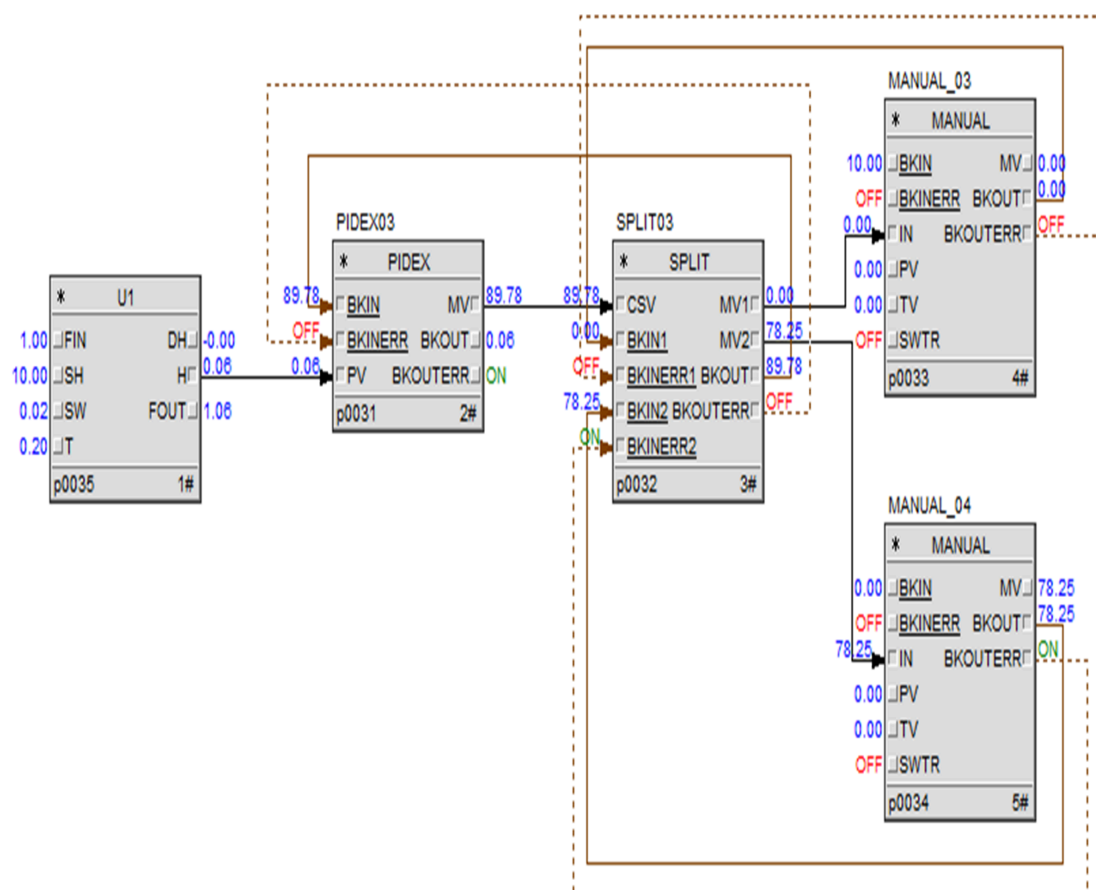


Figure 3.48 MANUAL_03 is in AUTO state

CSV of SPLIT03 is 89.78, so MV1 is still 0.00.

8. Switch PIDEX03 to MAN status. Modify MV of PIDEX03 to 20. SPLIT03 tracks MANUAL_03. The calculation is like: $(50.00-20.00)/50.00*100.00$. The real-time values is shown in the figure below.

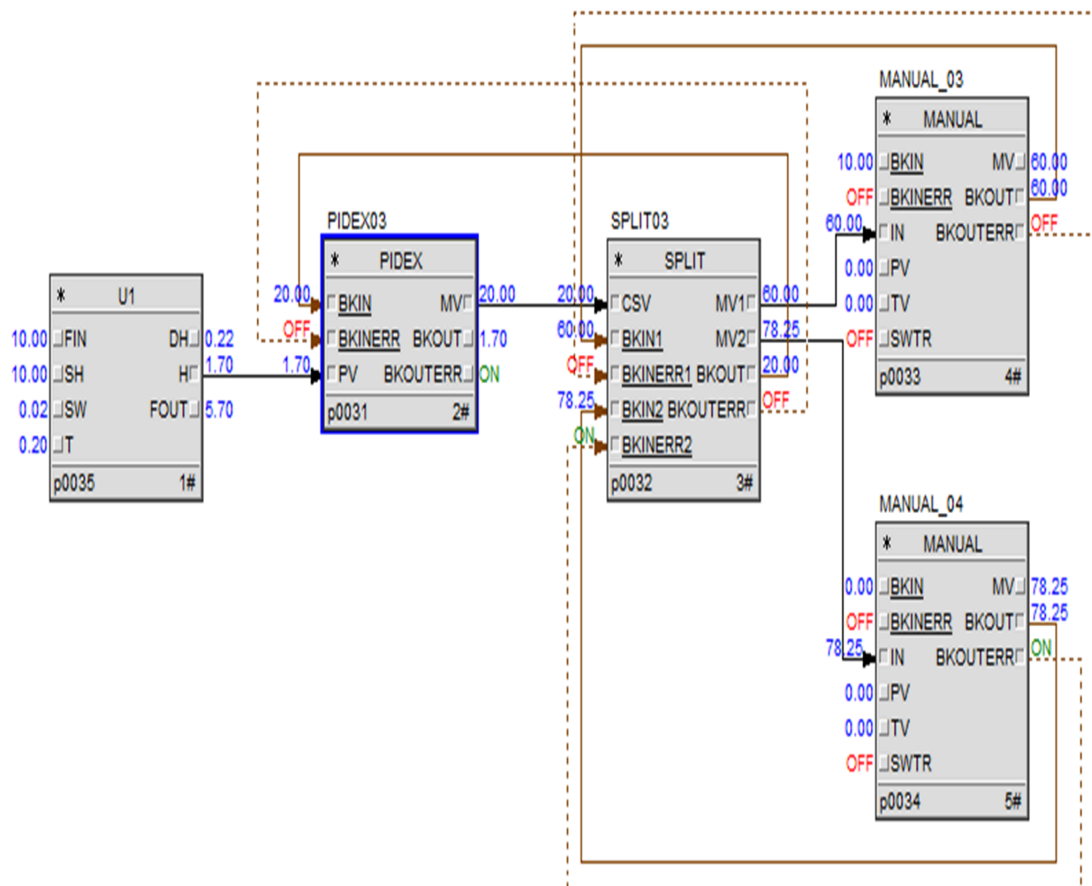
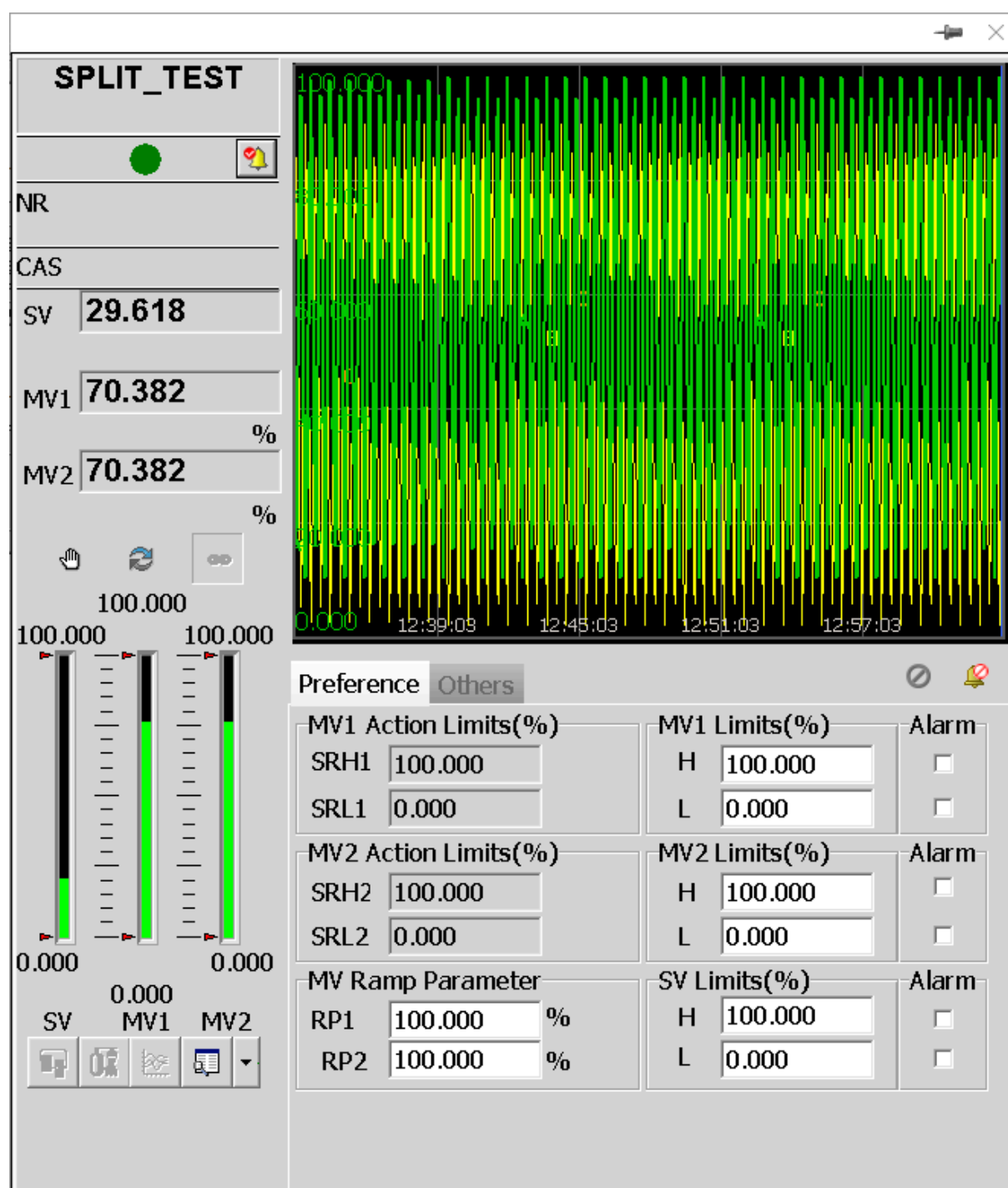


Figure 3.49 SPLIT tracks MANUAL_03

3.13.2 Panel Parameter



The screenshot shows a software interface with a 'Preference' tab selected. The interface is divided into several sections:

- Output Option:** Contains four checkboxes: 'Output 1' (unchecked), 'Output 2' (unchecked), 'Both' (checked), and 'Neither' (unchecked).
- MAN_OPT:** Contains two checkboxes: 'Panel' (checked) and 'Program' (unchecked).
- SV_OPT:** Contains two checkboxes: 'Panel' (unchecked) and 'Program' (checked).
- TR1 and TR2:** Each has a text input field set to '0.000' followed by a '%' symbol.
- Output 1:** Contains two checkboxes: 'Direct' (unchecked) and 'Reverse' (checked).
- Output 2:** Contains two checkboxes: 'Direct' (unchecked) and 'Reverse' (checked).

Figure 3.50 Parameter Graph

Table 3.53 Operation Instruction for Panel Parameter

Panel Parameter Name			Function BlockParameter Name	Initial Value	Value Range	Application Instruction
Preference	MV1 Action-Limits (%)	SRH1	SRH1	100.000	-	Output1 action-maximum
		SRL1	SRL1	0.000	-	Output1 actionminimum
	MV2 Action Limits (%)	SRH2	SRH2	100.000	-	Output2 action maximum
		SRL2	SRL2	0.000	-	Output2 action minimum
	SV Limits (%)	H	SVH	100.000	[SVS-CL,SVSCH]	H value setting of loop SV (select alarm enabled, or it is disabled). Note: SV limit is not affected by selection.
		L	SVL	0.000	[SVS-CL,SVSCH]	L value setting of loop SV (select alarm enabled, or it is disabled). Note: SV limit is not affected by selection.
	MV1 Limits (%)	H(MVH1)	MVH1	100.000	[MVS-CL,MVSCH]	H value setting of loop MV1 (select alarm enabled, or it

Table 3.53 Operation Instruction for Panel Parameter (continued)

Panel Parameter Name			Function BlockParameter Name	Initial Value	Value Range	Application Instruction
						is disabled). Note: MV limit is not affected by selection.
		L(MVL1)	MVL1	0.000	[MVS-CL,MVSCH]	L value setting of loop MV1 (select alarm enabled, or it is disabled). Note: MV limit is not affected by selection.
		H(MVH2)	MVH2	100.000	[MVS-CL,MVSCH]	H value setting of loop MV2 (select alarm enabled, or it is disabled). Note: MV limit is not affected by selection.
	MV2 Limits(%)	L(MVL2)	MVL2	0.000	[MVS-CL,MVSCH]	L value setting of loop MV2 (select alarm enabled, or it is disabled). Note: MV limit is not affected by selection.
	MV Ramp Parameter Settings	RP1	RP1	100.000	-	Balance ramp coefficient1
		RP2	RP2	100.000	-	Balance ramp coefficient2
Others	Output Option	Output 1	SW	-	-	Related parameter: SW, SW=1, distributed to MV1. MV2 tacks TV2.
		Output 2	SW	-	-	Related parameter: SW, SW=2, distributed to MV2. MV1 tacks TV1.
		Both	SW	√	-	Related parameter: SW, SW=3, distributed to two output points.
		Neither	SW	-	-	Related parameter: SW,SW=0,S-top signal distribution
	MAN_OPT Settings	Panel	MAN_OPT	√	-	OFF=Panel control
		Program	MAN_OPT	-	-	ON=Program control

Table 3.53 Operation Instruction for Panel Parameter (continued)

Panel Parameter Name			Function Block Parameter Name	Initial Value	Value Range	Application Instruction
	SV_OPT Settings	Panel	SV_OPT	-	-	OFF=Panel control
		Program	SV_OPT	√	-	ON=Program control
	TV	TV1	TV1	0.000	-	Track input value 1
		TV2	TV2	0.000	-	Track input value 2
	Output 1	Direct	SWPN1	-	-	Output 1 direct/reverse selection: OFF=Direct
		Reverse	SWPN1	√	-	Output 1 direct/reverse selection: ON=Reverse
	Output 2	Direct	SWPN2	-	-	Output 2 direct/reverse selection: OFF=Direct
		Reverse	SWPN2	√	-	Output 2 direct/reverse selection: ON=Reverse

3.13.3 Flag

Table 3.54 Flag List

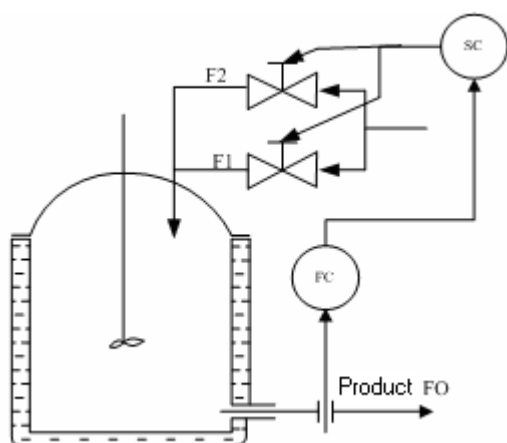
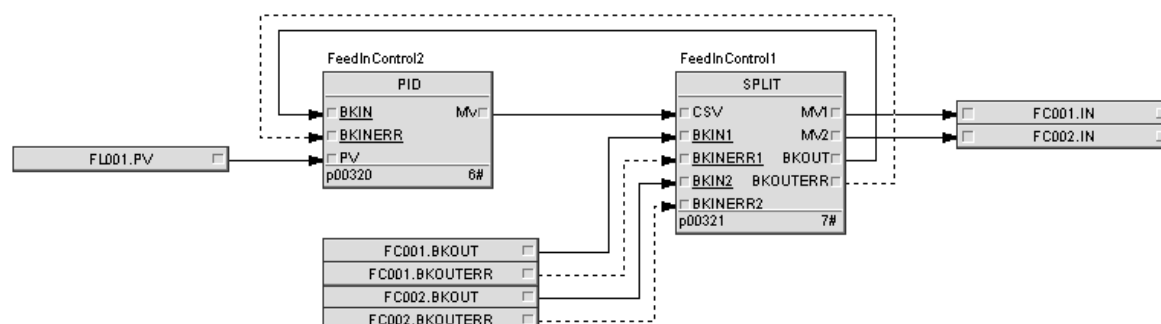
Flag	Alarm	Description
D0	OOS	Disable
D1	IMAN	Initialize Manually
D2	MAN	Manual
D3	TR	Track
D4	AUTO	Auto
D5	CAS	Cascade
D8	MVH1	Output 1 H Limit Alarm
D9	MVL1	Output 1 L Limit Alarm
D10	MVH2	Output 2 H Limit Alarm
D11	MVL2	Output 2 L Limit Alarm
D12	SVH	SV H Limit Alarm

Table 3.54 Flag List (continued)

Flag	Alarm	Description
D13	SVL	SV L Limit Alarm
D18	REVSC	Span H/L Limit Reverse
D19	CFGERR	Configuration Error
D25	AOF	Suppress Alarm

3.13.4 Application Example 1

It controls input based on the product output flow in the reaction kettle, and applies two control valves to ensure the control precision and fast reaction of the valve. The valve for F1 controls via tag FC001 and is a precision adjust valve. The valve for F2 controls via tag FC002 and is a rough adjust valve. FO measures via tag FL001.

**Figure 3.51 Split control diagram****Figure 3.52 Split control program**

Split function block parameter setting (set in the function block properties settings interface).

FeedInControl1

- SRH1: 30
- SRL2: 20
- SVEU: %
- MVEU1: %
- MVEU2: %
- Default values of other parameters keep unchanged.

FeedInControl2

- SWPN: ON(reverse action)
- SVEU: m^3/s
- MVEU: %
- Default values of other parameters keep unchanged.

After download, exit FeedInControl1 and FeedInControl2 from OOS mode, debug FeedInControl1 first and then debug FeedInControl2.

When debugging program, first invoke the function block panel and open the adjusting interface. If the function block is in IMAN mode, review the tag information of FC001 and FC002, and adjust the status of FC001 and FC002 until FC001.BKOUTERR=OFF, FC002.BKOUTERR=OFF, and the FlowControl2 is in MAN mode, as shown below. It can be switched manually.

3.13.5 Application Example 2

In the split control scheme of distributing head shown in Figure 3.53, the adjust object is gas-distributing pressure, executor is enter steam valve (valve A) and vent valve (valve B).

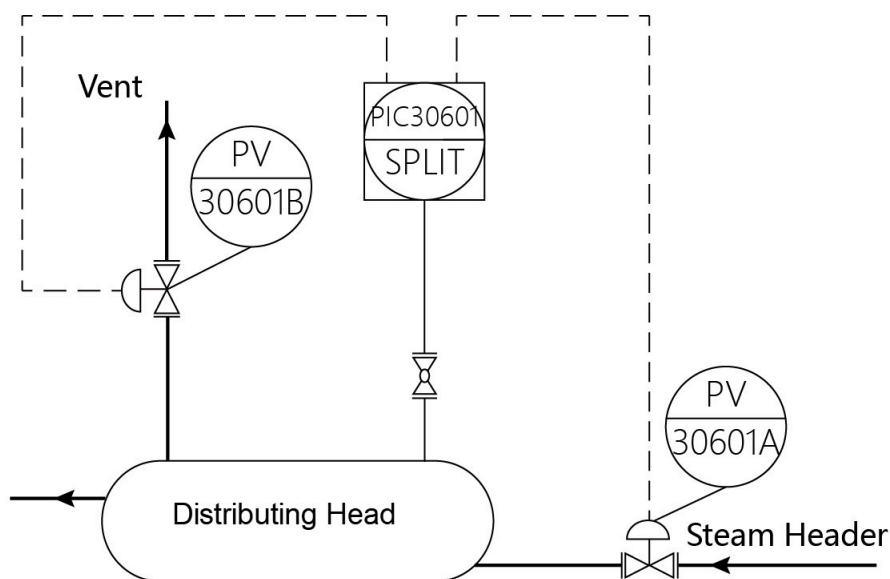


Figure 3.53 Split control diagram

The action curve is shown below. When PID adjuster outputs 0~50%, valve A acts from wholly open to wholly closed, valve B is wholly closed. When PID adjuster outputs 50~100%, valve A is wholly open, and valve B acts from wholly closed to wholly open.

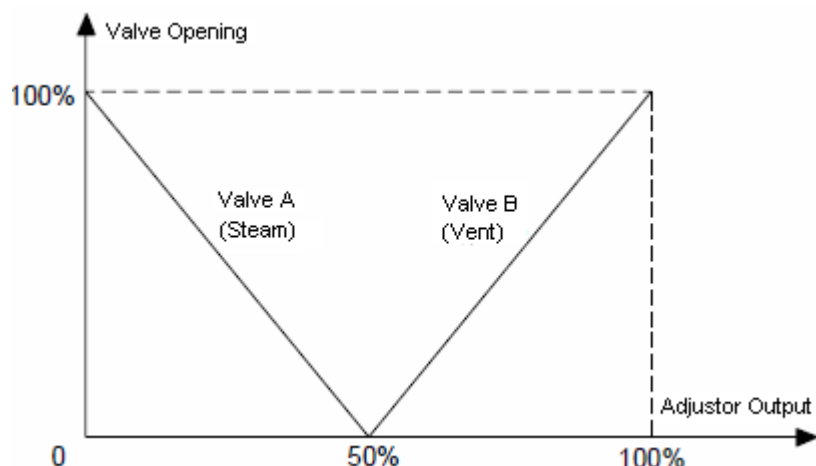


Figure 3.54 Pressure adjusting rules of PIC_30601 distributing head

Build Program

The program can be built by PIDEK (extended PID control function block), SPLIT (split control function block) and MANUAL (handheld function block). The split point of SPLIT can be set in range 0-100%. Details are shown below.

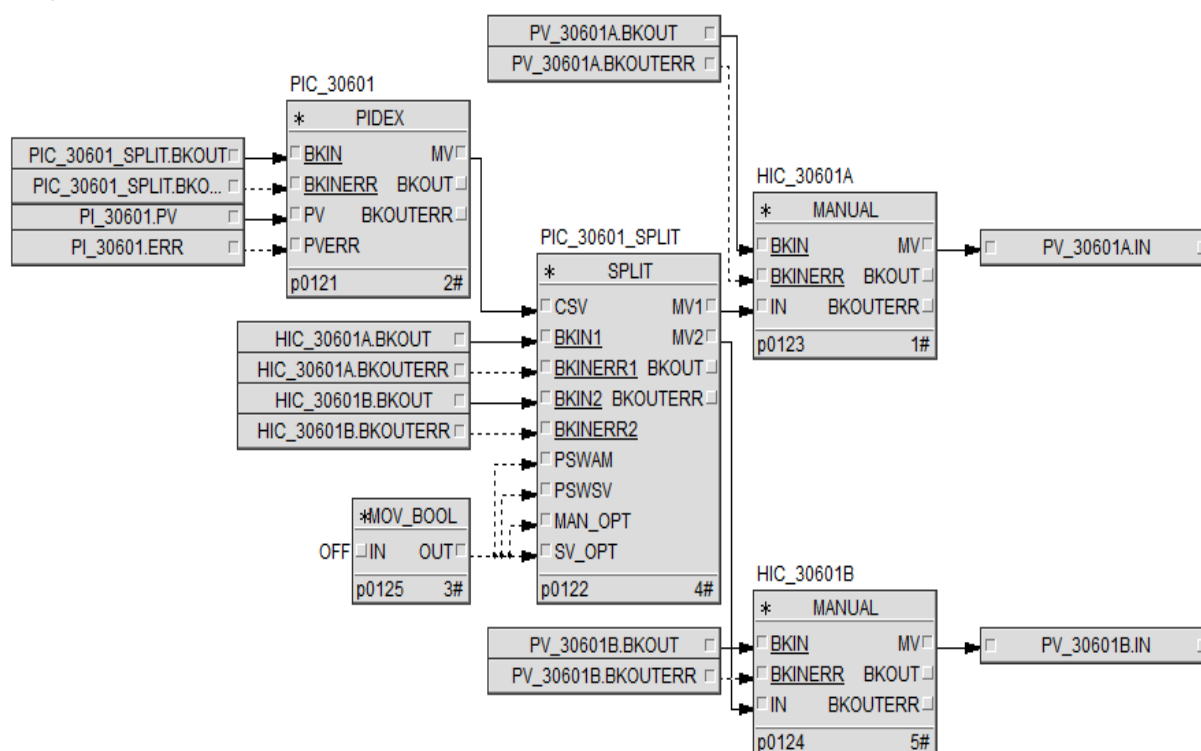


Figure 3.55 Build split control program

Instruction for function block and examples are shown below:

Table 3.55 Instruction for function block and examples

No.	Example	Type	Instruction
01	PI_30601	AI Input	PV Measuring Value
02	PV_30601A	AO Output	A Valve Control
03	PV_30601B	AO Output	B Valve Control
04	PIC_30601	Function Block Tag	PID Function Block Tag
05	PIC_30601_SPLIT	Function Block Tag	Split Control Function Block Tag
06	HIC_30601A	Function Block Tag	A Valve Handheld Function Block
07	HIC_30601B	Function Block Tag	B Valve Handheld Function Block

Parameter Settings

- PIDEX Function Block Parameter Settings:
Positive and negative actions should be set as SWPN=OFF (positive).
 - SV range L limit SVSCL, high value SVSCH, unit SVEU, should be same with PV range unit.
 - MV range L limit MVSCL, high value MVSCH, unit MVEU, keep the default 0~100% for adjusting valve.
 - SV L limit SVL, H limit SVH, should be same with SV range if SV limit function is not required, or SV can be set in 0~100.
 - MV L limit MVL, H limit MVH, keep the default 0 and 100 for adjusting valve if MV limit function is limited;
 - Select PID_OPT as PID type, keep the default PD_I mode (i.e. PID_OPT=2, proportion differential in advance).
 - Back mode MODE_OPT keeps the default manual (i.e. MODE_OPT=OFF).
 - Internal/ external set control source SV_OPT keeps the default program control (SV_OPT=ON). Note: SV_OPT settings for above parameters are used to avoid mistake setting loop as “Cascade” mode on panel.
- SPLIT Function Block Parameter Settings:
 - Set operation parameter SWPN1 (output 1 positive/ negative actions select) of basic parameter as negative (i.e. SWPN1=ON), operation parameter SWPN2 (output 2 positive/ negative actions select) as positive (i.e. SWPN2=OFF).
 - Operation action 1 L limit SRL1 applies default value 0, H limit SRH1 is set as split point 50. Operation action 2 L limit SRL2 is set as split point 50, H limit SRH2 applies default value 100.

- 2-channel output range L limits MVSCL1 and MVSCL2, H limits MVSCH1 and MVSCH2, units MVEU1 and MVEU2 applies default value 0~100%.
- SV range low values SVSCL1 and SVSCL2, high values SVSCH1 and SVSCH2, unit SVEU applies default value 0~100%.
- Manual/ auto control source MAN_OPT keeps default panel control (i.e. MAN_OPT=OFF). External set control source SV_OPT keeps default program settings (i.e. SV_OPT=ON).
- Back mode MODE_OPT can keep the default manual back (i.e. MODE_OPT=OFF), or set as auto back (i.e. MODE_OPT=ON). If set as auto back, SPLIT function block can switch its status by the down stream module, and reduce manual operation.
- **MANUAL Function Block Parameter Settings:**
Handheld PV range low value PVSCL, high value PVSCH, unit PVEU, MV range low value MVSCL, high value MVSCH, unit MVEU are all set as 0~100%.
Manual/auto of handheld selects control source as manual (i.e. MAN_OPT=OFF).
Note: BKIN of upstream function block should connect BKOUT of down stream function block, BKINERR should connect BKOUTERR of down stream. The down stream function block of PID function block is split function block. The down stream function block of split function block is handheld function block. The down stream function block of handheld function block is AO tag.

Alarm Settings

- Alarm functions of PID function block should set alarm enable and alarm limit as required.
- Alarm functions of handheld function block should set alarm enable and alarm limit as required.

Notes

- If input PV has fault, the PID loop enters into PVERR status, the loop enters into manual status automatically. PID output MV keeps the same.
- Design for split control should judge the positive/ negative output of loop first, then decide the split interval, such as split point bit 50% (AO output 12mA). Split action intervals of adjusting valves are generally continuous, while not continuous or overlapping are also acceptable.
- Split control for 3 or more adjusting valves need to add SPLIT function block, 2-level split.
- Valve position curves of typical dual-adjust valve split control are shown below (not limited to examples here):

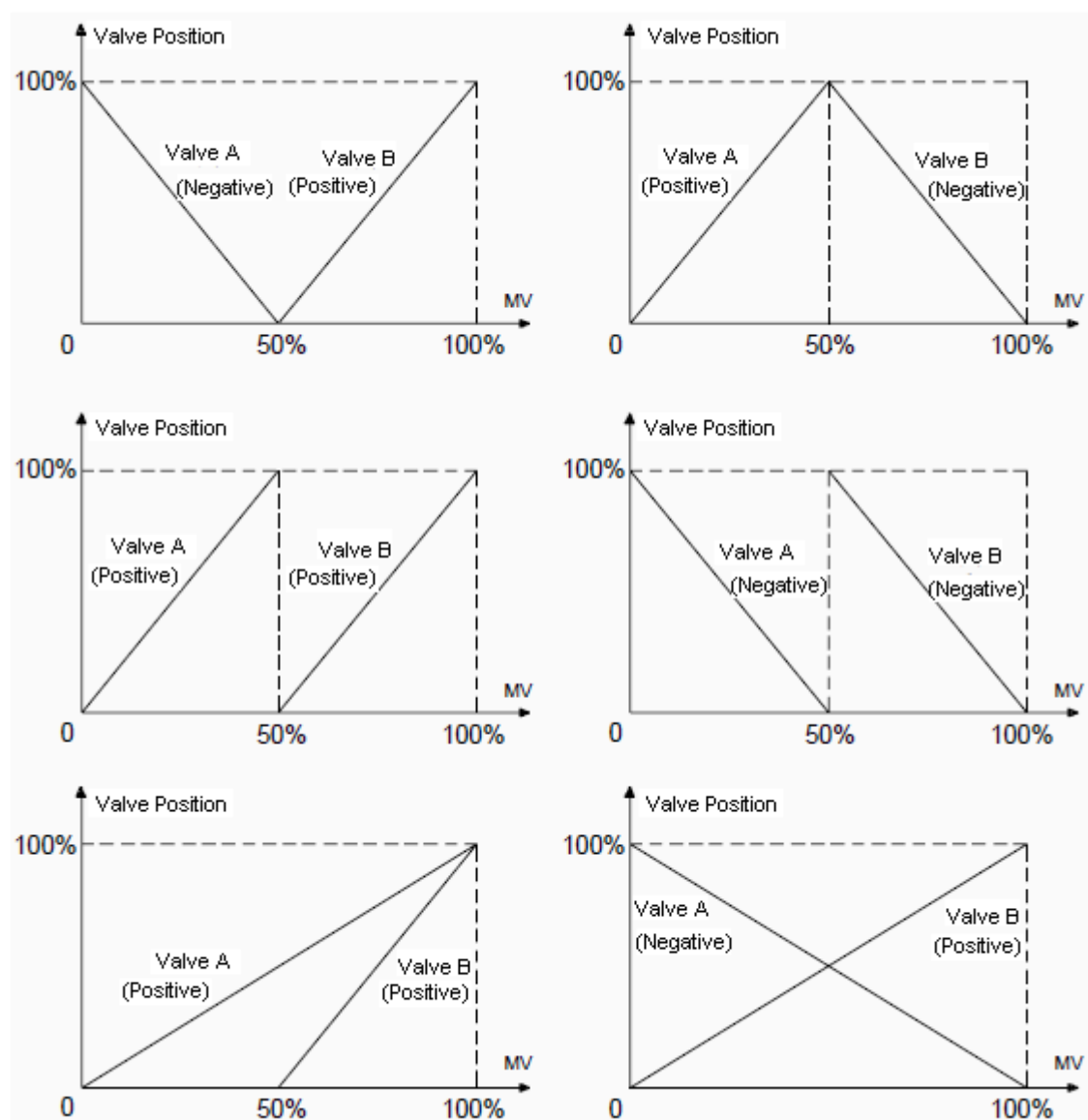


Figure 3.56 Typical split control action relations

- Control panel can call function block name from HMI directly.

3.13.6 Application Example 3

If it is required to switch handoperator's working mode from the MANUAL mode to the AUTO mode in the downstream, split control function block's output can ramp. The program building is shown below:

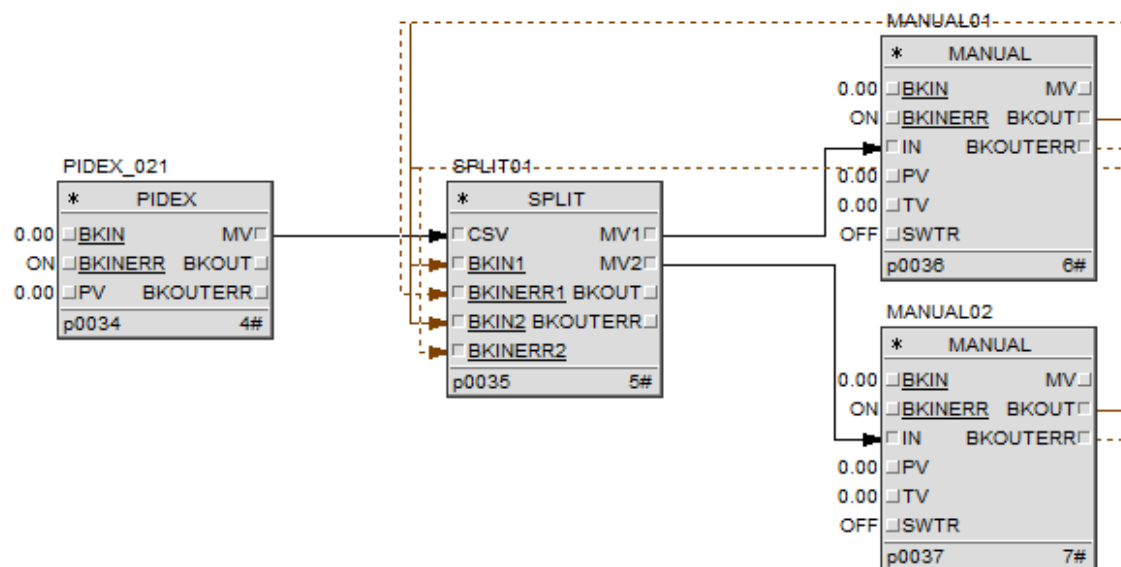


Figure 3.57 SPLIT control program diagram

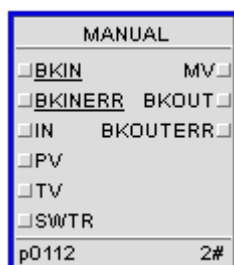
For detailed parameter configuration, refer to the actual conditions and the illustration of the corresponding function block.

3.14 Handheld Function Block (MANUAL)

Auto/manual output can be set by handheld function block. In manual mode, output value can be tuned; in auto mode, output can be tuned according to input value of upstream FB; In track mode, output value changes with track value set; The function of force manual mode is the same as manual mode but this mode cannot be transferred to manual mode and auto mode.

It is a complex function block and its running time is 150μs.

Please refer to the "Overview" and "Application Foundation of Control Function Block" before using the function block.



3.14.1 Parameter Description

Table 3.56 Parameter description and application of MANUAL Function Block

Name			Description	Up-load	Properties	Application Reference
Basic Parameters	Range Settings	MVSCH	MV high scale	-	Configuration Parameter	The same as MV actual value H limit.
		MVSCL	MV low scale	-	Configuration Parameter	The same as MV actual value L limit.
		PVSCH	PV high scale	-	Configuration Parameter	The same as PV actual value H limit.
		PVSCL	PV low scale	-	Configuration Parameter	The same as PV actual value L limit.
		MVEU	MV engineer unit	-	Configuration Parameter	Set in the function block properties settings interface.
		MVDLEN	MV decimal digits [0,5]	-	Configuration Parameter	Used for data displayed on function block panel (equal to 3 as default).
		PVEU	PV engineer unit	-	Configuration Parameter	Set in the function block properties settings interface.
		PVDLEN	PV decimal digits [0,5]	-	Configuration Parameter	Used for data displayed on function block panel (equal to 3 as default).
	Output Limits	MVH	MV H limit value	TRUE	Operation Parameter	Value range [MVS-CL,MVSCH]Perform H limits for output value
		MVL	MV L limit value	TRUE	Operation Parameter	Value range [MVS-CL,MVSCH]Perform L limits for output value
Extended Parameters	Base Input Pin Settings	BKIN	Feedback input	-	Input Pin	Connect to BKOUT of downstream block
		BKINERR	Feedback status input	-	Input Pin	Connect to BKOUT of downstream block ERR
		IN	Upstream block input value	-	Input Pin	External loop control value MV
		PV	Process value of loop closed control process	-	Input Pin	Connect to measuring point AI

Table 3.56 Parameter description and application of MANUAL Function Block (continued)

Name			Description	Up-load	Properties	Application Reference
		TV	Track input value(In track mode, MV=TV)	-	Input Pin	Connect to measuring point AIRelated parameter: SWTR
		SWTR	Track switch: OFF=not track, ON=track	-	Input Pin	Connect to upstream interlock condition input,Related parameter: TV
	Advance Input Pin Settings	EMMAN	Force manual switch:OFF=off, ON=manual	-	Input Pin	Connect to upstream interlock condition input,Refer to Note1
		PSWAM	Program manual and auto control switch, OFF=program manual control, ON=program auto control	-	Input Pin	Connect the upstream outputEnabled when MAN_OPT=ON
		MAN_OPT	Manual-automatic control source switch, ON= manual-automatic selection controlled by PSWAM, OFF= manual-automatic selection controlled by SWAM	-	Input Pin	Connect the upstream output-Related parameter: PSWAM, SWAM
		SWRCAS	Remote Cascade Switch (ON=to Remote Cascade)	-	Input Pin	-
		RSV	Remote Cascade Value	-	Input Pin	-
		SWINC	MV lock increase (MV cannot increase) switch-SWINC=ON, lock increase	-	Input Pin	Connect the upstream output Enabled when the function block is auto or cascade

Table 3.56 Parameter description and application of MANUAL Function Block (continued)

Name		Description	Up-load	Properties	Application Reference	
		SWDEC	MV lock decrease (MV cannot decrease) switch-SWINC=ON, lock decrease	-	Input Pin	Connect the upstream output. enabled when function block is automatic or cascade
		HOLD	MV holds the current output value, ON= hold the current output value	-	Input Pin	Connect to upstream output,
	Output Pin	MV	PID operation output value	-	Output Pin	Connect to electric manual instrument.If the floating point of MV is abnormal, the MV is equal to the upper period value or the lower range limit. Please refer to Mode Illustration for details.
		BKOUT	Feedback output value	-	Output Pin	Connect to the BKIN of Upstream Block, Related parameter: BK_OPT
		BKOUTERR	Feedback status value	-	Output Pin	Connect to the BKINERR of Upstream Block
		MODE	Work mode	-	Output Pin	-
	Input Alarm Settings	PVHH	PV HH limit alarm value	TRUE	Operation Parameter	Refer to Input Process
		PVH	PV H limit alarm value	TRUE	Operation Parameter	Refer to Input Process
		PVL	PV L limit alarm value	TRUE	Operation Parameter	Refer to Input Process
		PVLL	PV LL limit alarm value	TRUE	Operation Parameter	Refer to Input Process
		PVHYS	Process value alarm hysteresis	TRUE	Operation Parameter	Refer to Input Process
	Advance Settings	MODE_-OPT	ON=auto return, OFF=manual return	-	Configuration Parameter	Refer to Transition Process of Function Block Modes
		TB	Balance time(s)	TRUE	Operation Parameter	Refer to Note 2

Table 3.56 Parameter description and application of MANUAL Function Block (continued)

Name		Description	Up-load	Properties	Application Reference
		ENSAFEOP	Output enable of force manual status ON: enable OFF: disable	FALSE	Configuration Parameter Refer to Note 4
		SWMMV	Whether to equal to preset MV value when switch to manual status	TRUE	Operation Parameter Related parameter: MMV
		MMV	Preset MV value (switch to manual)	TRUE	Operation Parameter Enabled when SWMMV=ON
		SWRAMP	MV ramp switch OFF: stop ON: run	FALSE	Operation Parameter Refer to Note 3
		RAMP_MMV	MV ramp target (manual mode is valid)	FALSE	Operation Parameter Refer to Note 3
		RAMP_OPT	MV ramp mode 0: time 1: slope	TRUE	Operation Parameter Refer to Note 3
		TRAMP_EU	MV ramp time unit 0: second 1: minute 2: hour	TRUE	Operation Parameter Refer to Note 3
		TRAMP	MV ramp time	TRUE	Operation Parameter Refer to Note 3
		KRAMP_EU	MV ramp coefficient unit 0: slope/second 1: slope/minute	TRUE	Operation Parameter Refer to Note 3
		KRAMP	MV ramp coefficient	TRUE	Operation Parameter Refer to Note 3
	Fase/Slow/Increase/Decrease Settings	SMV	MV manual slow increase/decrease value (%)	TRUE	Operation Parameter Set MV manual slow increase/decrease percentage in function block properties setting, $SMV \leq FMV$ Related parameter: MVSCH
		GMV	MV safety protection in-	TRUE	Operation Parameter -


Table 3.56 Parameter description and application of MANUAL Function Block (continued)

Name			Description	Up-load	Properties	Application Reference
			put increase or decrease value			
		FMV	MV manual fast increase/decrease value (%)	TRUE	Operation Parameter	Set MV manual fast increase/decrease percentage in function block properties setting Related parameter: MVSCL
	Alarm	PVH-HIND	PVHH alarm indication	-	Monitoring Parameter	Refer to Integral Cutting
		PVHIND	PV H Limit alarm indication	-	Monitoring Parameter	Refer to Integral Cutting
		PVLIND	PV L limit alarm indication	-	Monitoring Parameter	Refer to Integral Cutting
		PVLLIND	PV LL limit alarm indication	-	Monitoring Parameter	Refer to Integral Cutting
		MVHIND	MV H limit alarm indication	-	Monitoring Parameter	Refer to Integral Cutting
		MVLIND	MV L limit alarm indication	-	Monitoring Parameter	Refer to Integral Cutting
	Operator Command	SWAM	Manual and auto switch:OFF=manual, ON=auto	-	Operation Parameter	Enabled when MAN_OPT=OFF
		SWFIX	Fix command	-	Operation Parameter	When SWFIX=ON, not output the control logic result of function block to downstream function block
		LOCK	Mode lock OFF=unlock ON=lock	-	Operation Parameter	-
		RMT_OVRD	Override remote mode (ON=override)	-	Operation Parameter	-
	Manual Output Value	MANMV	Manual output value	-	Operation Parameter	The output value MV is equal to manual SVMANMV in force manual or manual mode.

Table 3.56 Parameter description and application of MANUAL Function Block (continued)

Name			Description	Up-load	Properties	Application Reference
	Extend- ed Range Settings	HORLIM	Extended range maximum percentage	-	Configura- tion Parame- ter	Refer to Output Process
		LORLIM	Extended range minimum percentage	-	Configura- tion Parame- ter	Refer to Output Process
	Alarm En- abled and Suppress	AOF	Suppress module alarm, On=prohibit to display alarm.	TRUE	Operation Parameter	Refer to Integral Cutting
		ENALM	Alarm enable	TRUE	Alarm Parameter	Refer to Integral Cutting
		FLAG	Flag	-	Output Pin	Refer to Integral Cutting
	OOS Set- tings	SWOOS	OOS mode setting switch (ON=OOS mode)	TRUE	Operation Parameter	Set as ON at the first time of function block downloading
		OOSVAL	OOS mode output value	TRUE	Operation Parameter	Related parameter: OOS_-OPT=ON
		OOS_-OPT	OOS mode output value type. when OOS_-OPT =ON, MV=OOS-VAL, when OOS_OPT =OFF, maintain the MV	-	Configura- tion Parame- ter	Refer to About

Note1: Running mode

Mode	Serial Number	Priority	Parameter Condition					
			SWOOS	BKINERR	SWTR	EMMAN	SWCAS	SWAM
OOS	1	 High Low	ON	-	-	-	-	-
IMAN	2		OFF	ON	-	-	-	-
TR	3		OFF	OFF	ON	-	-	-
EMMAN	9		OFF	OFF	OFF	ON	-	-

Mode	Serial Number	Priority	Parameter Condition					
			SWOOS	BKINERR	SWTR	EMMAN	SWCAS	SWAM
RCAS	7		OFF	OFF	OFF	OFF	ON	-
MAN	4		OFF	OFF	OFF	OFF	OFF	OFF
AUTO	5		OFF	OFF	OFF	OFF	OFF	ON

Note 2

When balance time TB is less than TS (control cycle), IN equals MV if it is under auto status. If TB is set as larger than cycle TS value, MV will be near IN after manual/auto switch, but not become IN directly.

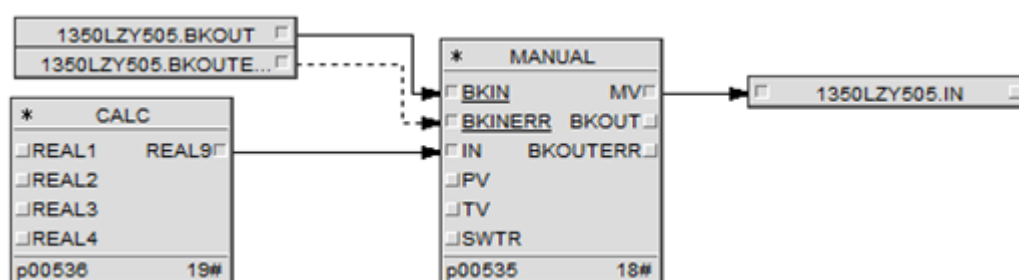


Figure 3.58 Example configuration

Note 3

In manual mode, MV can ramp up by time or by slope. SWRAMP controls if the ramping action starts.

- When RAMP_OPT=0, MV ramps up by time. In the defined ramping time (TRAMP), it ramps up from the current set value to the target value (RAMPMMV) in a constant speed.
- When RAMP_OPT=1, MV ramps up by a slope of KRAMP from the current set value to the target value (RAMPMMV).
- When MV reaches RAMPMMV, SWRAM=OFF.
- Time unit is set by TRAMP_EU and ramping rate unit is set by RAMP_EU.
- In other modes, SWRAMP=OFF.
- During ramping, you can set SWRAMP as OFF to stop ramping.

Note 4: ENSAFEOP function

- When ENSAFEOP=ON (enabled)
 - If BKINERR=ON, enter EMMAN mode. Priority: OOS>IMAN=EMMAN>TR>MAN=AUTO
In EMMAN mode, you can manually modify the MV value but you cannot switch it to MAN, AUTO, or TR mode.
 - If BKINERR=OFF and the block is set as manual fallback, enter MAN mode. If it is set to auto fallback, enter the mode before the fault occurs.
- When ENSAFEOP=OFF (disabled), the output process mode after the function block tag enters the fail-safe state is consistent with the configuration setting.

3.14.2 Mode Illustration

This part introduces the modes of MANUAL function block and the switching methods.

A variety of modes are available for PID function block, such as OOS, EMMAN, MAN, IMAN, AUTO, CAS, RCAS, TR, and OR.

Mode Switching

- When SWOOS=ON, it enters OOS mode.
- When SWOOS=OFF and BKINERR=ON,
 - If ENSAFEOP=OFF, it enters IMAN mode.
 - If ENSAFEOP=ON, it enters EMMAN mode.
- When SWOOS=OFF, BKINERR=OFF, SWTR=ON,
 - If TVERR=OFF, enters TR mode.
 - If TVERR=ON, enters MAN mode.
- When SWOOS=OFF, BKINERR=OFF, SWTR=OFF,
 - If the mode lock is on (LOCK=ON), you cannot switch modes by means of commands (SWRCAS, SWAM, SWSV, etc.).
 - If the mode lock is off (LOCK=OFF), and override switch is off (RMT_OVRD=OFF),
 - SWROUT=OFF and SWRCAS=ON: enters RCAS mode.
 - SWROUT=OFF, SWRCAS=OFF, and SWAM=OFF: enters MAN mode.
 - SWROUT=OFF, SWRCAS=OFF, SWAM=ON, and SWSV=OFF: enters AUTO mode.
 - SWROUT=OFF, SWRCAS=OFF, SWAM=ON, and SWSV=ON: enters CAS mode.
 - If the mode lock is off (LOCK=OFF), and override switch is on (RMT_OVRD=ON),
 - SWAM=OFF, enters MAN mode.
 - SWAM=ON, SWSV=OFF: enters AUTO mode.
 - SWAM=ON, SWSV=ON: enters CAS mode.

- If the function block is in CAS or RCAS mode, when SVERR=ON, it switches to AUTO mode and override is OFF. If MODE_OPT=OFF (manual fallback), mode lock is unlocked, and the function block remains in AUTO mode after the fault is resolved. If MODE_OPT=ON (auto fallback), mode lock remains the previous status, and the function block switches to the original mode after the fault is resolved.
- If the function block is in AUTO, CAS or RCAS mode, when PVERR=ON, it switches to MAN mode and override is OFF. If MODE_OPT=OFF (manual fallback), mode lock is unlocked, and the function block remains in MAN mode after the fault is resolved. If MODE_OPT=ON (auto fallback), mode lock remains the previous status, and the function block switches to the original mode after the fault is resolved.

Mode Fallback

Mode fallback function allows a function block falling back automatically or manually (default). Work mode (MODE) and standby work mode (IMODE) of each function block are only for operators' reference.

- When MODE_OPT=OFF, manual fallback is applied. For manual fallback, the function block exits from IMAN, EMMAN, or TR mode and goes back to MAN mode.
- When MODE_OPT=ON, auto fallback is applied. For auto fallback, the function block exits from IMAN, EMMAN, or TR mode and goes back to its original target mode.
- If falling back from OOS mode, it enters MAN mode either way.
- If the system goes through a cold reset, it enters MAN mode either way.

Override and Mode Lock

- In OOS mode, RMT_OVRD=OFF, LOCK=OFF, SWTR=OFF, SWAM=OFF, and SWSV=OFF.
- In IMAN, or EMMAN mode, RMT_OVRD=OFF, SWTR=OFF, SWAM=OFF, and SWSV=OFF. When it is manually falling back, unlock the mode lock. Regarding auto fallback, the mode lock remain the previous status.
- In TR mode, except for SWTR is not reset, other parameters and settings are the same as in IMAN mode.

3.14.3 Application Illustration

The float-point exception of output values means that the output values are not floating-point format, or a meaningless output value is produced in a calculation that performs a divide-by-zero operation. When floating-point is abnormal, the function block's output values shall conform to the following rules:

- If there's the normal value of previous period, MV outputs the value of previous period.
- If there's the abnormal value of previous period or no previous period value, MV outputs the lower range limit.

3.14.4 Panel Parameter

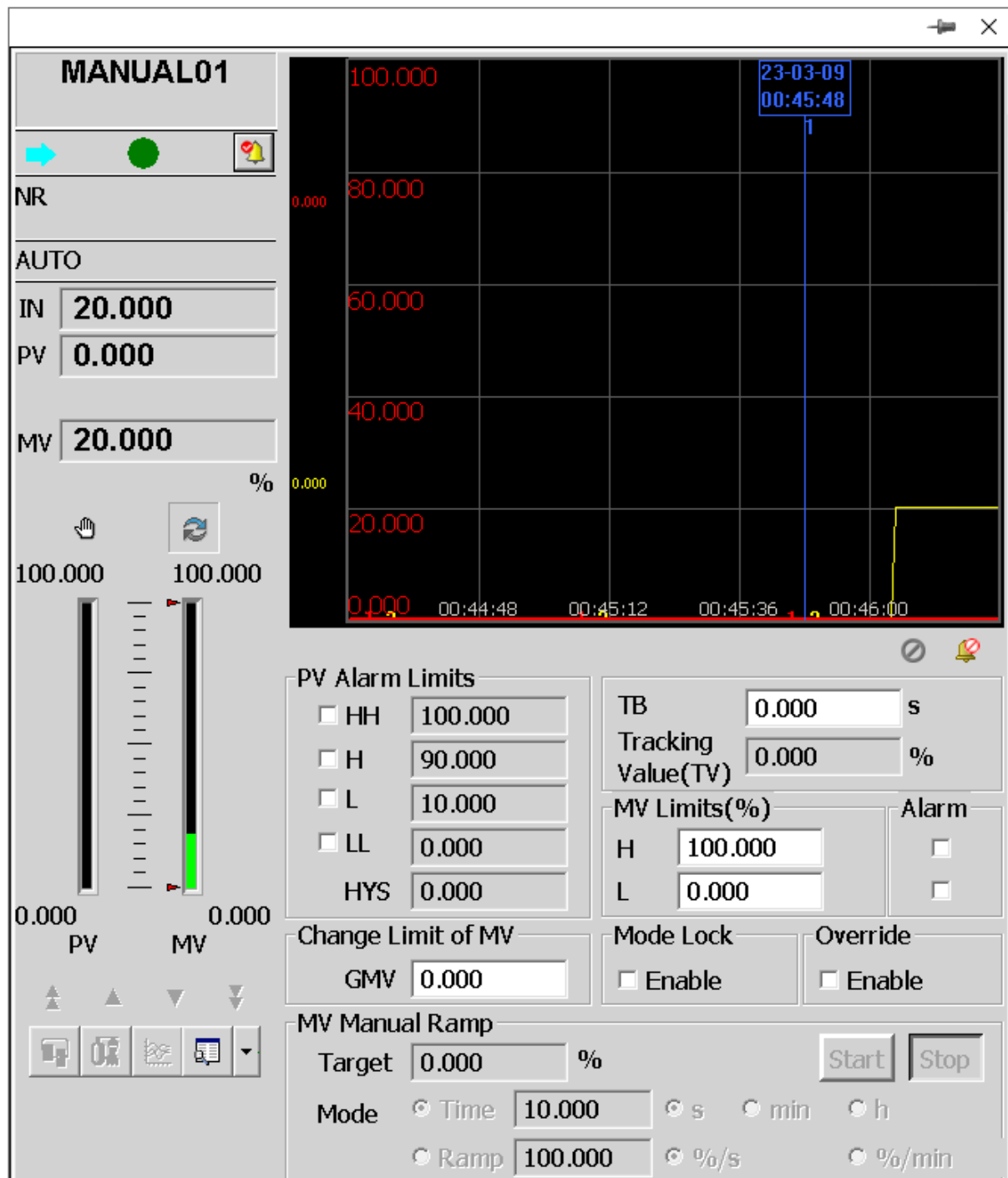


Figure 3.59 Parameter Graph

Table 3.57 Operation Instruction for Panel Parameter

Panel Parameter Name			Function Block Parameter Name	Initial Value	Value Range	Application Instruction
Preference	PV Alarm	HH	PVHH	100.000	[SVSCL,SVSCH]	HH alarm value setting of loop PV (select alarm enabled, or it is disabled).
		H	PVH	90.000	[SVSCL,SVSCH]	H alarm value setting of loop PV(select alarm enabled, or it is disabled)
		L	PVL	10.000	[SVSCL,SVSCH]	L alarm value setting of loop PV(select alarm enabled, or it is disabled)
		LL	PVLL	0.000	[SVSCL,SVSCH]	LL alarm value setting of loop PV. (select alarm enabled, or it is disabled)
		Hys-teresis	HYS	0.000	-	PV Process value alarm hysteresis
	Balance Time (s)	TB (s)	TB (s)	0.000	-	Balance time without interference switch
	Trac (%)	Trac (%)	Trac (%)	0.000	-	Read-only, track input value(%)
	MV Limit (%)	H	MVH	100.000	[MVS-CL,MVSCH]	H value setting of loop MV (select alarm enabled, or it is disabled). Note: MV limit is not affected by selection.
		L	MVL	0.000	[MVS-CL,MVSCH]	L value setting of loop MV (select alarm enabled, or it is disabled). Note: MV limit is not affected by selection.
	Change Limit of MV	GMV	GMV	0.000	-	

3.14.5 Flag

Table 3.58 Flag List

Flag	Alarm	Description
D0	OOS	Disable
D1	IMAN	Initialize Manually
D2	MAN	Manual
D3	TR	Track
D4	AUTO	Auto
D8	PVHH	PV HH Limit Alarm
D9	PVLL	PV LL Limit Alarm
D10	PVH	PV H Limit Alarm
D11	PVL	PV L Limit Alarm
D14	MVH	Output H Limit Alarm
D15	MVL	Output L Limit Alarm
D18	REVSCL	Span H/L Limit Reverse or output value float abnormal
D19	CFGERR	Configuration Error
D24	EMMAN	Force manual Alarm
D25	AOF	Suppress Alarm
D26	FIX	FIX

3.14.6 Application Example

To control the field manual adjusting valve, as shown in the figure below, and it can be displayed and operated in the diagram.

Handheld can perform open-loop control for analog adjusting target, and is no need to perform the closed-loop PID control. It is often used for controlling field manual adjusting valve, transducer rotation setting and other control targets.

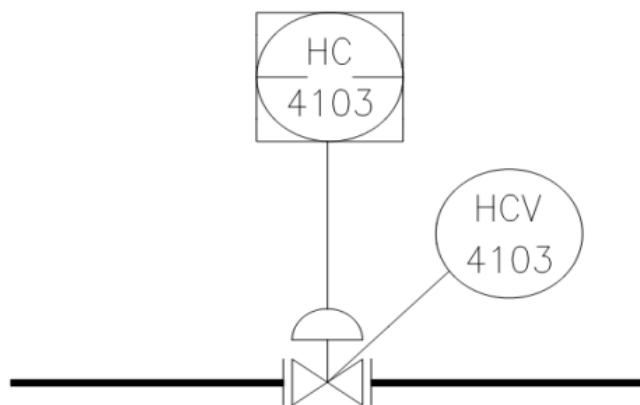


Figure 3.60 Diagram of handheld

Its programming is shown below, which can be realized via MANUAL, the interface of host computer can achieve the control for AO via the tag of function block.

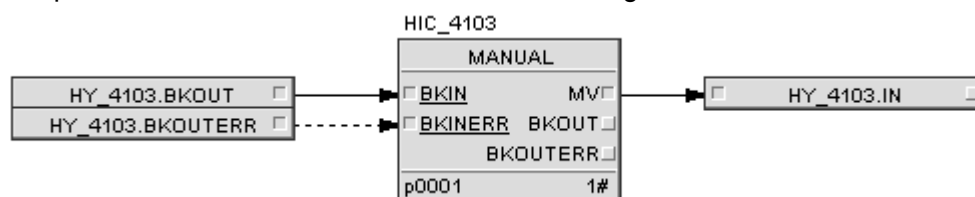


Figure 3.61 Programming of handheld

The function block instruction and examples are shown in the table below.

Table 3.59 Function Block Instruction and Examples

NO.	Example	Type	Instruction	Remark
001	HIC_4103	Tag of Function Block	Function Block Tag of Hand-held	
002	HY_4103	AO (Output)	MV	

Parameter settings of MANUAL:

- PVSCL: 0~100% in default
- PVSCH: 0~100% in default
- PVEU: 0~100% in default
- If measurement value exists, its range should be set as same as the range of PV.
- MVSCL: 0~100% in default
- MVSCH: 0~100% in default
- MVEU: 0~100% in default
- MODE_OPT: OFF
- MAN_OPT: ON

- BKIN should connect with the BKOUT of downstream function block, BKINERR should connect with the BKOUTERR of downstream function block. AO tag can be the downstream function block for single loop.
- Set the alarm enabled and limit of alarm function according to the requirements.

The operation parameters MAN_OPT, PSWAM (OFF in default) are set to prevent from wrong operation to "AUTO" mode by the operator on the panel. The automatic control can be set when required.

Notice:

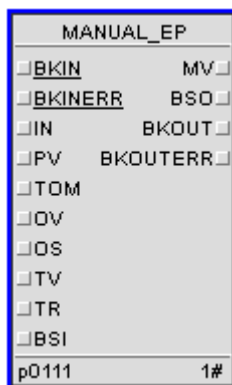
The control panel can invoke the name of function block from HMI directly.

3.15 Electric Manual Operation Function Block (MANUAL_EP)

The electric manual operation function block provides six work modes which are OOS, IMAN, TRACK, OR, MAN, AUTO. In auto mode, output can be tuned according to input value of upstream FB. In manual mode, output value can be tuned manually. In track mode, output value changes with track value set. In override mode, output value changes with override input.

It is a complex function block and its running time is 100μs.

Please refer to the "Overview" and "Application Foundation of Control Function Block" before using the function block.



3.15.1 Parameter Description

Table 3.60 Parameter description and application of MANUAL_EP Function Block

Name			Description	Upload	Properties	Application Reference
Basic Parameters	Range Settings	MVSCH	MV high scale	-	Configuration Parameter	The same as MV actual value H limit.

Table 3.60 Parameter description and application of MANUAL_EP Function Block (continued)

Name			Description	Upload	Properties	Application Reference
		MVSCL	MV low scale	-	Configuration Parameter	The same as MV actual value L limit.
		SVSCH	SV high scale	-	Configuration Parameter	The same as PV actual value H limit.
		SVSCL	SV low scale	-	Configuration Parameter	The same as PV actual value L limit.
		SVEU	SV engineer unit	-	Configuration Parameter	Set in the function block properties settings interface.
		MVEU	MV engineer unit	-	Configuration Parameter	Set in the function block properties settings interface.
		SVDLEN	SV decimal digits [0,5]	-	Configuration Parameter	Used for data displayed on function block panel (equal to 3 as default).
		MVDLEN	MV decimal digits [0,5]	-	Configuration Parameter	Used for data displayed on function block panel (equal to 3 as default).
	Limits	SVH	SV H limit value	TRUE	Operation Parameter	Value range [SVSCL,SVSCH]
		SVL	SV L limit value	TRUE	Operation Parameter	Value range [SVSCL,SVSCH]
		MVH	MV H limit value	TRUE	Operation Parameter	Value range [MVSCL,MVSCH]
		MVL	MV L limit value	TRUE	Operation Parameter	Value range [MVSCL,MVSCH]
		DMVLIM	MV output rate variety limit value. Used to prevent the MV from overlarge modification in a short time.	TRUE	Operation Parameter	Refer to Integral Cutting

Table 3.60 Parameter description and application of MANUAL_EP Function Block (continued)

Name			Description	Upload	Properties	Application Reference
Extended Parameters	Base Input Pin Settings	BKIN	Feedback input	-	Input Pin	Connect to BKOUT of downstream block
		BKIN-ERR	Feedback status input	-	Input Pin	Connect to BKOUT of downstream block ERR
		IN	Upstream function block input value	-	Input Pin	External loop control value MV
		PV	Process value of loop closed control process	-	Input Pin	Connect to measuring point AI
		TOM	Switch to Manual Input	-	Input Pin	Connect to upstream interlock condition input, enabled when it is ON.
		TOA	Switch to Auto Input	-	Input Pin	Connect to upstream interlock condition input, enabled when it is ON.
		OV	Override Input	-	Input Pin	Connect the upstream output, Refer to Parameter Description
		OS	Override Input Switch	-	Input Pin	Upstream interlock condition input, Refer to Note4
		TV	Track input value (In track mode, MV=TV)	-	Input Pin	Connect to measuring point AI. Related parameter: SWTR.
		TR	Track Input Switch	-	Input Pin	Connect to upstream interlock condition input,
		BSI	Bias Input	-	Input Pin	Connect the upstream output, can be set in program.
	Advance Input Pin Settings	SV	SV	-	Input Pin	Refer to Set Variable Process

Table 3.60 Parameter description and application of MANUAL_EP Function Block (continued)

Name			Description	Upload	Properties	Application Reference
		SWINC	MV lock increase (MV cannot Increase), ON= lock increase	-	Input Pin	Connect the upstream output. enabled when function block is automatic or cascade
		SWDEC	MV lock decrease (MV cannot decrease), ON= Lock decrease	-	Input Pin	Connect the upstream output. enabled when function block is automatic or cascade
		HOLD	MV holds the current output value, ON= hold the current output value	-	Input Pin	Connect to upstream output,
	Output Pin	MV	PID operation output value	-	Output Pin	Connect to electric manual instrument.If there's a float abnormal happened to the MV value, the MV will be set as the value of previous period or the lower limit. Please refer to Application Illustration for details.
		BSO	Current bias output	-	Output Pin	Connect to downstream inputCan be set in program
		BKOUT	Feedback output value	-	Output Pin	Connect to the BKIN of Upstream Block, Related parameter: BK_OPT
		BKOUTERR	Feedback status value	-	Output Pin	Connect to the BKINERR of Upstream Block
	Input Alarm Settings	PVHH	PV HH limit alarm value	TRUE	Operation Parameter	Refer to Input Process
		PVH	PV H limit alarm value	TRUE	Operation Parameter	Refer to Input Process

Table 3.60 Parameter description and application of MANUAL_EP Function Block (continued)

Name			Description	Upload	Properties	Application Reference
		PVL	PV L limit alarm value	TRUE	Operation Parameter	Refer to Input Process
		PVLL	PV LL limit alarm value	TRUE	Operation Parameter	Refer to Input Process
		PVHYS	Process value alarm hysteresis	TRUE	Operation Parameter	Refer to Input Process
	Advance Settings	SWBS	Enable or disable bias in calculation	TRUE	Operation Parameter	When the upstream input or inner logic of function block is set as ON, bias is enabled in calculation, Refer to Note2
		SWTB	Enable or disable balance time in calculation	TRUE	Operation Parameter	When the upstream input or inner logic of function block is set as ON, apply Balance time
		TB	Balance time	TRUE	Operation Parameter	-
		MODE_-OPT	ON=auto return-OFF=manual return (as default)	-	Configuration Parameter	Refer to Set Variable Process
	Fase/Slow/Increase/Decrease Settings	SVTR_-OPT	Track PV switch enable/disable: OFF=not track, ON=track. If PV> SVH/ SVL, SV= range limit. Used to prevent the output MV from interference when changing the control mode.	-	Configuration Parameter	
		SMV	MV manual slow increase/decrease value (%)	TRUE	Operation Parameter	Set MV manual slow increase/decrease percentage in function block properties setting, $SMV \leq FMV$ Related parameter: MVSCH

Table 3.60 Parameter description and application of MANUAL_EP Function Block (continued)

Name			Description	Upload	Properties	Application Reference
		FMV	MV manual fast increase/decrease value (%)	TRUE	Operation Parameter	Set MV manual fast increase/decrease percentage in function block properties settingRelated parameter: MVS-CL
		SSV	SV slow increase/decrease value (%)	TRUE	Operation Parameter	Set SV manual slow increase/decrease percentage in function block properties settingSSV≤FSV, Related parameter: SVSCH
		FSV	SV fast increase/decrease value (%)	TRUE	Operation Parameter	Set SV manual fast increase/decrease percentage in function block properties settingRelated parameter: SVS-CL
		GMV	MV safety protection input increase or decrease value	TRUE	Operation Parameter	-
		GSV	SV safety protection input increase or decrease value	TRUE	Operation Parameter	-
	Alarm	PVH-HIND	PVHH alarm indication	-	Monitoring Parameter	Refer to Integral Cutting
		PVHIND	PV H Limit alarm indication	-	Monitoring Parameter	Refer to Integral Cutting
		PVLIND	PV L limit alarm indication	-	Monitoring Parameter	Refer to Integral Cutting
		PVL-LIND	PV LL limit alarm indication	-	Monitoring Parameter	Refer to Integral Cutting
		MVHIND	MV H limit alarm indication	-	Monitoring Parameter	Refer to Integral Cutting
		MVLIND	MV L limit alarm indication	-	Monitoring Parameter	Refer to Integral Cutting

Table 3.60 Parameter description and application of MANUAL_EP Function Block (continued)

Name			Description	Upload	Properties	Application Reference
		SVHIND	SV H limit alarm indication	-	Monitoring Parameter	Refer to Integral Cutting
		SVLIND	SV L limit alarm indication	-	Monitoring Parameter	Refer to Integral Cutting
		DMVHIND	MV positive rate limit indication	-	Monitoring Parameter	Refer to Integral Cutting
		DMVLIND	MV negative rate limit indication	-	Monitoring Parameter	Refer to Integral Cutting
	Operator Command	MAN	Manual switch	-	Operation Parameter	Refer to Transition Process of Function Block Modes
		AUTO	Auto switch	-	Operation Parameter	Refer to Transition Process of Function Block Modes
	Status	OM	Manual output	-	Output Pin	The function block is in MAN mode, OM=ON, or OM=OFF
		OA	Output compensation, used for feedforward control	-	Output Pin	Connect to measuring point AI (feedforward signal), Related parameter: OK, OBThe function block is in AUTO mode, OA=ON, or OA=OFF
		MODE	Work mode	-	Monitoring Parameter	
		IMODE	Standby mode mode	-	Monitoring Parameter	Refer to Transition Process of Function Block Modes
	Manual Output Value	MANMV	Manual output value	-	Operation Parameter	Output value= MANMV in manual mode
	Extended Range Settings	HORLIM	Extended range maximum percentage	-	Configuration Parameter	Refer to Output Process
		LORLIM	Extended range minimum percentage	-	Configuration Parameter	Refer to Output Process

Table 3.60 Parameter description and application of MANUAL_EP Function Block (continued)

Name			Description	Upload	Properties	Application Reference
		AOF	Suppress module alarm, On=prohibit to display alarm.	TRUE	Operation Parameter	Refer to Integral Cutting
		ENALM	Alarm enable	TRUE	Alarm Parameter	Refer to Integral Cutting
		FLAG	Flag	-	Output Pin	Refer to Integral Cutting
	OOS Settings	SWOOS	OOS mode setting switch (ON=OOS mode)	TRUE	Operation Parameter	Set as ON at the first time of function block downloading
		OOSVAL	OOS mode output value	TRUE	Operation Parameter	Related parameter: OOS_OPT=ON
		OOS_OPT	OOS mode output value type. when OOS_OPT=ON, MV=OOSVAL, when OOS_OPT=OFF, maintain the MV	-	Configuration Parameter	Refer to About

Note 1. Work mode**Table 3.61 Working mode and parameter condition**

Mode	Serial Number	Parameter Condition				
		SWOOS	BKINERR	SWTR	OR	SWAM
OOS	1	ON	—	—	—	—
IMAN	2	OFF	ON	—	—	—
TR	3	OFF	OFF	ON	—	—
OR	11	OFF	OFF	OFF	ON	—
MAN	4	OFF	OFF	OFF	OFF	OFF
AUTO	5	OFF	OFF	OFF	OFF	ON

“—” means parameters can be any condition of ON or OFF.

Note 2. Bias Output

When SWBS = ON, bias output is enabled.

In MAN mode, $BSO = MV - IN$, if now SWTB = OFF, BSO will be back written to BSI.

In AUTO mode, $MV = BSI + IN$, $BSO = BSI$.

When SWBS = OFF, bias input lock is 0.

Note 3. Balance Process

When it is switched to AUTO mode from other modes, there may be huge bias between the value calculated from Input IN and the value of original output. In order to make output transition smooth, use first inertia balance process. The output step is shown as follows:

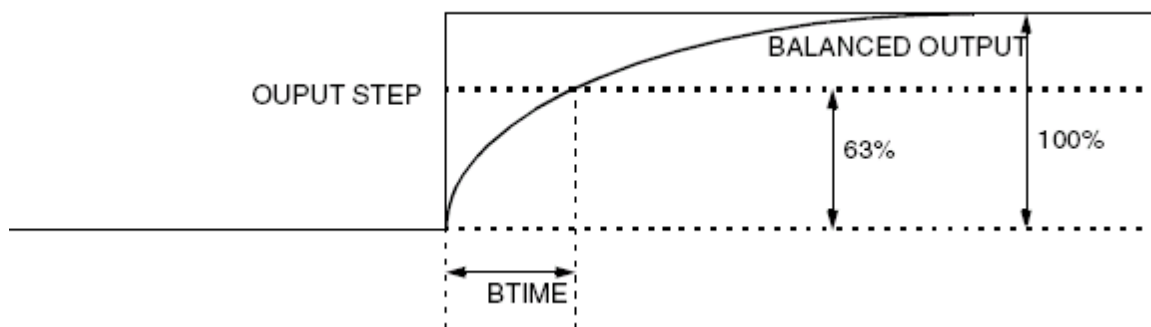


Figure 3.62 Figure 2-9 Balance Process Figure

Note 4. OS logic

OS logic means that when the self-control system receiving abnormal signals, such as accident alarm, bias alarm and fault, the OS logic will perform logic functions, such as switching auto to manual, increase priority, decrease priority, increase prohibited, decrease prohibited, etc., and transform the system to the safe status set previously.

3.15.2 Application Illustration

The float abnormal of output values means that the output values are not float format, or a meaningless output value is produced in a calculation that performs a divide-by-zero operation. When float abnormal happened, the function block's output values shall conform to the following rules:

- If there's the normal value of previous period, MV outputs the value of previous period.
- If there's the abnormal value of previous period or no previous period value, MV outputs the lower range limit.

3.15.3 Panel Parameter

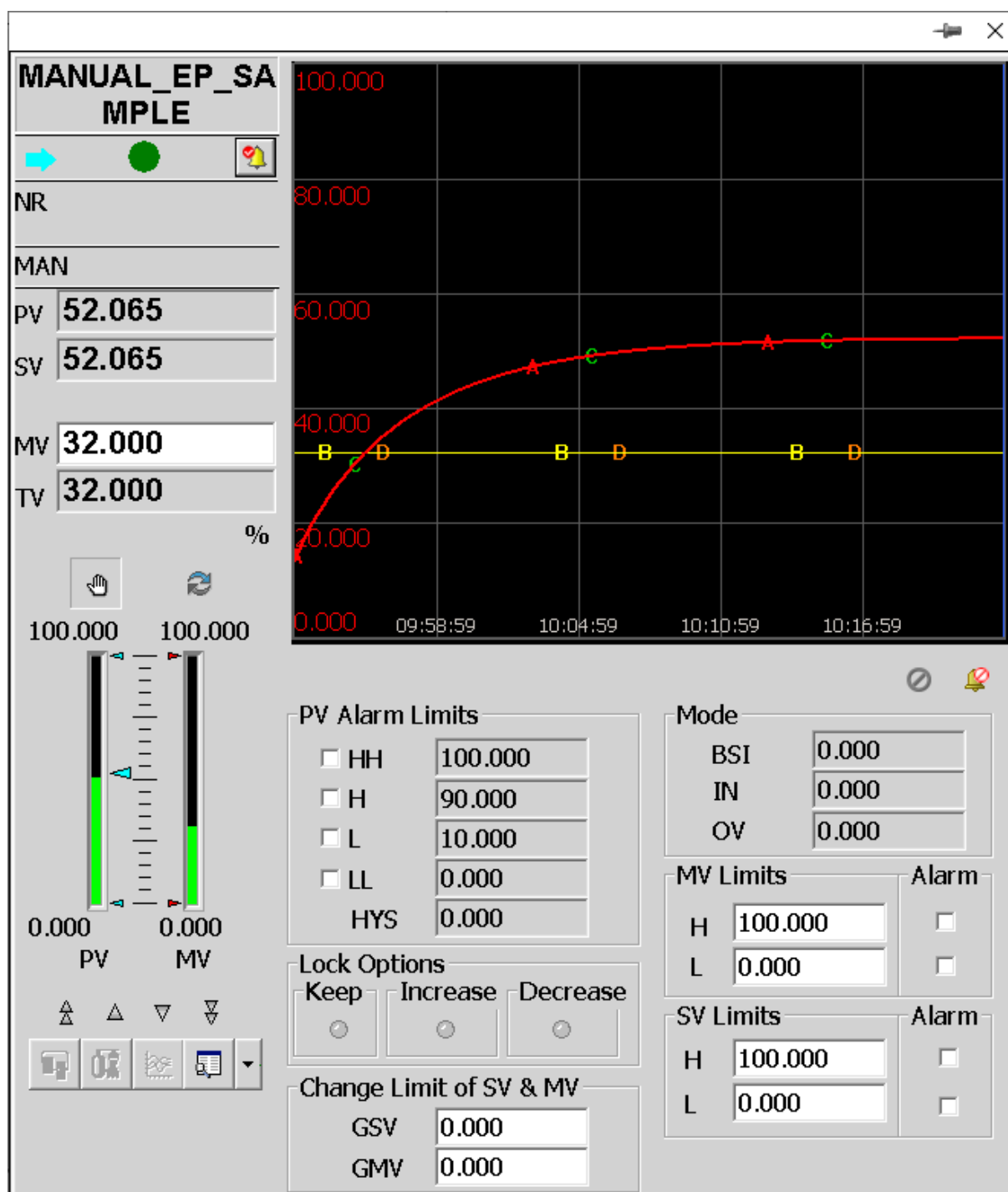


Table 3.62 Operation Instruction for Panel Parameter

Name		Panel Parameter Name	Initial Value	Value Range	Application Instruction
PV Alarm Limit Settings	HH	PVHH	100.000	[SVS-CL,SVSCH]	HH alarm value setting of loop PV (select alarm enabled, or it is disabled).
	H	PVH	90.000	[SVS-CL,SVSCH]	H alarm value setting of loop PV(select alarm enabled, or it is disabled)

Table 3.62 Operation Instruction for Panel Parameter (continued)

Name		Panel Parameter Name	Initial Value	Value Range	Application Instruction
	L	PVL	10.000	[SVS-CL,SVSCH]	L alarm value setting of loop PV(select alarm enabled, or it is disabled)
	LL	PVLL	0.000	[SVS-CL,SVSCH]	LL alarm value setting of loop PV. (select alarm enabled, or it is disabled)
	Hys-tere	PVHYS	0.000	-	PV Process value alarm hysteresis
SV Limit Settings	H	SVH	40.000	[SVS-CL,SVSCH]	H value setting of loop SV (select alarm enabled, or it is disabled). Note: SV limit is not affected by selection.
	L	SVL	0.000	[SVS-CL,SVSCH]	L value setting of loop SV (select alarm enabled, or it is disabled). Note: SV limit is not affected by selection.
MV Limit Settings	H	MVH	100.000	[MVS-CL,MVSCH]	H value setting of loop MV (select alarm enabled, or it is disabled). Note: MV limit is not affected by selection.
	L	MVL	0.000	[MVS-CL,MVSCH]	L value setting of loop MV (select alarm enabled, or it is disabled). Note: MV limit is not affected by selection.
Mode	BSI	BSI	0.000	-	Read-only, Bias Input
	IN	IN	0.000	-	Read-only, Upstream function block input value
	OV	OV	0.000	-	Read-only, Override Input
Lock Options	Keep	HOLD	Off	ON/OFF	Can only debug in custom program, Select it and the indicator on panel is ON.
	In-crease	SWINC	Off	ON/OFF	Can only debug in custom program, Select it and the indicator on panel is ON.
	De-crease	SWDEC	Off	ON/OFF	Can only debug in custom program, Select it and the indicator on panel is ON.
Change Limit of SV & MV	GSV	GSV	0.000	-	SV safety protection input increase or decrease value
	GMV	GMV	0.000	-	MV safety protection input increase or decrease value

3.15.4 Flag

Table 3.63 Flag List

Flag Code	Alarm	Description
D0	OOS	Disable
D1	IMAN	Initialize Manually
D2	MAN	Manual
D3	OS	Override
D4	AUTO	Auto
D5	TR	Track
D8	PVHH	PV HH Limit Alarm
D9	PVLL	PV LL Limit Alarm
D10	PVH	PV H Limit Alarm
D11	PVL	PV L Limit Alarm
D12	SVH	SV H Limit Alarm
D13	SVL	SV L Limit Alarm
D14	MVH	Output H Limit Alarm
D15	MVL	Output L Limit Alarm
D18	REVSCL	Span H/L Limit Reverse or output value float abnormal
D19	CFGERR	Configuration Error
D22	DMVH	MV Positive Rate Limit Alarm
D23	DMVL	MV Negative Rate Limit Alarm
D25	AOF	Suppress Alarm

3.15.5 Example

Adjust the temperature 11_44TE21A to achieve the temperature automatic control, and can be shown and operated in graphics.

Single loop (simple control system), refers to a closed loop feedback control system consisted of a controlled object, a detection transducer, a controller and a performer. It is often applied in occasion with short delay time for controlled object, not a lot changes for load and interference, and not high requirements for control quality.

Detail program is shown in Figure 3.63, in which applies PID control function block and handheld function block. Operation node interface can achieve monitoring and control of loop in graphics via calling handheld function block tag.

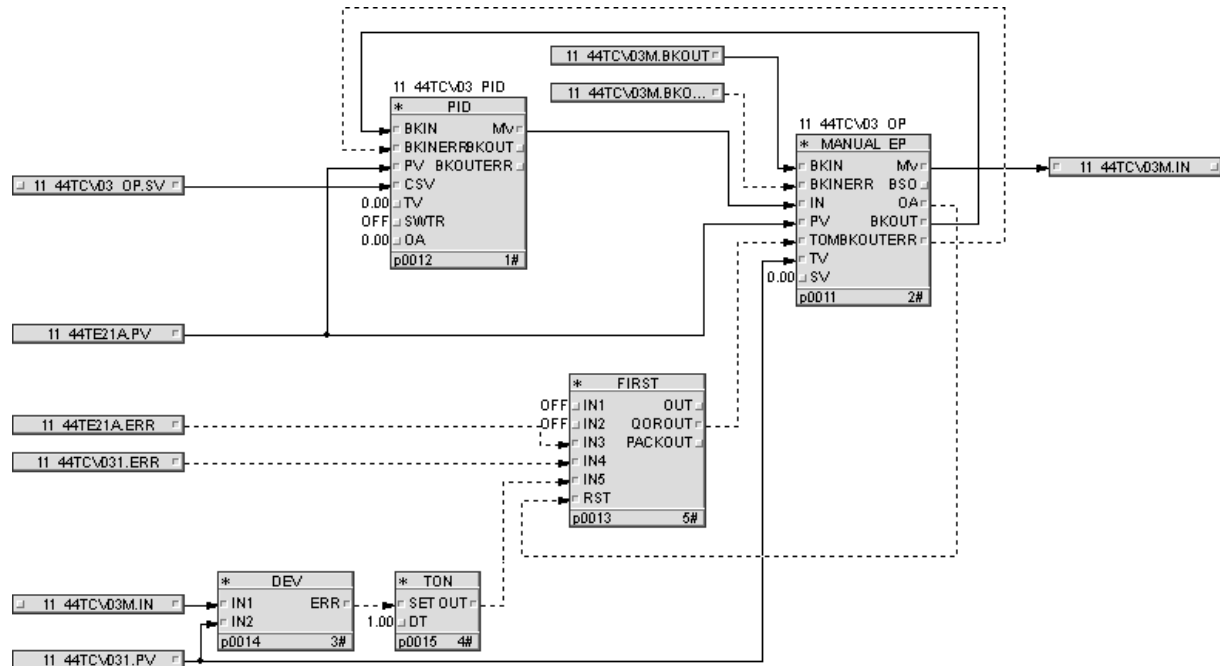


Figure 3.63 Single loop program with handheld

Instruction for function block and example is shown below:

Table 3.64 Instruction of function block and example

No.	Example	Type	Instruction	Remarks
001	11_44TCV03_PID	Function block tag	PID function block tag	PID
002	11_44TCV03_OP	Function block tag	Handheld function block tag	MANUAL_EP
003	11_44TCV03M	AO output	Level regulating valve	
004	11_44TE21A	AI input	Level detect signal	

Parameter settings of PID function block:

PSWAM: ON

Set program internal/external set control as ON

SWPN: set according to the feature settings of controlled object

MAN OPT: ON

SV OPT: ON

PID_OPT: 1

SVTR OPT: ON

MODE OPT: ON

MVSCL, MVSCH, MVEU: same unit with PV range.

SVSCL, SVSCH, SVEU: same unit with PV range.

DL (deviation alarm value of PV and SV) is set as 10% of controlled object range.

MVH, MVL: same settings with performer range.

SVL, SVH: same with PV range if SV limit function is not required.

DMVLIM: 5

DB: 0.5% of control object range.

MODE_OP=OFF

BKIN should connect BKOUT of handheld function block, BKINERR should connect BKOUTERR of handheld function block.

Parameter settings of handheld function block:

MVSCL, MVSCH: same with performer range.

SVSCL, SVSCH: same with PV range.

MVH, MVL: same settings with performer range.

SVL, SVH: same with PV range if SV limit function is not required.

DMVLIM: 2

Alarm settings

- Positive deviation alarm
- Negative deviation alarm

Note:

Control panel can call function block name from HMI directly.

3.16 Maximum Selection Function Block (ASH)

ASH function block can implement the input selection of the first channel, when value of the second channel is larger than that of the first, the output switches to the second channel and alarm is generated. It will not be switched to first channel until the value of the first channel is larger than that of the second, meanwhile the alarm is eliminated.

It is a complex function block and its running time is 90μs.

Please refer to the "Overview" and "Application Foundation of Control Function Block" before using the function block.

* ASH	
IN1	OUT
ALM1	BKOUT
IN2	BKOUTERR
ALM2	BKOUT2
BKIN	BKOUTER2
BKINERR	
p0031	1#

3.16.1 Parameter Description

Table 3.65 Parameter description and application of ASH Function Block

Name			Description	Upload	Properties	Application Reference
Basic Parameters	Range Settings	INSCH	Input Range H	-	Configuration Parameter	The same as the actual value of IN H
		INSCL	Input Range L	-	Configuration Parameter	The same as the actual value of IN L
		OUTSCH	Output Range H	-	Configuration Parameter	The same as the actual value of OUT H
		OUTSCL	Output Range L	-	Configuration Parameter	The same as the actual value of OUT L
		INEU	IN actual value unit	-	Configuration Parameter	Set in the function block properties settings interface.
		OUTEU	OUT actual value unit	-	Configuration Parameter	Set in the function block properties settings interface.
		INDLEN	Input decimal digits [0,5]	-	Configuration Parameter	Used for data displayed on function block panel (equal to 3 as default).
		OUT-DLEN	Output decimal digits [0,5]	-	Configuration Parameter	Used for data displayed on function block panel (equal to 3 as default).
Extended Parameters	Input Pin	IN1	Input 1	-	Input Pin	Contact to AI tagRefer to Note1, 2 Control the output and has the overall switch function from input range to output range
		ALM1	Input 1Alarm	-	Input Pin	Connect to measuring point AI.ERRRefer to Note1, 2
		IN2	Input 2	-	Input Pin	Contact to AI tagRefer to Note1, 2 Control the output and has the overall switch function from input range to output range
		ALM2	Input 2Alarm	-	Input Pin	Connect to measuring point AI.ERRRefer to Note1, 2
		BKIN	Feedback input	-	Input Pin	Connect to BKOUT of downstream block
		BKINERR	Feedback status input	-	Input Pin	Connect to BKOUT of downstream block ERR

Table 3.65 Parameter description and application of ASH Function Block (continued)

Name		Description	Upload	Properties	Application Reference	
	Output Pin	OUT	Output value	-	Output Pin	Connect to electric manual instrumentRefer to Note2
		BKOUT	Feedback output value	-	Output Pin	Connect to the BKIN of Upstream Block, Related parameter: BK_OPT
		BKOUTERR	Feedback status value	-	Output Pin	Connect to the BKIN-ERR of Upstream Block
		BKOUT2	Feedback output2	-	Output Pin	Connect to the BKIN of Upstream Block, Related parameter: BK_OPT
		BKOUTER2	Feedback status out-put2	-	Output Pin	Connect to the BKIN-ERR of Upstream Block
	Ad- vance Settings	BK_OPT	BKOUT process (0=normal; 1=balanced time; 2=dual channel output)	TRUE	Configuration Parameter	Association: BKOUT, BKOUT2, refer to Note 5.
		TFLT	Balance switch time (s)	TRUE	Operation Parameter	Balance switch is used when the output selection source changed, and performs smooth transition for the output value. When TFLT=0.0, the balance is disabled.
		SAFE_-OPT	Safety mode selection (OFF= ordinary mode, ON= advanced mode)	-	Configuration Parameter	Refer to Note3
	Status	SEL1	Input 1 selected	-	Monitoring Parameter	Display the currently selected signal1
		SEL2	Input 2 selected	-	Monitoring Parameter	Display the currently selected signal2
		ERR1	Input 1 bad quality	-	Monitoring Parameter	Display the signal quality1
		ERR2	Input 2 bad quality	-	Monitoring Parameter	Display the signal quality2
		ERR	Module fault	-	Monitoring Parameter	

Table 3.65 Parameter description and application of ASH Function Block (continued)

Name			Description	Upload	Properties	Application Reference
		OVERIDE	Override Alarm	-	Monitoring Parameter	Refer to ^{Note1} “Override Alarm” ^{Note4}
		HOLD	MV holds the current output value, ON= hold the current output value	-	Monitoring Parameter	Connect to upstream output,
	Alarm Enabled and Suppress	AOF	Suppress module alarm. On=prohibit to display alarm.	TRUE	Operation Parameter	Refer to Integral Cutting
		ENALM	Alarm enable	TRUE	Alarm Parameter	Refer to Integral Cutting
		FLAG	Flag	-	Output Parameter	Refer to Integral Cutting
	OOS Settings	SWOOS	OOS mode setting switch (ON= OOS mode)	TRUE	Operation Parameter	Set as ON at the first time of function block downloading

Note 1. Maximum Selection Output

When input ALM1=OFF and ALM2=OFF:

If $IN1 \geq IN2$, then $OUT=IN1$ and $OVERIDE=OFF$;

If $IN1 < IN2$, then $OUT=IN2$ and $OVERIDE=ON$, until $IN1 \geq IN2$, alarm $OVERIDE=OFF$ and $OUT=IN1$.

Note 2. Input Alarm

When $IN1$ is selected, if $ALM1=ON$, then $ERR1=ON$, OUT is maintained, and $BKOUTERR=ON$, it will not be switched to output $IN2$ even if $IN1 < IN2$.

When $IN1$ is selected, if $ALM2=ON$, then $ERR2=ON$, OUT and $BKOUTERR$ will depend on the selection of security mode.

When $IN2$ is selected, if $ALM2=ON$, then $ERR2=ON$, OUT is maintained, and $BKOUTERR=ON$, it will not be switched to output $IN1$ even if $IN1 \geq IN2$.

When $IN2$ is selected, if $ALM1=ON$, then $ERR1=ON$, OUT and $BKOUTERR$ will depend on the selection of security mode

Note 3. Security Mode

When SAFE_OPT=OFF, if one input channel (IN1) is selected while the other input channel (IN2) generates alarm (ALMn), the current selected channel (IN1) will be still selected and BKOUTERR=OFF.

When SAFE_OPT=ON, if one channel used to output while the other generates input alarm (ALMn), the output will be maintained and BKOUTERR=ON.

Note 4: OVERRIDE alarm will be enabled after outline download.

Note 5: High-select non-disturbance switch

When BK_OPT=0, press Note 1 to perform high-selection output normally.

When BK_OPT=1, the balance item value (IN1/IN2-OUT after switching) is restricted. When the balance item exceeds IN1-IN2, the balance item value is maintained at (IN1-IN2) attenuation for one scheduling period. When TFLT≠0, the output MV climbs to the target value according to the balance switching time TFLT.

When BK_OPT=2, add dual feedback output. When No. 1 is selected by high, BKOUT=IN1; when No. 1 is not selected by high, BKOUT=OUT. When No. 2 is selected by high, BKOUT2=IN2; when No. 2 is not selected by high, BKOUT2=OUT. When BK_OPT=0/1, BKOUT2 is invalid, BKOUT2=0, BKOUTER2=OFF.

Under OOS, the value of BKOUT2 is maintained, and BKOUTER2=ON, which is consistent with the original processing.

3.16.2 Panel Parameter



Table 3.66 Operation Instruction for Panel Parameter

Name			Panel Parameter Name	Initial Value	Value Range	Application Instruction
Preference	Alarm Enable	Input 1 Quality Alarm	ALM1	-	ON/OFF	Selected and the input alarm is enabled Related parameter: ALM1
		Input 2 Quality Alarm	ALM2	-	ON/OFF	Selected and the input alarm is enabled Related parameter: ALM2

Table 3.66 Operation Instruction for Panel Parameter (continued)

Name			Panel Parameter Name	Initial Value	Value Range	Application Instruction
		Override Alarm	OVERIDE	-	ON/OFF	Selected and the override alarm is enabled Related parameter: OVERIDE
	Balance Switch Time (s)	Time Coefficient (TFLT)	TFLT	1.000	-	-

3.16.3 Flag

Table 3.67 Flag

Flag	Alarm	Description
D0	HOLD	Hold
D7	OVERIDE	OVERRIDE
D8	OOS	Disable
D9	IMAN	Initialize Manually
D10	SEL1	Select 1
D11	SEL2	Select 2
D13	IN1ERR	Quality of input 1 is bad
D14	IN2ERR	Quality of input 2 is bad
D19	CFGERR	Configuration Error
D20	AOF	Suppress Alarm
D23	ERR	Fault

3.16.4 Application Example

If it is required to realize dual PID output select-high control, this control process can ensure the switch without disturbance. The building of the program is shown below:

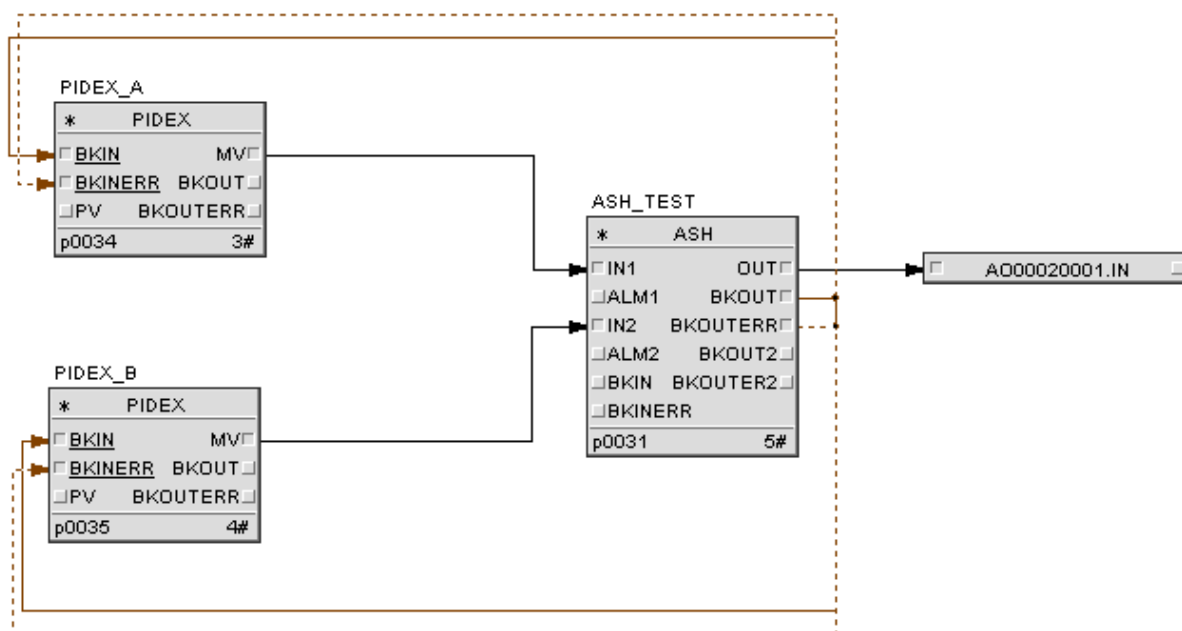


Figure 3.64 ASH override without disturbance ($BK_OPT=0/1$)

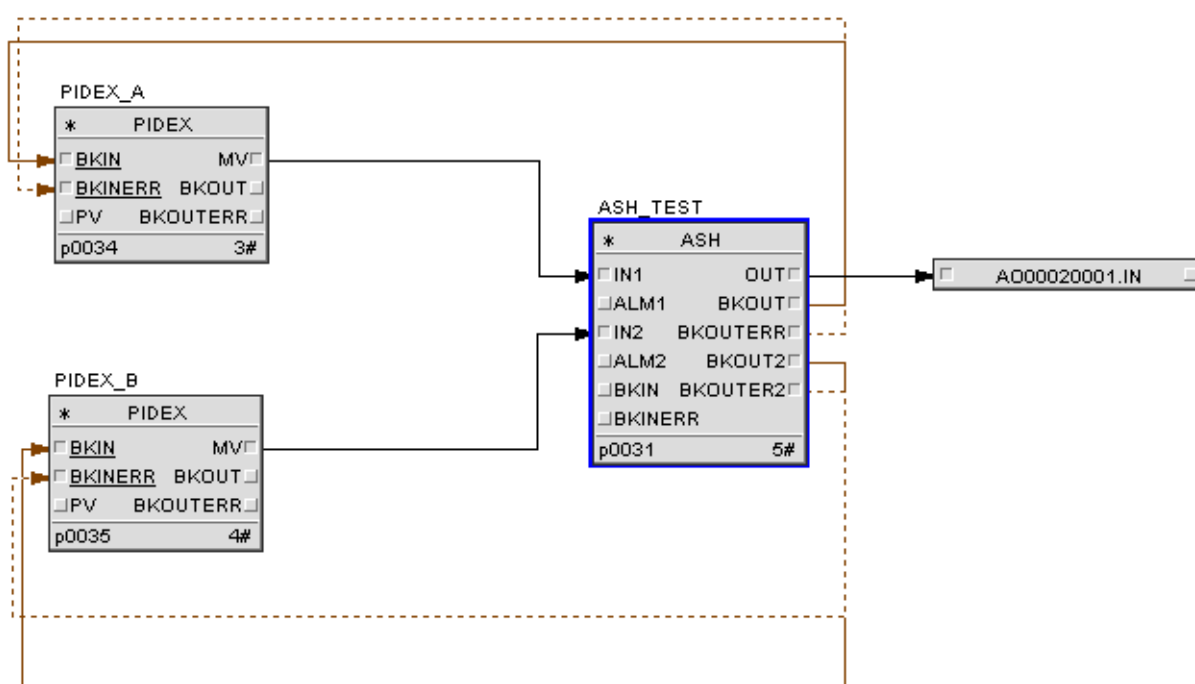


Figure 3.65 ASH override without disturbance ($BK_OPT=2$)

For details of PIDEX and ASH function block's parameter configuration, refer to the actual condition and the illustration of the corresponding function block.

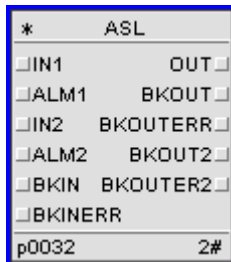
3.17 Minimum Selection Function Block (ASL)

ASL function block can implement the input selection of the first channel, when value of the second channel is smaller than that of the first, the output switches to the second channel and

alarm is generated. It will not be switched to first channel until the value of the first channel is smaller than that of the second, meanwhile the alarm is eliminated.

It is a complex function block and its running time is 90μs.

Please refer to the "Overview" and "Application Foundation of Control Function Block" before using the function block.



3.17.1 Parameter Description

Table 3.68 Parameter instruction and application of ASL Function Block

Name			Description	Up-load	Properties	Application Reference
Basic Parameters	Range-Settings	INSCH	Input Range H	-	Configuration Parameter	The same as the actual value of IN H
		INSCL	Input Range L	-	Configuration Parameter	The same as the actual value of IN H
		OUT-SCH	Output Range H	-	Configuration Parameter	The same as the actual value of OUT H
		OUTSCL	Output Range L	-	Configuration Parameter	The same as the actual value of OUT L
		INEU	Input unit	-	Configuration Parameter	Set in the function block properties settings interface.
		OUTEU	Output unit	-	Configuration Parameter	Set in the function block properties settings interface.
		INDLEN	Input decimal digits [0,5]	-	Configuration Parameter	Used for data displayed on function block panel (equal to 3 as default).
		OUT-DLEN	Output decimal digits [0,5]	-	Configuration Parameter	Used for data displayed on function block panel (equal to 3 as default).
Extended Parameters	Input Pin	IN1	Input 1	-	Input Pin	Contact to AI tagRefer to Note1, Note2Control the

Table 3.68 Parameter instruction and application of ASL Function Block (continued)

Name			Description	Up-load	Properties	Application Reference
						output and has the overall switch function from input range to output range
		ALM1	Input 1Alarm	-	Input Pin	Connect to measuring point AI.ERRRefer to Note1, Note2
		IN2	Input 2	-	Input Pin	Contact to AI tagRefer to Note1, 2Control the output and has the overall switch function from input range to output range
		ALM2	Input 2Alarm	-	Input Pin	Connect to measuring point AI.ERRRefer to note1, 2
		BKIN	Feedback input	-	Input Pin	Connect to BKOUT of downstream block
		BKIN-ERR	Feedback status input	-	Input Pin	Connect to BKOUT of downstream block ERR
	Output Pin	OUT	Output Value	-	Output Pin	Connect to electric manual instrumentRefer to Note2
		BKOUT	Feedback output value	-	Output Pin	Connect to the BKIN of Upstream Block, Related parameter: BK_OPT
		BKOUTERR	Feedback status value	-	Output Pin	Connect to the BKINERR of Upstream Block
		BKOUT2	Feedback output2	-	Output Pin	Connect to the BKIN of Upstream Block, Association: BK_OPT
		BKOUTER2	Feedback status output2	-	Output Pin	Connect to the BKINERR of Upstream Block
	Advance-Settings	BK_OPT	BKOUT process (0=normal, 1=balanced time, 2=dual channel output)	TRUE	Configuration Parameter	Association: BKOUT, BKOUT2, refer to Note5
		TFLT	Balance switch time (s)	TRUE	Operation Parameter	Balance switch is used when the output selection source changed, and performs smooth transition for the output value. When TFLT=0.0, the balance is disabled.

Table 3.68 Parameter instruction and application of ASL Function Block (continued)

Name			Description	Up-load	Properties	Application Reference
	Status	SAFE_-OPT	Safety mode selection (OFF= ordinary mode, ON= advanced mode)	-	Configura-tion Para-meter	Refer to ^{Note3}
		SEL1	Input 1 selected	-	Monitoring Parameter	Display the currently se-lected signal1
		SEL2	Input 2 selected	-	Monitoring Parameter	Display the currently se-lected signal2
		ERR1	Input 1 bad quality	-	Monitoring Parameter	Display the signal quality1
		ERR2	Input 2 bad quality	-	Monitoring Parameter	Display the signal quality2
		ERR	Module fault	-	Monitoring Parameter	-
		OVERIDE	Override Alarm	-	Monitoring Parameter	Refer to high select func-tion block ^{Note1} “Override Alarm”Refer to Parameter Description ^{Note4}
		HOLD	Hold Status	-	Monitoring Parameter	Connect upstream up-stream outputEnable when in automatic or cascade mode
	Alarm Enable and Sup-press	AOF	Suppress mod-ule alarm,	TRUE	Operation Parameter	Refer to Integral Cutting
		ENALM	Alarm enable	TRUE	Alarm Para-meter	Refer to Integral Cutting
		FLAG	Flag	-	Output Pin	Refer to Integral Cutting
	OOS Settings	SWOOS	Function block disabled (ON=prohibited)	TRUE	Operation Parameter	Set as ON at the first time of function block download-ing

Note 1. Minimum Selection Output

When input ALM1=OFF and ALM2=OFF:

If $IN1 \leq IN2$, then $OUT=IN1$ and $OVERIDE=OFF$;

If $IN1 > IN2$, then $OUT=IN2$ and $OVERIDE=ON$, until back to $IN1 \leq IN2$, alarm $OVERIDE=OFF$ and $OUT=IN1$

Note 2. Input Alarm

When $OUT=IN1$, if $ALM1=ON$, then $ERR1=ON$, OUT is maintained, and $BKOUTERR=ON$, it will not be switched to output $IN2$ even if $IN1>IN2$.

When $OUT=IN1$, if $ALM2=ON$, then $ERR2=ON$, OUT and $BKOUTERR$ will depend on the selection of security mode.

When $OUT=IN2$, if $ALM2=ON$, then $ERR2=ON$, OUT is maintained, and $BKOUTERR=ON$, it will not be switched to output $IN1$ even if $IN1\leq IN2$.

When $OUT=IN2$, if $ALM1=ON$, then $ERR1=ON$, OUT and $BKOUTERR$ will depend on the selection of security mod

Note 3. Selection of Security Mode

When $SAFE_OPT=OFF$, if one channel used to output while the other generates input alarm ($ALMn$), the current output channel will be maintained and $BKOUTERR=OFF$.

When $SAFE_OPT=ON$, if one channel used to output while the other generates input alarm ($ALMn$), and the output is maintained will be maintained and $BKOUTERR=ON$.

Note 4: OVERRIDE alarm will be enabled after outline download

Note 5: Low-select non-disturbance switch

When $BK_OPT=0$, press Note 1 to perform low selection output normally.

When $BK_OPT=1$, the balance item value ($IN1/IN2-OUT$ after switching) is restricted. When the balance item exceeds $IN1-IN2$, the balance item value is maintained at ($IN1-IN2$) attenuation for one scheduling period. When $TFLT\neq 0$, the output MV climbs to the target value according to the balance switching time $TFLT$.

When $BK_OPT=2$, add dual feedback output. When No. 1 is low-selected, $BKOUT=IN1$; When No. 1 is not low-selected, $BKOUT=OUT$. When No. 2 is low-selected, $BKOUT2=IN2$; When No. 2 is not low-selected, $BKOUT2=OUT$. When $BK_OPT=0/1$, $BKOUT2$ is invalid, $BKOUT2=0$, $BKOUTER2=OFF$.

Under OOS, the value of $BKOUT2$ is maintained, and $BKOUTER2=ON$, which is consistent with the original processing.

3.17.2 Panel Parameter

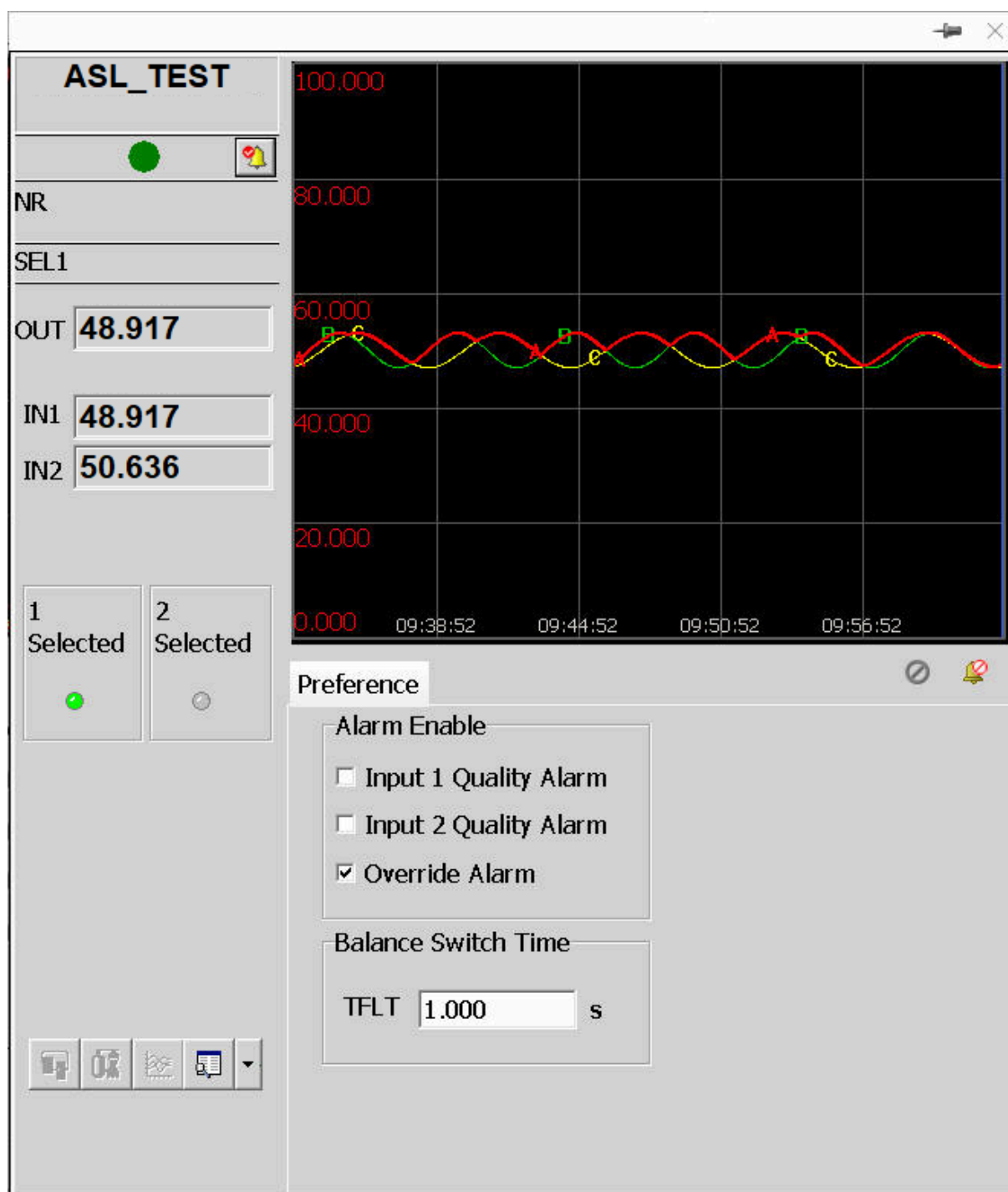


Figure 3.66 Operation Instruction for Panel Parameter

Panel Parameter Name			Function Block Parameter Name	Initial Value	Value Range	Application Instruction
Preference	Alarm Enable	Input 1 Quality Alarm	ALM1	-	ON/OFF	Selected and the input alarm is enabled Related parameter: ALM1
		Input 2 Quality Alarm	ALM2	-	ON/OFF	Selected and the input alarm is enabled

Panel Parameter Name			Function Block Parameter Name	Initial Value	Value Range	Application Instruction
						Related parameter: ALM2
		Override Alarm	OVERIDE	-	ON/OFF	Selected and the override alarm is enabled Related parameter: OVERIDE
	Balance Switch Time	Time Coefficient	TFLT	1.000	-	-

3.17.3 Flag

Table 3.69 Flag

Flag	Alarm	Instruction
D0	HOLD	Hold
D7	OVERIDE	OVERRIDE
D8	OOS	Disable
D9	IMAN	Initialize Manually
D10	SEL1	Select 1
D11	SEL2	Select 2
D13	IN1ERR	Quality of input 1 is bad
D14	IN2ERR	Quality of input 2 is bad
D19	CFGERR	Configuration Error
D20	AOF	Suppress Alarm
D23	ERR	Fault

3.17.4 Application Example

Dual loop select-low override control

To achieve the filed-valve adjustment and control as shown in Figure 3.67, two PV detects on the loop are LT_3037 and TE_3071. To achieve low select control of loop control, and it can be operated in flow chart.

Override control is a select control. When in normal working condition, control output will not overlimit, and can output it directly; when in abnormal working condition, output will exceeds limit, and the utmost limit method should be applied and select safe control output.

Override control often consists of low select override and high select override. Take two-loop low select override control as an example.

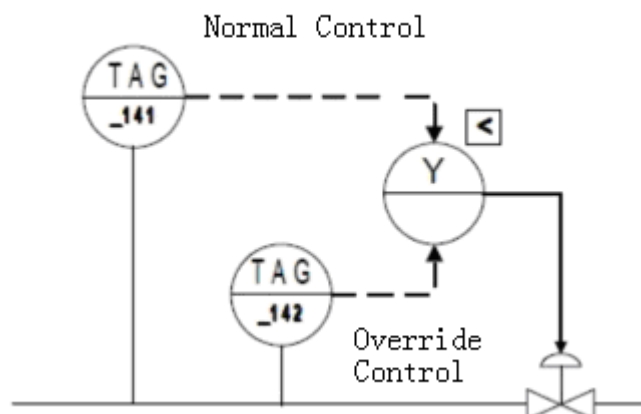


Figure 3.67 Dual loop select-low override control

Details of program are shown in below.

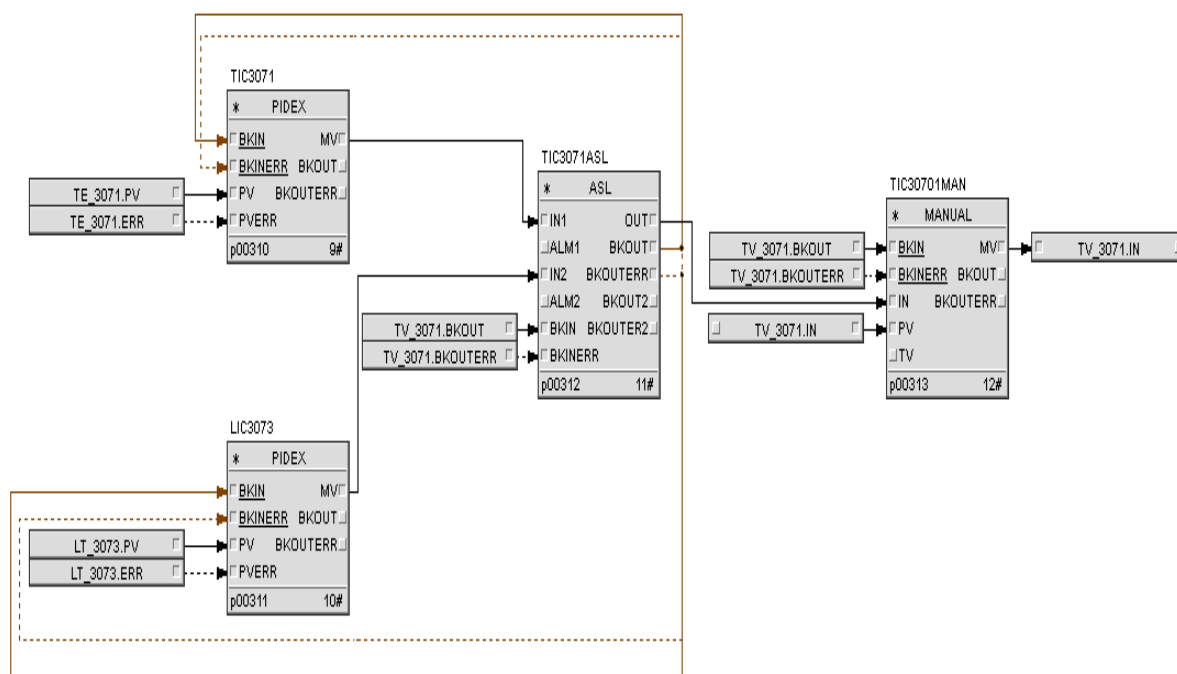


Figure 3.68 Dual loop select-low override control

Instructions of function block and example are shown below.

Table 3.70 Instructions of Function Block and Example

No.	Example	Type	Instruction	Remark
001	TE_3071	AI Input	PV of PID1	
002	LT_3073	AI Input	PV of PID2	
003	TV_3071	AO Output	Control Target	
004	TIC3071	Function Block Tag	PID1 Function Block Tag	
005	LIC3073	Function Block Tag	PID2 Function Block Tag	
006	TIC3071ASL	Function Block Tag	Low Select Override Function Block	
007	TIC30701MAN	Function Block Tag	Hand Control Function Block	

Parameter settings of PID:

- SVSCL, SVSCH, SVEU: the same as its input PV range unit.
- SVL, SVH: when SV amplitude is not needed, it should be same with SV range.

Parameter settings of ASL:

- Low select override control ASL has range switch function, while in this example, both its input and output correspond to valve opening, and the units of IN and OUT are set as 0~100%.
- INSCL=0
- INSCH=100
- OUTSCL=0
- OUTSCH=100

Alarm parameter settings:

- When PID inputting PV fault occurs, its PID loop enters into PVERR mode, and the loop switches to manual status automatically, PID outputting MV keeps.
- When low select override function block ASL select IN2 as output, override alarm will generate.
- PID function block inputs PV secondary H/L alarm when it is required.

The BKIN of input parameter in upstream function block basic parameter should connect with the BKOUT of its downstream function block. BKINERR should connect with the BKOUTERR of its downstream function block. The downstream function block of PID is ASL. The downstream function block of ASL is handheld. The downstream function block of handheld is AO tag.

Note:

Two-loop High Select Override Control

Two-loop high select override control replaces the low select ASL in two-loop low select override control diagram to high select ASH, as shown below.

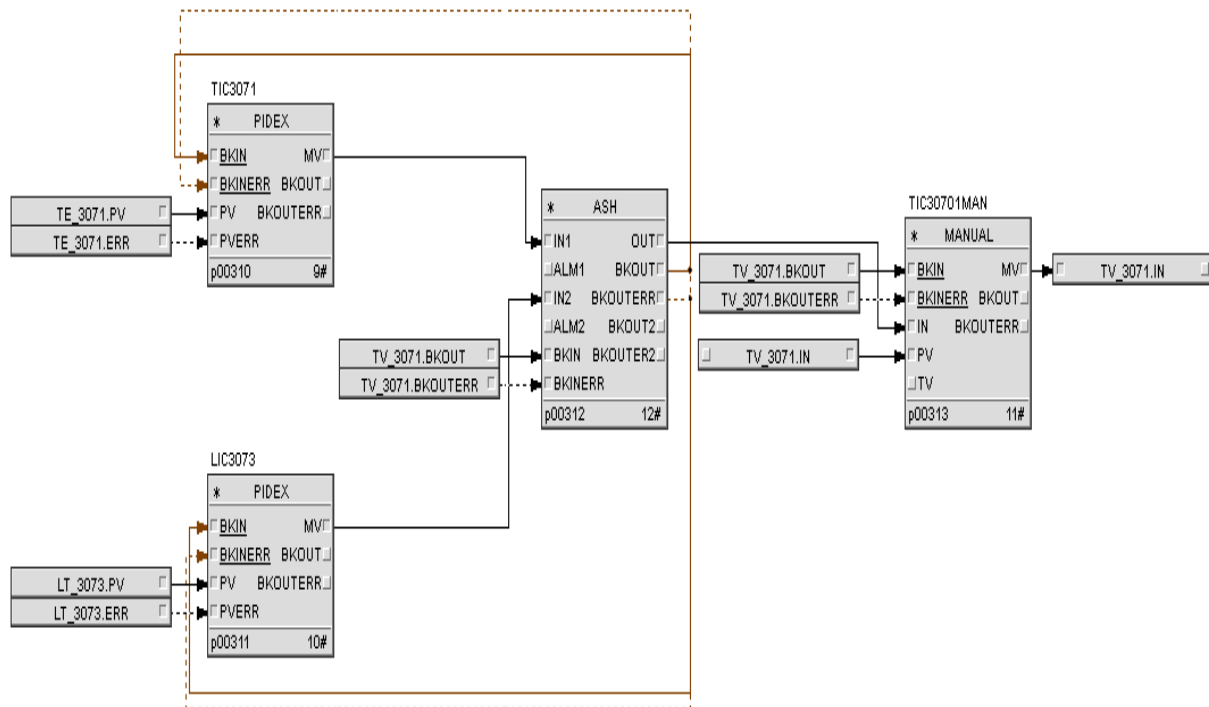


Figure 3.69 Dual loop select-high Override Control

Control panel can invoke the function block name in HMI directly.

Override with disturbance control

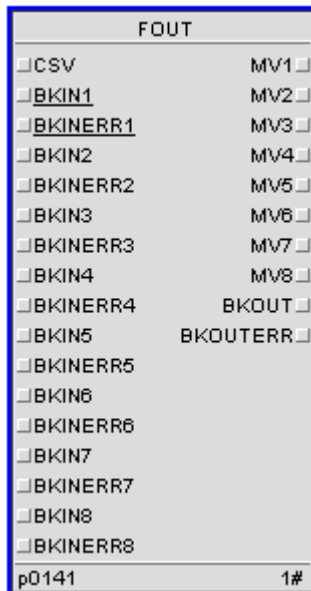
For details of low-select function block ASL's override without disturbance control, refer to high-select ASH's Application Example, but replace the high-select function block to the low-select function block.

3.18 Signal Distribution Function Block (FOUT)

It is mainly used for a master loop to distribute output signal to several slave loops. When the first slave loop is in cascade mode, it will be processed at first, otherwise, process other slave loops.

It is a complex function block and its running time is 50μs.

Please refer to the "Overview" and "Application Foundation of Control Function Block" before using the function block.



3.18.1 Parameter Description

Table 3.71 Parameter description and application of FOUT Function Block

Name			Description	Upload	Properties	Application Reference
Basic Parameters	Range-Settings	MVSCH1	MV1 high value	-	Configuration Parameter	The same as MV1 actual value H limit.
		MVSCL1	MV1 low value	-	Configuration Parameter	The same as MV1 actual value L limit.
		MVSCH2	MV2 high value	-	Configuration Parameter	The same as MV2 actual value H limit.
		MVSCL2	MV2 low value	-	Configuration Parameter	The same as MV2 actual value L limit.
		MVSCH3	MV3 high value	-	Configuration Parameter	The same as MV3 actual value H limit.
		MVSCL3	MV3 low value	-	Configuration Parameter	The same as MV3 actual value L limit.
		MVSCH4	MV4 high value	-	Configuration Parameter	The same as MV4 actual value H limit.

Table 3.71 Parameter description and application of FOUT Function Block (continued)

Name		Description	Upload	Properties	Application Reference
	MVSCL4	MV4 low value	-	Configuration Parameter	The same as MV4 actual value L limit.
	MVSCH5	MV5 high value	-	Configuration Parameter	The same as MV5 actual value H limit.
	MVSCL5	MV5 low value	-	Configuration Parameter	The same as MV5 actual value L limit.
	MVSCH6	MV6 high value	-	Configuration Parameter	The same as MV6 actual value H limit.
	MVSCL6	MV6 low value	-	Configuration Parameter	The same as MV6 actual value L limit.
	MVSCH7	MV7 high value	-	Configuration Parameter	The same as MV7 actual value H limit.
	MVSCL7	MV7 low value	-	Configuration Parameter	The same as MV7 actual value L limit.
	MVSCH8	MV8 high value	-	Configuration Parameter	The same as MV8 actual value H limit.
	MVSCL8	MV8 low value	-	Configuration Parameter	The same as MV8 actual value L limit.
	SVSCH	SV high scale	-	Configuration Parameter	The same as PV actual value H limit.
	SVSCL	SV low scale	-	Configuration Parameter	The same as PV actual value L limit.
	SVEU	SV engineer unit	-	Configuration Parameter	Set in the function block properties settings interface.
	MVEU1	MV1 actual value unit	-	Configuration Parameter	Set in the function block properties settings interface.
	MVEU2	MV2 actual value unit	-	Configuration Parameter	Set in the function block properties settings interface.

Table 3.71 Parameter description and application of FOUT Function Block (continued)

Name		Description	Upload	Properties	Application Reference
	MVEU3	MV3 actual value unit	-	Configuration Parameter	Set in the function block properties settings interface.
	MVEU4	MV4 actual value unit	-	Configuration Parameter	Set in the function block properties settings interface.
	MVEU5	MV5 actual value unit	-	Configuration Parameter	Set in the function block properties settings interface.
	MVEU6	MV6 actual value unit	-	Configuration Parameter	Set in the function block properties settings interface.
	MVEU7	MV7 actual value unit	-	Configuration Parameter	Set in the function block properties settings interface.
	MVEU8	MV8 actual value unit	-	Configuration Parameter	Set in the function block properties settings interface.
	SVDLEN	SV decimal digits [0,5]	-	Configuration Parameter	Used for data displayed on function block panel (equal to 3 as default).
	MVDLEN1	MV1 decimal digits [0,5]	-	Configuration Parameter	Used for data displayed on function block panel (equal to 3 as default).
	MVDLEN2	MV2 decimal digits [0,5]	-	Configuration Parameter	Used for data displayed on function block panel (equal to 3 as default).
	MVDLEN3	MV3 decimal digits [0,5]	-	Configuration Parameter	Used for data displayed on function block panel (equal to 3 as default).
	MVDLEN4	MV4 decimal digits [0,5]	-	Configuration Parameter	Used for data displayed on function block panel (equal to 3 as default).
	MVDLEN5	MV5 decimal digits [0,5]	-	Configuration Parameter	Used for data displayed on function block panel (equal to 3 as default).
	MVDLEN6	MV6 decimal digits [0,5]	-	Configuration Parameter	Used for data displayed on function

Table 3.71 Parameter description and application of FOUT Function Block (continued)

Name			Description	Upload	Properties	Application Reference
						block panel (equal to 3 as default).
		MVDLEN7	MV7 decimal digits [0,5]	-	Configuration Parameter	Used for data displayed on function block panel (equal to 3 as default).
		MVDLEN8	MV8 decimal digits [0,5]	-	Configuration Parameter	Used for data displayed on function block panel (equal to 3 as default).
	Direct/Reverse Switch Settings	SWPN1	Direct/Reverse switch. SV is not changed, the MV increases with the increasing of PV in direct action, and decreases with the increasing of PV in reverse action.	TRUE	Operation Parameter	OFF=Direct action, ON=Reverse action
		SWPN2	Direct/Reverse switch. SV is not changed, the MV increases with the increasing of PV in direct action, and decreases with the increasing of PV in reverse action.	TRUE	Operation Parameter	OFF=Direct action, ON=Reverse action
		SWPN3	Direct/Reverse switch. SV is not changed, the MV increases with the increasing of PV in direct action, and decreases with the increasing of PV in reverse action.	TRUE	Operation Parameter	OFF=Direct action, ON=Reverse action
		SWPN4	Direct/Reverse switch. SV is not changed, the MV increases with the increasing of PV	TRUE	Operation Parameter	OFF=Direct action, ON=Reverse action

Table 3.71 Parameter description and application of FOUT Function Block (continued)

Name			Description	Upload	Properties	Application Reference
			in direct action, and decreases with the increasing of PV in reverse action.			
		SWPN5	Direct/Reverse switch. SV is not changed, the MV increases with the increasing of PV in direct action, and decreases with the increasing of PV in reverse action.	TRUE	Operation Parameter	OFF=Direct action, ON=Reverse action
		SWPN6	Direct/Reverse switch. SV is not changed, the MV increases with the increasing of PV in direct action, and decreases with the increasing of PV in reverse action.	TRUE	Operation Parameter	OFF=Direct action, ON=Reverse action
		SWPN7	Direct/Reverse switch. SV is not changed, the MV increases with the increasing of PV in direct action, and decreases with the increasing of PV in reverse action.	TRUE	Operation Parameter	OFF=Direct action, ON=Reverse action
		SWPN8	Direct/Reverse switch. SV is not changed, the MV increases with the increasing of PV in direct action, and decreases with the increasing of PV in reverse action.	TRUE	Operation Parameter	OFF=Direct action, ON=Reverse action

Table 3.71 Parameter description and application of FOUT Function Block (continued)

Name			Description	Upload	Properties	Application Reference
Extended Parameters	Input Pin	CSV	Cascade	-	Input Pin	Connect to outer loop control value MV
		BKIN1	Feedback input1	-	Input Pin	Connect to BKOUT of downstream block , Refer to ^{Note1}
		BKIN-ERR1	Feedback status input1	-	Input Pin	Connect to BKOUT of downstream block ERR, Refer to ^{Note1}
		BKIN2	Feedback input2	-	Input Pin	Connect to BKOUT of downstream block, Refer to ^{Note1}
		BKIN-ERR2	Feedback status input2	-	Input Pin	Connect to BKOUT of downstream block ERR, Refer to ^{Note1}
		BKIN3	Feedback input3	-	Input Pin	Connect to BKOUT of downstream block , Refer to ^{Note1}
		BKIN-ERR3	Feedback status input3	-	Input Pin	Connect to BKOUT of downstream block ERR, Refer to ^{Note1}
		BKIN4	Feedback input4	-	Input Pin	Connect to BKOUT of downstream block , Refer to ^{Note1}
		BKIN-ERR4	Feedback status input4	-	Input Pin	Connect to BKOUT of downstream block ERR, Refer to ^{Note1}
		BKIN5	Feedback input5	-	Input Pin	Connect to BKOUT of downstream block , Refer to ^{Note1}
		BKIN-ERR5	Feedback status input5	-	Input Pin	Connect to BKOUT of downstream block

Table 3.71 Parameter description and application of FOUT Function Block (continued)

Name			Description	Upload	Properties	Application Reference
						ERR, Refer to Note1
		BKIN6	Feedback input6	-	Input Pin	Connect to BKOUT of downstream block , Refer to Note1
		BKIN-ERR6	Feedback status input6	-	Input Pin	Connect to BKOUT of downstream block ERR, Refer to Note1
		BKIN7	Feedback input7	-	Input Pin	Connect to BKOUT of downstream block , Refer to Note1
		BKIN-ERR7	Feedback status input7	-	Input Pin	Connect to BKOUT of downstream block ERR, Refer to Note1
		BKIN8	Feedback input8	-	Input Pin	Connect to BKOUT of downstream block , Refer to Note1
		BKIN-ERR8	Feedback status input8	-	Input Pin	Connect to BKOUT of downstream block ERR, Refer to Note1
	Output Pin	MV1	PID operation output value 1	-	Output Pin	Downstream CSV
		MV2	PID operation output value 2	-	Output Pin	Downstream CSV
		MV3	PID operation output value 3	-	Output Pin	Downstream CSV
		MV4	PID operation output value 4	-	Output Pin	Downstream CSV
		MV5	PID operation output value 5	-	Output Pin	Downstream CSV
		MV6	PID operation output value 6	-	Output Pin	Downstream CSV
		MV7	PID operation output value 7	-	Output Pin	Downstream CSV

Table 3.71 Parameter description and application of FOUT Function Block (continued)

Name			Description	Upload	Properties	Application Reference
		MV8	PID operation output value 8	-	Output Pin	Downstream CSV
		BKOUT	Feedback output value	-	Output Pin	Connect to the BKIN of Upstream Block, Related parameter: BK_OP- TRefer to ^{Note1}
		BKOUTERR	Feedback status value	-	Output Pin	Connect to the BKINERR of Upstream BlockRefer to ^{Note1}
	SV	SV	SV for loop closed control	TRUE	Operation Parameter	Refer to Set Variable Process
		SVRG_-OPT	SV range convert option:0=no convert,1=convert by percent	-	Configuration Parameter	0 by default.
	Alarm Enable and Suppress	AOF	Suppress module alarm, On=prohibit to display alarm.	TRUE	Operation Parameter	Refer to Integral Cutting
		FLAG	Flag	-	Output Pin	Refer to Integral Cutting
	OOS Settings	SWOOS	OOS mode setting switch (ON= OOS mode)	TRUE	Operation Parameter	Set as ON at the first time of function block downloading

Note . Basic function

BKINn and BKINERRn connect the corresponding BKOUT, BKOUTERR of the nth downstream salve loop.

BKOUT, BKOUTERR connect the corresponding BKIN, BKINERR of upstream master loop.



It is mainly used in cascade control of a master loop distributing output to several salve loops.

When the amount of cascade modes of salve loops is greater than 0, the salve loop newly added to the cascade mode will receive the cascade output of master loop directly, which means the set value input jumping.

When the amount of cascade modes of salve loops is 0, the salve loop newly added to the cascade mode will have the function of bumpless transfer, which means the set value is bumpless. If switched in at the same time, the one with the lower order is prior.

3.18.2 Panel Parameter



Range1 Range2 D/R Action  

Output5 Scale

H Limit L Limit

Output6 Scale

H Limit L Limit

Output7 Scale

H Limit L Limit

Output8 Scale

H Limit L Limit

Range1 Range2 D/R Action  

Output 1

☒ Direct Action
☐ Reverse Action

Output 2

☒ Direct Action
☐ Reverse Action

Output 3

☒ Direct Action
☐ Reverse Action

Output 4

☒ Direct Action
☐ Reverse Action

Output 5

☒ Direct Action
☐ Reverse Action

Output 6

☒ Direct Action
☐ Reverse Action

Output 7

☒ Direct Action
☐ Reverse Action

Output 8

☒ Direct Action
☐ Reverse Action

Table 3.72 Operation Instruction for Panel Parameter

Name		Panel Parameter Name	Initial Value	Value Range	Application Instruction
PID Operation Output Value %	MV1	MV1	0.000	[MVSCL,MVSCH]	Read-only, Operation output value 1
	MV2	MV2	0.000	[MVSCL,MVSCH]	Read-only, Operation output value 2
	MV3	MV3	0.000	[MVSCL,MVSCH]	Read-only, Operation output value 3

Table 3.72 Operation Instruction for Panel Parameter (continued)

Name		Panel Parameter Name	Initial Value	Value Range	Application Instruction	
		MV4	MV4	0.000	[MVSCL,MVSCH]	Read-only, Operation output value 4
		MV5	MV5	0.000	[MVSCL,MVSCH]	Read-only, Operation output value 5
		MV6	MV6	0.000	[MVSCL,MVSCH]	Read-only, Operation output value 6
		MV7	MV7	0.000	[MVSCL,MVSCH]	Read-only, Operation output value 7
		MV8	MV8	0.000	[MVSCL,MVSCH]	Read-only, Operation output value 8
Range1	Output 1 Scale	H Limit	MVSCH1	100.000	[MVSCL,MVSCH]	Read-only, H value setting of loop MV
		L Limit	MVSCL1	0.000	[MVSCL,MVSCH]	Read-only, L value setting of loop MV
	Output 2 Scale	H Limit	MVSCH2	100.000	[MVSCL,MVSCH]	Read-only, H value setting of loop MV
		L Limit	MVSCL2	0.000	[MVSCL,MVSCH]	Read-only, L value setting of loop MV
	Output 3 Scale	H Limit	MVSCH3	100.000	[MVSCL,MVSCH]	Read-only, H value setting of loop MV
		L Limit	MVSCL3	0.000	[MVSCL,MVSCH]	Read-only, L value setting of loop MV
	Output 4 Scale	H Limit	MVSCH4	100.000	[MVSCL,MVSCH]	Read-only, H value setting of loop MV
		L Limit	MVSCL4	0.000	[MVSCL,MVSCH]	Read-only, L value setting of loop MV
Range2	Output 5 Scale	H Limit	MVSCH5	100.000	[MVSCL,MVSCH]	Read-only, H value setting of loop MV

Table 3.72 Operation Instruction for Panel Parameter (continued)

Name			Panel Parameter Name	Initial Value	Value Range	Application Instruction
		L Limit	MVSCL5	0.000	[MVSCL,MVSCH]	Read-only, L value setting of loop MV
	Output 6 Scale	H Limit	MVSCH6	100.000	[MVSCL,MVSCH]	Read-only, H value setting of loop MV
		L Limit	MVSCL6	0.000	[MVSCL,MVSCH]	Read-only, L value setting of loop MV
	Output 7 Scale	H Limit	MVSCH7	100.000	[MVSCL,MVSCH]	Read-only, H value setting of loop MV
		L Limit	MVSCL7	0.000	[MVSCL,MVSCH]	Read-only, L value setting of loop MV
	Output 8 Scale	H Limit	MVSCH8	100.000	[MVSCL,MVSCH]	Read-only, H value setting of loop MV
		L Limit	MVSCL8	0.000	[MVSCL,MVSCH]	Read-only, L value setting of loop MV
	D/R Action	Output 1	Direct Action (selected)	SWPN1	√	ON/OFF
Reverse Action (selected)			SWPN1	-	ON/OFF	Selecting direct action is enabled.
Output 2		Direct Action (selected)	SWPN2	√	ON/OFF	Selecting direct action is enabled.
		Reverse Action (selected)	SWPN2	-	ON/OFF	Selecting reverse action is enabled.
Output 3		Direct Action (selected)	SWPN3	√	ON/OFF	Selecting direct action is enabled.
		Reverse Action (selected)	SWPN3	-	ON/OFF	Selecting reverse action is enabled.
Output 4		Direct Action (selected)	SWPN4	√	ON/OFF	Selecting direct action is enabled.

Table 3.72 Operation Instruction for Panel Parameter (continued)

Name			Panel Parameter Name	Initial Value	Value Range	Application Instruction
	Output 5	Reverse Action (selected)	SWPN4	-	ON/OFF	Selecting reverse action is enabled.
		Direct Action (selected)	SWPN5	√	ON/OFF	Selecting direct action is enabled.
	Output 6	Reverse Action (selected)	SWPN5	-	ON/OFF	Selecting reverse action is enabled.
		Direct Action (selected)	SWPN6	√	ON/OFF	Selecting direct action is enabled.
	Output 7	Reverse Action (selected)	SWPN6	-	ON/OFF	Selecting direct action is enabled.
		Direct Action (selected)	SWPN7	√	ON/OFF	Selecting direct action is enabled.
	Output 8	Reverse Action (selected)	SWPN7	-	ON/OFF	Selecting reverse action is enabled.
		Direct Action (selected)	SWPN8	√	ON/OFF	Selecting direct action is enabled.
	Output 9	Reverse Action (selected)	SWPN8	-	ON/OFF	Selecting reverse action is enabled.
		Direct Action (selected)	SWPN9	√	ON/OFF	Selecting direct action is enabled.

3.18.3 Flag

Table 3.73 Flag list

Flag	Alarm	Instruction
D0	OOS	Disable
D25	AOF	Suppress Alarm

3.18.4 Application Example

To control the water level, as shown below, the rotation speeds of two pumps should be same to avoid back flow for the output header pipe caused by the different rotation speeds. And the two

pumps can be switched between same rotation setting mode and separately setting mode, and it can be shown and operated in the diagram.

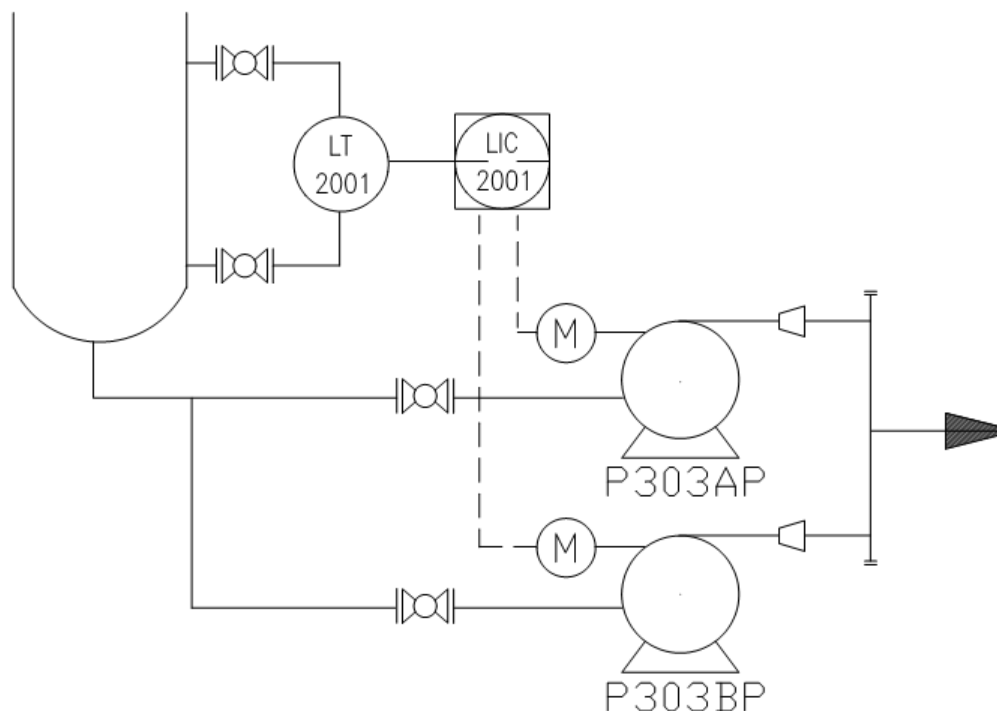


Figure 3.70 Diagram of single AI and double AO adjusting control

The single AI and double AO adjusting control means that the one PID loop controls 2 adjusting valves or handhelds at the same time. It is often applied when 2 adjusting valves or handhelds are required synchronized actions.

Its programming, which is shown in the figure below, can be achieved by applying function blocks such as PIDEK, FOUT and MANUAL, etc. And the data display and operation of the host computer interface can be achieved by the tags of function blocks.

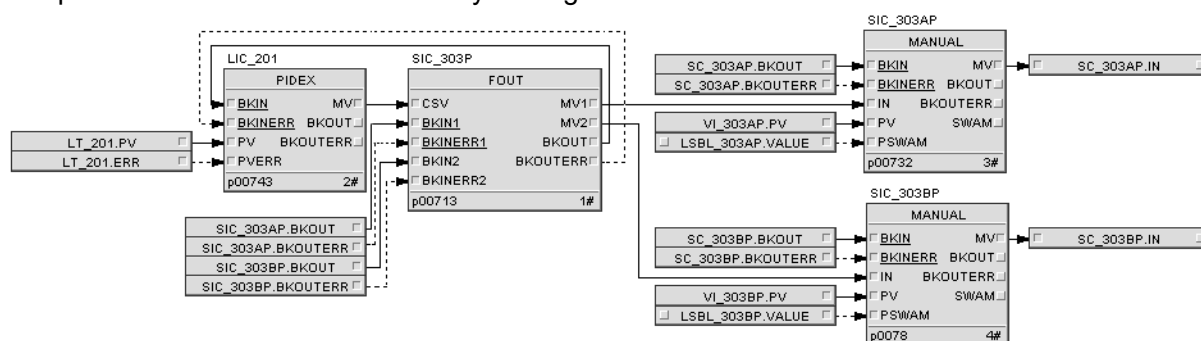


Figure 3.71 Programming of reactor water level control

The function block instruction and examples are shown in below.

Table 3.74 Function Block Instruction and Examples

NO.	Example	Type	Instruction	Remark
001	LT_201	AI (Input)	PV	

Table 3.74 Function Block Instruction and Examples (continued)

NO.	Example	Type	Instruction	Remark
002	VI_303AP	AI (Input)	Handheld Feedback1	
003	VI_303BP	AI (Input)	Handheld Feedback2	
004	SC_303AP	AO (Output)	Frequency Conversion1	
005	SC_303AP	AO (Output)	Frequency Conversion 2	
006	LIC_201	Tag of Function Block	Tag of PID	
007	SIC_303P	Tag of Function Block	Tag of Signal Distribution Function Block	
008	SIC_303AP	Tag of Function Block	Tag of Handheld1 Function Block	
009	SIC_303BP	Tag of Function Block	Tag of Handheld2 Function Block	

Setting the parameters of PIDEX.

- SVSCL, SVSCH, SVEU: the same as the input PV range unit (0~600KPa)
- The ranges of SVL and SVH should be the same as SV when the SV limit function is not required.
- MVSCL, MVSCL, MVEU: use the default value 0~100%
- MVL, MVH: are set in 0~100 when the MV output limit function is not required
- Parameter setting of FOUT: no setting
- Parameter setting of MANUAL:PVSCL, PVSCH, PVEU, MVSCL, MVSCH, MVEU: 0~100%
- Alarm Setting: SWPWF=ON

Notice:

The signal distribution function is mainly applied for distributing the setting output of a major loop to various minor loops of the downstream.

4 Logical Control Function Block Library

There are total 27 function blocks, including 18 complex function blocks and 9 simple function blocks in logical control function block library. Panel parameters of complex function blocks can be operated in real-time supervision software.

- MOTOR, MOTOR_EX, DIO-11M, DIO-21M and DI-2M function blocks are motor function blocks, which are mainly used to realize basic start-stop control and interlock protection of equipment.
- VALVE, VALVE_EX, DIO-11V, DIO-21V, DI-2V, DIO-01V and DIO-22V function blocks are valve-type function blocks, and valve-type function blocks mainly implement basic switch control and interlock protection of equipment.

Motor value function blocks are equipped with alarm reminders under various working conditions, which can effectively protect field equipment.

4.1 Software Pulse Sequence Output Function Block (SPO)

SPO function block switch the digital input signal to pulse output signal. The output pulse is controlled by the input signal and pulse select time. When the lasting time of input signal is less or equals to the change time of designated pulse width, output the first pulse. Otherwise, output the second pulse.

SPO function block is simple function block, and its runtime is 12μs.

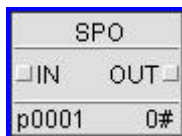


Table 4.1 SPO Pulse Sequence Output Function Block Parameter Instruction

Name			Description	Upload	Properties	Application Reference
Basic Parameters	Input pin	IN	Digital input signal. IN and TPLS work together to control the output signal, which is one of the two pulse signal with same cycle and different pulse width.	-	Input pin	Connected to digital signal.
	Output pin	OUT	Output cycle pulse signal.	-	Output pin	-
	Operation parameter	TPLS	Pulse cycle (in second). The cycle is	TRUE	Operation parameter	Set in the parameter Properties.

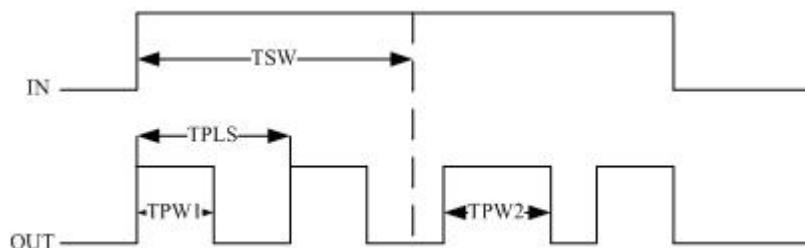
Table 4.1 SPO Pulse Sequence Output Function Block Parameter Instruction (continued)

Name			Description	Upload	Properties	Application Reference
			related to the cycle of program.			
		TSW	Pulse select time (in second). The interval of the two output signal is decided by TSW.	TRUE	Operation parameter	Set in the parameter Properties.
		TPW1	Pulse width for first pulse (in second).	TRUE	Operation parameter	Set in the parameter Properties.
		TPW2	Pulse width for second pulse (in second).	TRUE	Operation parameter	Set in the parameter Properties.

The output pulse is controlled by the input signal and pulse select time, the relation between of output signal and input signal is described following.

- When IN=ON, and the lasting time of input signal is less or equals to the choosing time of pulse, the output width is TPW1.
- When IN=ON, and the lasting time of input signal is greater then the choosing time of pulse, the output width is TPW2.
- When IN=OFF, stop pulse outputting and OUT=OFF.
- When the pulse choosing time equals to 0, the width of output pulse is TPW1, TPW2 does not work.
- When TPW1, TPW2 and TPW ARE LESS THAN 0, it holds the original values.
- When TPW1 and TPW2 are more then TPLS, TPW1 and TPW2 equal to TPLS.
- When TPLS are more than 0, but less than the period of current program, TPLS equals to the period of current program.

The timing sequence figures of output signal are shown as follow, please refer to Figure 4.1 to Figure 4.4, and the “n” in the figure is a nature number.

**Figure 4.1 $TPW2 > TPW1$ and $(TSW - TPLS \times n) > TPW2$**

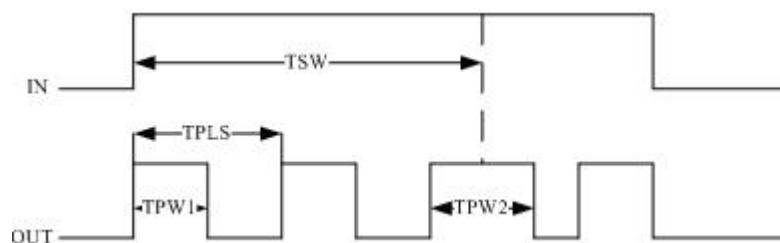


Figure 4.2 $TPW2 > TPW1$ and $(TSW - TPLS \times n) < TPW2$

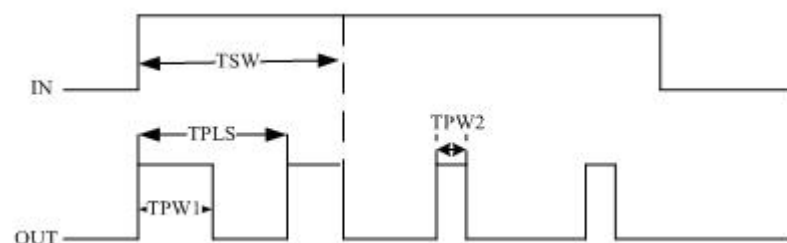


Figure 4.3 $TPW2 > TPW1$ and $(TSW - TPLS \times n) < TPW2$

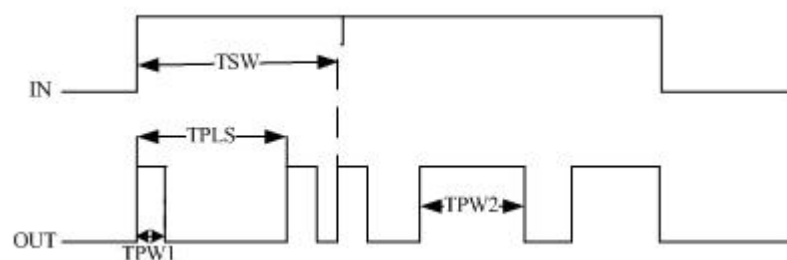


Figure 4.4 Timing sequence figure when $TPW2 < TPW1$

4.2 Digital Status Change Function Block (DSCA)

DSCA function block can count the status change times of input digital. It can count positive jump, negative jump or both of input digital by the setting of statistic mode "MODE".

DSCA function block is simple function block, and its running time is 4μs. The parameters of DSCA function block is described in Digital Status C.



Digital First SN Indicator Function Block (FIRST)

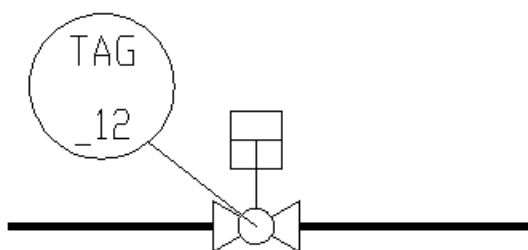
4.2.1 Parameter Description

Table 4.2 Digital Status Change Function Block Parameter Description

Name			Description	Upload	Properties	Application Reference
Basic Parameters	input pin	IN	Switch Input	-	Input pin	-
		START-UP	Switch for Statistics Start/ Stop: OFF=Stop, ON=Start	-	Input pin	-
		RST	Reset Signal: ON=Reset	-	Input pin	-
	output pin	OUT	Output for Change Time. Detail description of OUT is shown below this table.	-	Output pin	-
	configuration parameter	MODE	Statistics Mode: 0=Amount of Positive Hopping, 1=Amount of Negative Hopping, 2=Amount of Positive Hopping/Negative	-	configuration parameter	Set in the configuration Properties.

4.2.2 Application Example

To count the ON/OFF times of the field electromagnetic valve, and display on the diagram, as shown in below.

**Figure 4.5 Diagram of counting valve status modification**

The digital signals are “1” and “0”. In application, the statistics such as counting and accumulation should be performed for the digital change times. It is often used for counting the ON/OFF times of field valve and electric machine.

Its programming is shown below and can be achieved via DSCA. The statistics data of the host computer displayed data can be monitored via custom tag.

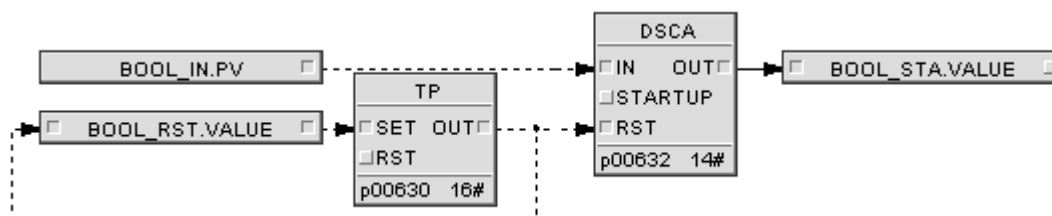


Figure 4.6 Programming of valve ON/OFF status statistics

The function block instruction and examples are shown below.

Table 4.3 Function block instruction and examples

NO.	Example	Type	Instruction	Remark
001	BOOL_IN	DI (Input)	Tag of DI	-
002	BOOL_RST	Custom BOOL	Tag of Reset	-
003	BOOL_STA	Custom UDINT	Custom Tag	For Accumulation Display

Setting parameters of DSCA:

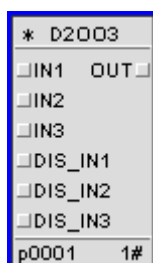
- STARTUP: ON
- MODE: 2

Setting parameters of TP:

- DT: 1
- No alarm setting

4.3 3-Channel Digital Selection Function Block(D2003)

This function block is used to judge the three input and enable input and output the judge.



Parameter Instruction

Table 4.4 Parameter Instruction

Parameter			Description	Upload	Reference
BasicParameter	Input Pin	IN1	Digital Value Input1	-	Initial value is OFF.
		IN2	Digital Value Input2	-	Initial value is OFF.

Table 4.4 Parameter Instruction (continued)

Parameter			Description	Upload	Reference
		IN3	Digital Value Input3	-	Initial value is OFF.
		DIS_-IN1	Digital Value Input1 Forbidden	-	Initial value is OFF.
		DIS_-IN2	Digital Value Input2 Forbidden	-	Initial value is OFF.
		DIS_-IN3	Digital Value Input3 Forbidden	-	Initial value is OFF.
	Output Pin	OUT		-	-
Extended Parameter	Supervision Parameter	NUM	The count of enabled DIS_INn.	-	USINT

Output Instruction

- When the values of DIS_IN1, DIS_IN2, DIS_IN3 are all OFF, and the count of the INn whose value is ON is more than 2, then the OUT is ON.
- When the values of DIS_IN1, DIS_IN2, DIS_IN3 are one ON and two OFF, and the count of the INn related to the DIS_INn, whose value is OFF, is more than 1, then the OUT is ON.
- When there are 2 values of DIS_IN1, DIS_IN2, DIS_IN3 equaled to ON, and the INn related to the other DIS_INn is ON, then the OUT is ON.
- When the value of DIS_IN1, DIS_IN2, DIS_IN3 are ON, then the OUT is OFF.

4.4 Switch Status Time Accumulation Function Block (SSTA)

SSTA function block accelerates the time when the digital status is ON or OFF. Statistic mode MODE sets to accelerate which status and the output acceleration time can be set in 4 formats: second, minute, hour and day.

SSTA function block is simple function block, and its running time is 11μs.



4.4.1 Parameter Description

The parameters of SSTA function block is described in Switch status TI.

Table 4.5 Switch status time accumulation function block parameter description

Name			Description	Upload	Properties	Application Reference
Basic Parameters	input pin	IN	Switch Input	-	Input pin	-
		START-UP	Start/Stop Switch for Accumulation: ON=Start, OFF=Stop	-	Input pin	-
		RST	Reset Signal: ON=Reset	-	Input pin	Valid while Positive transition-sensing
	output pin	OUT	Accumulative Time Output. Detail description of OUT is shown below this table.	-	Output pin	-
	operation parameter	INITVAL	Accumulation Initial Value	TRUE	operation parameter	Set in the function block Properties.
	configuration parameter	MODE	Select Switch for Accumulation Mode Mode=[0~3], On Status Time Accumulation-Mode=[4~7], Off Status Time Accumulation	-	configuration parameter	Set in the parameter Properties.

Description of OUT:

- When STARTUP=ON, output the change time of input digital status.
- When STARTUP=OFF, this function block stop to statistics. And the OUT will keep the statistics of the last week.
- When RST changing from OFF to ON, the OUT will be equal to INITVAL and the inner count of function block will be set as INITVAL.
- When the master controller cold startup, the OUT will be equal to INITVAL and STARTUP will be OFF and the inner count of function block will be set as 0.

Choices of MODE:

When Start/Stop Switch for accumulation STARTUP=ON, start acceleration.

- MODE=0
Accelerate the time when the status is ON.
OUT=acceleration time of input ON (second as unit) + acceleration initial value
- MODE=1

Accelerate the time when the status is ON.

$OUT = \text{acceleration time of input ON (second as unit)} / 60 + \text{acceleration initial value}$

- **MODE=2**

Accelerate the time when the status is ON.

$OUT = \text{acceleration time of input ON (second as unit)} / 3600 + \text{acceleration initial value}$

- **MODE=3**

Accelerate the time when the status is ON.

$OUT = \text{acceleration time of input ON (second as unit)} / 86400 + \text{acceleration initial value}$

- **MODE=4**

Accelerate the time when the status is OFF.

$OUT = \text{acceleration time of input OFF (second as unit)} + \text{acceleration initial value}$

- **MODE=5**

Accelerate the time when the status is OFF.

$OUT = \text{acceleration time of input OFF (second as unit)} / 60 + \text{acceleration initial value}$

- **MODE=6**

Accelerate the time when the status is OFF.

$OUT = \text{acceleration time of input OFF (second as unit)} / 3600 + \text{acceleration initial value}$

- **MODE=7**

Accelerate the time when the status is OFF.

$OUT = \text{acceleration time of input OFF (second as unit)} / 86400 + \text{acceleration initial value}$

4.4.2 Application Example

To count the running time of the field pump as shown below, and display in the flow chart. The digital signals are 1 and 0. The switch status time should be accumulated, displayed and counted.

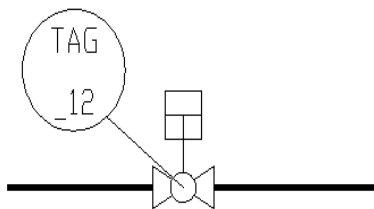


Figure 4.7 Diagram of pump running time display

Its programming is shown below and can be achieved via SSTA. The host computer interface can display data and monitor the statistic data via custom tag.

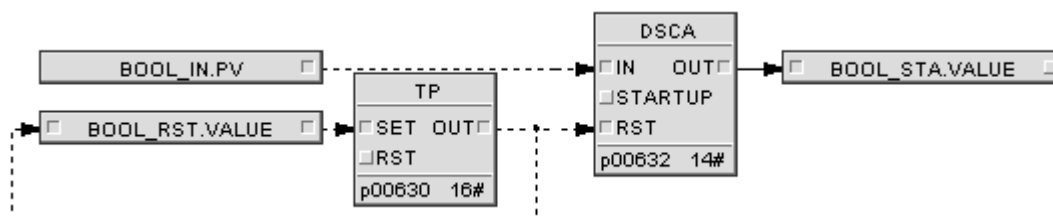


Figure 4.8 Programming of valve switch status statistics

The function block instruction and examples are shown below.

Table 4.6 Function block instruction and examples

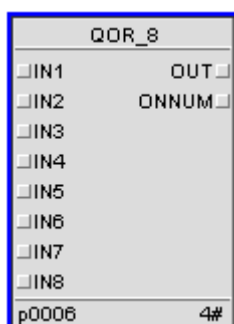
NO.	Example	Type	Instruction	Remark
001	BOOL_IN	DI (Input)	Digital Input Tag	
002	BOOL_RST	Custom BOOL	Reset Tag	
003	ON_TIME	Custom REAL	Custom Tag	For Time Display

Parameter settings of SSTA:

- STARTUP: ON
- MODE: 0

4.5 8 Input QOR Function Block (QOR_8)

QOR-8 function block restricts or operates 8inout BOOL type variables. QOR_8 function block is simple function block, and its running time is 6μs.



The parameters of QOR_8 function block is described in 8 input QOR function block.

4.5.1 Parameter Description

Table 4.7 8 input QOR function block parameter description

Name			Description	Upload	Properties	Application Reference
Basic Parameters	input pin	IN1	Switch Input1	-	Input pin	-

Table 4.7 8 input QOR function block parameter description (continued)

Name			Description	Upload	Properties	Application Reference
		IN2	Switch Input2	-	Input pin	-
		IN3	Switch Input3	-	Input pin	-
		IN4	Switch Input4	-	Input pin	-
		IN5	Switch Input5	-	Input pin	-
		IN6	Switch Input6	-	Input pin	-
		IN7	Switch Input7	-	Input pin	-
		IN8	Switch Input8	-	Input pin	-
	output pin	OUT	Detail description of OUT is shown below this table.	-	Output pin	-
		ONNUM	Amount of ON That Has Inputted.	-	Output pin	-
	configuration parameter	MODE	Operation Mode: ON=Greater and Equal; OFF=Equal	-	configuration parameter	-
	operation parameter	NUM	Limit or Operation Number. [0~8]	-	operation parameter	Set in the function block Properties.

Description of OUT is:

- MODE=ON When the number of function block variable ON is more than or equals to restricted or operated number NUM, output is ON, otherwise, OFF.
- MODE=OFF When the number of function block variable ON equals to restrict or operated number NUM, output is ON, otherwise, OFF. ONNUM is the number of function block actual input ON.

4.5.2 Application Example

To determine 8 DI, when there are 5 or more DI in status of ON, output is ON.

To determine the number of digital value, when the number of closed digital value is greater than or equal to the set number, output (BOOL) is ON, or it is OFF.

Details of program are shown below, it applies QOR_8.

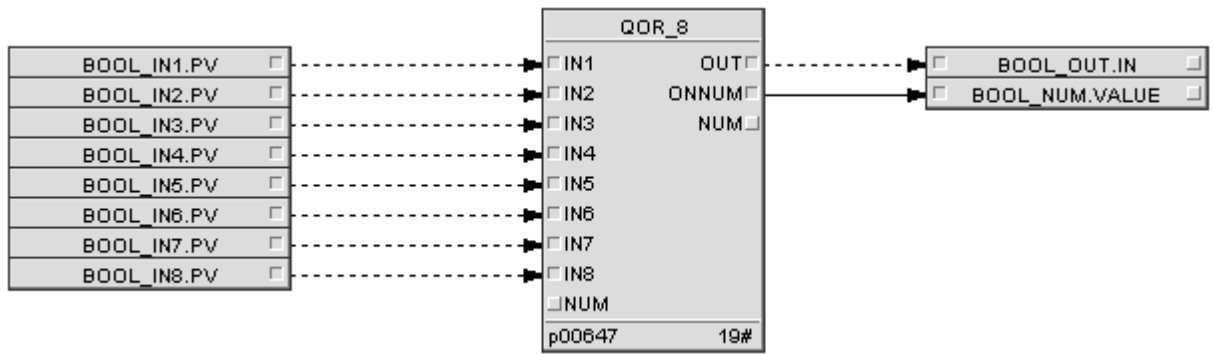


Figure 4.9 Program of Determine Digital Value Number

Instructions of function block and example are shown below.

Table 4.8 Instructions of Function Block and Example

No.	Example	Type	Instruction	Remarks
001	BOOL_IN1~7	DI Input	DI Tag	8 DI
002	BOOL_OUT	Custom BOOL	Output Tag	-
003	BOOL_NUM	Custom UINT	Custom Tag	Number of Input ON

Parameter Settings of QOR_8:

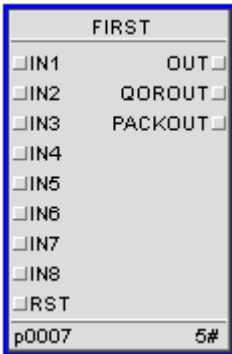
- NUM: 5
- MODE: ON

Note: When MODE=ON, working mode is "greater than or equal to". When MODE=OFF, working mode is "equal to".

4.6 Digital First SN Indicator Function Block (FIRST)

FIRST function block figures out the first digital serial number jumps from OFF to ON among 16 digital input. The priority of input signals is: when IN1 and IN2 jump from OFF to ON at the same time, output the serial number of IN1.

QOR_8 function block is simple function block, and its running time is 12μs.



The parameters of QOR_8 function block is described in Table 4.9.

Table 4.9 Digital first SN indicator function block parameter instruction

Name			Description	Upload	Properties	Application Reference
Basic Parameters	Input Pin	IN1	Switch Input1	-	Input pin	-
		IN2	Switch Input2	-	Input pin	-
		IN3	Switch Input3	-	Input pin	-
		IN4	Switch Input4	-	Input pin	-
		IN5	Switch Input5	-	Input pin	-
		IN6	Switch Input6	-	Input pin	-
		IN7	Switch Input7	-	Input pin	-
		IN8	Switch Input8	-	Input pin	-
		IN9	Switch Input9	-	Input pin	-
		IN10	Switch Input10	-	Input pin	-
		IN11	Switch Input11	-	Input pin	-
		IN12	Switch Input12	-	Input pin	-
		IN13	Switch Input13	-	Input pin	-
		IN14	Switch Input14	-	Input pin	-
		IN15	Switch Input15	-	Input pin	-
		IN16	Switch Input16	-	Input pin	-
		RST	Output “Reset Switch” (ON=Reset Switch). Output restore switch RST can only restore output when the input is not ON, when RST jumps, OUT=0, CI=OFF, eliminate input jump status in interior records. (It is thought there is no input jump.)	-	Input pin	Valid while Positive transition-sensing
		HOLD	Hold (ON: pause generating first out value, OFF: restore generating first out value)	-	Input pin	“Hold” only relates to whether output first out value and whether generate first out alarm, but not relates to other output parameters and will not influ-

Table 4.9 Digital first SN indicator function block parameter instruction (continued)

Name			Description	Upload	Properties	Application Reference
	Output Pin					ence the output of QOROUT, CI, and PACKOUT.
		OUT	Serial Number of Input Switch Value Which First from OFF To ON.	-	Output pin	-
		QOROUT	Restriction and output of the 16 input digitals.	-	Output pin	When the number of input digital ON is more than NUM, set QOROUT=ON, otherwise, QOROUT=OFF.
		CI	Indication That Input Switch Value Hopping:OFF=No Hopping, ON=Hopping	-	Output pin	-
		PACKOUT	Package Inputs and Output It. The data type of PACKOUT is UNIT.	-	Output pin	PACKOUT is the package output of input signals, that is, to compress 16 BOOL type input signals to 16 integer output. IN16 is the highest and IN1 is the lowest.
	Operation Parameter	NUM	Number or Default ON, [0~16]	TRUE	Operation Parameter	-
		AOF	Module Alarm Shield	TRUE	Operation Parameter	-
	Alarm Parameter	ENALM	Alarm Enable	TRUE	Alarm Parameter	-
		FLAG	Flag	-	Alarm Parameter	-

Note:

- When the output digital does not change, output OUT=0, CI=OFF.
- When the output digital changes from OFF to ON, output OUT is the first digital serial number that jumps from OFF to ON(1~16) and CI parameter ON. When there is no input signal jumps in this period, but several inputs jump at the same time, output OUT is the smallest serial number.

Table 4.10 Flag for FIRST

Flag	Monitoring Value	Instruction
D0	Enable (AOF)	Alarm Suppress (AOF)
D1	Disable	First Out Alarm (FIRST_ON)
D2	Disable	Input Jump Indication (CI)
D3	Disable	Limit or Output (QOROUT)
D4-D7	-	-

4.7 Blink Function Block (BLINK)

BLINK function block generates the output signals of pulse. When both input are ON, it blinks all the time.

BLINK function block is simple function block, and its running time is 1μs.

The parameters of BLINK function block is described in Table 4.11.

Table 4.11 Blink function block parameter instruction

Name			Description	Upload	Properties	Application Reference
Basic Parameters	Input pin	IN1	Switch Input1	-	input pin	-
		IN2	Switch Input2	-	input pin	-
	Output pin	OUT	Flash OutputWhen IN1=IN2=ON, output OFF and ON statuses on tern. Each status maintains one running period. Otherwise, output OUT trace IN1 input value.	-	output pin	-

Its true value table is shown as follows:

Table 4.12 Blink function block input and output true value table

IN1	IN2	OUT
OFF	OFF	OFF
OFF	ON	OFF
ON	OFF	ON
ON	ON	ON, OFF Blinking

4.8 Interval Control Function Block (DGAP)

DGAP function block and PID function block are different in control mode: PID function block outputs a series signal to control the equipments like valve; DGAP function block outputs the digital signal to control discrete equipments like switch valve.

This function block has two work modes. When MODE=OFF, the function block is in 2 modes and 2 statuses work mode; when MODE=ON, the function block is in 2 modes and 3 statuses work mode. In addition, this function block supports functions like measuring value alarm, error alarm, manual operation mode, hold mode and setting vale tracing measuring value.

DGAP function block is complex function block, and its running time is 20μs.



The parameters of DGAP function block is described in following table.

4.8.1 Parameter Description

Table 4.13 Parameter description of DGAP

Name			Description	Upload	Properties	Application
Basic Parameters	Range Parameters	SVSCH	Input Range High Limit	-	Configuration Parameter	Equal to high limit of PV.
		SVSCL	Input Range Low Limit	-	Configuration Parameter	Equal to low limit of PV.
		EU	Engineering Unit	-	Configuration Parameter	Set in the parameter Properties
		DLEN	Decimal Digits [0,5]	-	Configuration Parameter	Display on panel of this function block.
	Work mode	MODE	Operation Mode: OFF=BISTATE, ON=TRISTATE	-	Configuration Parameter	Set in the parameter Properties.
Extended Parameters	Input pins	PV	Measured Value	-	Input Pin	Connect to AI,
		CSV	Outer Set Point	-	Input Pin	Connect to output of upper function block.
	Output pins	OUTINC	Forward Output	-	Output Pin	Digital Signal

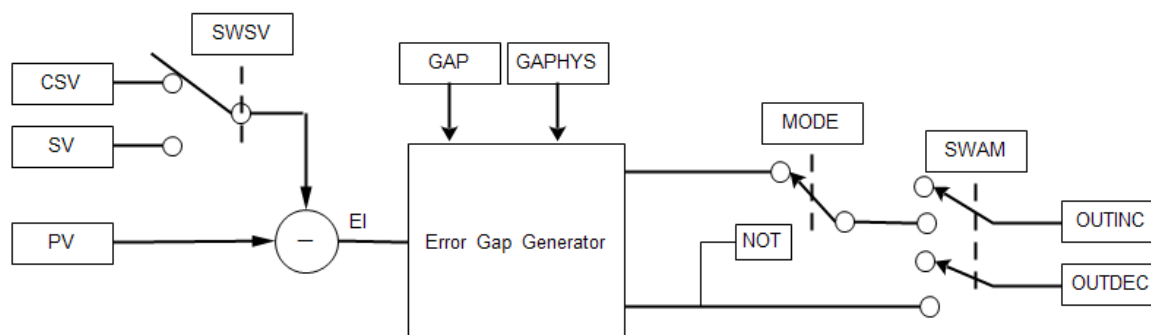
Table 4.13 Parameter description of DGAP (continued)

Name			Description	Upload	Properties	Application
		OUTDEC	Inverted Output	-	Output Pin	Digital Signal
		BKOUT	Feedback Output	-	Output Pin	When function block work in cascade, BKOUT=SV. When function block work in non-cascade, BKOUT=P.V.
		ERR	Function Block Alarm	-	Output Pin	-
		BKOUTERR	Whether Function Block Mode is Cascade Stage	-	Output Pin	Connect to the BKINERR of upper function block.
	Operation parameters	SWAM	Man/Auto Switch: On=Auto, Off=Man	-	Operation Parameter	-
		SWSV	Optional Switch for Setting Value: ON=Outer Setting Value, OFF=Inner Setting Value	-	Operation Parameter	-
		SV	Local Setting Value	TRUE	Operation Parameter	-
		EI	Deviation	-	Monitoring Parameter	EI=P.V-SV
	Alarm Setting	PVHH	Input HH Limit Alarm Value	TRUE	Operation Parameter	Refer to Input Process
		PVH	Input High Limit Alarm Value	TRUE	Operation Parameter	Refer to Input Process
		PVL	PV L Alarm Value	TRUE	Operation Parameter	Refer to Input Process
		PVLL	PV LL Alarm Value	TRUE	Operation Parameter	Refer to Input Process
		DVH	Positive Error Alarm Limit	TRUE	Operation Parameter	-
		DVL	Negative Error Alarm Limit	TRUE	Operation Parameter	-

Table 4.13 Parameter description of DGAP (continued)

Name			Description	Upload	Properties	Application
		DVHYS	Error Alarm Hysteresis Value	TRUE	Operation Parameter	-
		PVHYS	PV Alarm Hysteresis Value	TRUE	Operation Parameter	Refer to Input Process
	Gap Settings	GAP	Gap Width	TRUE	Operation Parameter	-
		GAPHYS	Gap Hysteresis Value	TRUE	Operation Parameter	-
	SV Track	SWSVTR	SV Track Switch in Manual Mode: SWSVTR=ON, SV Tracks PV; SWSVTR=OFF, SV Does not Track PV	-	Configuration Parameter	-
	Alarm Enable	AOF	Module Alarm Suppress-ON=Alarm Display Disabled	TRUE	Operation Parameter	Refer to Integral Cutting

1. Function Block Logic Figure

**Figure 4.10 function block logic figure**

2. 2 positions and 2 statuses work mode

When MODE=OFF, the function block is in 2 positions and 2 statuses work mode. The function block outputs OUTINC and OUTDEC statuses by comparing error EI ($EI = SV - PV$) and gap GAP between set value SV and process value PV.

In automatically operation status:

When EI ascends to the low limit of GAP in non-sensitive area, OUTINC=ON, OUTDEC=OFF.

When $EI = \text{GAP}/2$, OUTDEC and OUTINC keep the value of last week.

When EI ascends to the high limit of GAP in non-sensitive area, OUTINC=OFF, OUTDEC=ON.

When $EI = -\text{GAP}/2$, OUTDEC and OUTDEC keep the value of last week.

When EI returns to non-sensitive area ($-\text{GAP}/2 < EI < \text{GAP}/2$), OUTINC and OUTDEC maintains the original values. That is, when EI ascends from the low limit of GAP in non-sensitive area to non-sensitive area, OUTINC=ON, OUTDEC=OFF; when EI descends from the high limit of GAP in non-sensitive area to non-sensitive area, OUTINC=OFF, OUTDEC=ON.

The input and output relationships of function block are shown as follows:

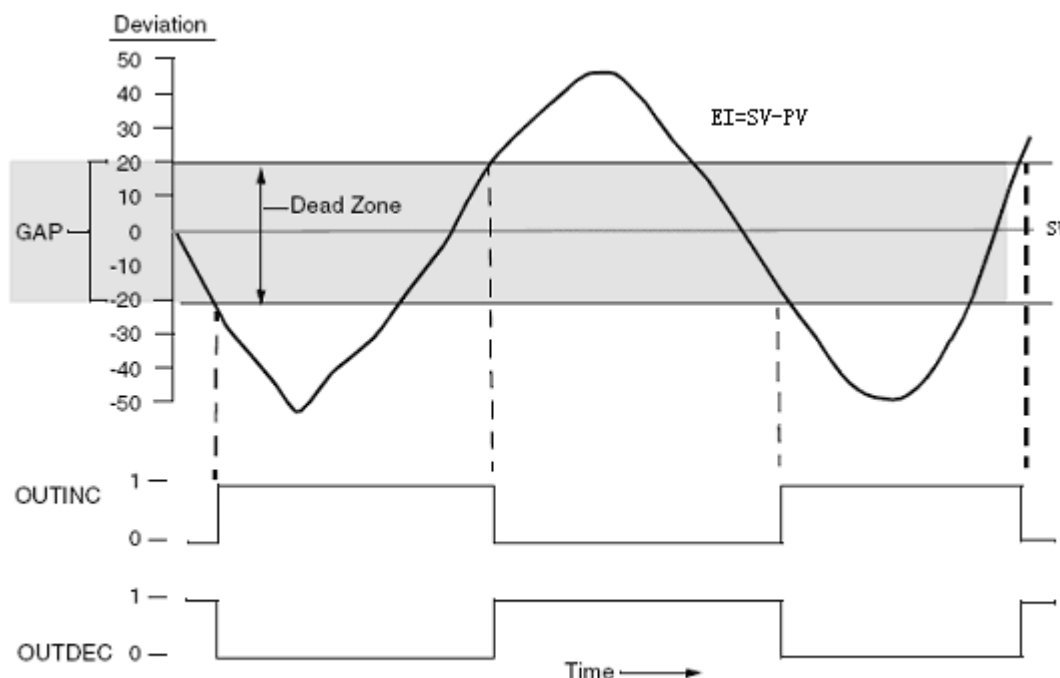


Figure 4.11 DGAP BISTATE operation mode

3. 2 positions and 3 statuses work mode

When MODE=ON, the function block is in 2 positions and 3 statuses work mode. The function block outputs OUTINC and OUTDEC statuses by comparing error EI ($EI = SV - PV$) and gap GAP between set value SV and process value PV, gap GAP and gap hysteresis GAPHYS.

In automatically operation status:

When error descends to $EI < -(\text{GAP}/2 + \text{GAPHYS})$, OUTINC=ON, OUTDEC=OFF. When error returns to GAP in non-sensitive area ($EI > -\text{GAP}/2$), OUTINC=OFF, OUTDEC keeps the value of last cycle.

When $EI = (\text{GAP}/2 + \text{GAPHYS})$, OUTDEC and OUTINC keep the value of last week.

When $EI = -(GAP/2 + GAPHYS)$, OUTDEC and OUTINC keep the value of last week.

When error exceeds to $EI > -(GAP/2 + GAPHYS)$, OUTINC=OFF, OUTDEC=ON .When error returns to GAP in non-sensitive area ($EI < -GAP/2$), OUTDEC=OFF, OUTINC keeps the value of last cycle.

The input and output relationships of function block are shown as follows:

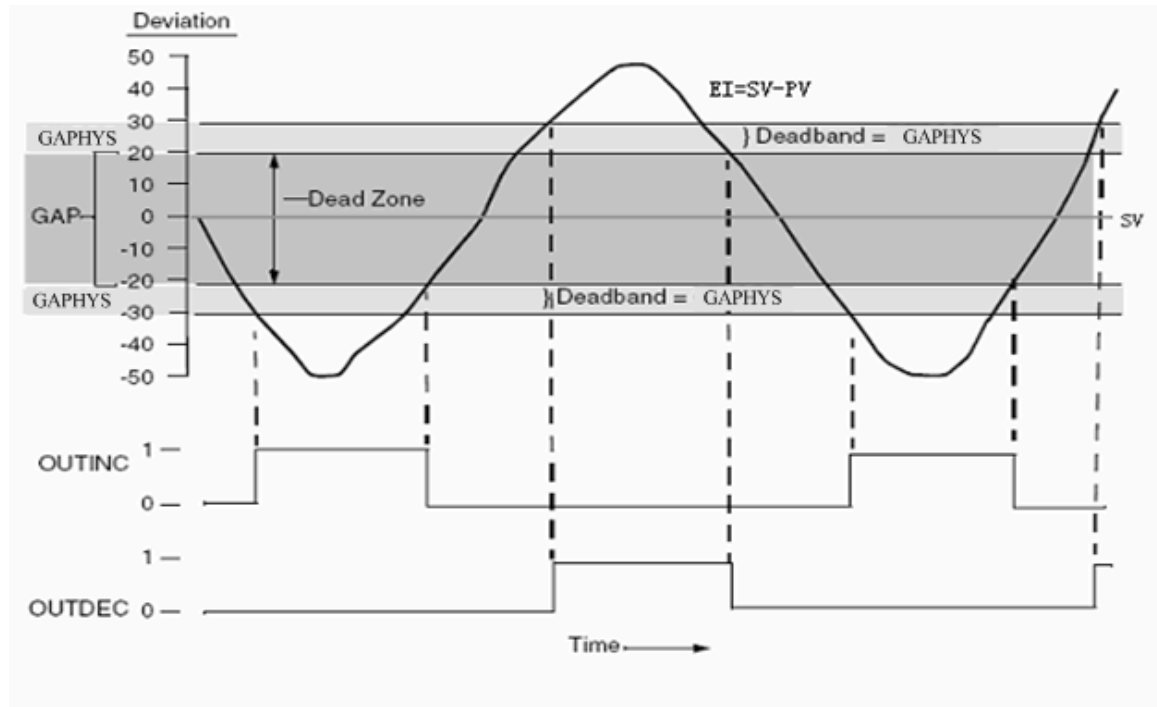


Figure 4.12 DGAP TRISTATE operation mode

4. Error alarm

The function block set positive error limit alarm dvh, negative error limit alarm dvl and error alarm hysteresis DVHYS.

Positive error limit alarm: when error EI is more than or equals to positive error limit dvh, in the flag, set positive error limit alarm symbol.

When error is less than DVH-DVHYS, in the flag, eliminate positive error limited alarm symbol.

Negative error limit alarm; when error EI is less than or equals to -DVL, in the flag, set negative error limit alarm symbol. When error is more than $-(DVL - DVHYS)$, in the flag, eliminate negative error limit alarm symbol.

5. Range high and low limit reversal alarm

When the limit of set value SVSCH is less than or equals to SVSCL, limit threshold overturn alarm.

6. Alarm high threshold overturn alarm

When $PVHH - PVHYS \leq PVH$ or $PVH - PVHYS \leq PVL + PVHYS$ or $PVL - PVHYS \leq PVL$, alarm limit threshold overturn alarm.

7. Manual operation mode

In manual operation mode, function block does not operate switch control, and OUTINC and OUTDEC can be set.

8. Feedback output value

When the function block is under string mode, BKOUT equals to set value.

When the function block is under non-string mode, BKOUT equals to process value

4.8.2 Panel Parameter

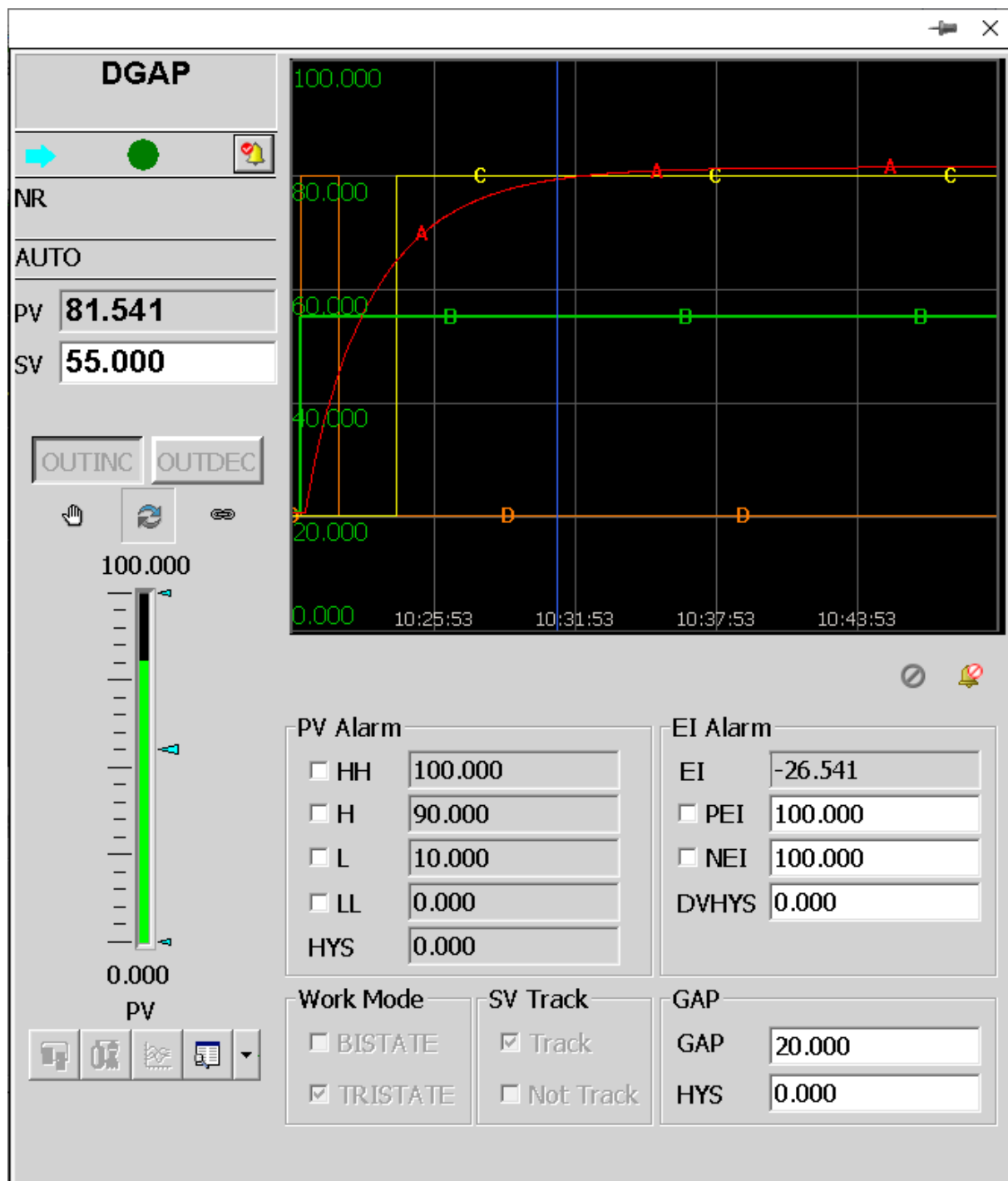


Table 4.14 Parameters Description of DGAP Panel

Panel Parameter Name		Function Block Parameter Name	Initial Value	Value Range	Application Instruction
PV Alarm	HH	PVHH	100.000	-	PV HH Alarm Value. When the PVHH alarm is selected, this is effective.
	H	PVH	90.000	-	PV high Alarm Value. PV high Alarm Value. When the PVH alarm is selected, this is effective.
	L	PVL	10.000	-	PV low Alarm Value. When the PV low alarm is selected, this is effective.
	LL	PVLL	0.000	-	PV LL Alarm Value. When the PVLL alarm is selected, this is effective.
	HYS	PVHYS	0.000	-	Hysteresis of PV alarm.
EI Alarm	EI	EI	0.000	-	Read only, EI=PV-SV
	PEI	-	100.000	-	When this is selected, the "positive deviation" is effective.
	NEI	-	100.000	-	When this is selected, the "negative deviation" is effective.
	DVHYS	DVHYS	0.000	-	-
Work Mode	BISTATE	MODE	-	-	MODE=OFF, the function block work in BISTRATE mode.
	TRIS-TATE	MODE	√	-	MODE=ON, the function block work in TRISTATUS mode.
SV Track Settings	Track	SWSVTR	√	-	SWSVTR=ON, then SV track PV.
	Not Track	SWSVTR	-	-	SWSVTR=OFF, then SV will not track PV.
GAP	GAP	GAP	20.000	-	-
	HYS	GAPHYS	0.000	-	-
Output	OUTINC	OUTINC	-	-	positive output
	OUTDEC	OUTDEC	-	-	negative output

4.8.3 Flag

Table 4.15 Flag

Flag	Alarm	Instruction
D0	OOS	Disable

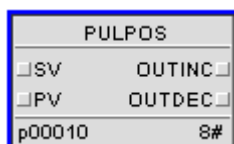
Table 4.15 Flag (continued)

Flag	Alarm	Instruction
D1	MAN	Manual
D2	AUTO	Auto
D3	CAS	Cascade
D4	PVHH	PV HH Limit Alarm
D5	PVH	PV H Limit Alarm
D6	PVL	PV L Limit Alarm
D7	PVLL	PV LL Limit Alarm
D8	PEI	Positive Deviation Alarm
D9	NEI	Negative Deviation Alarm
D10	REVSCL	Span H/L Limit Reverse
D13	AOF	Suppress Alarm
D14	ERR	Fault

4.9 Pulse Position Function Block (PULPOS)

PULPOS function block compares two analog input signals---set value and feedback value of process parameter (process value) and output two BOOL type output according to the result. When the process value is less than set value, generate positive output pulse; when it is more than the set value, generate negative output pulse.

PULPOS function block is simple function block, and its running time is 16μs.

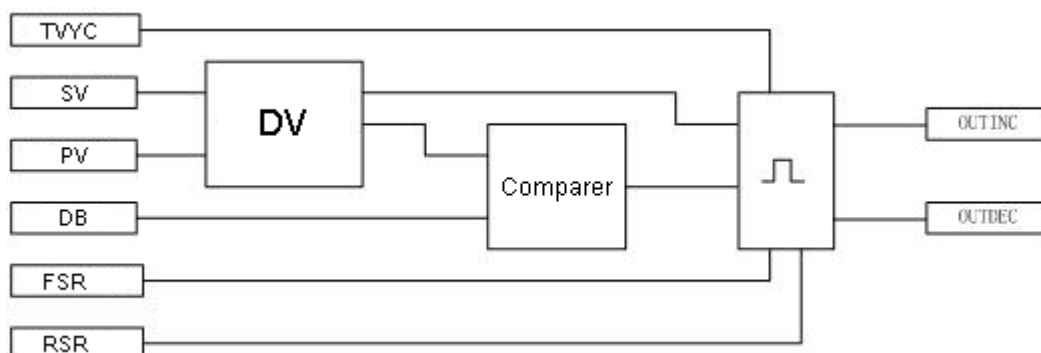
**Table 4.16 Pulse position function block parameter instruction**

Name			Description	Upload	Properties	Application Reference
Basic Parameters	Input Pin	SV	Setting Value	-	Input Pin	process value in REAL
		PV	Measured Value	-	Input Pin	process value in REAL
	Output Pin	OUTINC	Forward Pulse Output	-	Output Pin	-

Table 4.16 Pulse position function block parameter instruction (continued)

Name			Description	Upload	Properties	Application Reference
		OUT-DEC	Reverse Pulse Output	-	Output Pin	-
		EI	Deviation	-	Monitoring Parameter	EI=SV-PV
	Operation Parameter	FSR	Forward Travel Rate	TRUE	Operation Parameter	Unit in PV
		RSR	Reverse Travel Rate	TRUE	Operation Parameter	Unit in PV
		DB	Deviation Deadband	TRUE	Operation Parameter	Unit in PV
		TCYC	Output Pulse Cycle (Unit: S).When set pulse period TCYC is less than or equals to pulse width, output OUT-INC in pulse period are all ON.	TRUE	Operation Parameter	

Logic Time Sequencing

**Figure 4.13 Logic Time Sequencing Figure**

Each pulse period of function block outputs positive and negative pulse according to comparing result of error and dead zone.

- When error EI is in the limit of dead zone $[-DB, DB]$, there is no pulse output signal.
- When $EI > DB$, generate positive pulse.

$$\text{Pulse width} = \frac{SV - PV}{FSR} = \frac{EI}{FSR} \text{ (s)}$$

- When $EI < -DB$, generate the negative pulse.

$$\text{Pulse width} = \frac{PV - SV}{FSR} = \frac{-EI}{FSR} \text{ (s)}$$



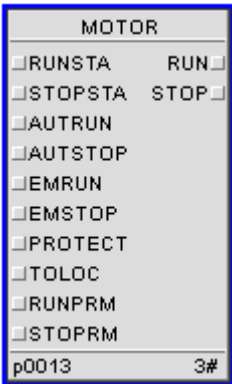
TIP:
When setting $FSR=0$ and $RSR=0$, then interior system precision is 0.0000001.

4.10 Motor Control Function Block (MOTOR)

There are two motor valve control function blocks in the system, which are the MOTOR function block which mainly controls the motor and the VALVE function block which mainly controls the valve. The motor function block is mainly to realize the basic start-stop control and interlock protection of the equipment.

The motor control function block MOTOR can be used to control the start and stop of a single device and realize interlock protection. When the function block receives the upper-level sequence control command or the function block panel command, it outputs the start and stop commands, so as to realize the control and operation of the controlled equipment. The MOTOR function block supports various alarms and can provide protection for the motor in the actual industrial production process. The MOTOR function block is generally suitable for dual-input dual-output devices. For single-input single-output or other types of devices, DIO-11M or other DIO-type function blocks are recommended.

This function block is a complicated one and the operating time is 20μs.



4.10.1 Parameter Description

Table 4.17 Motor control function block parameter description

Name			Description	Upload	Properties	Application Reference
Basic Parameters	Mode Setting	OUT-TYPE	Output command modes: 0=Pulse, 1=Pulse Sequence, 2=Long Signal ^{Note2}	-	Configuration Parameter	Refer to Work Flow
		SET-TYPE	Run Mode: 0=inch-ing, 1=consistent, 2=lock	-	Configuration Parameter	Refer to Work Flow
		REVTYPE	Reverse Stop Command Respond Mode, valid in manual mode and automatic mode.0=In the process of operating output, system does not respond to negative stop command.1=In the process of operating output, system responds to negative stop command and output stop command.	-	Configuration Parameter	When in manual and auto mode and lock mode, the system responds to input negative command and is irreverent to REVTYPE setting.
		OPFLACK	Whether to Confirm Running Fault.Set OPFLACK=OFF, running fault does not need to be confirmed and is not considered as restricted condition of new command input.Set OPFLACK=ON, running fault needs to be confirmed and is considered as restricted condition of new command input and is valid to manual/auto command, invalid to interlock command.	TRUE	Operation Parameter	-
		AUTO-CLR	Whether Auto-Remove Running Fault.Set AUTO-CLR=ON, running fault alarm OPFL will be eliminated automatically after status feedback signal is restored. Set AUTOCLR=OFF, running fault alarm	TRUE	Operation Parameter	-

Table 4.17 Motor control function block parameter description (continued)

Name			Description	Upload	Properties	Application Reference
			OPFL will be eliminated only after panel confirmation after status feedback signal is restored.			
		TRI-PACK	Whether To Confirm Trip Fault.Set TRI-PACK=OFF, TRIP will not need to confirmed and be used as restricted condition of new command input.Set TRI-PACK=ON, TRIP will need to confirmed and used as restricted condition of new command input and is valid to manual/auto command, invalid to interlock command.	TRUE	Operation Parameter	-
		IGNORALM	Shield Alarm When Input Command.Set IGNORALM =ON, FAIL, TRIP, FAULT and OPFL will not be used as restricted condition of new command input. Set IGNORALM =OFF, FAIL, TRIP, FAULT and OPFL will be used as restricted condition of new command input. And this is valid only in automatic and manual mode.	TRUE	Operation Parameter	-
		IGNORSTA	Ignore Feedback When Output Instruction.Set IGNORSTA=ON, current output does not judge feedback status and DRIVE is completely output.Set IGNORSTA=OFF, current output judges feedback status. If correct status feedback input exists, no more output of RUN	TRUE	Operation Parameter	-

Table 4.17 Motor control function block parameter description (continued)

Name			Description	Upload	Properties	Application Reference
			or STOP is necessary.			
		LOC-TYPE	Whether or not the on-site mode respond to the stop command, 0=not to respond, 1=to respond.	FALSE	Configuration Parameter	-
	Time Settings	TPW	Width of Output Pulse (Unit: S)Output pulse width. When single pulse and pulse list are output, define the width of high level of output pulse.	TRUE	Operation Parameter	TPW<TOC
		TOC	Equipment Travel Time (Unit: S)Equipment runtime. When the command is output and corresponding output feedback after TOC time, operation fault OPFL appears.	TRUE	Operation Parameter	TPW and TPLS are associate parameters.
		TPLS	Output Pulse Cycle (Unit: S)Pulse period. Pulse period defined when pulse list is output. When set TPLS<TPW, TPLS=TPW.	TRUE	Operation Parameter	If TPLS<TPW, TPW=TPLS (TPLS<TOC)
		TWAIT	Setting Interval of Button Pop-Up (Unit: S)	TRUE	Operation Parameter	-
Extended Parameters	Input Pin	RUNSTA	Run Interval Feedback	-	Input Pin	Measuring Point DI
		STOPSTA	Stop Status Feedback	-	Input Pin	Measuring Point DI
		AUTRUN	Auto-start Command	-	Input Pin	Upstream Output
		AUTSTOP	Auto-stop Command	-	Input Pin	Upstream Output
		EMRUN	Interlock Startup Command	-	Input Pin	Upstream Interlock InputWhen EMRUN=ON, it will

Table 4.17 Motor control function block parameter description (continued)

Name			Description	Upload	Properties	Application Reference
						be shown in the process alarm.
		EMS-TOP	Interlock Stop Command	-	Input Pin	Upstream Interlock Input When Interlock=ON, it will be shown in the process alarm.
		PROTECT	Protect	-	Input Pin	Upstream Output, refer to Work Flow
		TOLOC	On-site Control Switch (ON=On-site) <small>Note3</small>	-	Input Pin	Upstream Output, refer to Work Flow
		PACK	Program Input Confirm Signal Eliminate the running alarm by panel or program input signal PACK.	-	Input Pin	Upstream Output
		PSWAM	Program Manual and Auto Control Digital Input <small>Note4</small>	-	Input Pin	Upstream Output, refer to Work Flow
		RUN-PRM	Start Command Enable Signal When RUNPRM =ON, interlock run, auto run and manual run can output startup command.	-	Input Pin	Upstream Output
		STOP-PRM	Stop Command Enable Signal When STOPRM =ON, interlock stop, auto stop and manual stop can output stop command.	-	Input Pin	Upstream Output
		FBOPT	Select MAN/AUTO Control Source (OFF=Panel) <small>Note4</small>	-	Input Pin	Upstream Output, refer to Work Flow
		FAULT	DI Electrical Fault Output (ON=Fault)	-	Input Pin	Connect to Measuring Point DI
	Output Pin	RUN	Run Instruction Output	-	Output Pin	Output DO
		STOP	Stop Instruction Output	-	Output Pin	Output DO
	Operation Parameter	SWFIX	Fix Command	-	Operation Parameter	-

Table 4.17 Motor control function block parameter description (continued)

Name			Description	Upload	Properties	Application Reference
		MAN-RUN	MAN Startup Command	-	Operation Parameter	-
		MANS-TOP	MAN Stop Command	-	Operation Parameter	-
		SWAM	MAN/AUTO switch: ON=Auto, OFF=Manual ^{Note4}	-	Operation Parameter	refer to Work Flow
		ACK	Acknowledgement Signal	-	Operation Parameter	
	Status	FAIL	Equipment Fault (ON=Fault) When run status feedback RUNSTA and stop status feedback STOPSTA are both ON, feedback fault alarm FAIL will be started.	-	Monitoring Parameter	refer to Fault Diagnosis and Solution
		OPFL	Running Fault (ON=Fault) ^{Note5}	-	Monitoring Parameter	refer to Fault Diagnosis and Solution
		TRIP	Trip Indication (ON=Trip) ^{Note6}	-	Monitoring Parameter	refer to Fault Diagnosis and Solution
		LOC	On-site Control Indication	-	Monitoring Parameter	-
		STARUN	Equipment Run Status Indication (ON=Run)	-	Monitoring Parameter	-
		STAS-TOP	Equipment Stop Status Indication (ON=Prohibited)	-	Monitoring Parameter	
		MODE	Equipment Mode (Observe) ^{Note3}	-	Monitoring Parameter	refer to Fault Diagnosis and Solution
		RUN-FLAG	Run Command Output Process (Observe)	-	Monitoring Parameter	-
		STOPFLAG	Stop Command Output Process (Observe)	-	Monitoring Parameter	-
	Alarm Enabled and Suppress	AOF	Suppress Module Alarm	TRUE	Operation Parameter	-
		ENALM	Enable of Alarm	-	Operation Parameter	-

Table 4.17 Motor control function block parameter description (continued)

Name			Description	Upload	Properties	Application Reference
		FLAG	Flag Code	-	Output Pin	refer to Flag
	OOS Set-tings	SWOOS	In OOS Status (ON=Prohibited)	TRUE	Operation Parameter	-

Table 4.18 Macro parameter illustration

Macro Parameter	Initial Value	escription
MANRUN	Custom, for "ON" button on the corresponding function block panel.	Users can redefine the MANUAL ON command button on the panel.
MANSTOP	Custom, for "OFF" button on the corresponding function block panel.	Users can redefine the MANUAL OFF command button on the panel.
RUNPRM	Custom, for "ON PRM" button on the corresponding function block panel.	Users can redefine the ON PRM command button on the panel.
STOPPRM	Custom, for "OFF PRM" button on the corresponding function block panel.	Users can redefine the OFF PRM command button on the panel.

Motor function block's basic work flow is shown in the figure below.

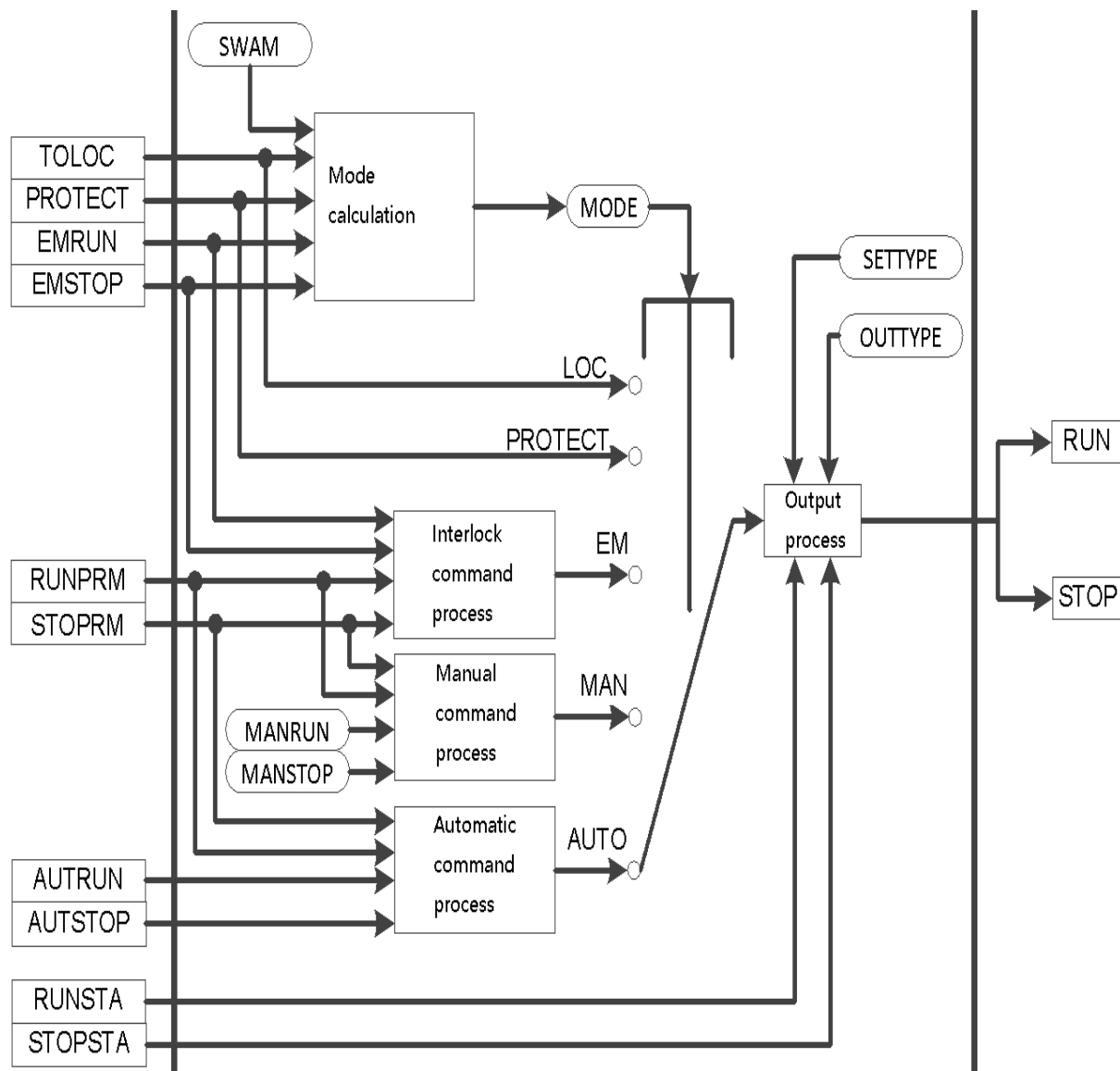


Figure 4.14 Basic work flow of MOTOR function block

In the above figure, the parameters in the rectangular block are input or output pins, and the parameters in the ellipse are the internal parameters of the function block. The functions of pattern calculation, input command validity detection and output processing are as follows.

- **Mode calculation:** used to determine the current working mode of the MOTOR function block. Refer to Table 1 for the parameter conditions corresponding to the working mode of the function block.
- **Instruction processing:** including interlocking instruction processing, manual instruction processing and automatic instruction processing. Its role is to confirm the necessary processing for the validity of the input and determine whether the input can trigger the output.

Refer to Table 1 for the conditions when the output RUN/STOP=ON is established in each mode.

- Output processing: The type of output signal and the reset condition are determined by the parameters SETTYPE, OUTTYPE and the status feedback parameters RUNSTA, STOPSTA. Refer to Table 4.21 for detailed output reset conditions.

4.10.2 Work Flow

Input Command Process

The MOTOR function block has the following six equipment modes arranged by priority: operation stop, local, protection, interlock, manual and automatic. The following table describes the corresponding conditions when the function block enters different modes, and the validity check of input instructions in different modes (that is, the conditions when the output RUN/STOP=ON is established in each mode):

Table 4.19 Input command validity check

MODE	Condition	Input command validity check (output command trigger condition)
Compute stop (MODE=1)	SWOOS=ON	The output is maintained and does not respond to various input commands;
Local (MODE=2)	SWOOS=OFF, TOLOC=ON	1) When LOCTYPE=0, the function block does not respond to start and stop commands. At this time, the input command is invalid, the output is reset, RUN=OFF, STOP=OFF; 2) When LOCTYPE=1, the function block responds to the stop command. Run output command reset (RUN=OFF), the stop command is output according to the current trigger command, if the function block meets any command of protection stop, interlock stop, manual stop, and automatic stop, it can be triggered. The trigger conditions are shown in the corresponding content of this table. ;
Protection (MODE=3)	SWOOS=OFF, TOLOC=OFF, PROTECT=ON	1) RUN=OFF; 2) OP=ON: PROTECT=OFF→ON;
Interlock (MODE=4)	SWOOS=OFF, TOLOC=OFF, PROTECT=OFF, EMRUN=ON or EMSTOP=ON	1) RUN=ON: EMRUN=OFF→ON (RUNPRM=ON, FAIL=OFF, FAULT=OFF) EMRUN=OFF→ON (RUNPRM=ON, IGNORALM=ON); 2) STOP=ON: EMSTOP=OFF→ON (STOPRM=ON, FAIL=OFF, FAULT=OFF) EMSTOP=OFF→ON (STOPRM=ON, IGNORALM=ON);
Manual (MODE=5)	SWOOS=OFF, TOLOC=OFF, PROTECT=OFF, EMRUN=OFF and EMSTOP=OFF, SWAM=OFF	1) RUN=ON: MANRUN=OFF→ON (RUNPRM=ON, FAIL=OFF, OPEL=OFF, TRIP=OFF, FAULT=OFF) MANRUN=OFF→ON (RUNPRM=ON, IGNORALM=ON); 2) STOP=ON: MANSTOP=OFF→ON (STOPRM=ON, FAIL=OFF, OPEL=OFF, TRIP=OFF, FAULT=OFF) MANSTOP=OFF→ON (STOPRM=ON, IGNORALM=ON);
Auto (MODE=6)	SWOOS=OFF, TOLOC=OFF	1) RUN=ON: AUTRUN=OFF→ON (RUNPRM=ON, FAIL=OFF, OPEL=OFF, TRIP=OFF, FAULT=OFF) AUTRUN=OFF→ON (RUN-

Table 4.19 Input command validity check (continued)

MODE	Condition	Input command validity check (output command trigger condition)
	F,PROTECT=OFF,EM-RUN=OFF and EMSTOP=OFF,SWAM=ON	PRM=ON,IGNORALM=ON);2) STOP=ON:AUTSTOP=OFF→ON(STOPRM=ON,FAIL=OFF,OPEL=OFF,TRIP=OFF,FAULT=OFF)AUTSTOP=OFF→ON(STOPRM=ON,IGNORALM=ON);

“→” means the transition of parameters from previous status to the current status.

Working mode illustration

Note1: Interlock

- If the interlocking start command is triggered first and the interlocking stop command is triggered within the effective time of the interlocking start, the interlocking start command will be executed first, and the interlocking stop command will be executed immediately after the interlocking stop command is triggered.
- If the interlock stop command is triggered first and the interlock start command is triggered within the effective time of the interlock stop, the interlock stop command will be executed first, and the interlock start command will be executed immediately after the interlock start command is triggered.



ATTENTION:

The effective time here refers to the time when the interlock start/stop command changes from ON to OFF.

Note2: Manual/Auto

- If a manual or automatic start/stop command is triggered at the same time, it will not respond to the command.
- If the start command is triggered first and the stop command is triggered within the effective time of the start command, the parameter REVTYPE determines whether to respond to the stop command. If the stop command is triggered first and the start command is triggered within the effective time of the stop command, the start command will not be responded to.
- If the interlocking start EMRUN is continuously ON, the manual stop and automatic stop commands are invalid. If the interlock stop EMSTOP is continuously ON, the manual start and automatic start commands are invalid.

Note3: auto/manual switch

- It can be automatically switched by FBOPT, SWAM, PSWAM.
- The function block defaults to SWAM=OFF, which is manual mode. On the contrary, when SWAM=ON is set, the function block is in automatic mode.
- When FBOPT=OFF, the manual automatic switching can be determined by the manual automatic button on the panel, and the SWAM status is synchronized with the manual or automatic status on the function block panel.
- When FBOPT=ON, the manual automatic switch is determined by the program input PSWAM, and the SWAM manual automatic switch is invalid. At this time, when PSWAM=OFF, it means that the program control is in manual mode, and the panel can be operated manually. When PSWAM=ON, the program control is automatic mode.

Output command process

- Output command mode (OUTTYPE)

According to the valve characteristics of the motor, the output command has three modes: pulse, pulse train and long signal. Next, take the start command output RUN as an example to illustrate the output signals in different modes.

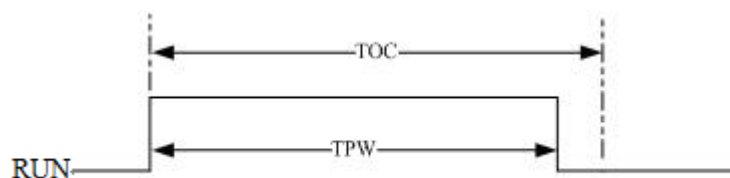


Figure 4.15 Pulse output mode (OUTTYPE=0)

In the above figure, TOC is the travel time of the device, and TPW is the width of the output pulse (that is, the time when the output pulse is high). The setting principle is $TPW \leq TOC$. If $TPW > TOC$, then force $TPW = TOC$.

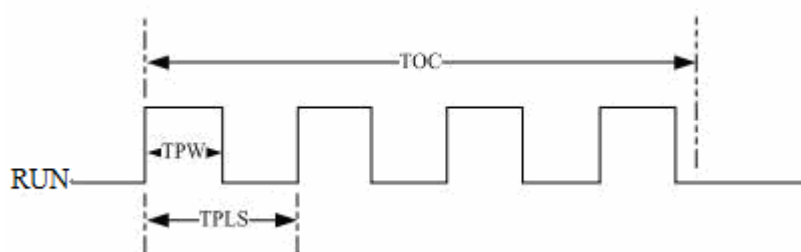


Figure 4.16 Pulse train output mode (OUTTYPE=1)

In the above figure, TPLS is the period of one pulse when the output is in pulse train mode. The setting principle is: $TPW \leq TPLS \leq TOC$. If $TPLS < TPW$, $TPLS = TPW$.

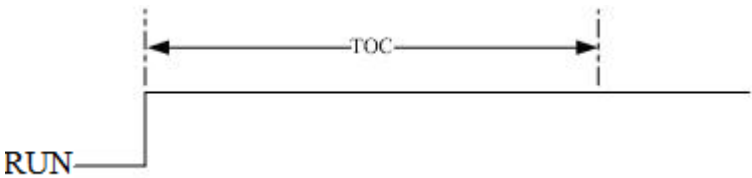


Figure 4.17 Long signal output mode (OUTTYPE=2)

- Operation mode (SETTYPE)
Taking into account the different process requirements and the switching characteristics of the equipment, the motor control function block supports three operating modes: jog, continuous and latching.
The following takes the pulse output mode as an example to illustrate the reset situation when the output command RUN does not ignore the status feedback (IGNORSTA=OFF) and ignores the status feedback (IGNORSTA=ON) in different operating modes. The reset condition of the stop output command STOP is the same as that of the start output command RUN.

Table 4.20 Output reset under different operating modes

	Inching mode	Consistent mode	Lock
Whether to ignore status feedback	Output command RUN/STOP will reset along with the input command	Output command RUN/STOP won't reset along with the input command	
Pulse output			
Not ignore status feedback			
Ignore status feedback			

In the above table, in the jog and continuous modes, when the status feedback is not ignored (IGNORSTA= OFF), the output command RUN is started and reset immediately after the running status feedback RUNSTA arrives. When the status feedback is ignored (IGNORSTA= ON), the arrival of the running status feedback RUNSTA will not affect the start output command RUN.

In the lock mode, regardless of whether the status feedback is ignored, the running status feedback RUNSTA will not affect the start of the output command RUN.

- Output reset condition

The following table describes the conditions for the output reset of the MOTOR function block in different LOCTYPE (whether the local mode responds to the stop command), STETTYPE (running mode) and MODE (device mode).

Table 4.21 Conditions of output reset

LOCTYPE	SETTYPE	MODE	Output reset condition
Local mode doesn't respond stop command	/	local	no output command
	inching	protection	PROTECT= OFF or (IGNORSTA= OFF and STOPSTA= ON);
		inter-lock	1) RUN: EMRUN=OFF or (IGNORSTA= OFF and RUNSTA= ON); 2) STOP: EMSTOP=OFF or (IGNORSTA= OFF and STOPSTA= ON);
		manual	1) RUN: MANRUN= OFF or (IGNORSTA= OFF and RUNSTA= ON); 2) STOP: MANSTOP= OFF or (IGNORSTA= OFF and STOPSTA= ON);
		auto	1) RUN: AUTRUN= OFF or (IGNORSTA= OFF and RUNSTA= ON); 2) STOP: AUTSTOP= OFF or (IGNORSTA= OFF and STOPSTA= ON);
	consistent	/	1) RUN: IGNORSTA= OFF and RUNSTA= ON; 2) STOP: PROTECT= OFF and (IGNORSTA= OFF and STOPSTA= ON);
	lock	/	not to reset, still normally output;
Local mode responds stop command	inching	local	1) RUN: unconditionally output reset; 2) STOP: PROTECT= OFF and EMSTOP= OFF and MANSTOP= OFF and AUTORUN=OFF or (IGNORSTA= OFF and STOPSTA= ON);
	consistent		1) RUN: unconditionally output reset; 2) STOP: PROTECT= OFF and IGNORSTA= OFF and STOPSTA= ON;
	lock		Not to reset, still normally output;

- Over-travel fault output reset

Over-travel fault refers to the operation fault alarm (OPFL=ON) when the corresponding feedback signal is not received within the travel time after the output command is issued in the jog, continuous or locked mode. In case of over-travel fault, the output commands RUN and STOP will be reset.

4.10.3 Fault Diagnosis and Solution

The function blocks include equipment failure alarm FAIL, operation failure alarm OPEL, equipment trip alarm TRIP, electrical failure alarm FAULT, power failure alarm POWOFF and interlocking dual-input failure alarm DBEMCMD in interlock mode. Among them, the operation fault OPEL can be masked by the OPFLACK parameter, the trip fault TRIP can be masked by the TRIPACK parameter, and the four faults FAIL, OPEL, TRIP, FAULT can be masked by the IGNORALM parameter.

Alarm detection in each mode

MODE	Alarm
Operating stop	Don't generate any alarm.
Local	Don't generate any alarm apart from the normal generation of electrical fault alarm.
Protection	For normally generating alarms, refer to device fault, operating fault, trip alarm and power off.
Interlock	If EMRUN=ON and EMSTOP=ON, it doesn't respond interlock command, generate DBEM-CMD alarm. Other alarm normally generates, refer to device fault, operating fault, trip alarm and power off alarm.
Manual	For normally generating alarms, refer to device fault, operating fault, trip alarm and power off alarm.
Auto	

Equipment fault FAIL

- Alarm generation
When the running status feedback RUNSTA and the stop status feedback STOPSTA are both ON, the equipment failure alarm FAIL is set.
- Elimination of alarms
When the running status feedback RUNSTA and the stop status feedback STOPSTA are not ON at the same time, the equipment failure alarm FAIL is cleared.

Operation failure OPFL

This section describes the conditions for the generation and elimination of the function block operation fault alarm, as well as the restrictions and effects on the input and output commands after the alarm is generated.

- **Alarm generation**
After the output command is issued, if the corresponding feedback signal is not received within the travel time TOC, the operation failure alarm OPFL is set.
- **Elimination of alarms**
When there is an OPFL alarm, if the new command input is valid, the OPFL alarm will be cleared.
- **Restrictions on input commands**
When IGNORALM=ON, no matter whether FAIL alarm and OPFL alarm exist or not, respond to new commands.
When IGNORALM=OFF, the new command will not be responded to when FAIL alarm exists, and OPFL is restricted by OPFLACK.
If OPFLACK=OFF is set, the operation fault does not need to be confirmed, and it is not used as a restriction condition for new command input.
Set OPFLACK=ON, the operation failure needs to be confirmed, which is one of the restrictive conditions of the new command input, the opponent's automatic command is valid, and the interlock command is invalid.
- **Impact on output commands**
In the jog and continuous modes, when the status feedback is not ignored (IGNORSTA=OFF), the output command RUN is started and reset immediately after the running status feedback RUNSTA arrives. When the status feedback is ignored (IGNORSTA=ON), the arrival of the running status feedback RUNSTA will not affect the start output command RUN.
In the LOCK mode, regardless of whether the status feedback is ignored (ie, IGNORSTA=OFF or ON), RUN and STOP will be reset when an operation failure OPFL occurs.

Trip alarm TRIP

This section describes the generation and elimination conditions of the function block trip alarm, and the effect on the output command after the alarm is generated.

- **Alarm generation**
When the equipment is in the running status and no valid stop command is input, the running status feedback disappears and a trip alarm TRIP is generated.
- **Elimination of alarms**

When there is a TRIP alarm, if the new command input is valid, the TRIP alarm will be cleared.

- Impact on output commands

In the blocking mode, when the status feedback is not ignored (ie, IGNORSTA=OFF), if a trip alarm occurs and the status feedback still has an error after the travel time is reached, the output RUN and RUNFLAG will be reset.

In the LOCK mode, when the status feedback is ignored (ie, IGNORSTA=ON), if a trip alarm occurs, the output RUN and RUNFLAG will not be affected.

Power failure alarm POWOFF

- Alarm generation

When it is not in the process of command output and there is no operation fault, if the feedback RUNSTA and STOPSTA are OFF at the same time, a power-down alarm POWOFF will be generated.

- Elimination of alarms

When the running status feedback RUNSTA and the stop status feedback STOPSTA are not OFF at the same time, the electric alarm POWOFF is eliminated.

Electrical fault FAULT

- Alarm generation

When the electrical fault input FAULT=ON, an electrical fault occurs.

- Elimination of alarms

When the electrical fault input FAULT=OFF, the electrical fault is eliminated.

4.10.4 Panel Parameter

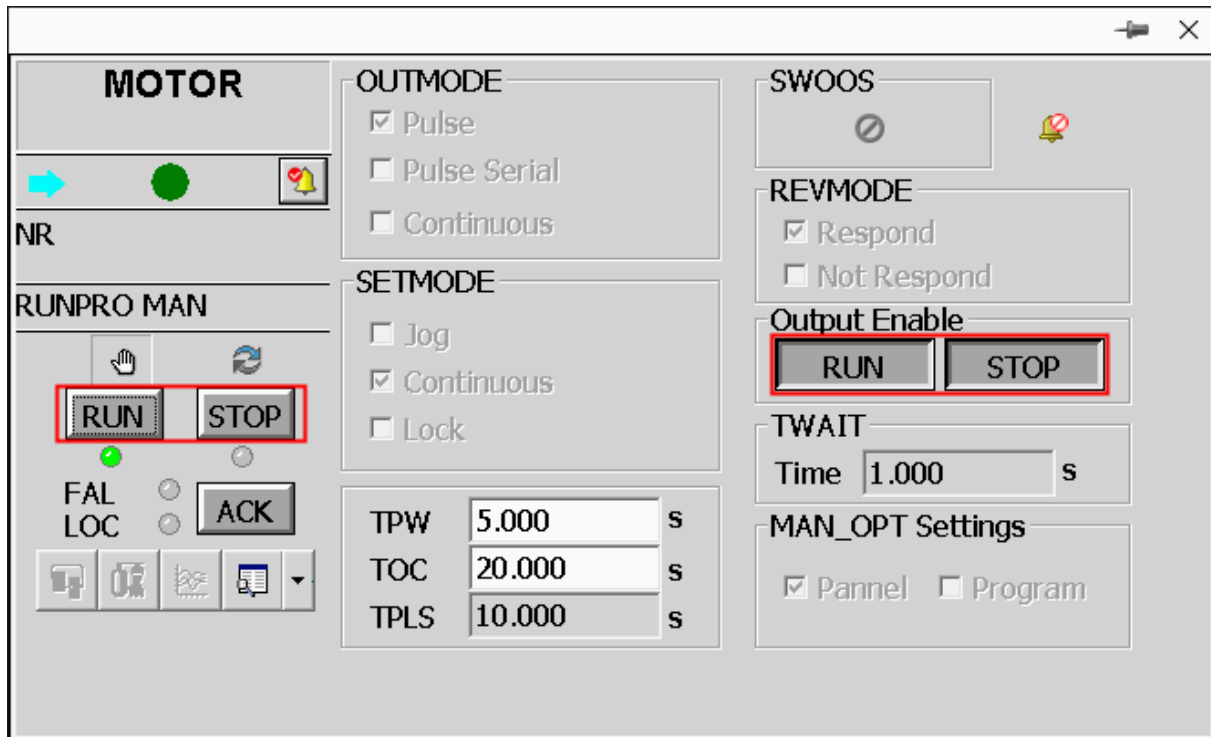


Figure 4.18 MOTOR function block panel paramters

As shown in the figure above, the button name can be modified in the macro parameters of the function block, and the maximum length is 0~64 characters (including Chinese, English, numbers and special characters). If the button name is not modified, the original default description will be displayed on the panel. When the length of the custom description exceeds the actual length of the button on the panel, it will be truncated and displayed according to the actual length of the button.

Table 4.22 MOTOR Parameter Instruction

Panel Parameter Name		Function Block Parameter Name	Initial Value	Value Range	Application Instruction
OUT-TYPE	Pulse	OUTTYPE	√	-	Read only, OUTTYPE=0, Set in the parameter Properties.
	Pulse Serial	OUTTYPE	-	-	Read only, OUTTYPE=1, Set in the parameter Properties.
	Continuous	OUTTYPE	-	-	Read only, OUTTYPE=2, Set in the parameter Properties.
SET-TYPE	Inching	SETTYPE	-	-	Read only, SETTYPT=0, Set in the parameter Properties.
	Continuous	SETTYPE	√	-	Read only, SETTYPE=1, Set in the parameter Properties.
	Lock	SETTYPE	-	-	Read only, SETTYPE=2, Set in the parameter Properties.

Table 4.22 MOTOR Parameter Instruction (continued)

Panel Parameter Name		Function Block Parameter Name	Initial Value	Value Range	Application Instruction
TPW(s)		TPW	5.000	≥0	When single pulse and pulse list are output, define the width of high level of output pulse.
TOC(s)		TOC	20.000	≥0	When the command is output and corresponding output feedback after TOC time, operation fault OPFL appears.
TPLS(s)		TPLS	10.000	-	Pulse period defined when pulse list is output.
REVTYPE	Respond	REVTYPE	√	-	Read only, 0=In the process of operating output, system does not respond to negative stop command.
	Not Respond	REVTYPE	-	-	Read only, 1=In the process of operating output, system responds to negative stop command and output stop command.
Output Enable	RUN	RUNPRM	Button is pressed.	-	Start Command Enable Signal
	STOP	STOPPRM	Button is pressed.	-	Stop Command Enable Signal
WAIT	Time(s)	TWAIT	1.000	≥0	Read only, Interval of Button Pop-Up, Set in the parameter Properties.
SWAM Settings	Panel	FBOPT	√	ON/OFF	Read only, FBOPT=OFF, Set in the parameter Properties.
	Program	FBOPT	-	ON/OFF	Read only, FBOPT=ON, Set in the parameter Properties.
Operation Button	RUN	MANRUN	-	-	MAN Startup Command
	STOP	MANSTOP	-	-	MAN Stop Command
	ACK	ACK	-	-	Acknowledgement Signal

4.10.5 Flag

Table 4.23 Flag list

Flag	Alarm	Description
D0	OOS	Disable
D1	LOC	On-site
D2	PROTECT	Protect
D3	EMRUN	Interlock Startup

Table 4.23 Flag list (continued)

Flag	Alarm	Description
D4	EMSTOP	Interlock Stop
D5	MAN	Manual
D6	AUTO	Auto
D7	POWOFF	Power-OFF Alarm
D8	FAULT	Electric Fault
D9	OPFL	Running Fault
D10	FAIL	Feedback Fault
D11	STARUN	Device Running Status
D12	STASTOP	Device Stop Status
D13	TRIP	Device Trip
D14	RUNPRO	Start Instruction Output Process
D15	STOPRO	Stop Instruction Output Process
D18	AOF	Suppress Alarm
D19	FIX	FIX
D24	DBEMCMD	Interlock Double Input Fault
D27	EM	Interlock status

4.10.6 Application Example

Example1: Motor function block example

[Requirement from field] To achieve the Dual-DI dual-DO field-pump start and stop control as shown in Figure 4.19, and can be operated on flow chart. When pump running fault (if after running time, the status feedback and control output are different, open the running fault alarm) occurs, no need to acknowledge. When pump trip occurs, acknowledge first and execute other operation.

Dual-DI dual-DO pump refers to that the start and stop of filed pump device is controlled and achieved by MOTOR function block's two DO signals, the pump status is shown by dual-DI signal feedbacks. It is often used to control start and stop of high power pump.

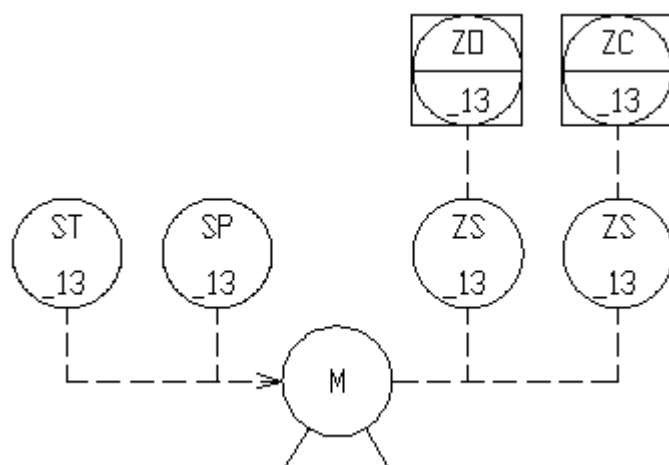


Figure 4.19 Dual-DI Dual-DO Pump

[MOTOR configuration] Details of program are shown below. It applies MOTOR control function block, and the upper computer interface can control DO via function block tag.

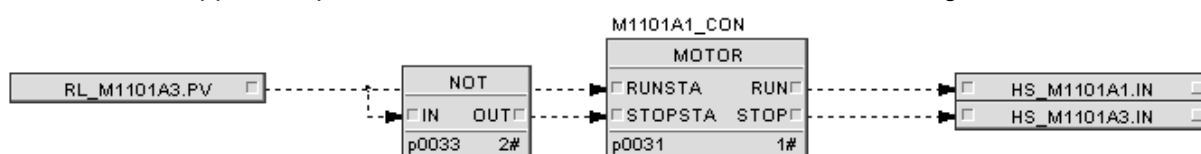


Figure 4.20 Program of Dual-DI Dual-DO Motor

Function block and example instructions are shown in the table below:

Table 4.24 Function Block and Example Instruction

NO.	Example	Type	Instruction	Remark
001	RL_M1101A3	DI Input	Pump Running Status Feed-back	Can perform 2 DI construction
002	HS_M1101A1	DO Output	Pump Start Control	
003	HS_M1101A2	DO Output	Pump Stop Control	
004	M1101A1_CON	Function Block Tag	Pump Control Function Block Tag	Supervision Tag

Parameter settings of MOTOR:

- FBOPT: ON
- PSWAM: OFF
- OPFLACK: OFF
- AUTOCLR: ON
- TRIPACK: ON
- IGNORSTA: OFF

- If pulse control is required, in configuration parameter OUTTYPE=0, SETTYPE=1, REVTYPE=1 and STPOUT=OFF;
- If long signal control is required, in configuration parameter OUTTYPE=2, SETTYPE=1, REVTYPE=1, STPOUT=OFF; when long signal control is applied and running time has reached, no matter the feedback arrives or not, output is OFF.

Note: the settings of FBOPT and PSWAM can avoid wrong operation for Auto button the panel. Other settings should be applied for auto control.

Alarm Settings:

- FAIL(Device Fault) alarm, when all function block switches are ON, FAIL outputs alarm (FAIL=ON);
- OPFL (running fault) alarm, when the status feedback of function block is different with its output, OPFL outputs alarm (OPFL=ON);
- TRIP(trip indication) alarm, if there is no stop output action, the open feedback changes from ON to OFF, TRIP outputs alarm (TRIP=ON);
- Set the operation parameter IGNORALM (input shield alarm) of basic parameter as not shield (IGNORALM=OFF), the input instruction is not influenced by alarm signals FAIL and OPFL.

Note: whether to acknowledge fault is determined by the settings of operation parameter OPFLACK.

Example 2: A complicated example of Motor function block

[Requirement from field] Realize the start and stop control of a motor on site.

- It is required that when the liquid level of the liquid storage tank downstream of the motor is higher than the low limit, the motor automatic start signal is triggered; when the liquid level of the liquid storage tank downstream of the motor is higher than the high limit, an automatic stop signal is triggered.
- When the temperature of the lubricating oil of the motor is higher than 100°C, the protective stop signal is triggered; when the liquid level of the liquid storage tank upstream of the motor is lower than 5m, the motor interlocking stop signal is triggered.
- When the motor is running faulty (that is, when the status feedback of the pump and the control output are inconsistent after the travel time, the running fault alarm) alarms without confirmation.

[MOTOR configuration] The detailed program structure is shown in the figure below, which is realized by MOTOR control function block.

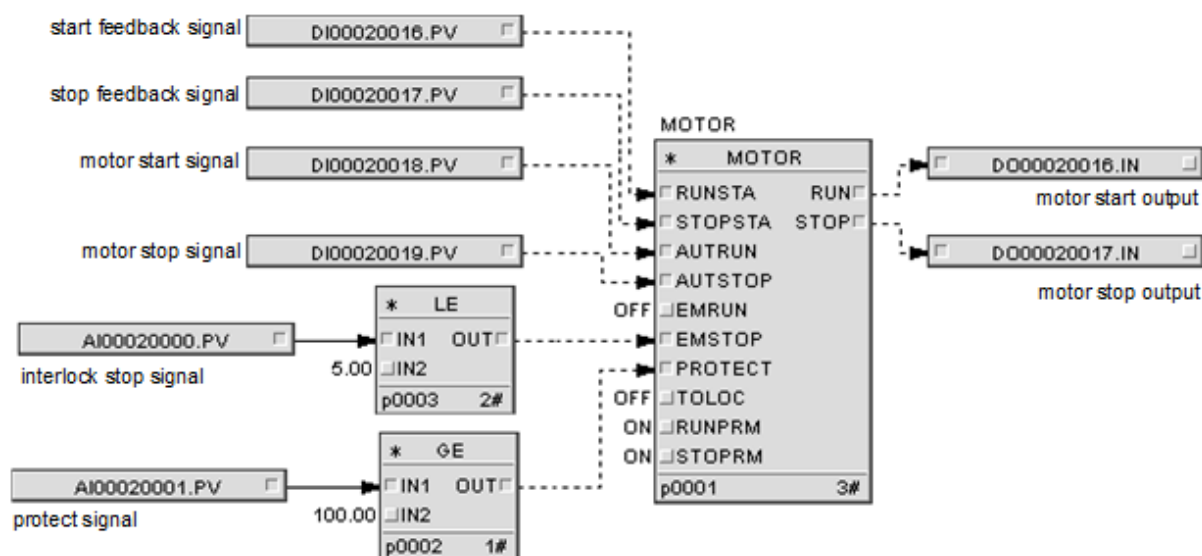


Figure 4.21 MOTOR function block program building

As shown in the figure above, function block and its tags are shown in the table below.

Table 4.25 Function block and corresponding tags

No	Instance	Type	Illustration	Remarks
001	DI00020016	DI input	motor starts status feedback	one DI building
002	DI00020017	DI input	motor stops status feedback	one DI building
003	DO00020016	DO output	motor starts output	—
004	DO00020017	DO output	motor stops output	—
005	AI00020000	AI input	interlock stops signal	—
006	AI00020001	AI input	protection signal	—
007	MOTOR	function block	motor control function block tag	monitoring tags

MOTOR function block parameter setting:

- FBOPT=ON and PSWAM=ON: program is auto control;
- OPFLACK=OFF: operating fault alarm needs no confirmation;
- AUTOCLR=ON: operating fault alarm can be automatically eliminated after receiving status feedback signal.

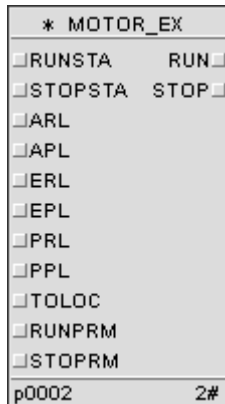
4.11 Command Level Motor Equipment Control Function Block (MOTOR_EX)

There are two motor valve control function blocks in the system, which are the MOTOR function block which mainly controls the motor and the VALVE function block which mainly controls the

valve. The motor function block is mainly to realize the basic start-stop control and interlock protection of the equipment.

MOTOR_EX is used to basic control and interlock protect to the single device. By this function block, single device can be controlled by the sequence command of upper level and operating in the function block panel.

This is the simple function block, and its running time is 20us.



4.11.1 Parameter Description

Table 4.26 Parameter Description

Parameter			Description	Upload	Parameter type	Reference
Basic-Parameter	Time Settings	TPW	Output pulse width(unit: second) When the output is single pulse or pulse train, TPW should be defined as the width of high of high level.	TRUE	Operation Parameter	TPW<TOC
		TOC	Device runtimes(unit: second) When the command sent and after TOC later, and the related output feedback is not ON, the OPFL will be set as ON.	TRUE	Operation Parameter	Related parameter: TPW and TPLS.
		TWAIT	Preset button popup time interval (unit: second)	TRUE	Operation Parameter	-
	Mode Settings	AUTOCLR	Whether auto-clear running fault and trip fault.When AUTOCLR = ON and OPFL generated, after status feedback signal restored, OPFL will be cleared.When AUTOCLR=OFF and OPFL generated, even if status feedback signal restored, OPFL only can be cleared after confirmed in the panel.	TRUE	Operation Parameter	-
		OPFLACK	Whether the running fault need to be confirmed.When OPFLACK=OFF, then the run-	TRUE	Operation Parameter	-

Table 4.26 Parameter Description (continued)

Parameter	Description	Upload	Parameter type	Reference
	ning fault need not be confirmed, and the running fault will not be the limit of inputting new command. When OPFLACK=ON and the running fault should be confirmed. And the running fault will be the limit of inputting new command of manual command, and it will be invalid to interlock command.			
TRIPACK	Whether the trip fault need to be confirmed. When TRIPACK=OFF and the trip fault need not to be confirmed, and the trip fault will not be the limit of inputting new command. When TRIPACK=ON and the trip fault should be confirmed. And the trip fault will be the limit of inputting new command of manual command, and it will be invalid to the interlock command.	TRUE	Operation Parameter	-
FAILACK	When FAILACK=ON and FAIL=ON, the manual command will not be responded.	TRUE	Operation Parameter	-
FAULTACK	When FAULTACK=ON and FAULT=ON, the manual command will not be responded.	TRUE	Operation Parameter	-
OUTTYPE	0 = Pulse, 1 = Hold By default, OUTTYPE=1.	-	Configuration Parameter	-
RSTOUT	Whether fault reset output (ON: reset)	-	Configuration Parameter	-
COMDOPR	Command priority (OFF: stop prioritized, ON: startup prioritized). By default, COMDOPR=OFF.	-	Configuration Parameter	-
REVTYPE	Reverse Stop Command Respond Mode. By default, REVTYPE=1, that is REVTYPE influencing the command of interlock start, interlock stop, manual mode and automatic mode.	-	Configuration Parameter	-
IGNORSTA	Output instruction ignores feedback (OFF: not ignore). When IGNORSTA=ON, current output does not judge feedback status, and output the complete RUN or STOP command by the OUTTYPE value. When IGNORS-	TRUE	Operation Parameter	-

Table 4.26 Parameter Description (continued)

Parameter			Description	Upload	Parameter type	Reference
			TA=OFF, current output judges feedback status and correct feedback status input existed, the RUN or STOP command will not output again.			
Ex- tend- ed	In- put Pin	RUNSTA	Run Status Feedback	-	Input Pin	Measuring Point DI
		STOPSTA	Stop Status Feedback	-	Input Pin	Measuring Point DI
		ARL	Auto-start Command	-	Input Pin	-
		APL	Auto-stop Command	-	Input Pin	-
		ERL	Interlock Startup Command	-	Input Pin	-
		EPL	Interlock Stop Command	-	Input Pin	-
		PRL	Protect Startup Command	-	Input Pin	-
		PPL	Protect Stop Command	-	Input Pin	-
		TOLOC	On-site Control Switch (ON=On-site) ^{note3}	-	Input Pin	Upstream Output
		FAULT	Digital Input Electric Fault Output (ON=Fault)	-	Input Pin	-
		READY	In addition to on-site (TOLOC=ON), fix (SWFIX=ON) and protection (PRL or PPL=ON) modes, input command is limited by standby signals, that is, only when READY=ON can it be executed.	-	Input Pin	-
		PACK	Program Input Confirm Signal When generated running fault or trip fault, the alarm can be eliminated in panel or program input signal PACK.	-	Input Pin	Upstream Output
		PSWAM	Program Switch of Manual or Auto	-	Input Pin	Upstream Output
		FBOPT	Manual/Auto Control Source Select(OFF:Panel)	-	Input Pin	Upstream Output
		RUNPRM	Startup Command Enable Signal When RUNPRM=ON, the command of interlock start, auto start, manual start can output ON.	-	Input Pin	Upstream Output

Table 4.26 Parameter Description (continued)

Parameter		Description	Upload	Parameter type	Reference	
		STOPRM	Stop Command Enable Signal-When STOPRM=ON, the command of interlock start, auto start, manual start can output OFF.	-	Input Pin	Upstream Output
	Output pin	RUN	Startup Command Output	-	Output Pin	Output DO
		STOP	Stop Command Output	-	Output Pin	Output DO
	Alarm Enable and Shield	FLAG	Flag	-	Output Pin	-
		AOF	Suppress Alarm	TRUE	Operation Parameter	-
		ENALM	Parameter Alarm Enable (Set parameter via select the “Settings “or not)	TRUE	Alarm Parameter	-
	Status	FAIL	Device Fault(ON: Faulty)Equipment Fault (ON= Fault) When run status feedback RUNSTA and stop status feedback STOPSTA are both ON, feedback fault alarm FAIL will be started.	-	Monitoring Parameter	-
		LOC	On-site Control Indication	-	Monitoring Parameter	-
		STARUN	Device Running Status Indication (ON=Run)	-	Monitoring Parameter	-
		STASTOP	Device Stop Status Indication (ON=Stop)	-	Monitoring Parameter	-
		MODE	Device Mode (Observe): operation stop local protection interlock manual automatic	-	Monitoring Parameter	-
		RUNFLAG	Startup Command Output Process (Observe)	-	Monitoring Parameter	-
		STOPFLAG	Stop Command Output Process (Observe)	-	Monitoring Parameter	-
		TP_R	Startup Trip Directive(ON: Trip)	-	Monitoring Parameter	-
		TP_P	Stop Trip Directive(ON: Trip)	-	Monitoring Parameter	-

Table 4.26 Parameter Description (continued)

Parameter			Description	Upload	Parameter type	Reference
		OF_R	Startup Failed Directive(ON: Failed)	-	Monitoring Parameter	-
		OF_P	Stop Failed Directive(ON: Failed)	-	Monitoring Parameter	-
		POWOFF	Poweroff Alarm Directive(ON:Poweroff)	-	Monitoring Parameter	-
		STATUS	Status	-	Monitoring Parameter	-
	Operation Parameter	MANRUN	Manual Startup Command	-	Operation Parameter	-
		MANSTOP	Manual Stop Command	-	Operation Parameter	-
		ACK	Confirm Signal	-	Operation Parameter	-
		SWAM	Manual/Auto Switch: OFF=Manual, ON=Auto	-	Operation Parameter	-
		TR_LOC	When local, the switch of output tracking, OFF:output reset, ON:ouput tracks feedback	TRUE	Operation Parameter	-
		SWFIX	Listed command	-	Operation Parameter	-
		SWTST	Debug commandWhen SWTST=ON, the FBD will in the debugging mode.	TRUE	Operation Parameter	-
		SWSIM	Simulate commandWhen SWSIM=OFF, the FBD can not run in simulate mode. When SWSIM=ON, the FBD can run in simulate mode.	TRUE	Operation Parameter	-
	SWDO	When simulating and SW-DO=OFF, the Function block output to DO; and if SWDO=ON, the Function block not output.	TRUE	Operation Parameter	-	
	OOS Settings	SWOOS	Switch of Out of Service (ON=Disable)	TRUE	Operation Parameter	-

4.11.2 Output Mode

- OUTTYPE=0

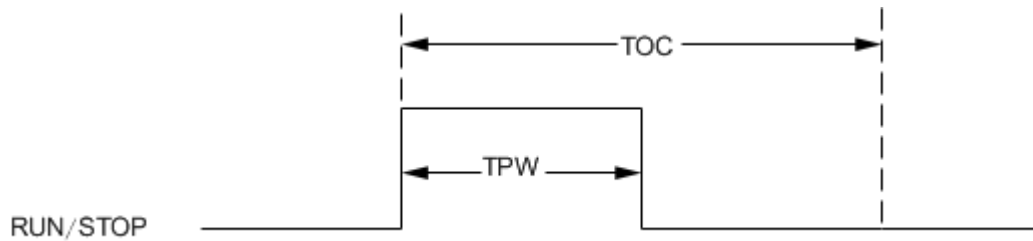


Figure 4.22 Pulse Output Mode(OUTTYPE=0)

- OUTTYPE=1

In this mode, STOP=OFF.

After sent start command, RUN=ON.

After sent start command, RUN=OFF.

In the cold start mode, RUN=OFF.

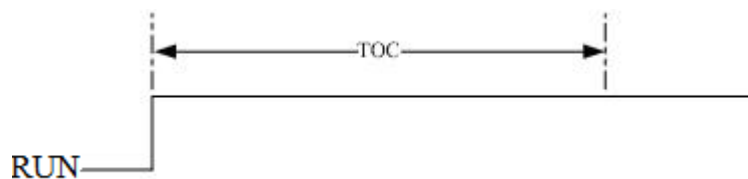


Figure 4.23 Output Hold Mode(OUTTYPE =1)

4.11.3 Detect and Deal Fault

Failed to start or stop

- Generate Alarm

When sent start command, if no start feedback signal during TOC, OF_R= ON.

When sent stop command, if no stop feedback signal during TOC, OF_P= ON.

In the status of OOS and LOC, OPFL will not be generated.
- Eliminate Alarm

If ACK=ON, eliminate the alarm of OF_R and OF_P.

When AUTOCLR = ON, if OF_R= ON and RUNSTA= ON, eliminate the alarm of OF_R.

When AUTOCLR = ON, if OF_P= ON and STOPSTA = ON, eliminate the alarm of OF_P.

If the new input command is valid, eliminate the alarm of OF_R and OF_P.
- Limit to the Input Command

If OPFLACK= ON and OF_R= ON, the command of MANRUN and ARL can not be executed.

If OPFLACK= OFF and OF_P= ON, the command of MANRUN and ARL can be executed.

The command of ERL, EPL,PRL and PPL is not limit by the above principle.
- Effect to the Output Command

When RSTOUT= ON, output holding, and failed to start, then reset RUN.

Failed to stop, nothing will be changed.

When RSTOUT= OFF, output holding, and failed to start, then RUN will not be reset.

When RSTOUT= OFF, output holding, and failed to start, then RUN will not be reset.

Failed to stop, nothing will be changed.

Abnormal Start/Stop

- Generate Alarm
After got the signal of RUNSTA without RUN , then generate the alarm of TP_P.
After got the signal of STOPSTA without STOP, then generate the alarm of TP_R.
- Eliminate Alarm
If ACK= ON, then eliminate the alarm of TP_R and TP_P.
If AUTOCLR= ON, when the RUNSTA vanished, the alarm of TP_P will be eliminated, when the STOPSTA vanished, the alarm of TP_R will be eliminated,
If the input new command is valid, then eliminate the alarm of TP_P and TP_R.
- Limit to the input command
When TRIPACK = ON and TP_P/TP_R= ON, then the command of MANRUN, MANSTOP, ARL and APL will not be responded.
- Effect to the Output Command
If STOUT = ON and output holding, when the trip alarm, TP_R and TP_P generated, then reset RUN.

Alarm of FAIL

- Generate the alarm
When the RUNSTA AND STOPSTA are all ON, generate the alarm of fail.
- Eliminate the alarm
When the RUNSTA AND STOPSTA are not ON at the same time, eliminate the alarm of fail.
- Limit to the input command
When FAILACK= ON and FAIL= ON, then the input command of MANRUN, MANSTOP, ARL and APL will not be responded.
- Limit to the output command
no

Alarm of POWOFF

- Generate the alarm
When not in the process of command output and there is no OPFL, and RUNSTA= ON & STOPSTA= ON, then generate the alarm of POWOFF.
- Eliminate the alarm
When the RUNSTA AND STOPSTA are not OFF at the same time, eliminate the alarm of POWOFF.
- Limit to input command
no
- Limit to the output command
no

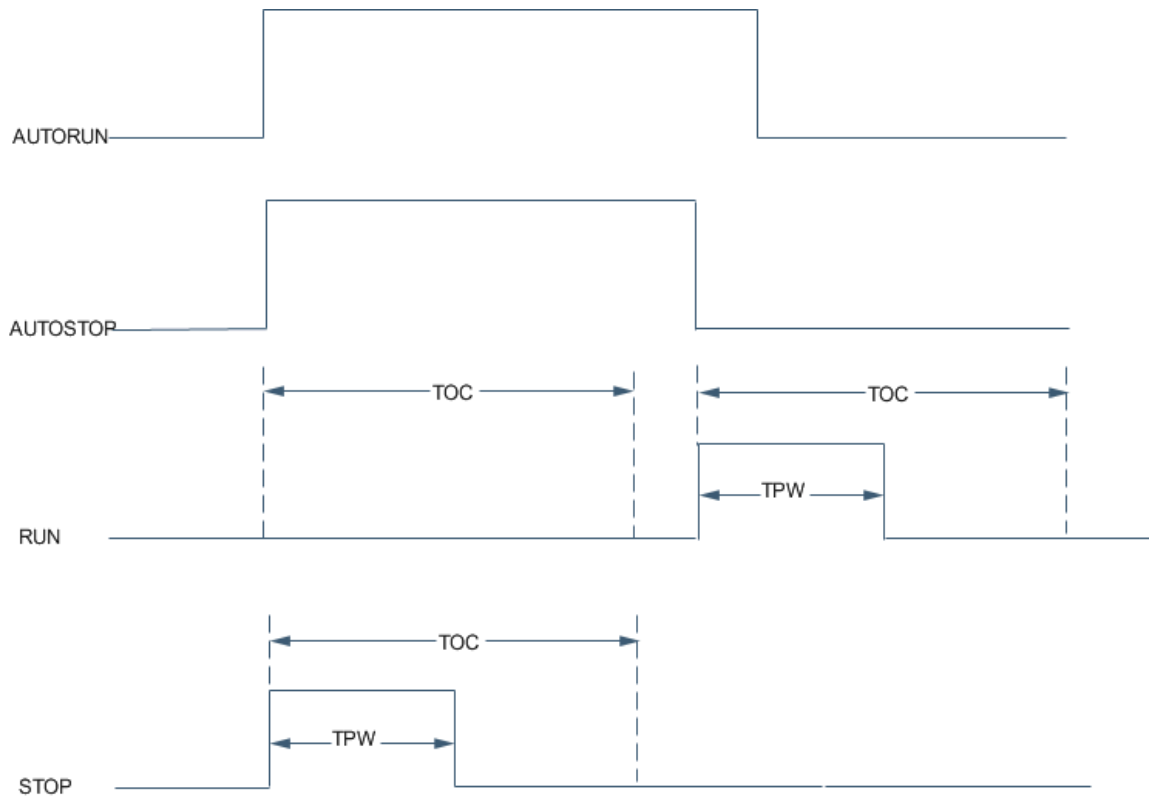
Alarm of FAIL

- Generate the alarm
When FAULT = ON, generate the alarm of FAULT.
- Eliminate the alarm
When FAULT = OFF, eliminate the alarm of FAULT.
- Limit to the input command
When FAULACK= ON and FAULT= ON, then the command of MANRUN, MANSTOP, ARL and APL will not be responded.
- Limit to the output command
When RSTOUT = ON and output holding, generate the alarm of FAULT and reset RUN.

4.11.4 Command Priority

COMDOPR is used to configure the priority of command. By default, COMDOPR=OFF, that is the stop command is prioritized.

- When the stop command is prioritized, and the stop command and run command in the same level existed, then the stop command will be responded. As shown as figure below, AUTORUN and AUTOSTOP, RUN and STOP, that are run command and stop command at the same level, and the stop commands are responded.



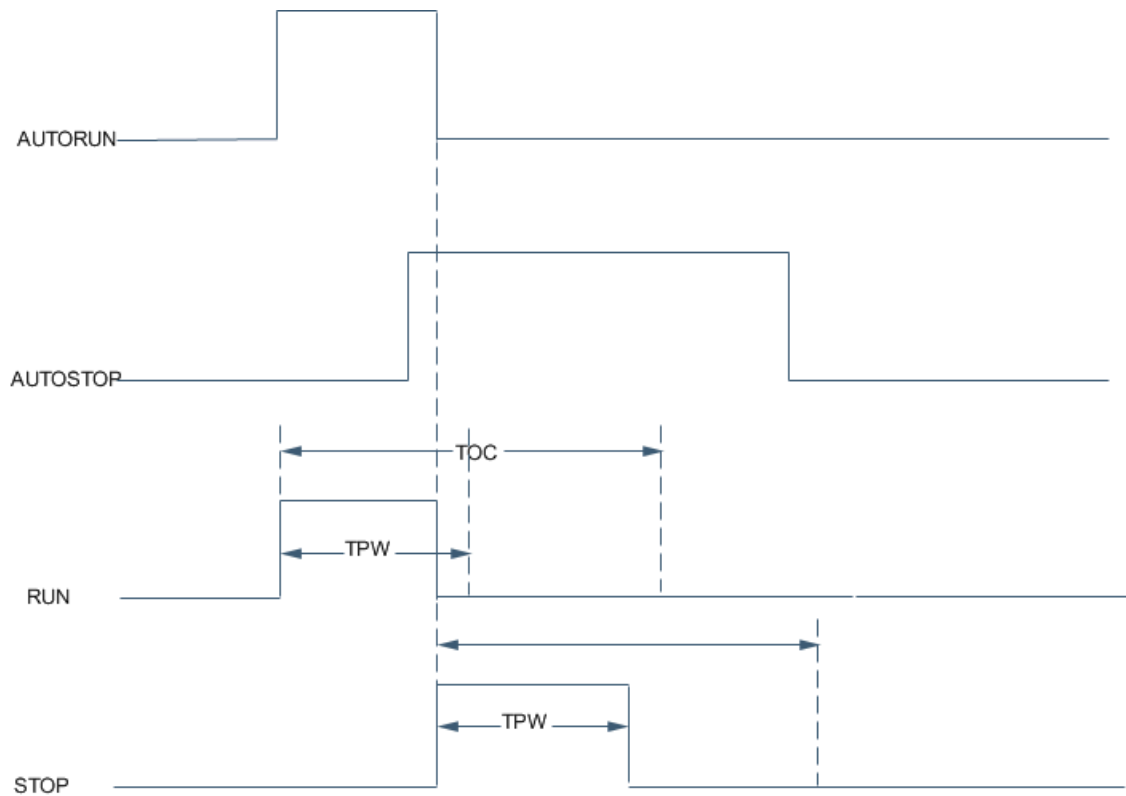
- When the start command is prioritized, and the stop command and run command in the same level existed, then the start command will be responded.

4.11.5 REVTYPE

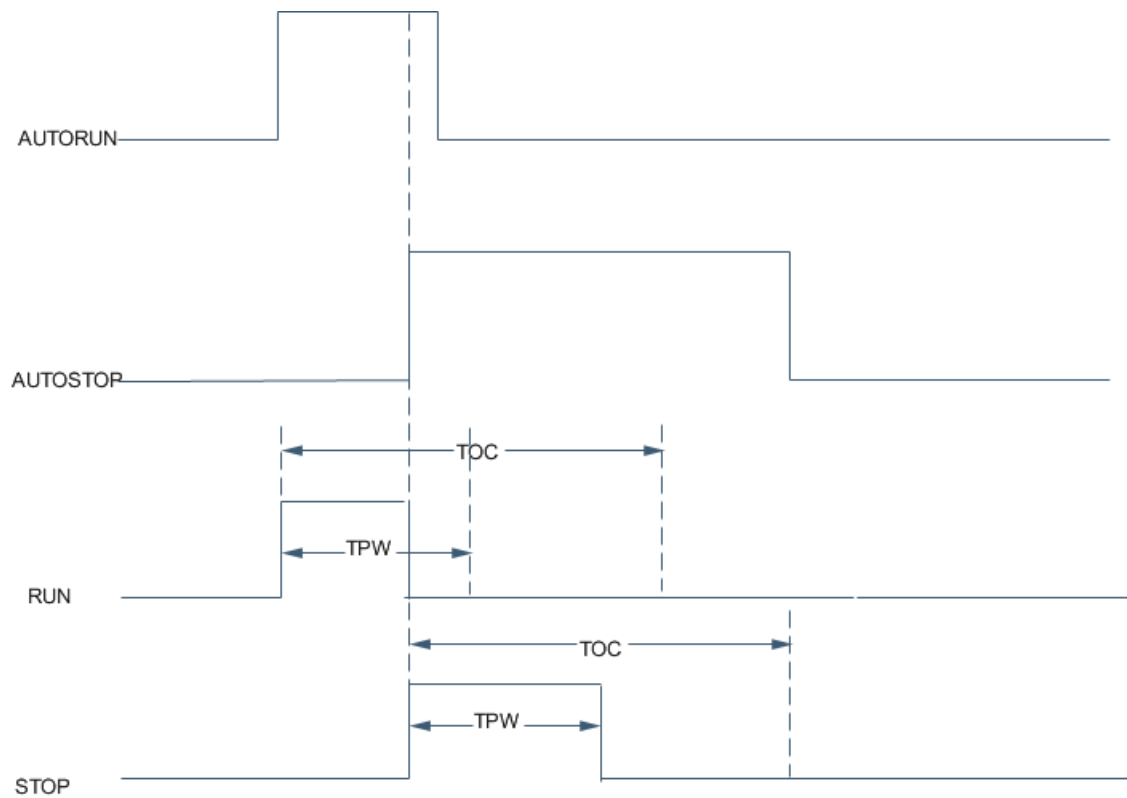
REVTYPE is used to configure reverse stop command respond mode. In the process of stop and start, it is valid to the ERL, EPL, ARL, APL, MANRUN and MANSTOP. By default, responding the reverse stop command.

In the process of start, the configure of REVTYPE will influence the ERL, EPL, ARL, APL, MANRUN and MANSTOP.

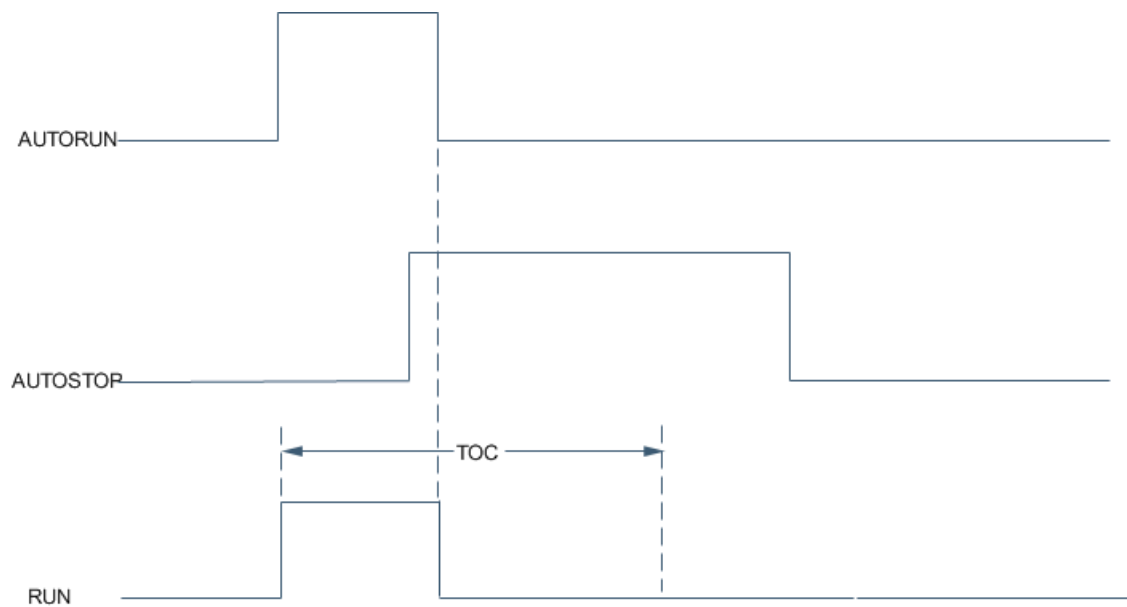
- When REVTYPE=1, and the output signal is pulse(start command is prioritized) , the start and stop signal will be responded as shown as figure below.



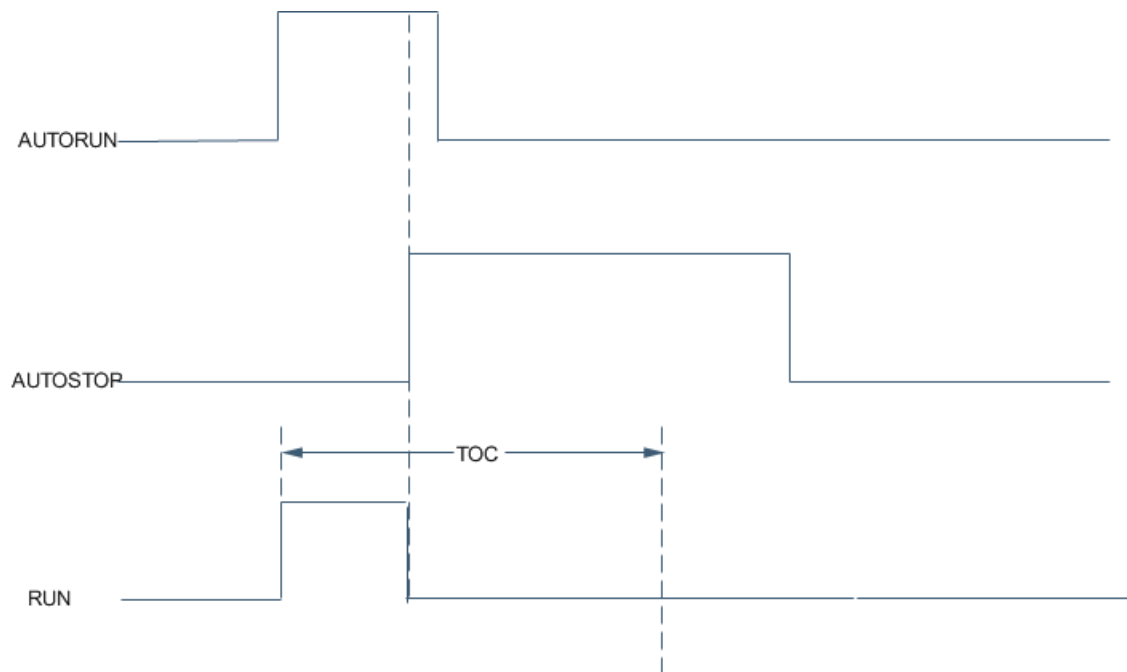
- When REVTYPE=1, and the output signal is pulse(stop command is prioritized) , the start and stop signal will be responded as shown as figure below.



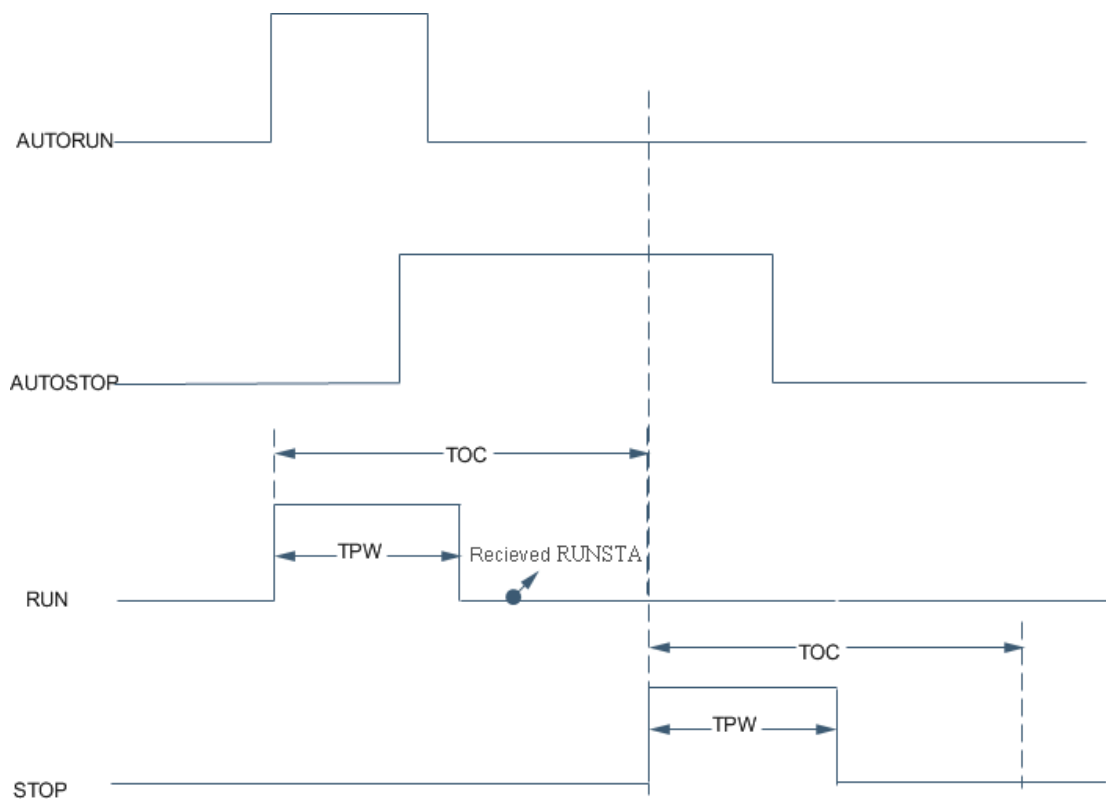
- When REVTYPE=1, and the output signal is holding(start command is prioritized) , the start and stop signal will be responded as shown as figure below.



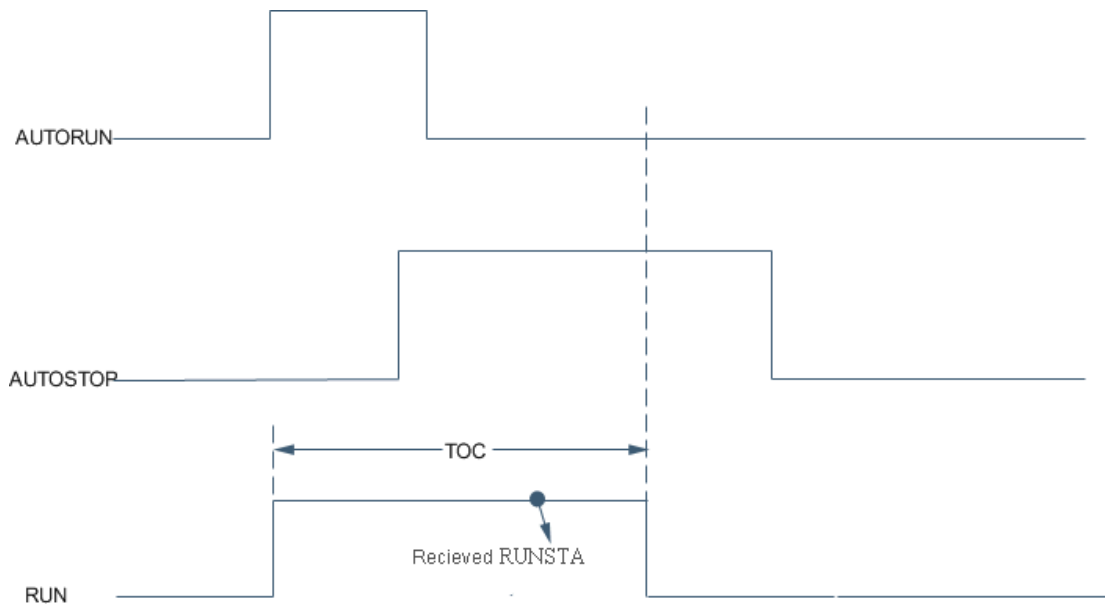
- When REVTYPE=1, and the output signal is holding(stop command is prioritized) , the start and stop signal will be responded as shown as figure below.



- When REVTYPE= 0
 - And output signal is pulse, the start and stop signal will be responded as shown as figure below.



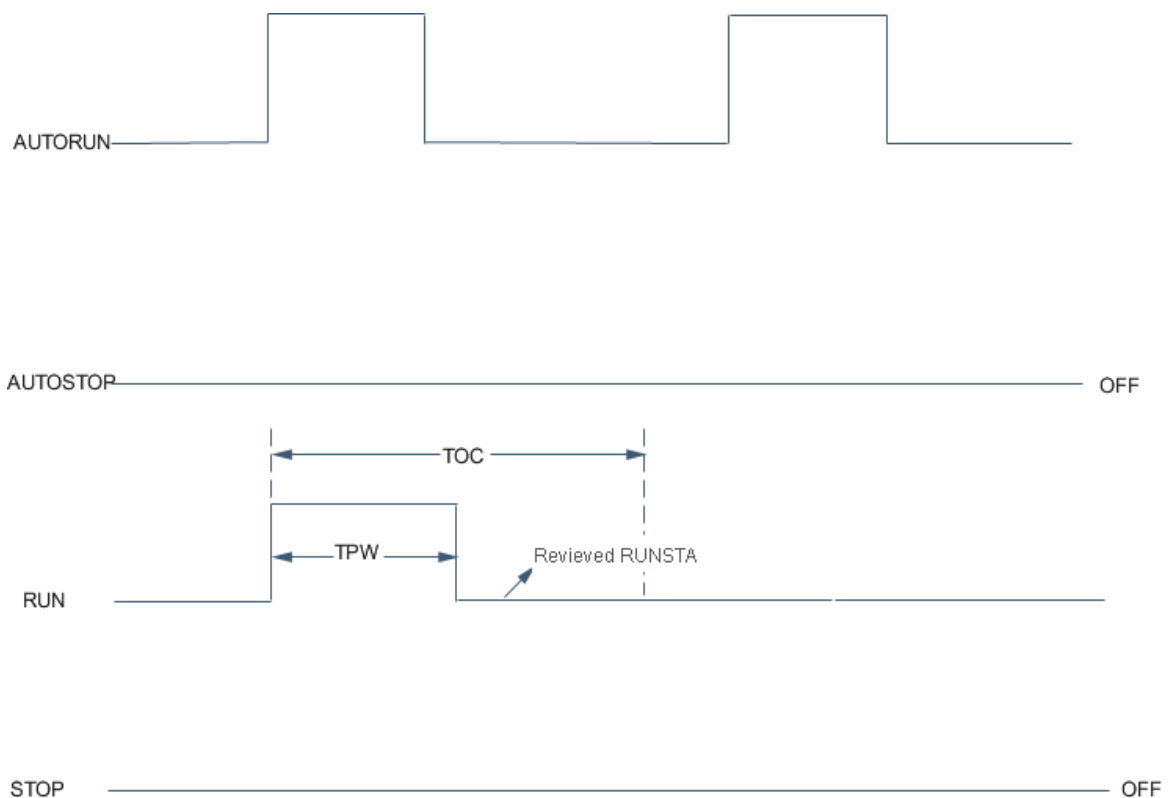
- And output holding, the start and stop signal will be responded as shown as figure below.



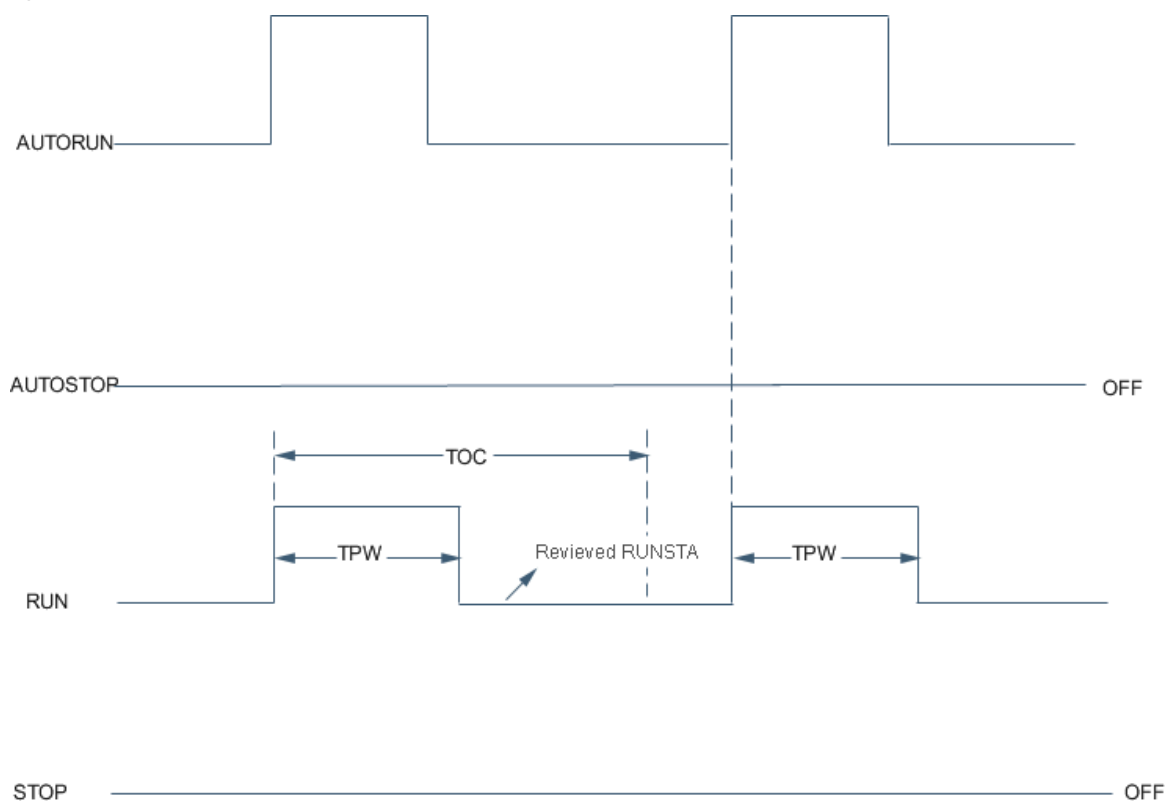
4.11.6 IGNORSTA

IGNORSTA is used to configure the function of slight feedback.

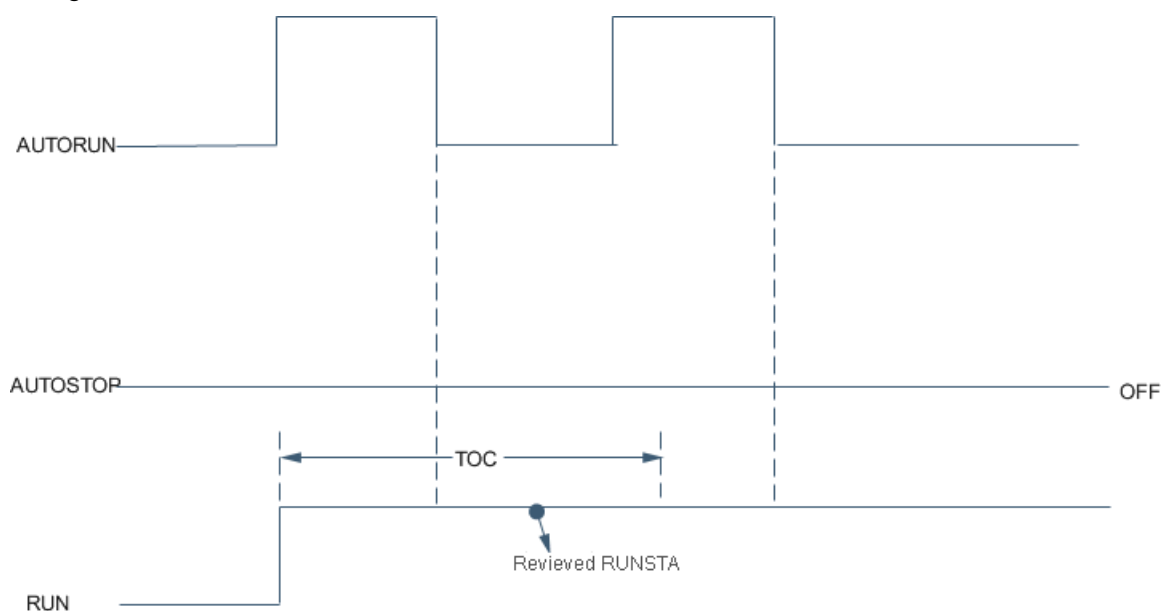
- When IGNORSTA=OFF and output pulse, the signal of start and stop will work as shown as figure below.



- When IGNORSTA=ON and output pulse, the signal of start and stop will work as shown as figure below.



- When the output holding, then the output will not be triggered again no matter the configuration of IGNORSTA.



4.11.7 Output Process of Command Response

- SWFIX

When SWFIX=ON, the function block will in the mode of SWFIX.

When the function block is in the process of start or stop, then the mode of the function block can not be changed to SWFIX. It doesn't respond to protection, interlock or manual/auto output command.

When the function block in the mode of SWFIX, then the command of PRL, PPL, EPL, ERL, APL, ARL, MANSTOP and MANRUN.

- SWTST

When the function block in the mode of SWTST, then it only can response the command of APL, ARL, MANSTOP and MANRUN. Other commands including ERL, EPL, PRL, PPL, TOLOC, RUNPRM/STOPRM, FAIL, TRIP, FAULT, OPFL will be limited, as well as interlock.

- SWSIM

When the command in the mode of SWSIM, all the alarm will not be generated, and the function block will get the feedback signal by the output command. When SWSIM= ON, and if SWDO= OFF, the Function block output to DO, and if SWDO= ON, the Function block not output.

If the function block is in the process of start or running, it's mode can not be changed to simulating.

- OOS(MODE= 1)

When WOOS=ON, the function block will be in the status of OOS, and will not respond any command with output holding. And at this time, the mode of the function block can not be changed to listed, debugging and simulating.

- TOLOC(MODE= 2)

In the mode of debugging, TOLOC command can not be responded.

When TOLOC=ON, and function block will changed into the mode of On-site, and when the pulse output then reset output command, and when output holding then the result will changed by the configure of TR_LOC

- TR_LOC= ON If the function block has no fault, then output feedback of tracking. If the function block has fault, then RUN= OFF.
- TR_LOC= OFF, then RUN= OFF

When the function block In the mode of On-site, the input command will be invalid, and the function block will not be limited by the RUNPRM or STOPRM. The alarm of OPFL and TRIP can not be generated, and the alarm of FAIL, POWOFF, FAULT will be generated.

- PRL/PPL(MODE= 3)

When SWFIX= ON or SWTST= ON, the command of PRL and PPL will not be responded.

When PRL/PPL= ON, the function block will be in the protect mode, then output stop command. And PPL will not be limited by PRL, status feedback signal and alarm.

When PRL = ON and PPL= ON, the output is decided by the priority:

- If stop command is prioritized, then output the stop command. After PPL changed to OFF and PRL holding as ON, then output the start command.
- If start command is prioritized, then output the start command. After PRL changed to OFF and PPL holding as ON, then output the stop command.

When PRL = OFF and PPL= OFF, the command of ERL, EPL, MANRUN , MANSTOP, ARL and APL can be responded.

- ERL/ EPL(MODE=4)

When SWFIX=ON, SWTST=ON and READY=OFF, the command of ERL and EPL will not be responded.

When ERL= ON or EPL= ON, the function block will be in the mode of interlock, and the input interlock command will be check by electrical level.

When ERL = ON and EPL= ON, the output is decided by the priority:

- If stop command is prioritized, then output the stop command. After EPL changed to OFF and ERL holding as ON, then output the start command.
- If start command is prioritized, then output the start command. After ERL changed to OFF and EPL holding as ON, then output the stop command.

The valid of the ERL and EPL is limited by the RUNPRM and STOPRM.

- MANRUN/MANSTOP and ARL/APL (Manual mode MODE= 5, Automatic mode MODE= 6)
In the status of SWFIX and READY= ON, the command of MANRUN,MANSTOP, ARL and APL will not be responded. And only in the status excluded the above, the function block can be in the manual mode or automatic mode. In the automatic mode, the command is decided by ARL and APL. In the manual mode, the command is decided by MANRUN and MANSTOP.

The input of the command MANRUN,MANSTOP, ARL and APL will be detected by electric level. And if the start command and stop command is received at the same time, the command validity is decided by the priority:

- If stop command is prioritized, then output the stop command. After the stop command changed to OFF and start command still being ON, then output the start command.
- If start command is prioritized, then output the start command. After the start command changed to OFF and stop command still being ON, then output the stop command.

The valid of MANRUN, MANSTOP, ARL and APL is limited by RUNPRM, STOPRM, FAIL, TRIP, FAULT, OPFL. And the limit of TRIP can be shielded by TRIPACK, and the limit of OPFL can be shielded by OPFLACK.

NOTE:

- The function block will switch to the automatic mode or manual mode, if its mode is not OOS, interlock, protect or on-site.
 - The function block can switch its work mode between automatic mode and manual mode by FBOPT, SWAM and PSWAM.
 - The word mode of function block only can be switch on its panel, when FBOPT= OFF. The work mode of function block only can be switch on by PSWAM, when FBOPT= ON.
-

4.11.8 Status Definition

Table 4.27 Status Value List

Status	Value
TP_P	7
TP_R	6
OF_P	5
OF_R	4
FAIL	3
STASTOP	2
STARUN	1
POWOFF	0
NONE	8

4.11.9 Flag

Table 4.28 Flag List

Flag	Alarm	Description
D0	OOS	Disable
D1	LOC	On-site
D2	PROTECT	Protect
D3	EMRUN	Interlock Startup
D4	EMSTOP	Interlock Stop
D5	MAN	Manual
D6	AUTO	Auto
D7	POWOFF	Power-OFF Alarm
D8	FAULT	Electric Fault
D10	FAIL	Feedback Fault
D11	STARUN	Device Running Status
D12	STASTOP	Device Stop Status
D14	RUNPRO	Start Instruction Output Process
D15	STOPRO	Stop Instruction Output Process
D16	EMRUNCON	Indicates the interlock start condition
D17	EMSTPCON	Indicates the interlock stop condition
D18	AOF	Suppress Alarm
D19	FIX	FIX
D22	MANRUN	Manual Startup
D23	MANSTOP	Manual Stop
D25	FORCE	Force
D26	SIMUL	Simulation
D27	TP_P	Trip of stopping
D28	TP_R	Trip of starting
D29	OF_P	Stop running fault
D30	OF_R	Start running fault

4.11.10 Panel Parameter

Panel of MOTOR_EX is shown as below.

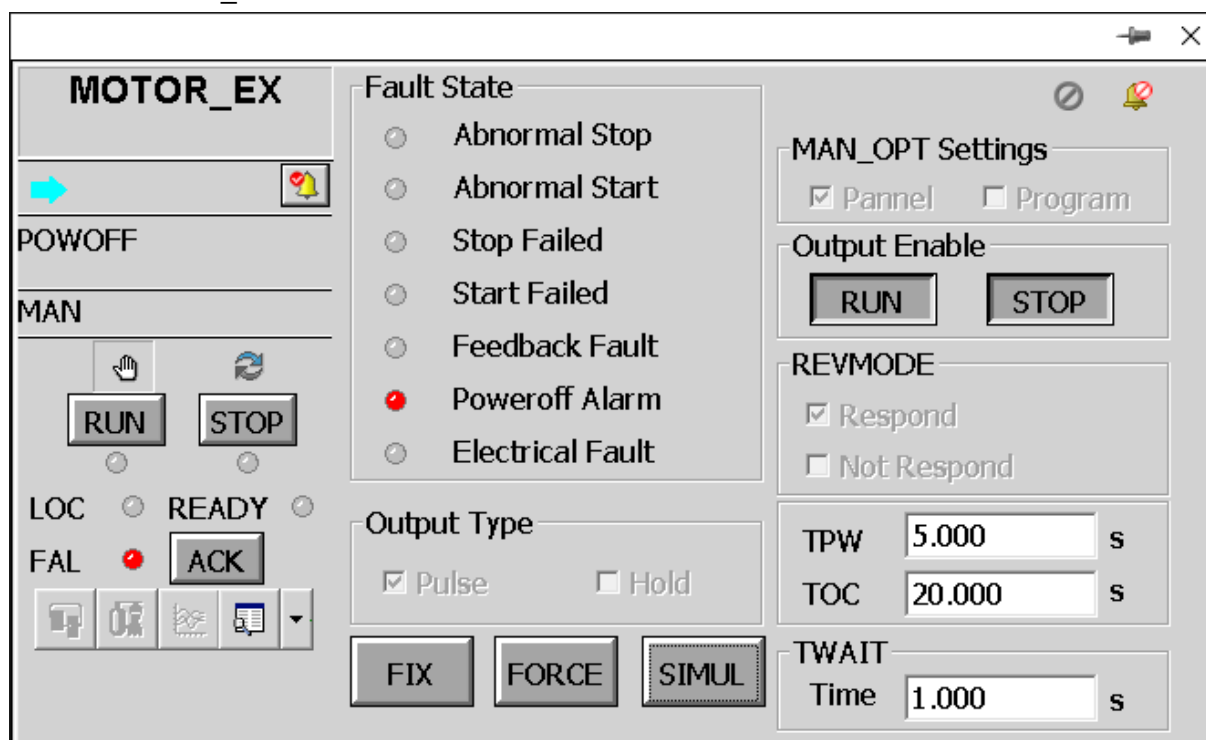


Figure 4.24 MOTOR_EX Panel

Table 4.29 MOTOR_EX Panel Parameter

Panel Parameter	Function Block Parameter	Initial Value	Value Range	Application Instruction
Fault Status	Abnormal Stop	TP_R	-	-
	Abnormal Start	TP_P	-	-
	Stop Failed	OF_R	-	-
	Start Failed	OF_P	-	-
	Feedback Fault	POWOFF	-	-
	Poweroff Alarm	FAIL	-	-
	Electrical Fault	FAULT	ON	ON/OFF FAULT =ON means that there is DI fault input.
Output Type	Pulse	OUTTYPE	1	[0,4] When OUTTYPE=0, the output signal is pulse.
	Hold	OUTTYPE	1	[0,4] When OUTTYPE=1, the output will be holding.

Table 4.29 MOTOR_EX Panel Parameter (continued)

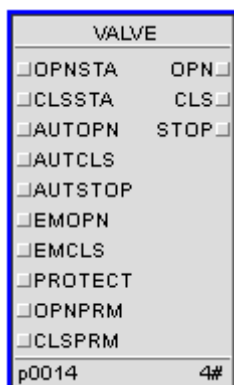
Panel Parameter		Function Block Parameter	Initial Value	Value Range	Application Instruction
MAN_OPT Settings	Panel	FBOPT	√	ON/OFF	Read only, and FBOPT is set in FBD parameter. And when FBOPT=OFF, the manual/auto control source can be selected on panel.
	Program	FBOPT	-	ON/OFF	Read only, and FBOPT is set in FBD parameter. And when FBOPT=ON, the manual/auto control source can be selected in program.
Output Enable	RUN	RUNPRM	-	-	-
	STOP	STOPRM	-	-	-
REVMODE	Re-sponse	REVTYPE	√	-	Read only, 0=In the process of operating output, system does not respond to negative stop command.
	Not Re-sponse	REVTYPE	-	-	Read only, 1=In the process of operating output, system responds to negative stop command and output stop command.
TPW		TPW	5.000	≥0	When single pulse and pulse list are output, define the width of high level of output pulse.
TOC		TOC	20.000	≥0	When the command is output and corresponding output feedback after TOC time, operation fault OPFL appears.
WAIT	time(s)	TWAIT	1.000	≥0	Read only, Interval of Button Pop-Up, Set in the parameter Properties.
But-ton	RUN	MANRUN	-	-	MAN Startup Command
	STOP	MANSTOP	-	-	MAN Stop Command
	ACK	ACK	-	-	Acknowledgement Signal
	FIX	SWFIX	-	-	Click this button, FBD will work in Listing mode.
	FORCE	SWTST	-	-	Click this button, FBD will work in debugging status.
	SIMUL	SWSIM	-	-	Click this button, FBD will work in simulating status.

4.12 Valve Control Function Block (VALVE)

There are two motor valve control function blocks in the system, which are the MOTOR function block which mainly controls the motor and the VALVE function block which mainly controls the valve. The valve function block is mainly to realize the basic switch control and interlock protection of the equipment.

The VALVE function block completes the basic open, close, and stop control and interlock protection of a single device. When the function block receives the upper-level sequence control command or the function block panel command, it outputs the open, close, and stop commands, so as to realize the receiving Control and operation of control equipment. The VALVE function block supports various alarms, which can provide effective protection for the actual industrial production process. VALVE function blocks are generally suitable for dual-input and three-output devices. For single-input single-output or other types of field devices, DIO-11V or other DIO-type function blocks are recommended.

VALVE function block is complex function block, and its running time is 20μs.



4.12.1 Parameter Description

Table 4.30 Valve control function block parameter description

Name			Description	Upload	Properties	Application Reference
Basic Parameters	Mode Setting	OUTTYPE	Output Instruction Mode: 0=Pulse, 1=Pulse Series, 2=Long-Signal	-	Configuration Parameter	-
		SETTYPE	Mode: 0= Inching, 1=Continuum	-	Configuration Parameter	-
		REVTTYPE	Answer Mode of Reverse Instruction: 0=No Answer, 1=Answer and Output, 2=Answer And Stop	-	Configuration Parameter	-
		STPOUT	Output Instruction of STOP: When STPOUT=OFF, stop command only represents the logical stop, it is not output to the equipment. When STPOUT=ON, stop command represents the logical stop and is output with TPW pulse width.	TRUE	Operation Parameter	-

Table 4.30 Valve control function block parameter description (continued)

Name		Description	Upload	Properties	Application Reference
	OPFLACK	Whether to Confirm Running Fault: Set OPFLACK=OFF, running fault does not need to be confirmed and is not considered as restricted condition of new command input. Set OPFLACK=ON, running fault needs to be confirmed and is considered as restricted condition of new command input and is valid to manual/auto command, and invalid to the interlock.	TRUE	Operation Parameter	-
	AUTO-CLR	Whether Auto-Remove Running Fault: Set AUTOCLR=ON, running fault alarm OPFL will be eliminated automatically after status feedback signal is restored. Set AUTOCLR=OFF, running fault alarm OPFL will be eliminated only after panel confirmation after status feedback signal is restored.	TRUE	Operation Parameter	-
	TRIPACK	Whether to Confirm Trip Fault: When TRIPACK=OFF, then the trip fault do not need to be confirmed and do not use as input condition of new command. When TRIPACK = ON, then the trip fault need to be confirmed and used as input condition of new Man/auto command, but it's invalid to the interlock command.	TRUE	Operation Parameter	-
	IGNO-RALM	Shield Alarm When Input Command. When IGNORALM=ON, then FAIL, TRIP, FAULT, OPFL will not use as input condition of new command. When IGNORALM=OFF, then FAIL, TRIP, FAULT, OPFL will use as input condition of new interlock command and Man/auto command.	TRUE	Operation Parameter	-
	IGNORSTA	Ignore Feedback when Output Instruction. When status feedback is ignored and IGNORSTA=ON, an OPN	TRUE	Operation Parameter	-

Table 4.30 Valve control function block parameter description (continued)

Name			Description	Upload	Properties	Application Reference
	Time Set-tings		command or CLS command will output depending on OUTTYPE setting. When status feedback is not ignored and IGNORSTA=OFF, the restore outputs command when corresponding status feedback reaches.			
		TPW	Output pulse width. When single pulse and pulse list are output, define the width of high-level of output pulse.	TRUE	Operation Parameter	-
		TOC	Devise Travel Time (Unit: S) When the command is output and corresponding output feedback after TOC time, operation fault OPFL appears.	TRUE	Operation Parameter	-
		TPLS	Output Pulse Cycle (Unit: S) Pulse period defined when pulse list is output. When set $TPLS < TPW$, $TPLS = TPW$.	TRUE	Operation Parameter	-
		TWAIT	Setting Interval of Button Pop-Up (Unit: S)	TRUE	Operation Parameter	-
Extended Param-e-ters	Input pin	OPNSTA	Open Bit Feedback	-	Input Pin	Measuring Point DI
		CLSSTA	Close Bit Feedback	-	Input Pin	Measuring Point DI
		AUTOPN	Auto-Open Command	-	Input Pin	Upstream Output
		AUTCLS	Auto-Close Command	-	Input Pin	Upstream Output
		AUTSTOP	Auto-Stop Command	-	Input Pin	Upstream Output
		EMOPN	Interlock Open Command	-	Input Pin	Upstream Interlock Signal When EMOP-N=ON, it will be shown in the process alarm.
		EMCLS	Interlock Close Command	-	Input Pin	Upstream Interlock Signal-When EM-

Table 4.30 Valve control function block parameter description (continued)

Name			Description	Upload	Properties	Application Reference
						CLS=ON, it will be shown in the process alarm.
		PRO-TECT	Protect	-	Input Pin	Upstream Output
		TOLOC	Control Switch with on The Spot (ON=on the Spot)	-	Input Pin	Upstream Output
		PACK	Confirm Signal of Program Input Eliminate the running alarm or trip alarm by panel or program input signal PACK.	-	Input Pin	Upstream Output
		OPNPRM	Open-Output Enable SignalOpen permitted signal. When OPNPRM=ON, interlock open, auto open and manual open can output open command.	-	Input Pin	Upstream Output
		CLSPRM	Close- Output Enable SignalClose permitted command. When CLSPRM=ON, interlock close, auto close and manual close can output close command.	-	Input Pin	Upstream Output
		PSWAM	Control Switch Input of Software Man/Auto	-	Input Pin	Upstream Output
		FBOPT	Select Man/Auto Control Source(OFF= Panel Control)	-	Input Pin	Upstream Output
	Output pin	OPN	Output the Open Instruction	-	Output Pin	Output DO
		CLS	Output the Close Instruction	-	Output Pin	Output DO
		STOP	Output the Stop Instruction	-	Output Pin	Output DO
	Operation pin	SWFIX	Command of Listing	-	Operation Parameter	-
		MANOPN	Manual Open Command	-	Operation Parameter	-
		MANCLS	Manual Close Command	-	Operation Parameter	-
		MANS-STOP	Manual Stop Command	-	Operation Parameter	-

Table 4.30 Valve control function block parameter description (continued)

Name			Description	Upload	Properties	Application Reference
		SWAM	Man/Auto Switch:ON=Auto, OFF=Man	-	Operation Parameter	-
		ACK	Confirm Signal	-	Operation Parameter	-
	Status	FAIL	Device Fault When open status feedback OPNSTA and close status feedback CLSSTA are both ON, feedback fault FAIL=ON.	-	Monitoring Parameter	-
		OPFL	Running Fault (ON= Fault)	-	Monitoring Parameter	-
		TRIP	Trip Indication (ON= Trip)	-	Monitoring Parameter	-
		LOC	Indication of Device Open All	-	Monitoring Parameter	-
		STAOPN	Indication of Device Close All	-	Monitoring Parameter	-
		STACLS	Indication of Device Stop in the Middle	-	Monitoring Parameter	-
		STASTOP	Device Mode (Observe)	-	Monitoring Parameter	-
		MODE	Running Fault (ON=Fault)	-	Monitoring Parameter	-
		OPN-FLAG	Output Process of Open-Command (Observe)	-	Monitoring Parameter	-
		CLSFLAG	Output Process of Close-Command (Observe)	-	Monitoring Parameter	-
		STOPFLAG	Output Process of Stop-Command (Observe)	-	Monitoring Parameter	-
	Alarm Enabled and Suppress	AOF	Suppress Module Alarm	TRUE	Operation Parameter	-
		ENALM	Enable of Alarm	-	Operation Parameter	-
		FLAG	Flag Code	-	Output Pin	-
	OOS Setting	SWOOS	with OOS Status (ON=Prohibited)	TRUE	Operation Parameter	-

Table 4.31 Macro parameter illustration

Macro Parameters	Initial Values	Description
MANOPN	Custom, corresponding to the "on" button on the function block panel	Users can redefine the description of the manual command button on the panel
MANCLS	Custom, corresponding to the "off" button on the function block panel	Users can redefine the description of the manual off command button on the panel
MANSTOP	Custom, corresponding to the "stop" button on the function block panel	Users can redefine the description of the manual stop command button on the panel
OPNPRM	Custom, corresponding to the "Enable" button on the function block panel	Open command output on the panel allows redefinition of signal description
CLSPRM	Custom, corresponding to the "Off Allow" button on the function block panel	Close command output on the panel allows redefinition of signal description

4.12.2 Work Flow

Input command processing

The VALVE function block has the following seven equipment modes arranged by priority: operation stop, local, protection, interlock, manual stop, manual and automatic. The following table describes the corresponding conditions for the function block to enter different modes, as well as the validity check of input instructions in different modes (that is, the conditions when the output OPN/CLS/STOP= ON is established in each mode):

Table 4.32 Input command validity check

MODE	Condition	Input command validity check (Output command triggering condition)
Computing stop (MODE=1)	SWOOS=ON	Output remains, don't respond to each input command;
Local (MODE=2)	SWOOS=OFF, TOLOC=ON	Input command invalidity; output reset; OPN=OFF, CLS=OFF; STOP=OFF;
Protection (MODE=3)	SWOOS= OFF, TOLOC=OFF, PROTECT=ON	1) OPN=OFF; 2) CLS=ON: PROTECT=OFF→ON; 3) STOP=OFF;
Interlock (MODE=4)	SWOOS=OFF, TOLOC=OFF, PROTECT=OFF, EMOPN=ON or EMCLS=ON	1) OPN=ON:EMOPN=OFF→ON(OPNPRM=ON, FAIL=OFF):EMOPN=OFF→ON(OPNPRM=ON, IGNORALM=ON); 2) CLS=ON;EMCLS=OFF→ON(CLSPRM=ON, FAIL=OFF):EMCLS=OFF→ON(CLSPRM=ON, IGNORALM=ON); 3) STOP=OFF;
Manually stop (MODE=5)	SWOOS=OFF, TOLOC=OFF,	1) OPN=OFF; 2) CLS=OFF;

Table 4.32 Input command validity check (continued)

MODE	Condition	Input command validity check (Output command triggering condition)
	PROTECT=OFF, EMOPN=OFF and EMCLS=OFF, MANSTOP=ON	3) STOP=ON: MANSTOP=OFF → ON (SPOUT=ON);
Manual (MODE=6)	SWOOS=OFF, TOLOC=OFF, PROTECT=OFF, EMOPN=OFF and EMCLS=OFF, MANSSTOP=OFF, SWAM=OFF	1) OPN=ON: MANOPN=OFF → ON (OPNPRM=ON, FAIL=OFF, OPEL=OFF, TRIP=OFF); MANOPN=OFF → ON (OPNPRM=ON, IGNORALM=ON); 2) CLS=ON: MANCLS=OFF → ON (CLSPRM=ON, FAIL=OFF, OPEL=OFF, TRIP=OFF); MANCLS=OFF → ON (CLSPRM=ON, IGNORALM=ON); 3) STOP=OFF;
Auto (MODE=7)	SWOOS=OFF, TOLOC=OFF, PROTECT=OFF, EMOPN=OFF and EMCLS=OFF, MANSSTOP=OFF, SWAM=ON	1) OPN=ON: AUTOPN=OFF → ON (RUNPRM=ON, FAIL=OFF, OPEL=OFF, TRIP=OFF); AUTOPN=OFF → ON (OPNPRM=ON, IGNORALM=ON); 2) CLS=ON: AUTCLS=OFF → ON (CLSPRM=ON, TRIP=OFF, OPEL=OFF, TRIP=OFF); AUTCLS=OFF → ON (CLSPRM=ON, IGNORALM=ON); 3) STOP=OFF; MANSTOP=OFF → ON (SPOUT=ON);

“→” means the transition of parameters from previous status to the current status.

Working mode illustration

Note 1: Interlock

- If the interlock open command is triggered first and the interlock close command is triggered within the effective time of the interlock open, the interlock open command will be executed first, and the interlock close command will be executed immediately after the interlock close command is triggered.
- If the interlock close command is triggered first and the interlock open command is triggered within the effective time of the interlock close, the interlock close command will be executed first, and the interlock open command will be executed immediately after the interlock open command is triggered.



ATTENTION:

The effective time here refers to the time when the interlock open/close command changes from ON to OFF.

Note 2: Manual stop

- The priority of manual stop is higher than automatic open, automatic close, automatic stop, manual open, and manual close.
- If either of the interlocking commands EMOPN or EMCLS is ON, the manual stop command is invalid.

Note 3: Manually automatic

- If the interlock open EMOPN is continuously ON, the manual close and automatic close commands are invalid.
- If EMCLS is continuously ON when the interlock is closed, the manual open and automatic open commands are invalid.

Note 4: Automatic switching by hand

- It can be automatically switched by FBOPT, SWAM, PSWAM.
- The function block defaults to SWAM=OFF, which is manual mode. On the contrary, when SWAM=ON is set, the function block is in automatic mode.
- When FBOPT=OFF, the manual automatic switching can be determined by the manual automatic button on the panel, and the SWAM status is synchronized with the manual or automatic status on the function block panel.
- When FBOPT=ON, the manual automatic switch is determined by the program input PSWAM, and the SWAM manual automatic switch is invalid. At this time, when PSWAM=OFF, it means that the program control is in manual mode, and the panel can be operated manually. When PSWAM=ON, the program control is automatic mode.

Output Mode Selection

- Output command mode (OUTTYPE)

According to the characteristics of the valve, the output command has three modes of pulse, pulse train and long signal to choose from. Next, take the open command output OPN as an example to illustrate the output signals in different modes.

As shown in the figure below, TOC is the travel time of the device, and TPW is the width of the output pulse (that is, the time when the output pulse is high). The setting principle is that $TPW \leq TOC$, if $TPW > TOC$, $TPW = TOC$ is mandatory.

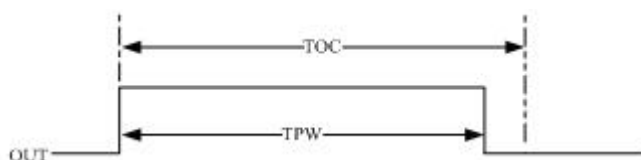


Figure 4.25 Pulse output mode OUTTYPE=0

As shown in the figure below, TPLS is the period of one pulse when the output is in pulse train mode. The setting principle is: $TPW \leq TPLS \leq TOC$. If $TPLS < TPW$, force $TPLS = TPW$.

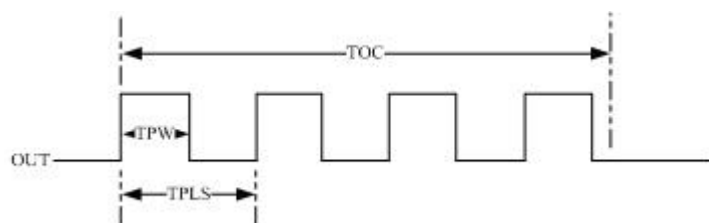


Figure 4.26 Pulse train output mode **OUTTYPE=1**

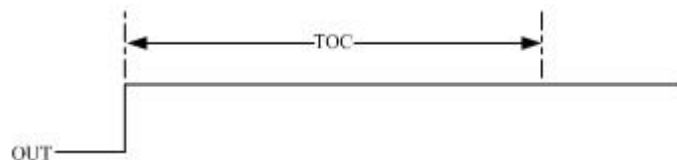


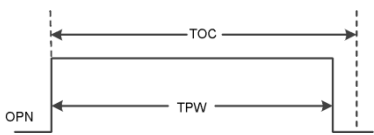
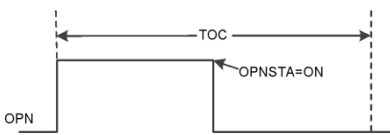
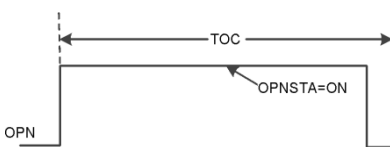
Figure 4.27 Long signal output mode **OUTTYPE=2**

- **SETTYPE**

According to the process requirements and the switching characteristics of equipment, the valve function block supports jog and continuous operation modes.

The following takes the pulse output mode as an example to illustrate the reset situation when the open command output **OPN** is not ignored (**IGNORSTA=OFF**) and the status feedback (**IGNORSTA=ON**) is not ignored in different operating modes. The reset condition of the off command output **CLS** is the same as that of the on command output **OPN**.

Table 4.33 Output reset conditions in each mode

	Inching	Consistent
whether to ignore status feedback	Output command OPN/CLS/STOP resets with the input command's reset	Output command OPN/CLS/STOP don't reset with the input command's reset
Pulse output		
Not ignore status feedback		
Ignore status feedback		

In the above table, in jog and continuous mode, when the status feedback is not ignored (IGNORSTA=OFF), the open command output OPN will be reset immediately after the open end feedback OPNSTA arrives. When the status feedback is ignored (IGNORSTA=ON), the arrival of the open end feedback OPNSTA will not affect the open command output command OPN.

- Output reset condition

The following table describes the VALVE function block in different MODE (device mode), SETTYPE (operating mode) are respectively the conditions of jog and continuous output reset.

Table 4.34 Output command reset condition

SETTYPE	MODE	Output reset condition
/	Local	There is no output command;
Inching	Protection	PROTECT=OFF or (IGNORSTA=OFF and CLSSTA=ON);
	Interlock	OPN:EMOPN=OFF or (IGNORSTA=OFF and OPNSTA=ON); CLS:EMCLS=OFF or (IGNORSTA=OFF and CLSSTA=ON); STOP;/
	Manual stop	OPN;/ STOP:MANSTOP=OFF;
	Manual	OPN:MANOPN=OFF or (IGNORSTA=OFF and OPNSTA=ON); CLS:MANCLS=OFF or (IGNORSTA=OFF and CLSSTA=ON); STOP;/
	Auto	OPN:AUTOPN=OFF or (IGNORSTA=OFF and OPNSTA=ON); CLS:AUTCLS=OFF or (IGNORSTA=OFF and CLSSTA=ON); STOP:AUTSTOP=OFF;
Consistent	/	OPN:IGNORSTA=OFF and OPNSTA=ON; CLS:PROTECT=OFF and (IGNORSTA=OFF and CLSSTA=ON); STOP;/



ATTENTION:

In the above table, the premise of each output instruction reset is that it has been triggered before the reset.

- Over-travel fault refers to the operation fault alarm (OPFL=ON) when the corresponding feedback signal is not received within the travel time after the output command is issued in the jog and continuous mode. In case of over-travel fault, the output commands OPN, CLS, STOP will be reset.

4.12.3 Fault Diagnosis and Solution

VALVE function block has equipment fault FAIL, operation fault alarm OPFL, trip alarm TRIP and interlock dual input fault alarm DBEMCMD in the interlock mode. In which, OPFLACK can shield the operating fault alarm OPEL, TRIPACK can shield trip fault TRIP, IGNORALM can shield FAIL, OPEL, TRIP.

Table 4.35 Fault detection under each mode

MODE	Alarm
Operating stops	Not to generate any alarm.
Local	Not to generate any alarm.
Protection	To generate alarms, refer to equipment failure, trip alarm, and trip alarm.
Interlock	If EMOPN=ON and EMCLS=ON, the interlock command is not responded, and a DBEM-CMD alarm is generated. Other alarms are generated normally, see equipment failure, trip alarm, and trip alarm.
Manual stop	To generate alarms, refer to equipment failure, trip alarm, and trip alarm.
Manual	
Auto	

Equipment Fault (FAIL)

- Alarm Generation
When the open end feedback OPNSTA and the closed end feedback CLSSTA are ON at the same time, the equipment failure alarm FAIL is set.
- Alarm Elimination
When the open end feedback OPNSTA and the closed end feedback CLSSTA are not ON at the same time, the equipment failure alarm FAIL is cleared.

Operating Fault (OPFL)

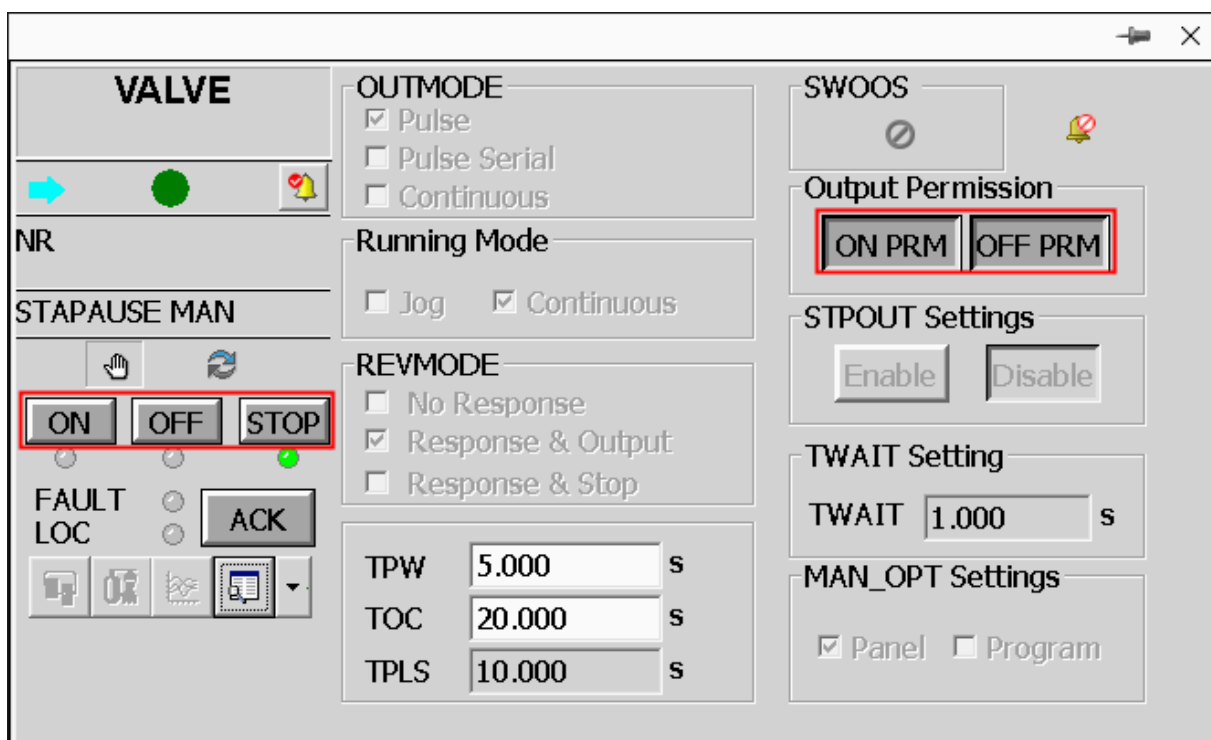
- Alarm Elimination
After the output command is issued, if the corresponding feedback signal is not received within the travel time TOC, the operation failure alarm OPFL is set.

- Alarm Elimination
When there is an OPFL alarm, if the new command input is valid, the OPFL alarm will be cleared.
- Impact on output commands
In inching mode and consistent mode, OPFL will reset the output commands OPN and CLS when an operation failure occurs.

TRIP

- Alarm Generation
When there is no open output, a trip alarm TRIP is generated when the open feedback arrives or the close feedback is cancelled.
When there is no off output, a trip alarm TRIP will be generated when the off feedback arrives or the on feedback is cancelled.
- Alarm Elimination
When there is a TRIP alarm, if the new command input is valid, the TRIP will be cleared.

4.12.4 Panel Parameter



As shown in the figure above, the button name in the red box can be modified in the macro parameters of the function block, and the maximum length is 0~64 characters (including Chinese, English, numbers and special characters). If the button name is not modified, the original default

description will be displayed on the panel. When the length of the custom description exceeds the actual length of the button on the panel, it will be truncated and displayed according to the actual length of the button.

Table 4.36 Panel Parameter Instruction

Panel Parameter Name		Function Block Parameter Name	Initial Value	Value Range	Application Instruction
OUT-TYPE	Pulse	OUTTYPE	√	-	Read only, OUTTYPE=0, Set in the parameter Properties.
	Pulse Serial	OUTTYPE	-	-	Read only, OUTTYPE=1, Set in the parameter Properties.
	Continuous	OUTTYPE	-	-	Read only, OUTTYPE=2, Set in the parameter Properties.
Running Mode	Inching	SETTYPE	-	-	Read only, SETTYPT=0, Set in the parameter Properties.
	Continuous	SETTYPE	√	-	Read only, SETTYPE=1, Set in the parameter Properties.
REVTYPE Mode	Not Response	REVTYPE	-	-	0=In the process of operating output, system does not respond to negative stop command.
	Output	REVTYPE	√	-	1=In the process of operating output, system responds to negative stop command and output negative stop command.
	Stop	REVTYPE	-	-	2=In the process of operating output, system responds to negative stop command and is considered as stop command.
TPW(s)		TPW	5.000	≥0	When single pulse and pulse list are output, define the width of high-level of output pulse.
TOC(s)		TOC	20.000	≥0	When the command is output and corresponding output feedback after TOC time, operation fault OPFL appears.
TPLS(s)		TPLS	10.000	-	Read only, Pulse period defined when pulse list is output. When set TPLS<TPW, TPLS=TPW.
Output Permission	ON PRM	OPNPRM	The button is pressed.	-	Output signal with on permission
	OFF PRM	CLSPRM	The button is pressed.	-	Output signal with off permission

Table 4.36 Panel Parameter Instruction (continued)

Panel Parameter Name		Function Block Parameter Name	Initial Value	Value Range	Application Instruction
ST-POUT Settings	Enable	STPOUT	The button is not pressed.	-	The button pressed means STPOUT=ON, and stop command is output.
	Disable	STPOUT	The button is pressed.	-	The button pressed means STPOUT=OF and stop command will not be output.
TWAIT Setting	TWAIT(s)	TWAIT	1.000	≥0	Read only, Setting Interval of Button Pop-Up, Set in the parameter Properties.
Manual/Auto - CS switch	Panel	FBOPT	√	-	Read only, FBOPT=OFF, Set in the parameter Properties.
	Program	FBOPT	-	-	Read only, FBOPT=ON, Set in the parameter Properties.
Operation Button	OPN	MANOPN	-	-	Manual Open Command
	CLS	MANCLS	-	-	Manual Close Command
	STP	MANSTOP	-	-	Manual Stop Command
	ACK	ACK	-	-	Confirm Signal

4.12.5 Flag

Table 4.37 Flag

Flag Code	Alarm	Instruction
D0	OOS	Disable
D1	LOC	On-site
D2	PROTECT	Protect
D3	EMOPN	Interlock Open
D4	EMCLS	Interlock Close
D5	MANSTOP	Manual Stop
D6	MAN	Manual
D7	AUTO	Auto
D9	OPFL	Running Fault
D11	FAIL	Feedback Fault

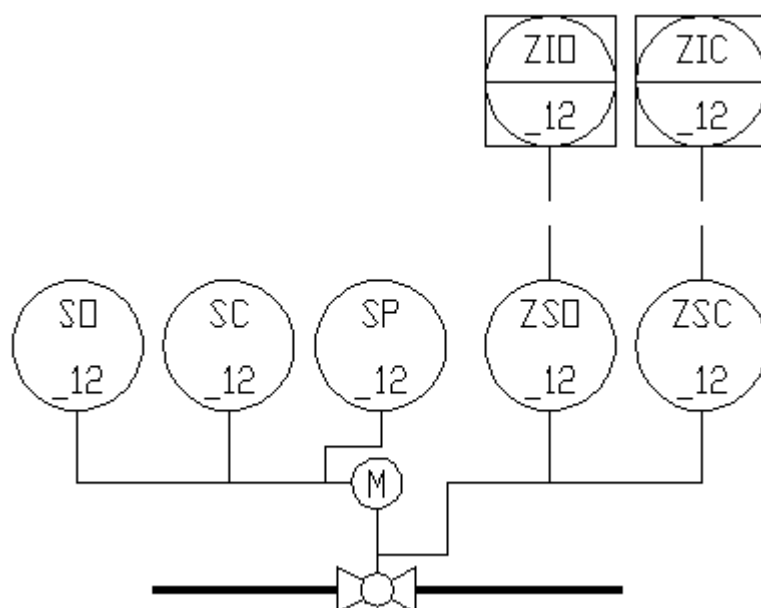
Table 4.37 Flag (continued)

Flag Code	Alarm	Instruction
D12	STAOPN	Devices All Open
D13	STACLS	Devices All Closed
D14	STAPAUSE	Device Middle Stop
D15	TRIP	Device Trip
D16	OPNPRO	Open Instruction Output Process
D17	CLSPRO	Close Instruction Output Process
D18	STOPRO	Stop Instruction Output Process
D21	AOF	Suppress Alarm
D22	FIX	FIX
D24	DBEMCMD	Interlock Double Input Fault

4.12.6 Application Example

To achieve the program building of the dual DI dual DO pump in the figure below and can be operated on flow chart. When pump running fault (if after running time, the status feedback and control output are different, open the running fault alarm) occurs, no need to acknowledge. When pump trip occurs, acknowledge first and execute other operation.

Dual-DI three DO pump refers to that the on, off and stop of filed pump device is controlled by three DO signals, the pump status is shown by dual-DI signal feedbacks.

**Figure 4.28 Dual-DI Dual-DO pump**

Details of program are shown in the figure below. It applies VALVE function block, and the upper computer interface can control DO via function block tag.

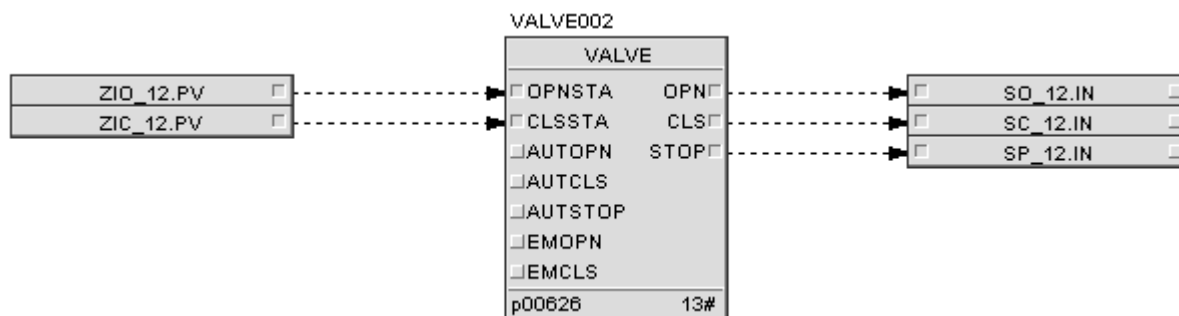


Figure 4.29 Program of Dual-DI Three DO Valve

Function block and example instructions are shown in the table below:

Table 4.38 Function Block and Example Instruction

NO.	Example	Type	Instruction	Remark
001	SO_12	DO Output	Valve On Control	
002	SC_12	DO Output	Valve Off Control	
003	SP_12	DO Output	Valve Stop Control	
004	ZIO_12	DI Input	Valve On Status Feedback	
005	ZIC_12	DI Input	Valve Off Status Feedback	
006	VALVE002	Function Block Tag	Valve Control Function Block Tag	Supervision Tag

Parameter settings of VALVE:

- FBOPT: ON
- PSWAM: OFF
- OPFLACK: OFF
- AUTOCLR: ON
- TRIPACK: OFF
- IGNORSTA: ON
- If pulse control is required, in configuration parameter OUTTYPE= 0, SETTYPE= 1, REVTYPE= 1 and STPOUT= ON;
- If long signal control is required, in configuration parameter OUTTYPE= 2, SETTYPE= 1, REVTYPE= 1, STPOUT= ON; when long signal control is applied and running time has reached, no matter the feedback arrives or not, output is OFF.

Note: the settings of FBOPT and PSWAM can avoid wrong operation for Auto button on the panel. Other settings should be applied for auto control.

Alarm Settings:

- FAIL(Device Fault) alarm, when all function block switches are ON, FAIL outputs alarm (FAIL= ON);
- OPFL (running fault) alarm, when the status feedback of function block is different with its output, OPFL outputs alarm (OPFL= ON);
- TRIP(trip indication) alarm, if there is no stop output action, the open feedback changes from ON to OFF, TRIP outputs alarm (TRIP= ON);
- Set the operation parameter IGNORALM (input shield alarm) of basic parameter as not shield (IGNORALM= OFF), the input instruction is not influenced by alarm signals FAIL and OPFL.

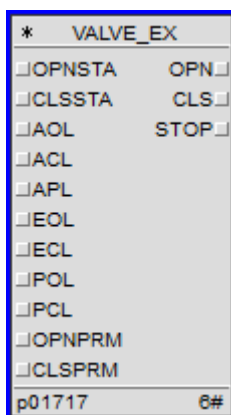
Note: whether to acknowledge fault is determined by the settings of operation parameter OPFLACK.

4.13 Command Level Valve Equipment Control Function Block (VALVE_EX)

There are two motor valve control function blocks in the system, which are the MOTOR function block which mainly controls the motor and the VALVE function block which mainly controls the valve. The valve function block is mainly to realize the basic switch control and interlock protection of the equipment.

VALVE_EX is used to basic control and interlock protect to the single device. By this function block, single device can be controlled by the sequence command of upper level and operating in the function block panel.

This is the simple function block, and its running time is 20us.



4.13.1 Parameter Description

Table 4.39 Table 4-39 Parameter description

Parameter			Description	Upload	Parameter type	Reference
Basic-Parameter	Time Settings	TPW	Output pulse width(unit: second) When the output is single pulse or pulse list, TPW should be defined as the width of high of high level.	TRUE	Operation Parameter	TPW<TOC
		TOC	Device runtimes(unit: second) When the command sent and after TOC later, and the related output feedback is not ON, the OPFL will be set as ON.	TRUE	Operation Parameter	Related parameter: TPW and TPLS.
		TWAIT	Preset button pop-up time interval(s)	TRUE	Operation Parameter	-
	Mode Settings	OPFLACK	Whether the running fault need to be confirmed.When OPFLACK=OFF, then the running fault need not be confirmed, and the running fault will not be the limit of inputting new command.When OPFLACK=ON and the running fault should be confirmed. And the running fault will be the limit of inputting new command of interlock command and manual command.	TRUE	Operation Parameter	-
		AUTOCLR	Whether auto-clear running fault and trip fault. When AUTOCLR = ON and OPFL generated, after status feedback signal restored, OPFL will be cleared.When AUTOCLR=OFF and OPFL generated, even if status feedback signal restored, OPFL only can be cleared after confirmed in the panel.	TRUE	Operation Parameter	-
		TRIPACK	Whether the trip fault need to be confirmed.When TRIPACK=OFF and the trip fault need not to be confirmed, and the trip fault will not be the limit of inputting new command.When TRIPACK =ON and the trip fault should be confirmed. And the trip fault will be the limit of inputting new com-	TRUE	Operation Parameter	-

Table 4.39 Table 4-39 Parameter description (continued)

Parameter		Description	Upload	Parameter type	Reference
		mand of interlock command and manual command.			
	RSTOUT	Whether fault reset output(ON: reset)	-	Operation Parameter	-
	FAILACK	When FAILACK =ON and FAIL=ON, the manual command will not be responded.	TRUE	Operation Parameter	-
	FAULTACK	When FAULTACK =ON and FAULT=ON, the manual command will not be responded.	TRUE	Operation Parameter	-
	IGNORSTA	Output instruction ignores feedback(OFF: not ignore) If IGNORSTA=ON, output the complete OPN command or CLS command by OUTTYPE without judged the output feedback. If IGNORSTA=OFF, output with judging the output feedback, and not output the OPN command and CLS command after received right feedback.	TRUE	Operation Parameter	-
	IGNORALM	Input Command Shield Alarm (OFF: NO) If IGNORALM= ON, the new command will not be limited by the alarm of FAIL, TRIP, FAULT and OPFL. If IGNORALM= OFF, the new command will be limited by the alarm of FAIL, TRIP, and OPFL. (That means when these faults exist, interlock and manual-automatic commands will not be responded, while LOC and POL commands are not restricted.)	TRUE	Operation Parameter	-
	OUTTYPE	0 = Single DO hold1= Double DO short pulse 2= Double DO long pulse including stop command, and the Stop command is short pulse. 3= Double DO hold 4=Triple DO short pulse By default, OUTTYPE=1.There is no	-	Configuration Parameter	-

Table 4.39 Table 4-39 Parameter description (continued)

Parameter			Description	Upload	Parameter type	Reference
			stop command if OUTTYPE equaled to 0,1,3, because there is no intermediate status while running normally. When the OUTTYPE equaled to 3, one DO should be ON and the other is OFF. And the two DO should be OFF while cold start.			
		REVTYPE	Reverse Command Respond Mode: 0: No respond, 1: Respond and output, 2: Respond and stop. It is only valid when the FBD is in the mode of interlock, auto and manual.	-	Configuration Parameter	-
		COMDOPR	Priority(ON: open prioritized, OFF: close prioritized)	-	Configuration Parameter	-
		IVO	When the type is Single DO Hold, output is negated(ON: output is negated)	-	Configuration Parameter	-
Extended Parameter	Input Pin	OPNSTA	Open Bit Feedback	-	Input Pin	Measuring Point DI
		CLSSTA	Close Bit Feedback	-	Input Pin	Measuring Point DI
		AOL	Auto-open Command	-	Input Pin	-
		ACL	Auto-close Command	-	Input Pin	-
		APL	Auto-stop Command	-	Input Pin	-
		EOL	Interlock Open Command	-	Input Pin	-
		ECL	Interlock Close Command	-	Input Pin	-
		POL	Protect Open Command	-	Input Pin	-
		PCL	Protect Close Command	-	Input Pin	-
		TOLOC	On-site Control Switch (ON=On-site)	-	Input Pin	Upstream Output
		FAULT	DI Electric Fault	-	Input Pin	-
		READY	ReadyBy default, READY=ON.	-	Input Pin	-

Table 4.39 Table 4-39 Parameter description (continued)

Parameter			Description	Upload	Parameter type	Reference
		PACK	Program Input Confirm Signal When OPFL or TRIP alarm happened, the alarm can be eliminated on panel or input PACK.	-	Input Pin	Upstream Output
		PSWAM	Program Switch of Manual or Auto	-	Input Pin	Upstream Output
		FBOPT	Manual/Auto Control Source Select(OFF=Panel)	-	Input Pin	Upstream Output
		OPNPRM	Open Output Enable Signal Only when OPNPRM=ON, the command of ARL, ERL and MANRUN can output ON.	-	Input Pin	-
		CLSPRM	Close Output Enable Signal- Only when CLSPRM=ON, the command of APL, EPL and MANSTOP can output ON.	-	Input Pin	Upstream Output
	Output Pin	OPN	Open Command Output	-	Output Pin	Output to DO
		CLS	Close Command Output	-	Output Pin	Output to DO
		STOP	Stop Command Output	-	Output Pin	Output to DO
	Operation Parameter	SWFIX	Listed command	-	Operation Parameter	-
		MANOPN	Manual Open Command	-	Operation Parameter	-
		MANCLS	Manual Close Command	-	Operation Parameter	-
		MANSTOP	Manual Stop Command	-	Operation Parameter	-
		ACK	Confirm Signal	-	Operation Parameter	-
		SWAM	Manual/Auto Switch: OFF=Manual, ON=Auto	-	Operation Parameter	-
		SWTST	Debug command When SWTST=ON, the function block will be in the debug mode.	-	Operation Parameter	-
		SWSIM	Simulate command When SWSIM=OFF, the function block has no simulation function, When SWSIM=ON, the function block has simulation function.	-	Operation Parameter	-

Table 4.39 Table 4-39 Parameter description (continued)

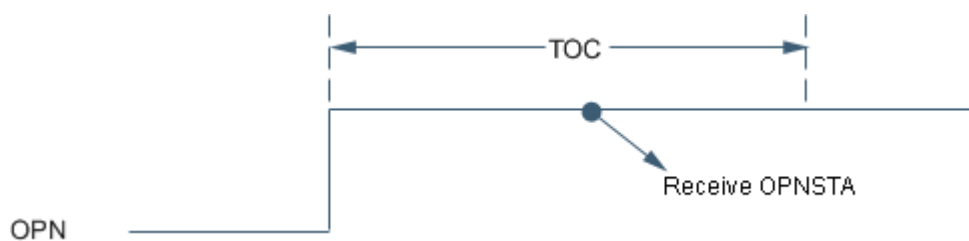
Parameter			Description	Upload	Parameter type	Reference
		SWDO	When simulating, OFF: Function block output, ON: Function block not output	-	Operation Parameter	-
		TR_LOC	When the function block in the mode of on-site, the switch of output tracking, OFF: output reset, ON: output tracks feedback.	-	Operation Parameter	-
	Status	FAIL	Feedback Fault When OPNSTA= ON and CLSSTA= ON at the same time, then FAIL will be ON.	-	Monitoring Parameter	-
		LOC	On-site Control Indication	-	Monitoring Parameter	-
		STAOPN	Devices All Open Indication	-	Monitoring Parameter	-
		STACLS	Devices All Close	-	Monitoring Parameter	-
		STASTOP	Devices Stop Indication	-	Monitoring Parameter	-
		MODE	Device Mode (Observe)	-	Monitoring Parameter	-
		OPNFLAG	Open Command Output Process (Observe)	-	Monitoring Parameter	-
		CLSFLAG	Close Command Output Process (Observe)	-	Monitoring Parameter	-
		STOPFLAG	Stop Command Output Process (Observe)	-	Monitoring Parameter	-
		TP_O	Trip Open (ON: Trip)	-	Monitoring Parameter	-
		TP_C	Trip Close (ON: Trip)	-	Monitoring Parameter	-
		OF_C	Operation Fault Close (ON: Fault)	-	Monitoring Parameter	-
		OF_O	Operation Fault Open (ON: Fault)	-	Monitoring Parameter	-
		POWOFF	Power-OFF Alarm	-	Monitoring Parameter	-

Table 4.39 Table 4-39 Parameter description (continued)

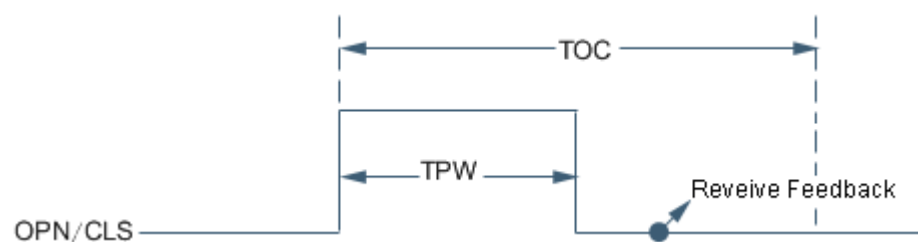
Parameter			Description	Upload	Parameter type	Reference
		STATE	Status	-	Monitoring Parameter	-
	Alarm Enable and Shield	AOF	Suppress Alarm	TRUE	Operation Parameter	-
		FLAG	Flag	-	Output Pin	-
		ENALM	Enable of Alarm	-	Operation Parameter	-
	OOSSetting	SWOOS	Switch of Out of Service (ON=Disable)	TRUE	Operation Parameter	-

4.13.2 Output Mode

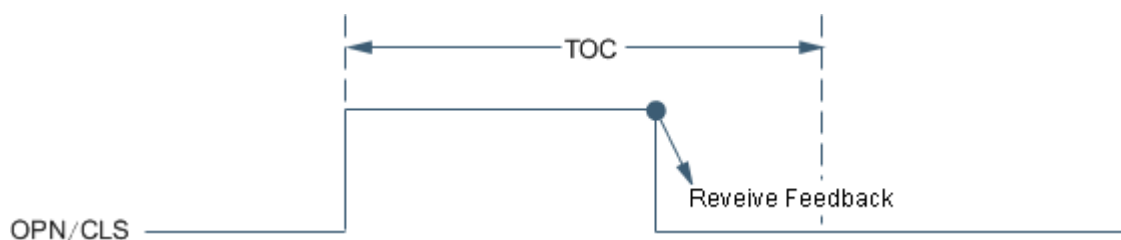
- Single DO hold

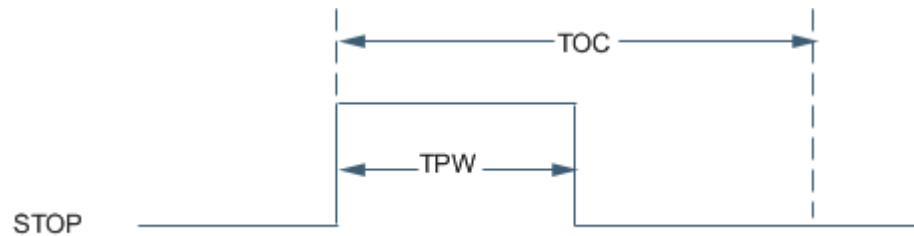
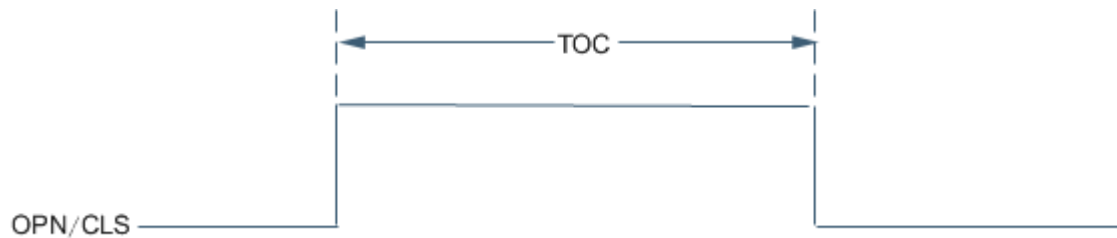


- Double DO short pulse

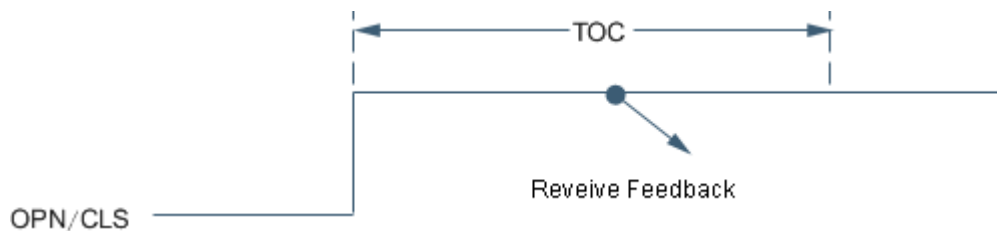


- Double DO long pulse including stop command, and the Stop command is short pulse. Reset output after TOC or received feedback signal.

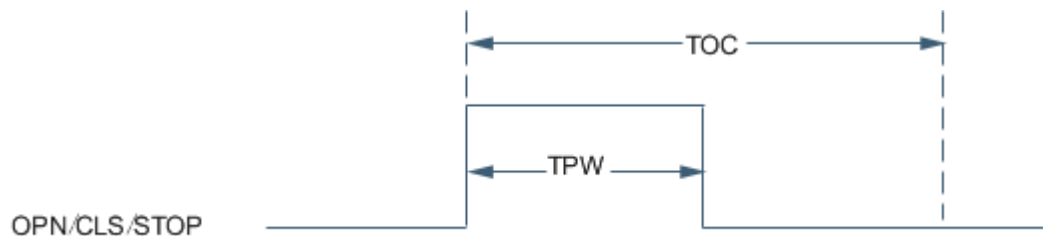




- Double DO hold



- Triple DO short pulse



4.13.3 Detect and Deal Fault

OF_O/OF_C

- Generate Alarm

When OUTTYPE=0, 1 or 2, and no feedback signal received after output signal and pass TOC, OF_O/OF_C will be set as ON.

When OUTTYPE=3 or 4, and no feedback signal received during TOC, OF_O/OF_C will be set as ON. If received STOP, the schedule will be stop.

When the function block is in the mode of OOS or LOC, OF_O alarm and OF_C alarm will not be generated.

- Eliminate Alarm

If ACK = ON, the OF_O alarm and OF_C alarm will be eliminated.

When AUTOCLR = ON and OF_O alarm or OF_C alarm generated, if the status feedback recovered, the OF_O alarm and OF_C alarm will be eliminated.

When the input command valid, the OF_O alarm and OF_C alarm will be eliminated.

- Limit to the Input Command

When OPFLACK=ON

- If OF_O=ON, the MANOPN will be limited.
- If OF_C =ON, the MANCLS will be limited.

When OPFLACK=ON

- If OF_O=ON, the MANOPN will not be limited.
- If OF_C =ON, the MANCLS will not be limited.

- Effect to the Output Command

- RSTOUT = ON

When OUTTYPE=0, and OF_O=ON or OF_C=ON, the function block will output OFF to DO.

When OUTTYPE=1, nothing to do to the output.

When OUTTYPE=2, if OF_O=ON, OPN will be OFF. if OF_C=ON, CLS will be OFF.

When OUTTYPE=3, nothing to do to the output.

When OUTTYPE=4, nothing to do to the output.

- RSTOUT = OFF, When OUTTYPE=3, nothing to do to the output.

TP_O/TP_C

- Generate Alarm

When received OPNSTA without OPN, TP_O alarm will be generated.

When received CLSSTA without CLS, TP_C alarm will be generated.

- Eliminate Alarm

If ACK = ON, eliminate TP_O alarm and TP_C alarm. If the input command valid, eliminate TP_O alarm and TP_C alarm.

- Limit to the Input Command

When TRIPACK = ON and TRIP= ON, and the command of AOL, ACL, MANOPN, ANCLS and MANSTOP will not be responded.

- Effect to the Output Command

Null

FAIL

- Generate Alarm

When OPNSTA and CLSSTA all be ON at the same time, the FAIL will be ON.

- **Eliminate Alarm**
When RUNSTA and STOPSTA are not be ON at the same time, the FAIL will be OFF.
- **Limit to the Input Command**
When FAILACK= ON and FAIL= ON, and the command of AOL, ACL, MANOPN, MANCLS and MANSTOP will not be responded.
- **Effect to the Output Command**
Null

POWOFF

- **Generate Alarm**
When no output command and no OPFL alarm, if OPNSTA and CLSSTA be OFF at the same time, generate POWOFF alarm.
- **Eliminate Alarm**
When RUNSTA and STOPSTA are not OFF at the same time, eliminate POWOFF alarm.
- **Limit to Input Command**
Null
- **Effect to the Output Command**
Null

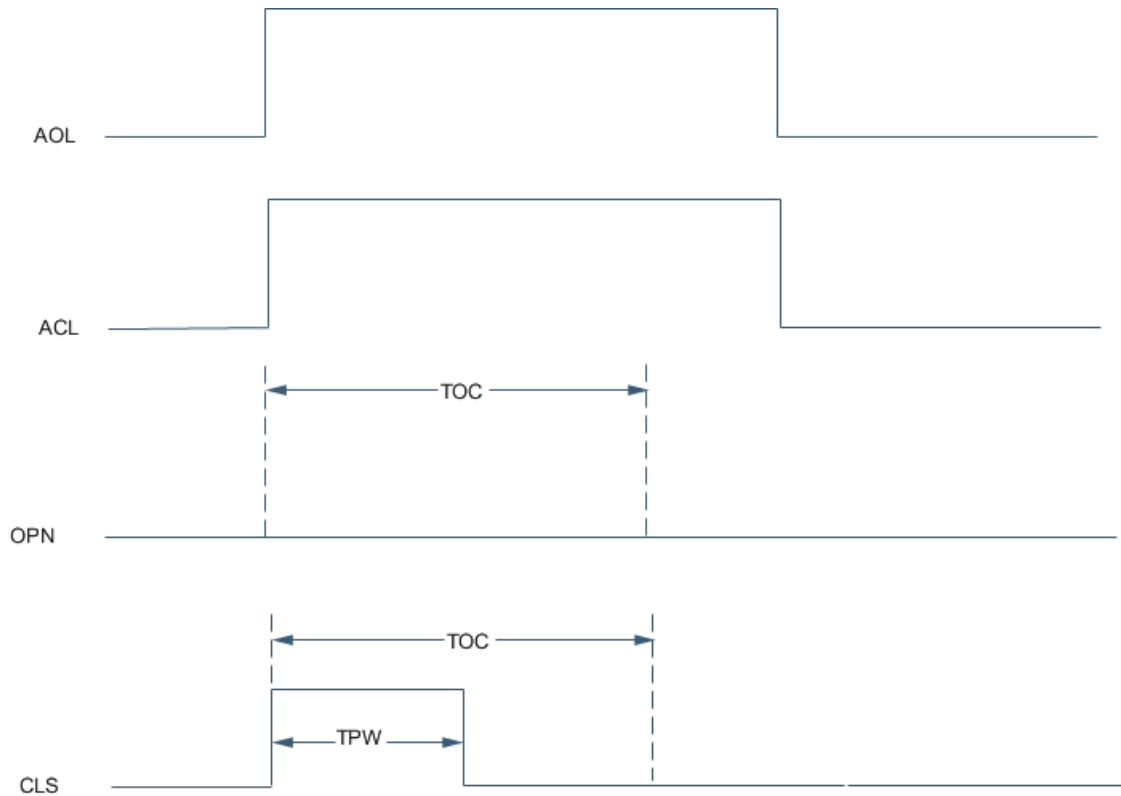
FAULT

- **Generate Alarm**
When FAULT = ON, generate FAULT alarm.
- **Eliminate Alarm**
When FAULT = ON, eliminate FAULT alarm.
- **Limit to Input Command**
When FAULACK= ON and FAULT= ON, and the command of AOL, ACL, MANOPN, MANCLS and MANSTOP will not be responded.
- **Effect to Output Command**
When RSTOUT = ON, output holding and FAULT=ON, the output will be reset. When OUTTYPE=0 and FAULT=ON, the function block will set DO as OFF. When OUTTYPE=3 and FAULT=ON, the function block will set DO as OFF.

4.13.4 Command Priority

COMDOPR is used to define the priority of command.

- When close command is prioritized, and there are close command and open command at the same time, the close command will be responded. As shown as figure below, AOL and ACL, OPN and CLS, those are commands at the same level, and the close commands are responded.



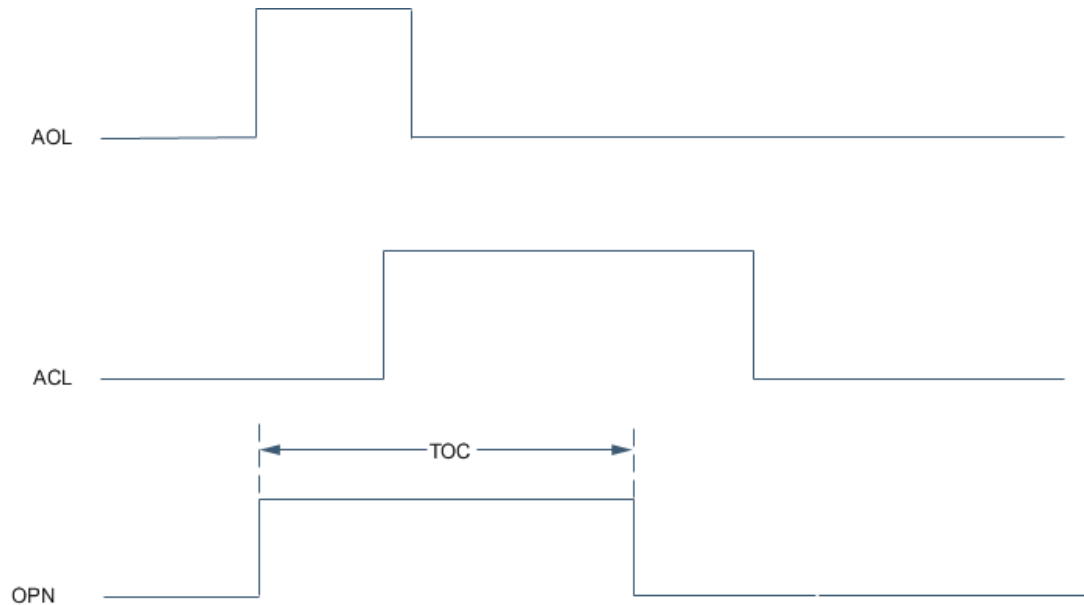
- When open command is prioritized, and there are close command and open command at the same time, the open command will be responded.
- If there are MANOPN, MANCLS and MANSTOP command at the same time, the MANSTOP is prioritized.

4.13.5 REVTYPE

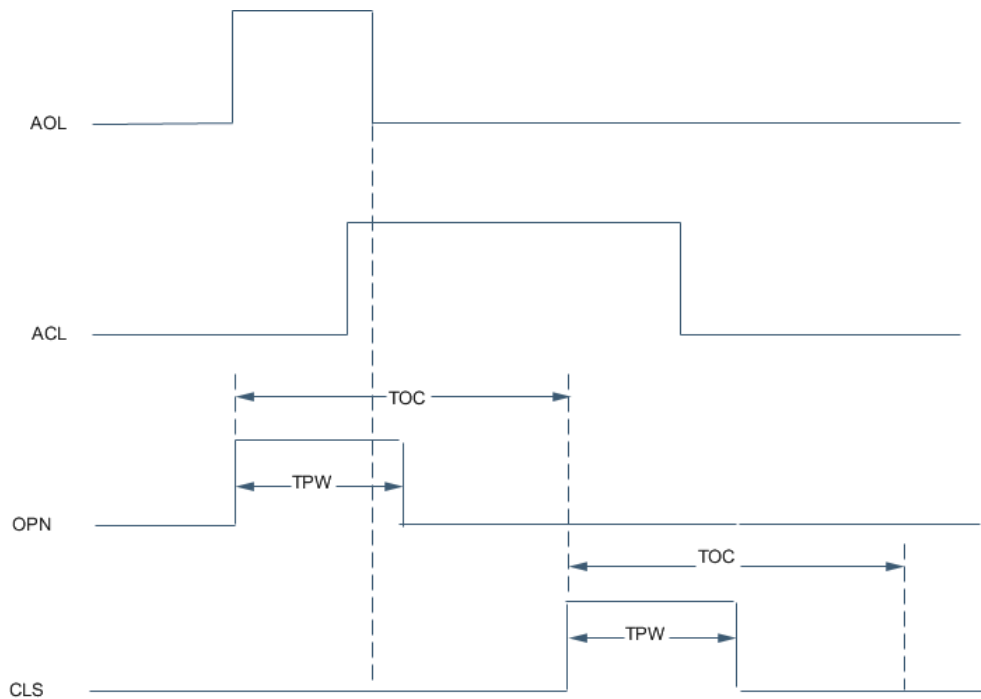
REVTYPE is used to configure respond mode of reverse stop command.

- Do not respond the reverse command in the process of output.

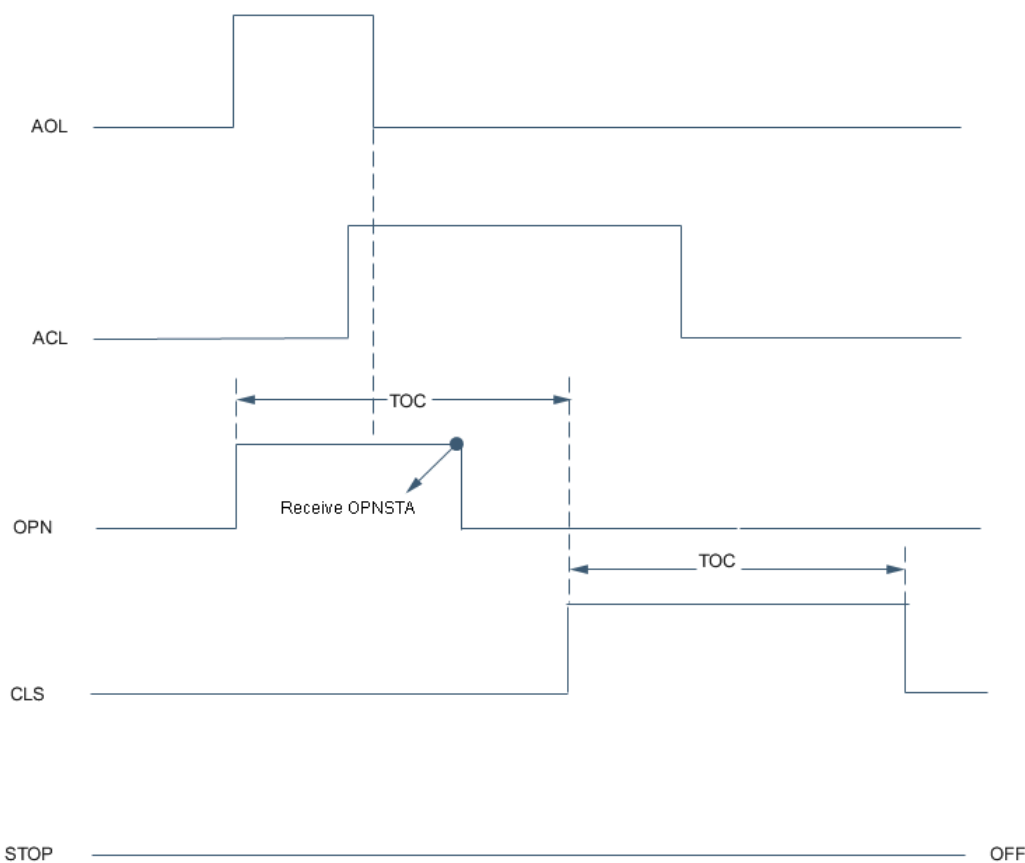
- When OUTTYPE=0, Single DO hold



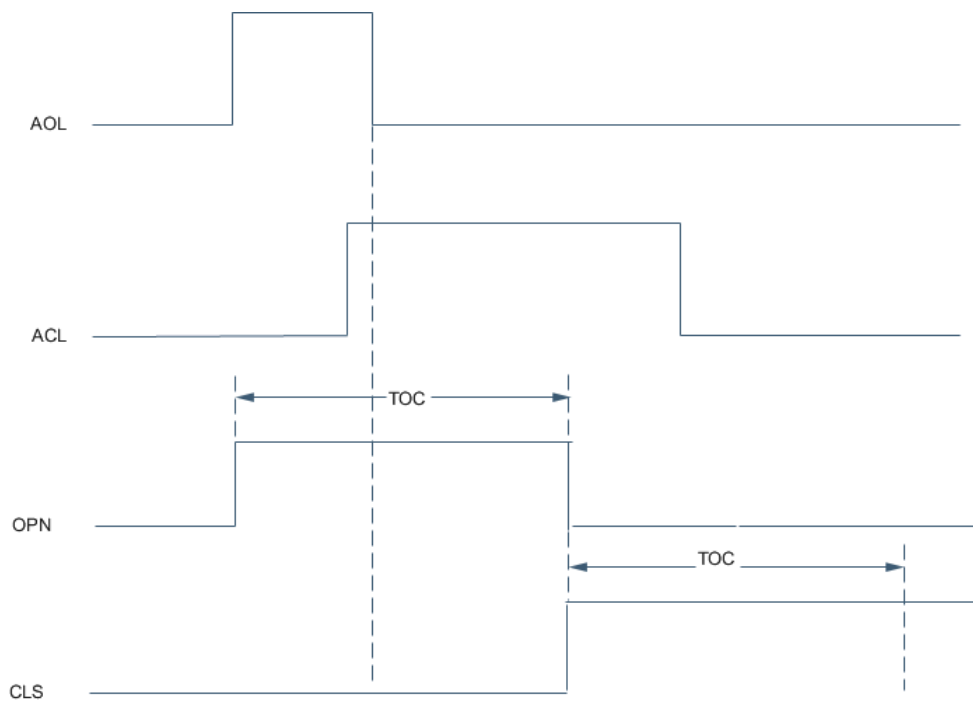
- When OUTTYPE=1, Double DO short pulse



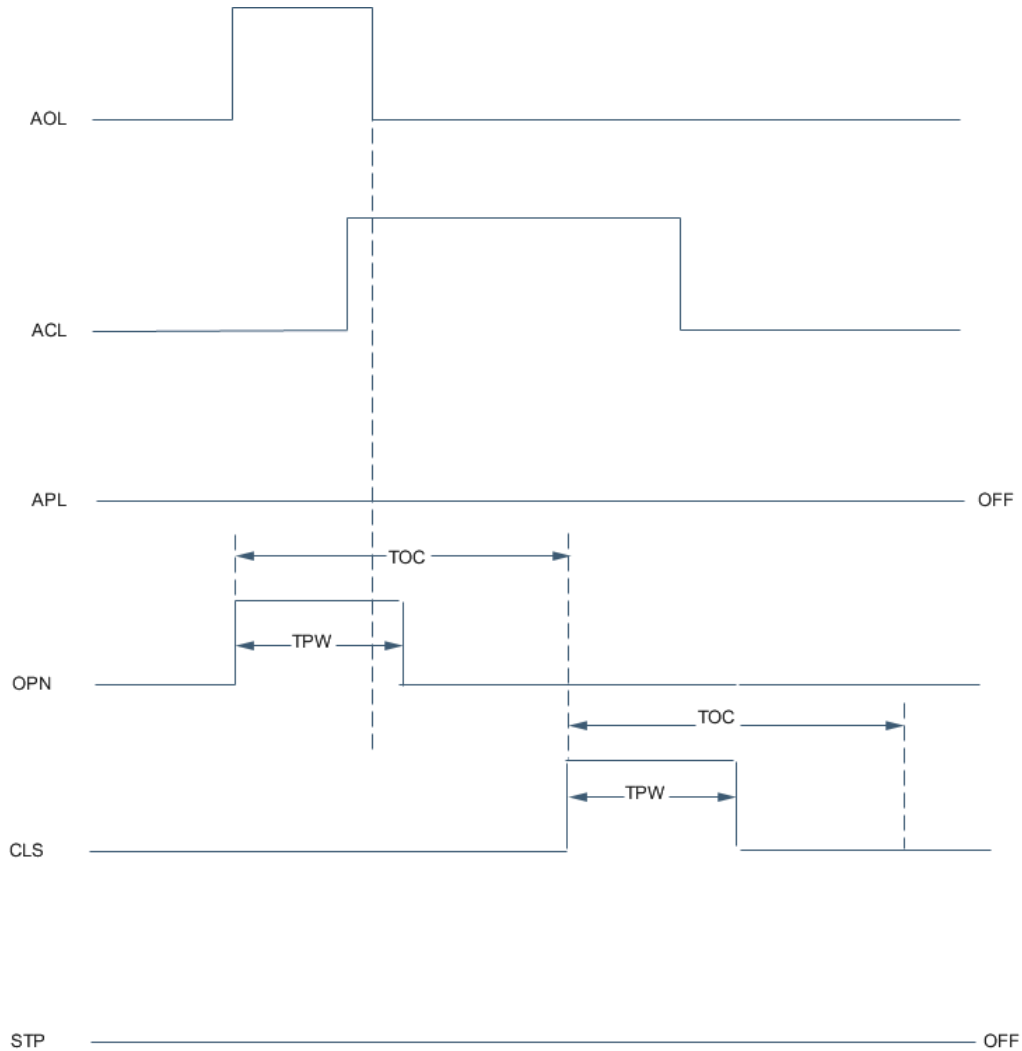
- When OUTTYPE=2, Double DO long pulse including stop command



- When OUTTYPE=3, Double DO hold

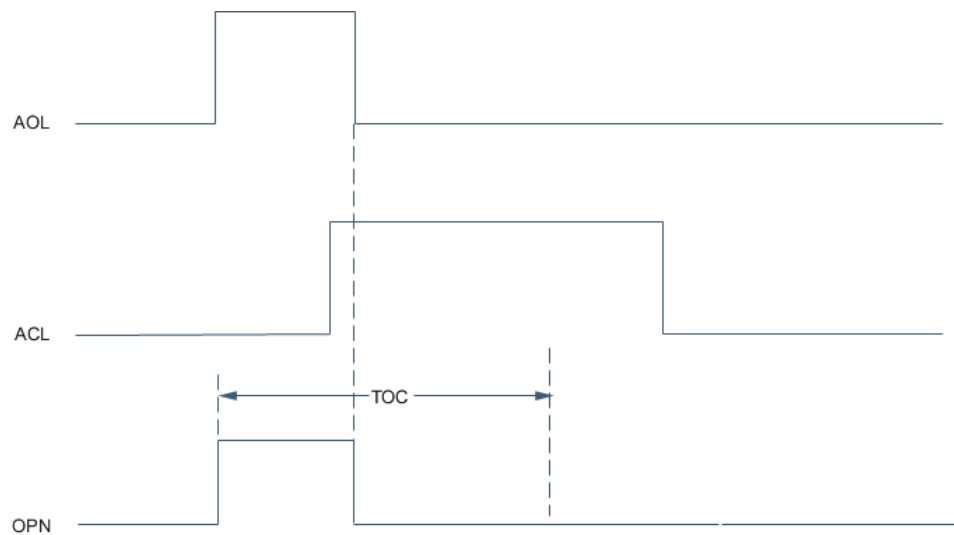


- When OUTTYPE=4, Triple DO short pulse

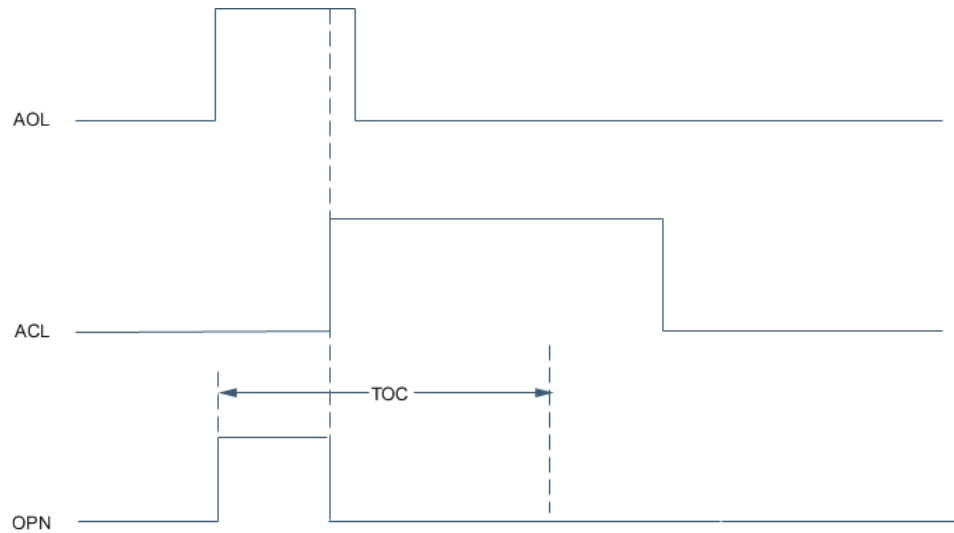


- Response and output reverse command during output.

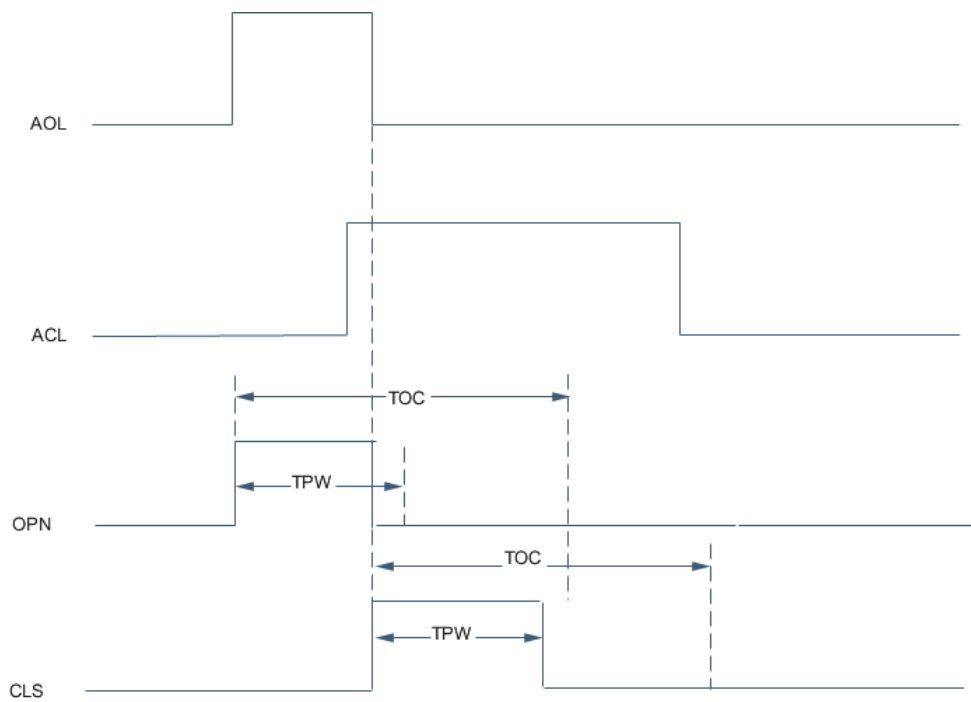
- When OUTTYPE=0, Single DO hold
And the open command prioritized.



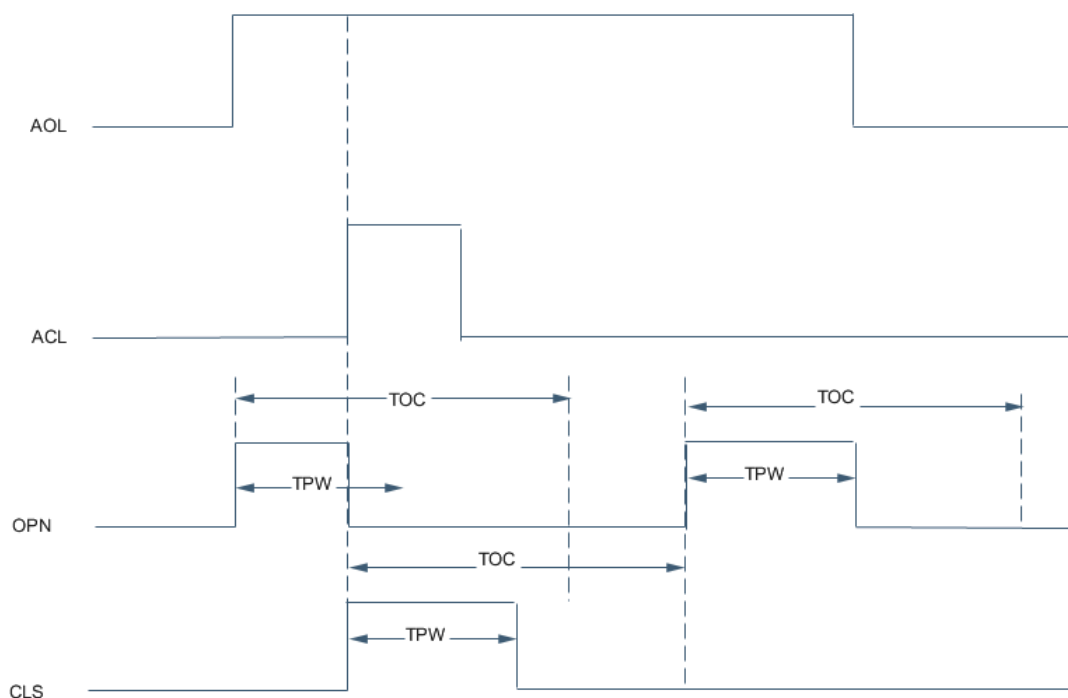
And the close command prioritized.



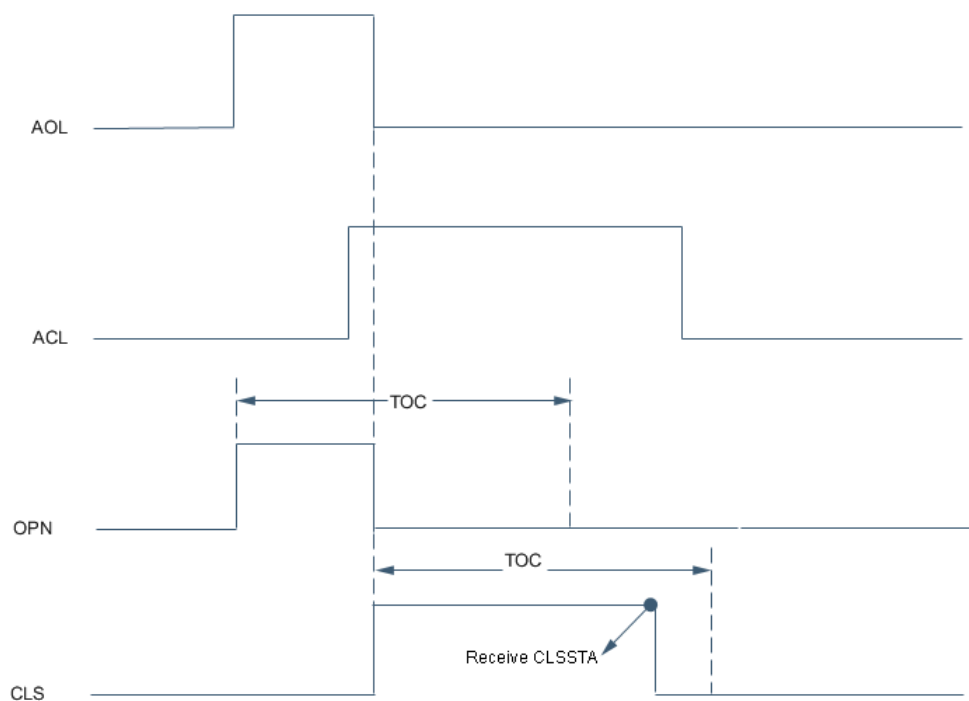
- When OUTTYPE=1, Double DO short pulse
If open command is prioritized.



If close command is prioritized.

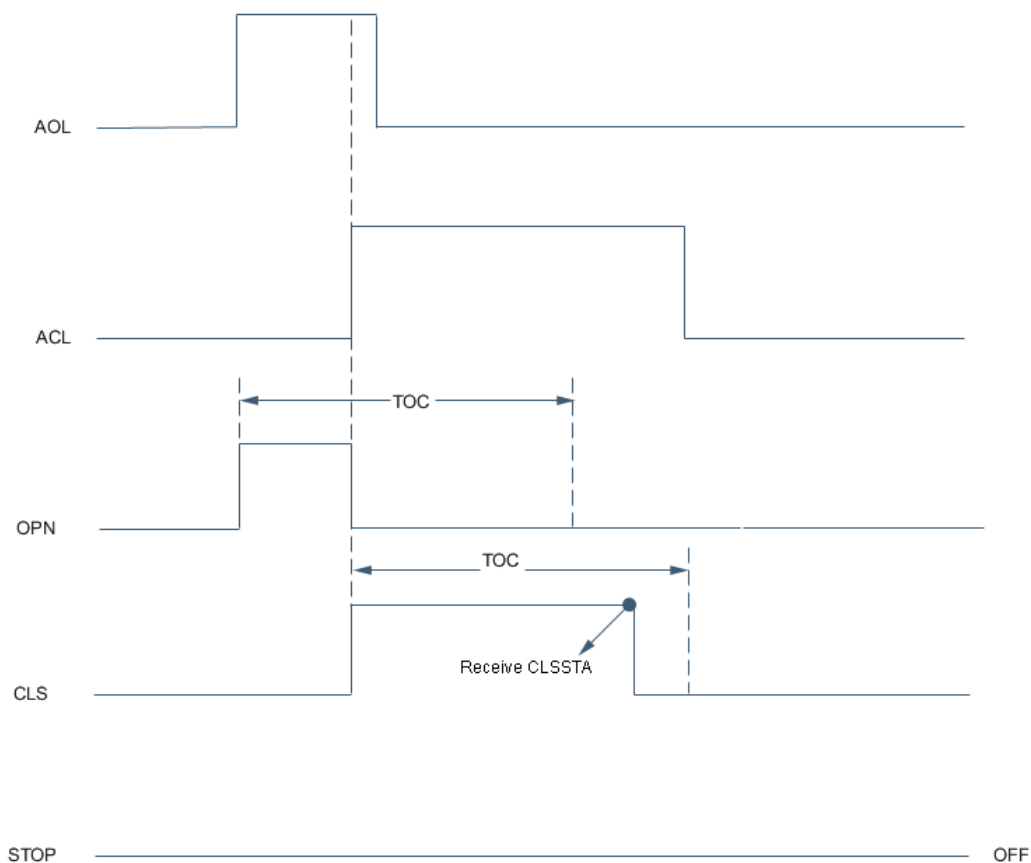


- When OUTTYPE=2, Double DO long pulse including stop command
If open command is prioritized.

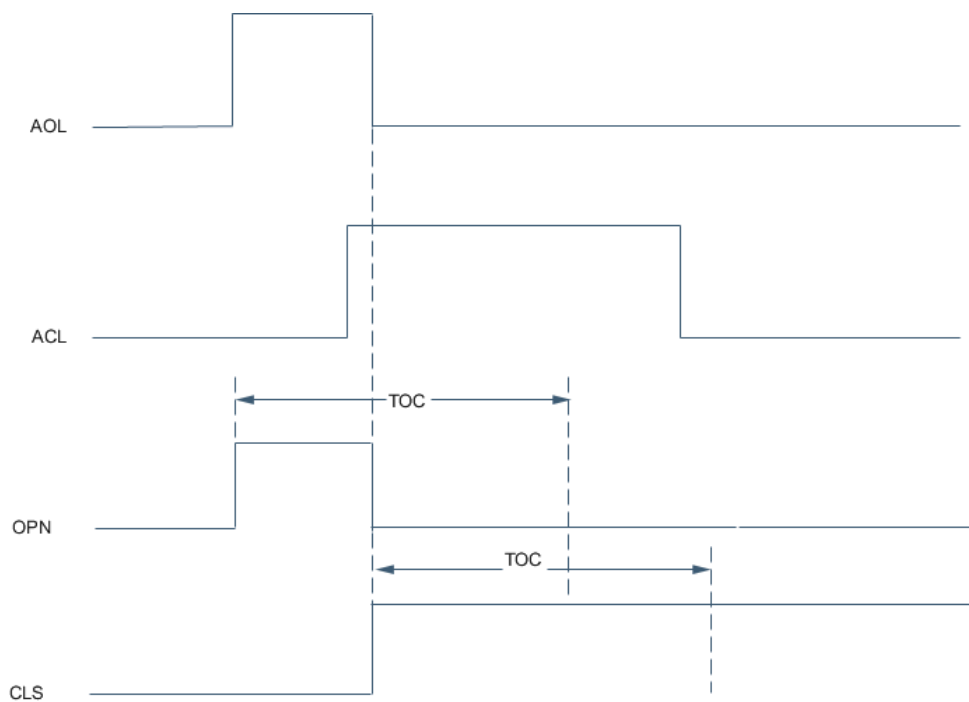


STOP ————— OFF

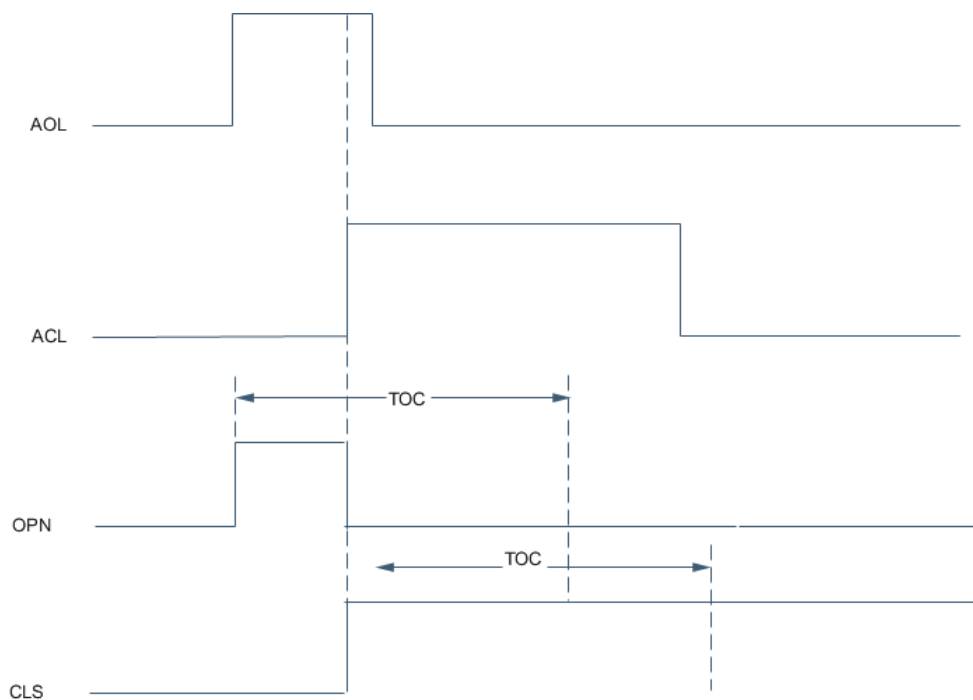
If close command is prioritized.



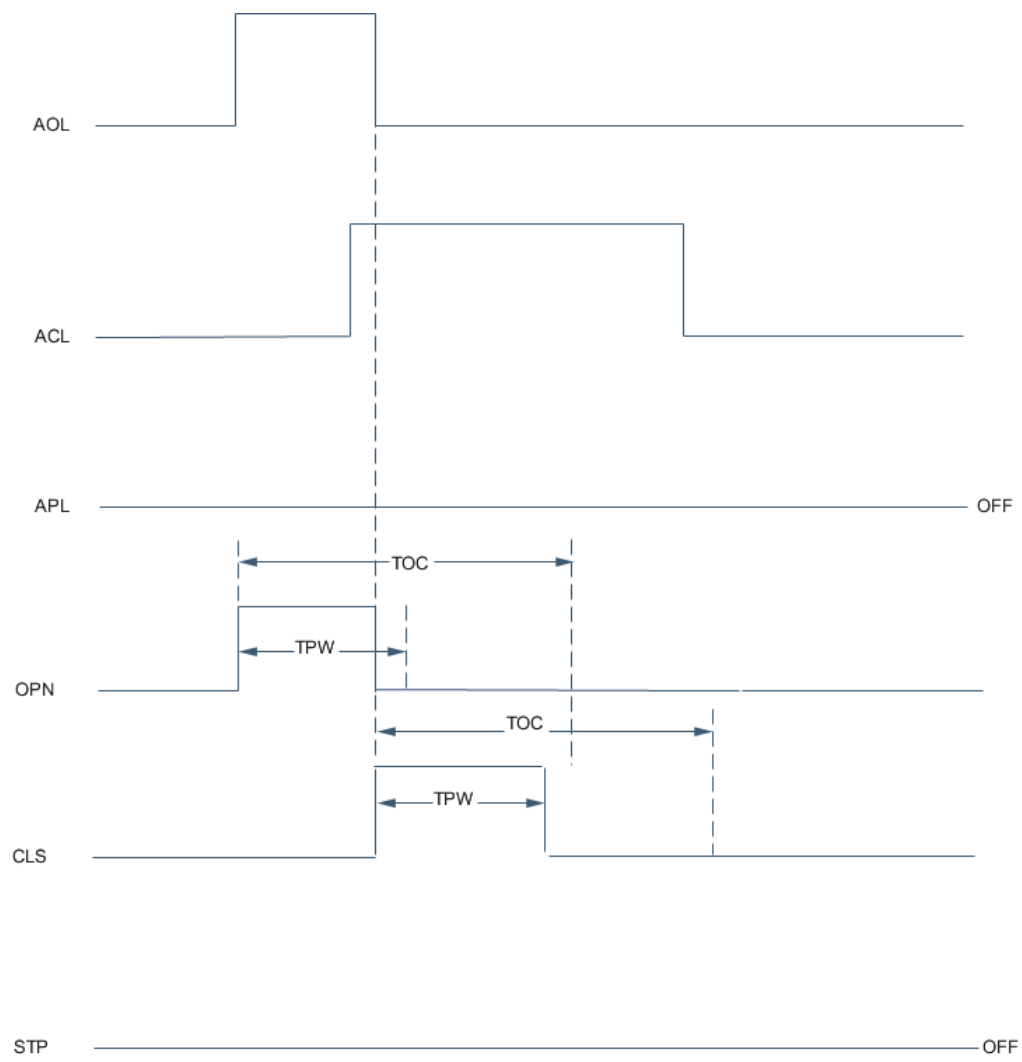
- When OUTTYPE=3, Double DO hold
If close command is prioritized.



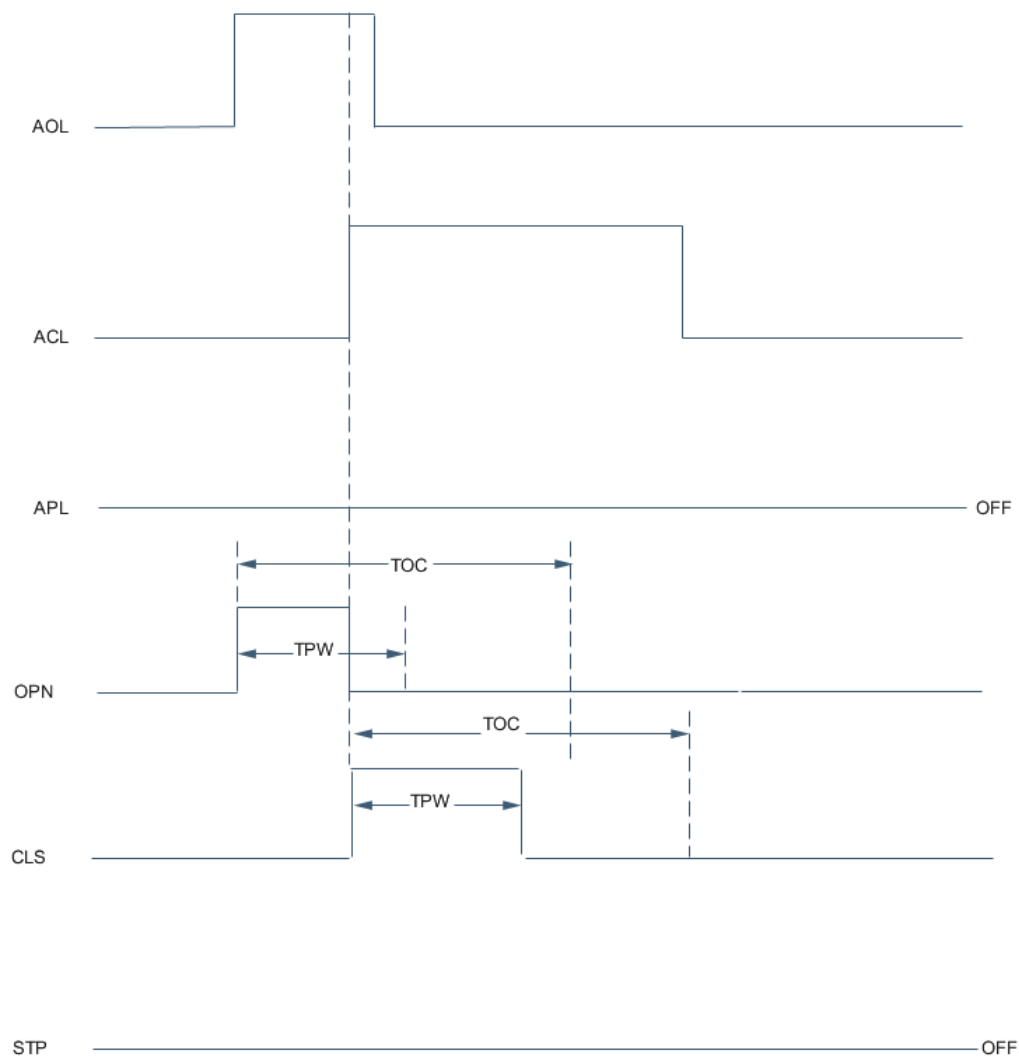
If close command is prioritized.



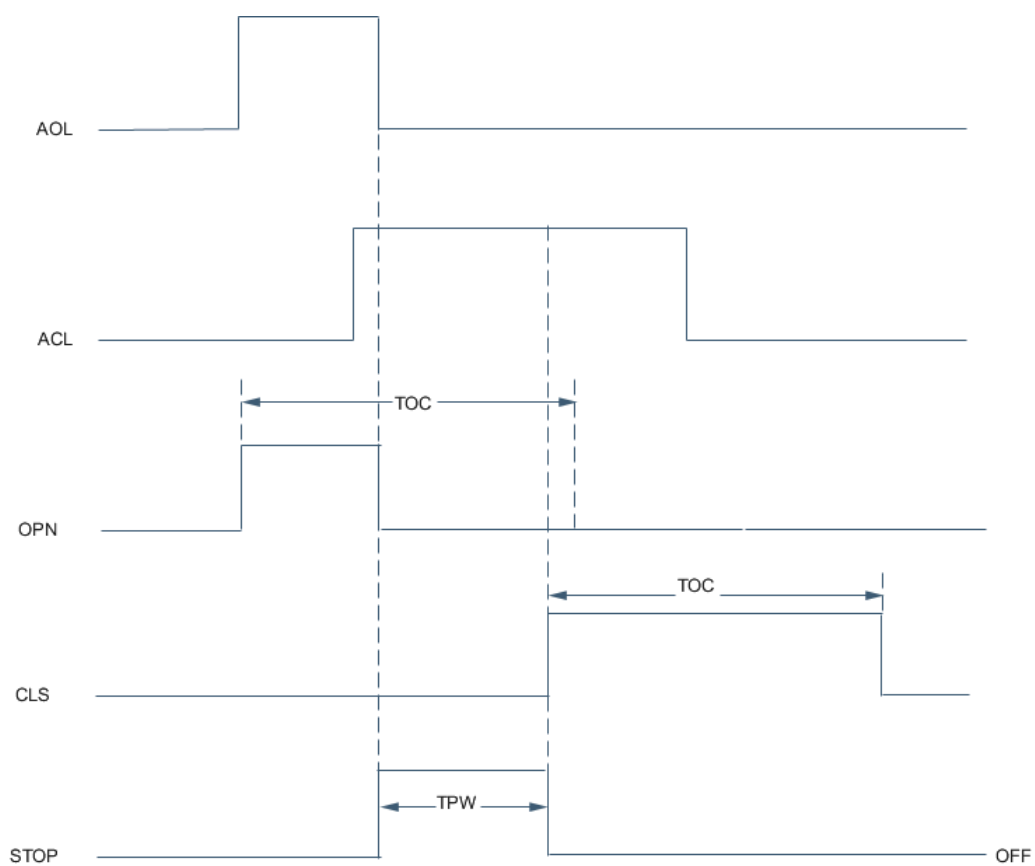
- When OUTTYPE=4, Triple DO short pulse
If open command is prioritized.



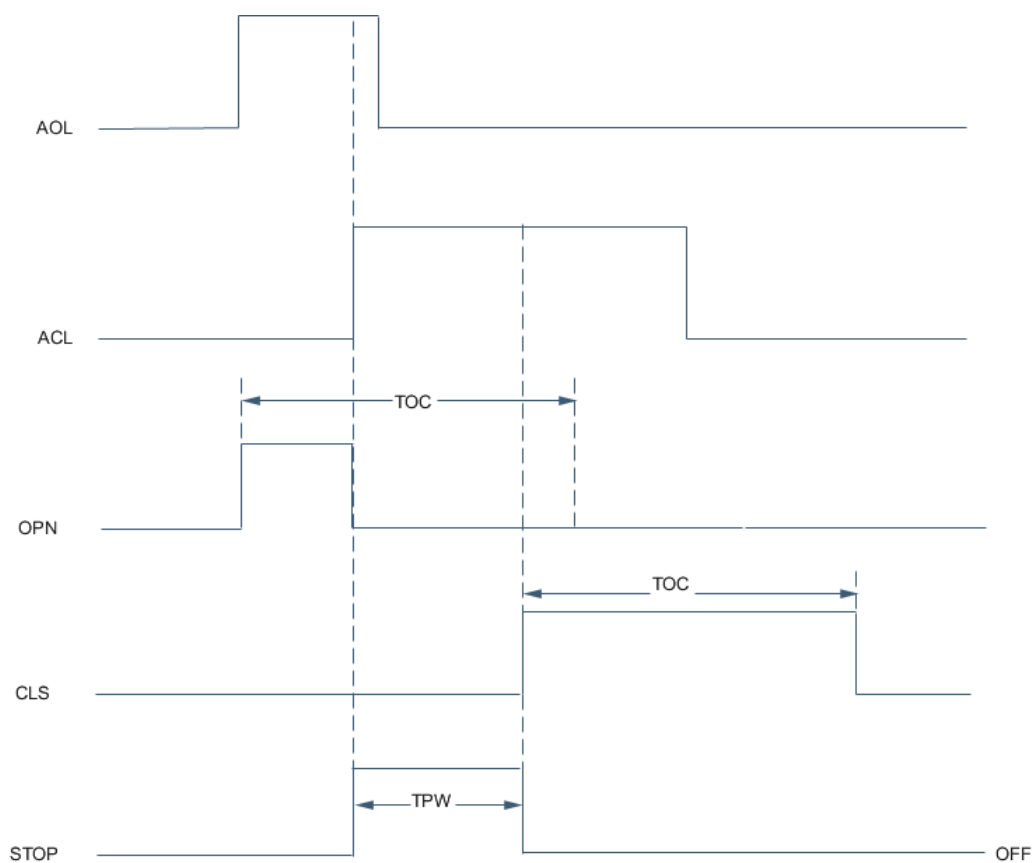
If close command is prioritized.



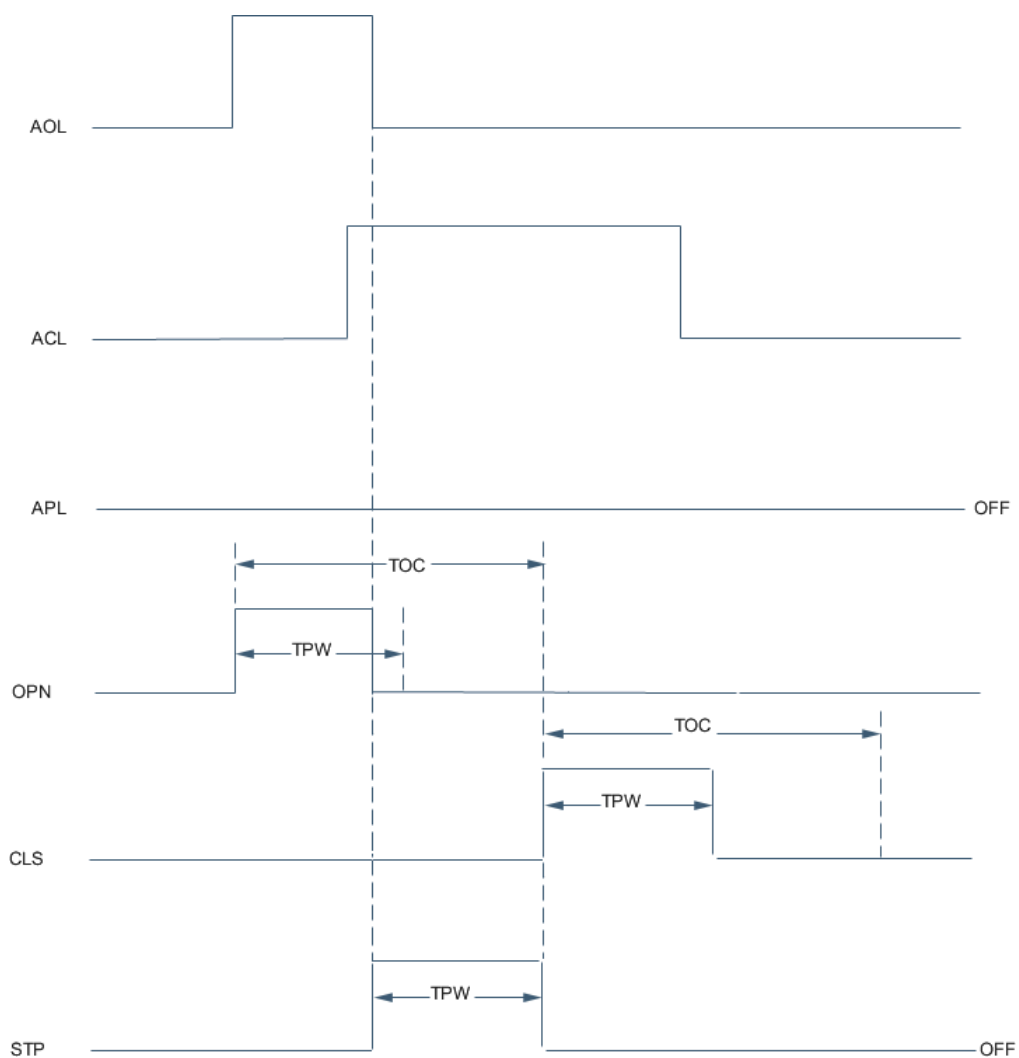
- Response reverse command and output stop command.
 - When OUTTYPE=2, Double DO long pulse including stop command
- If open command is prioritized.



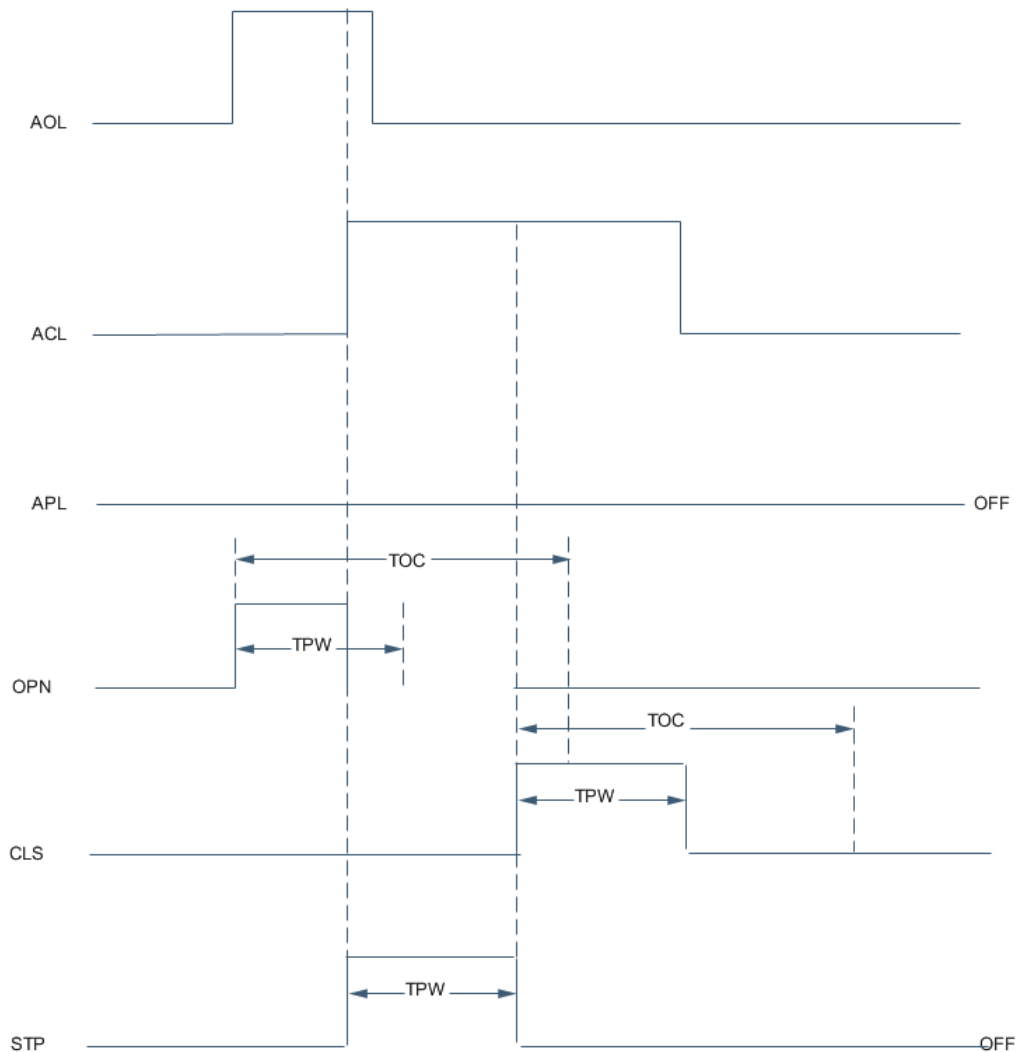
If close command is prioritized.



- When OUTTYPE=4, Triple DO short pulse
If open command is prioritized.



If close command is prioritized.



4.13.6 IGNORSTA

When OUTTYPE= 0, 1 or 2, regardless of the value of IGNORSTA, the output will not be retrigged.

When OUTTYPE= 0, 1 or 2, and IGNORSTA= ON, the output will be retrigged.

4.13.7 Mode

- List Mode

When SWFIX=ON, and the function block will be in SWFIX mod. In the process of open or close, the function block can not switch to the SWFIX mode. After the function block in the SWFIX mode, the command of AOL, ACL, APL, EOL, ECL, POL, PCL, MANOPN, MANCLS and MANSTOP will not be responded as well as interlock.

- **Debug(Force) Mode**
In this mode, only AOL, ACL, APL, MANOPN, MANCLS and MANSTOP can be responded. And the above command will not be limited by RUNPRM, STOPRM, FAIL, TRIP, FAULT and OPFL, as well as interlock.
- **Simulating Mode**
In this mode, all the alarms will not be generated, and the related feedback will be defined by output feedback.
If SWDO=OFF, and the function block will output to DO.
If SWDO=ON, and the function block will not output to DO.
If the function block is in the status of opening or opened, it will not be in simulating mode.
- **OOS(MODE=1)**
When SWOOS=ON, and the function block will be in OOS mode, and no command will be responded, and the output will be holding. When the function block is in the mode of list, debug or simulating, it can not switch to the OOS mode.
- **On-site (MODE=2)**
When the function block is in debug mode, it can not switch to the on-site mode. When TOLOC=ON, the function will switch to the on-site mode.

OUTTYPE=0	The output is decided by the value of TR_LOC. When TR_LOC=ON and the function block has no fault, output the feedback of track. When TR_LOC=ON and the function block has fault, output RUN as OFF. When TR_LOC=OFF, output RUN as OFF.
OUTTYPE=1	Reset the current output.
OUTTYPE=2	Reset the current output.
OUTTYPE=3	The output is decided by the value of TR_LOC. When TR_LOC=ON and the function block has no fault, output the feedback of track. When TR_LOC=ON and the function block has fault, output RUN as OFF. When TR_LOC=OFF, output RUN as OFF.
OUTTYPE=4	Reset the current output.

In the on-site mode,

- The input command will be invalid.
- OPNPRM and CLSPRM will be invalid.
- Do not generate the alarm of OPFL and TRIP, and generate the alarm of FAULT, POWOFF and FAIL.
- **POL/ PLC(MODE=3)**
In the list mode and debug mode, do not response POL command and PCL command.

When POL/PCL=ON, the function block will be in protect mode, and output stop command. POL/PCL is not limited by CLSPRM, feedback signal, alarm and READY.

When POL/PCL changed to OFF, the command of AOL, ACL, APL, EOL, ECL, MANOPN, MANCLS and MANSTOP can be responded.

- Interlock (MODE=4)

In the mode of list and debug, and READY=OFF, EOL and ECL command will not be responded. When EOL=ON or ECL=ON, the function block will be in interlock mode, and the interlock command will be detected by electrical level. The valid of EOL and ECL will be limited by OPNPRM and LCSPRM.

- Manually Stop (MODE=5)

When OUTTYPE=2 or 4, MANSTOP is valid. Otherwise, MANSTOP is invalid. The priority of MANSTOP is more higher than the priority of AOL, ACL, APL, MANOPN and MANCLS.

- MODE=6/7

When the function block is in list mode and READY=OFF, do not response the command of MANOPN, MANCLS, AOL and ACL. When the above status is not happened, the function block can be in the auto mode or manual mode. In the auto mode, the output command is decided by AOL, ACL and APL. In the manual mode, the output command is decided by MANCLS and MANOPN. The command of AOL, ACL, APL, MANCLS and MANOPN is limited by OPNPRM, CLSRM, FAIL, TRIP, OPFL. And TRIP can be shielded by TRIPACK, OPFL can be shielded by OPFLACK. FAIL, TRIP and OPFL can be shielded by IGNORALM.

- Switch between Auto Mode and Manual Mode

When OOS, TOLOC, PCL, ECL and MANSTOP are all not ON, the function block will be in auto mode or manual mode. By the value of FBOPT, SWAM, PSWAM, function block can switch between auto mode and manual mode. When FBOPT=OFF, the mode can be switched on its panel.

When FBOPT=ON, the mode can be switched by PSWAM.

4.13.8 Status Definition

Table 4.40 Status Value List

Status	Value
TP_C	9
TP_O	8
OF_C	7
OF_O	6
CLSFLAG	5

Table 4.40 Status Value List (continued)

Status	Value
OPNFLAG	4
FAIL	3
STACLS	2
STAOPN	1
POWOFF	0
Others	10

4.13.9 Flag

Table 4.41 Flag List

Flag	Alarm	Description
D0	OOS	Disable
D1	LOC	On-site
D2	PROTECT	Protect
D3	EMOPN	Interlock Open
D4	EMCLS	Interlock Close
D5	MANSTOP	Manual Stop
D6	MAN	Manual
D7	AUTO	Auto
D8	POWOFF	Power-OFF Alarm
D9	OF_O	Close failed
D10	FAULT	Electric Fault
D11	FAIL	Feedback Fault
D12	STAOPN	Devices All Open
D13	STACLS	Devices All Closed
D14	STAPAUSE	Device Middle Stop
D16	OPNPRO	Open Instruction Output Process
D17	CLSPRO	Close Instruction Output Process
D18	STOPRO	Stop Instruction Output Process

Table 4.41 Flag List (continued)

Flag	Alarm	Description
D19	EMOPNCON	Interlock Open Condition
D20	EMCLSCON	Interlock Close Condition
D21	AOF	Suppress Alarm
D22	FIX	FIX
D23	MANOPN	Manual Open
D24	MANCLS	Manual Close
D26	FORCE	Force
D27	SIMUL	Simulation
D28	TP_C	Abnormal Close
D29	TP_O	Abnormal Open
D30	OF_C	Close Failed

4.13.10 Panel Parameter

Panel of VALVE_EX is shown as below.

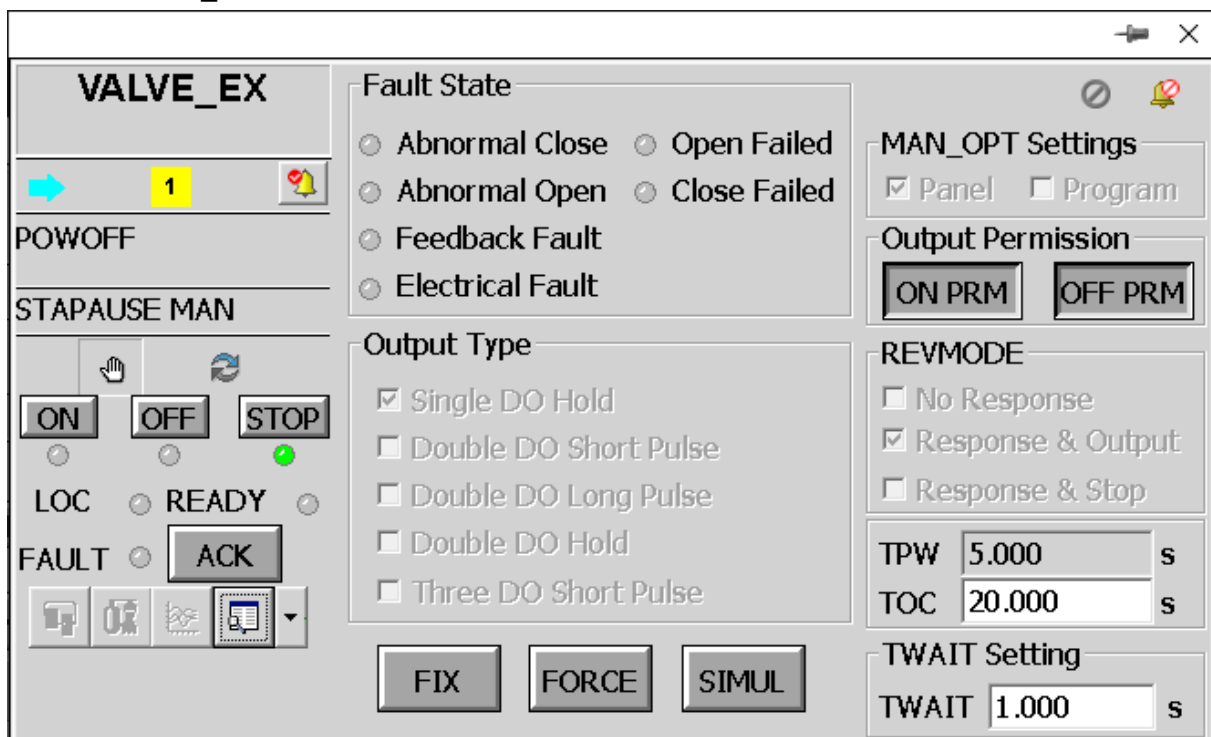
**Figure 4.30 VALVE_EX Panel**

Table 4.42 VALVE_EX Panel Parameter

Panel Parameter		Function Block Parameter	Initial Value	Value Range	Application Instruction
Fault State	Abnormal Close	TP_O	-	-	-
	Abnormal Open	TP_C	-	-	-
	Open Failed	OF_O	-	-	-
	Close Failed	OF_C	-	-	-
	Feedback Fault	POWOFF	-	-	-
	Electrical Fault	FAIL	-	-	-
Output Type	Single DO Hold	OUTTYPE	1	[0,4]	OUTTYPE=0
	Double DO Short Pluse	OUTTYPE	1	[0,4]	OUTTYPE=1
	Double DO Long Pulse	OUTTYPE	1	[0,4]	OUTTYPE=2
	Double DO Hold	OUTTYPE	1	[0,4]	OUTTYPE=3
	Three DO Short Pulse	OUTTYPE	1	[0,4]	OUTTYPE=4
MAN_ OP Set- tings	Panel	FBOPT	√	ON/OFF	Read only, and FBOPT is set in FBD parameter. And when FBOPT=OFF, the manual/auto control source can be selected on panel.
	Program	FBOPT	-	ON/OFF	Read only, and FBOPT is set in FBD parameter. And when FBOPT=ON, the manual/auto control source can be selected in program.
Output Permis- sion	ON PRM	OPNPRM	-	ON/OFF	Signal of open command permitWhen OPNPRM=ON, EOL, AOL and MANOPN can output.
	OFF PRM	CLSPRM	-	ON/OFF	Signal of close command permitWhen CLSPRM=ON, ECL, ACL and MANCLS can output.
REVMODE	Response & Output	REVTYPE	-	-	REVTYPE = 1
	Response & Stop	REVTYPE	-	-	REVTYPE = 2

Table 4.42 VALVE_EX Panel Parameter (continued)

Panel Parameter		Function Block Parameter	Initial Value	Value Range	Application Instruction
	No Response	REVTYPE	-	-	REVTYPE = 0
TPW		TPW	5.000	≥0	When single pulse and pulse list are output, define the width of high level of output pulse.
TOC		TOC	20.000	≥0	When the command is output and corresponding output feedback after TOC time, operation fault OPFL appears.
TWAIT Setting	Time(s)	TWAIT	1.000	≥0	Read only, Interval of Button Pop-Up, Set in the parameter Properties.
Button	ON	MANOPN	-	-	Manual Open Command
	OFF	MANCLS	-	-	Manual Close Command
	STOP	MANSTOP	-	-	Manual Stop Command
	ACK	ACK	-	-	Acknowledgement Signal
	FIX	SWFIX	-	-	Click this button, FBD will work in Listing mode.
	FORCE	SWTST	-	-	Click this button, FBD will work in debugging status.
	SIMUL	SWSIM	-	-	Click this button, FBD will work in simulating status.

4.14 Two Outputs Balance Control Function Block (BALANCE)

In double- execution institution system, two control stations can be in auto mode. Automatically control signals control corresponding execution institution through corresponding control station and two institutions and assistant equipments change under the control of automatically control signals.

When one side of institution cannot generate the equivalent force of another one as some fault, proper operation will reduce control output of default side and the other side will compensate the reduced force. That will reduce interfere to the process.

The balance control function block realizes its function with manual operator function block together.

BALANCE function block is complex function block, and its running time is 10μs.



4.14.1 Parameter Description

Table 4.43 Two outputs balance control function block parameter description

Name			Description	Upload	Properties	Application Reference
Basic Parameters	Output Limits	MVH1	Output A HighLimit	TRUE	Operation Parameter	Value range is [SCL, SCH].
		MVL1	Output A LowLimit	TRUE	Operation Parameter	Value range is [SCL,SCH]
		MVH2	Output B HighLimit	TRUE	Operation Parameter	Value range is [SCL,SCH]
		MVL2	Output B LowLimit	TRUE	Operation Parameter	Value range is [SCL,SCH]
	Range Settings	SCH	Range High Limit	-	Configuration Parameter	-
		SCL	Range Low Limit	-	Configuration Parameter	-
		EU	Engineering Unit	-	Configuration Parameter	-
		CSVLEN	CSV Decimal Digits [0,5]	-	Configuration Parameter	Display Decimal Digits of the input in the panel, and the default value is 3.
		MVDLEN	MV Decimal Digits [0,5]	-	Configuration Parameter	Display Decimal Digits of the input in the panel, and the default value is 3.
	Extended Parameter	Input Pin	CSV	Balance Input Value	-	Input Pin

Table 4.43 Two outputs balance control function block parameter description (continued)

Name			Description	Upload	Properties	Application Reference
		SWTR1	Output A Track Switch (ON=Tracking)	-	Input Pin	Connect to BKOUTERR of the MANUAL function block A.
		TV1	Track Input Value A	-	Input Pin	Connect to BKOUTERR of the MANUAL function block A.
		SWTR2	Track Switch for Output B (ON=Tracking)	-	Input Pin	Connect to BKOUTERR of the MANUAL function block B.
		TV2	Track Input Value B	-	Input Pin	Connect to BKOUTERR of the MANUAL function block B.
	Output Pin	MV1	Output A.Connects input terminal of A manual operator function block [MVL1, MVH1].	-	Output Pin	When SWTR1=ON and SWTR2=ON then MV1=TV1 and MV2=TV2.When SWTR1=ON and SWTR2=OFF, then MV1=TV1 and MV2=2CSV – MV1.When SWTR1=OFF and SWTR2=ON, then MV1=2CSV – MV2 and MV2=TV2.When SWTR1=OFF and SWTR2=OFF, then MV1=CSV + BIAS and MV2=CSV – BIAS.
		MV2	OutputB connects input terminal of B manual operator function block [MVL1, MVH1].	-	Output Pin	
		BKOUT	Feedback Output	-	Output Pin	Connect to BKIN of up-

Table 4.43 Two outputs balance control function block parameter description (continued)

Name			Description	Upload	Properties	Application Reference
						per function block. When SWTR1= ON and SWTR2=ON, then BKOUT= (TV1+TV2)/2. Else BKOUT=CSV.
		BKOUTERR	Output Feed-back Status	-	Output Pin	Connect to BKIN of upper function block. When SWTR1= ON SWTR2=ON, then BKOUT= (TV1+TV2)/2. Else BKOUT=CSV.
	OOS SETTINGS	SWOOS	In the OOS Status (ON=Prohibited)	TRUE	Operation Parameter	-
	Alarm Enabled and Suppress	AOF	Suppress Module Alarm	TRUE	Operation Parameter	-
	Parameter Settings	BIAS	Man-Set Biasing Value	-	Operation Parameter	-
	Extend Range Settings	HORLIM	Expand Range High Limit	-	Configuration Parameter	-
		LORLIM	Expand Range Low Limit	-	Configuration Parameter	-
	Change Rate Limit	DMVLIM1	Per second-change rate limit of Output A	-	Configuration Parameter	-
		DMVLIM2	Per second-change rate limit of Output B	-	Configuration Parameter	-
	Alarm Enabled	ENALM	Alarm Enabled	-	Configuration Parameter	-

4.14.2 Panel Parameter

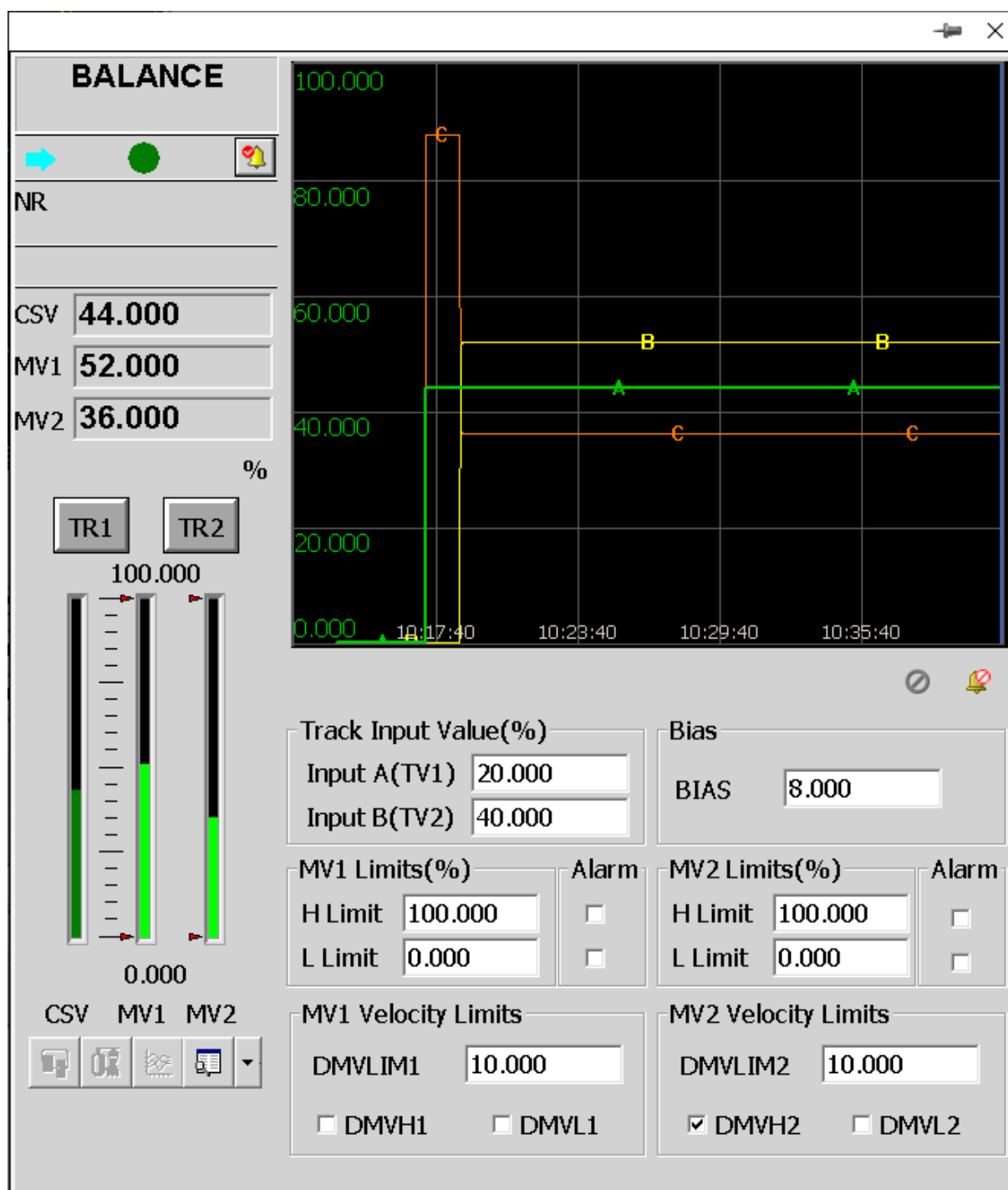


Table 4.44 panel parameter instruction

Panel Parameter Name		Function Block Parameter Name	Initial Value	Value Range	Application Instruction
Track Input Value	Input A(TV1)	TV1	0.0000	-	-
	Input B(TV2)	TV2	0.0000	-	-
BIAS	BIAS	BIAS	0.0000	-	-

Table 4.44 panel parameter instruction (continued)

Panel Parameter Name		Function Block Parameter Name	Initial Value	Value Range	Application Instruction
MV1 Limits	MVH1	MVH1	100.0000	[SCL,SCH]	-
	MVL1	MVL1	0.0000	[SCL,SCH]	-
MV2 Limits	MVH2	MVH2	100.0000	[SCL,SCH]	-
	MVL2	MVL2	0.0000	[SCL,SCH]	-
MV1 Velocity	DMVLIM1	DMVLIM1	0.00	-	-
MV2 Velocity	DMVLIM2	DMVLIM2	0.00	-	-

4.14.3 Flag

Table 4.45 Flag list

Flag	Alarm	Instruction
D0	OOS	Disable
D1	AOF	Suppress Alarm
D2	TR1	Input1 Track
D3	TR2	Input2 Track
D4	MVH1	Output 1 H Limit Alarm
D5	MVL1	Output 1 L Limit Alarm
D6	MVH2	Output 2 H Limit Alarm
D7	MVL2	Output 2 L Limit Alarm
D8	DMVH1	Output A change rate high limit alarm
D9	DMVL1	Output A change rate low limit alarm
D10	DMVH2	Output B change rate high limit alarm
D11	DMVL2	Output B change rate low limit alarm

4.14.4 Function Illustration

Process of BIAS

- When SWTR1=ON and SWTR2=ON, input 1 and input 2 are both in tracking status. BIAS can't be changed.
- When SWTR1=OFF and SWTR2=ON, input 1 and input 2 are all in auto status. BIAS can be set a more that 0, less than CSV and positive integer.
- When one input is in auto status or two inputs are both in auto status, BIAS can't be changed. BIAS will be assigned as the deviation of the two input, when one input or two input is in the auto status.

Process of Output

- When SWTR1= OFF and SWTR2= OFF, input1 and input2 are aboth in auto status .
 $MV1 = CSV + BIAS$
 $MV2 = CSV - BIAS$
 The change rate of MV1 and MV2 are limited. If you want to MV1, MV2 to output corresponding values, you need to set DMVLIM1 and DMVLIM2 as one non-zero positive integer.
- When SWTR1=ON and SWTR2=OFF, input1 is in the tracking status, and input2 is in the auto status.
 $MV1 = TV1$
 $BIAS = MV1 - CSV$
 $MV2 = CSV - BIAS$
 The change rate of MV2 is limited. If you want to MV2 to output corresponding values, you need to set DMVLIM2 as one non-zero positive integer.
- When SWTR1= OFF and SWTR2= ON, input1 is in the auto status, and the input2 is in the tracking status.
 $MV2 = TV2$
 $BIAS = CSV - MV2$
 $MV1 = CSV + BIAS$
 The change rate of MV1 is limited. If you want to MV1 to output corresponding values, you need to set DMVLIM1 as one non-zero positive integer.
- Input1 and input2 are both in the tracking status.
 $MV1 = TV1$
 $MV2 = TV2$
 $BIAS = (TV1 - TV2) / 2$

4.15 Single DI/DO Start/Stop Control Function Block (DIO-11M)

There are two motor valve control function blocks in the system, which are the MOTOR function block which mainly controls the motor and the VALVE function block which mainly controls the valve. The motor function block is mainly to realize the basic start-stop control and interlock protection of the equipment.

DIO-11M function block enables control and interlock protect to single DI feedback/ single DO output equipment by last level sequence control command or operator by panel.

DIO-11M function block is complex function block, and its running time is 20μs.

4.15.1 Parameter Description

Table 4.46 Single DI/DO Start/Stop Control Function Block parameter instruction

Name			Description	Upload	Properties	Application Reference
Basic Parameters	Mode Setting	TOC	Device Runtime (Unit: s)	TRUE	Operation Parameter	-
		OPFLACK	Whether to Confirm Running Fault (ON=True) When OPFLACK=ON and the running fault should be confirmed. And the running fault will be the limit of inputting new command of manual command, and it will be invalid to the interlock command.	TRUE	Operation Parameter	-
		AUTOCLR	Whether to Eliminate Operation Failure Auto (ON=Auto)	TRUE	Operation Parameter	-
		IGNORSTA	Output Command Ignore Feedback (OFF=NO)	TRUE	Operation Parameter	-
		SAFE_OPT	Output Safety Mode Selection (OFF=Not Reset Output, ON=Reset Output)	TRUE	Operation Parameter	-

Table 4.46 Single DI/DO Start/Stop Control Function Block parameter instruction (continued)

Name			Description	Upload	Properties	Application Reference
		PCMD_OPT	PCMD mode(OFF=level trigger, ON=edge trigger)	TRUE	Operation Parameter	-
Extended Parameters	Input Pin	ACK	Status Feedback (ON=Run OFF=Stop)	-	Input Pin	Measuring Point DI
		PCMD	Command Input (ON=Start OFF=Stop)	-	Input Pin	Upstream Output
		EMSTART	Interlock Startup Command	-	Input Pin	Upstream Interlock InputWhen EMSTART=ON, it will be shown in the process alarm.
		EMSTOP	Interlock Stop Command	-	Input Pin	Upstream Interlock InputWhen EMSTOP=ON, it will be shown in the process alarm.
		PSWAM	Program Manual and Auto Control Digital Input	-	Input Pin	Upstream Output
		RUNPRM	Start Command Enable Signal	-	Input Pin	Upstream Output
		STOPRM	Stop Command Enable Signal	-	Input Pin	Upstream Output
		FBOPT	Manual-automatic Control Source Switch(OFF=Panel)	-	Input Pin	Upstream Output
		PACK	Program Failure Confirm	-	Input Pin	Upstream Output
	Output Pin	DRIVE	Driver Output	-	Output Pin	Output DO
	Alarm Enabled and Suppress	AOF	Suppress Module Alarm	TRUE	Operation Parameter	-
		ENALM	Alarm Enable	TRUE	Operation Parameter	-
		FLAG	Flag	-	Output Parameter	-

Table 4.46 Single DI/DO Start/Stop Control Function Block parameter instruction (continued)

Name			Description	Upload	Properties	Application Reference
	OOS SET-TINGS	SWOOS	In OOS Status (ON=Prohibited)	TRUE	Operation Parameter	-
	Operation Parameter	MCMD	Manual Command(ON=Start OFF=Stop)	-	Operation Parameter	-
		SWAM	Manual-automatic Switch(ON=Auto OFF=Manual)	-	Operation Parameter	-
		MACK	Manual Confirm	-	Operation Parameter	-
	Status	OPFL	Running Fault (ON=Fault)	-	Monitoring Parameter	-
		STARUN	Device Running Status Indication(ON=Run)	-	Monitoring Parameter	-
		STASTOP	Device Stop Status Indication(ON=Prohibited)	-	Monitoring Parameter	-
		MODE	Device Mode(Observe)	-	Monitoring Parameter	-
		RUNFLAG	Startup Command Output Process(Observe)	-	Monitoring Parameter	-
		STOPFLAG	Stop Command Output Process(Observe)	-	Monitoring Parameter	-

Table 4.47 Macro parameter illustration

Macro Parameter	Initial Value	Description
MCMD_ON	Custom, corresponding to the "start" button on the function block panel	Users can redefine the description of the manual start command.
MCMD_OFF	Custom, corresponding to the "stop" button on the function block panel	Users can redefine the description of the manual stop command.
RUNPRM	Custom, corresponding to the "ON PRM" button on the function block panel	Users can redefine the description of the start command permission signal.
STOPRM	Custom, corresponding to the "OFF PRM" button on the function block panel	Users can redefine the description of the stop command permission signal.

4.15.2 Work Flow

Input command process

The DIO-11M function block has the following four device modes arranged by priority: operation stop, interlock, manual and automatic. The following table describes the corresponding conditions when the function block enters different modes, and the validity check of input commands in different modes.

Table 4.48 Input command validity check

MODE	Condition	Input command validity check (output command trigger condition)
Computing stop(MODE= 1)	SWOOS= ON	Output remains, don't respond to each input command;
Interlock(MODE= 4)	SWOOS= OFF, EMSTART= ON or EMSTOP= ON	DRIVE= ON: EMSTART= OFF→ON(RUNPRM= ON); DRIVE= OFF: EMSTOP= OFF→ON(STOPRM= ON);
Manual(MODE= 5)	SWOOS= OFF, EMSTART= OFF and EMSTOP= OFF, SWAM= OFF	DRIVE= ON: 1) MCMD= OFF→ON(RUNPRM= ON,OPFL= OFF); 2) MCMD= OFF→ON(RUNPRM= ON,OPFLACK= OFF); DRIVE=OFF: 1) MCMD= ON→OFF(STOPRM= ON,OPFL= OFF); 2) MCMD= ON→OFF(STOPRM= ON,OPFLACK= OFF);
Auto(MODE= 6)	SWOOS= OFF, EMOPN= OFF and EMCLS= OFF, SWAM= ON	DRIVE=ON: 1) PCMD= OFF→ON(RUNPRM= ON,OPFL= OFF); 2) PCMD= OFF→ON(RUNPRM= ON,OPFLACK= OFF); DRIVE=OFF: 1) PCMD= ON→OFF(STOPRM= ON,OPFL= OFF); 2) PCMD= ON→OFF(STOPRM= ON,OPFLACK= OFF);

The following is a supplementary description of each working mode.

Note 1: Interlock

- If the interlocking start command is triggered first and the interlocking stop command is triggered within the effective time of the interlocking start, the interlocking start command will be executed first, and the interlocking stop command will be executed immediately after the interlocking stop command is triggered.

- If the interlock stop command is triggered first and the interlock start command is triggered within the effective time of the interlock stop, the interlock stop command will be executed first, and the interlock start command will be executed immediately after the interlock start command is triggered.

**ATTENTION:**

The valid time refers to the transition time from ON to OFF of interlock start/ stop commands.

Note 2: Manually automatic

- If the interlocking start EMSTART is continuously ON, the manual stop and automatic stop commands are invalid.
- If the interlock stop EMSTOP is continuously ON, the manual start and automatic start commands are invalid.

Note 3: Automatic switching by hand

- It can be automatically switched by FBOPT, SWAM, PSWAM.
- The function block defaults to SWAM=OFF, which is manual mode. On the contrary, when SWAM=ON is set, the function block is in automatic mode.
- When FBOPT=OFF, the manual automatic switching can be determined by the manual automatic button on the panel, and the SWAM status is synchronized with the manual or automatic status on the function block panel.
- When FBOPT=ON, the manual automatic switch is determined by the program input PSWAM, and the SWAM manual automatic switch is invalid. At this time, when PSWAM=OFF, it means that the program control is in manual mode, and the panel can be operated manually. When PSWAM=ON, the program control is automatic mode.

4.15.3 Fault Diagnosis and Solution

The function block has operation failure alarm OPFL and interlocking dual-input failure alarm DBEMCMD. The operation failure OPEL can be shielded by the OPFLACK parameter. The alarm detection in each mode is shown in the table below:

Table 4.49 Alarm detection in each mode

MODE	Alarm
Computing stop	It won't generate any alarm.
Interlock	If EMSTART= ON and EMSTOP= ON, it doesn't respond the interlco command, and generates DBEMCMD alarm. For the generation of operating fault, refer to OPFL.

Table 4.49 Alarm detection in each mode (continued)

MODE	Alarm
Manual	The generation of operating fault alarm, refer to OPFL
Auto	

OPFL

- Alarm generation
After the output command is issued, if the corresponding feedback signal is not received within the travel time TOC, the operation failure alarm OPFL is set.
- Acknowledgement and elimination of alarms
When an operation failure occurs, the alarm can be eliminated through the panel "Alarm Elimination", or the program can input the confirmation signal PACK to eliminate the alarm.
Set AUTOCLR= ON, when the operation failure alarm OPFL is generated, if the status feedback signal is restored, the OPFL alarm will be automatically eliminated.
Set AUTOCLR= OFF, when the operation failure alarm OPFL is generated, even after the status feedback signal is restored, the OPFL alarm still needs to be confirmed by the panel before it can be eliminated.
- Restrictions on input commands
If OPFLACK= OFF is set, the operation fault does not need to be confirmed, and it is not used as a restriction condition for new command input.
Set OPFLACK= ON, the operation failure needs to be confirmed, which is one of the restrictive conditions of the new command input, the opponent's automatic command is valid, and the interlock command is invalid.
- Impact on output commands
When SAFE_OPT= ON, an operation failure alarm OPEL is generated, and DRIVE= OFF is output.

4.15.4 Panel Parameter

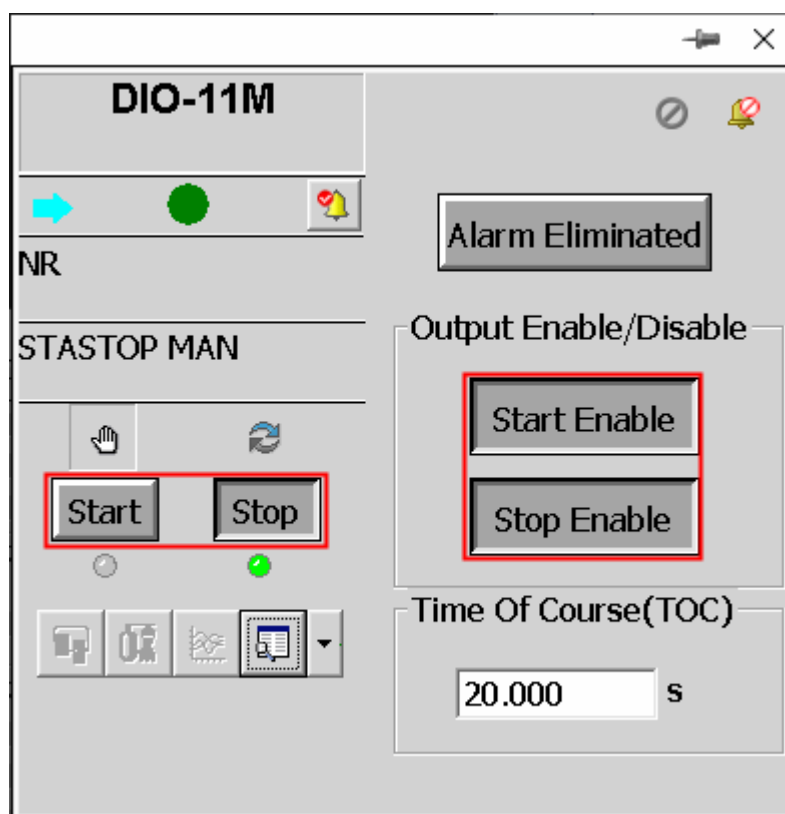


Figure 4.31 Panel of "DIO-11M"

As shown in the figure above, the button names in the red box can be modified in the macro parameters in the function blocks, the maximum length is from 0 to 64 characters (including Chinese characters, English letters, numbers and special characters). If users don't modify the button names, the panel will display the default name. When the custom length exceeds the regulated display length, the custom description will not be completely displayed, but rather displayed in the regulated display length.

The indicator under the button "Start" and button "Stop" is used to indicate the status of the button.

- If the value of button is "ON", the indicator will be green.
- If the value of button is "OFF" or the communication bad, the indicator will be gray.

Table 4.50 Table 4-50 Panel Parameter Instruction

Panel Parameter Name		Parameter Name	Initial Value	Value Range	Application Instruction
Alarm Eliminated		PACK	OFF	-	Eliminate the running alarm by panel or program input signal PACK.
Output Enable/Disable	Start Enable	RUNPRM	ON	-	-
	Stop Enable	STOPRM	ON	-	-

Table 4.50 Table 4-50 Panel Parameter Instruction (continued)

Panel Parameter Name	Parameter Name	Initial Value	Value Range	Application Instruction
Time of Course(s)	TOC	20.0000	-	-

4.15.5 Flag

Table 4.51 Flag list

Flag	Alarm	Description
D0	OOS	Disable
D3	EMRUN	Interlock Startup
D4	EMSTOP	Interlock Stop
D5	MAN	Manual
D6	AUTO	Auto
D9	OPFL	Running Fault
D11	STARUN	Device Running Status
D12	STASTOP	Device Stop Status
D14	RUNPRO	Start Instruction Output Process
D15	STOPRO	Stop Instruction Output Process
D18	AOF	Suppress Alarm
D24	DBEMCMD	Interlock Double Input Fault
D27	EM	EM Status

4.15.6 Application Example

To achieve the field-pump transducer start and stop control as shown in the figure below, and can be operated on flow chart. When pump running fault (if after running time, the status feedback and control output are different, open the running fault alarm) occurs, no need to acknowledge. When pump trip occurs, acknowledge first and execute other operation.

One DI one DO pump refers to that the on, off and stop of filed pump device is controlled by one DO signal, the pump status is shown by dual-DI signal feedbacks. It is often used to control start and stop of pump transducer.

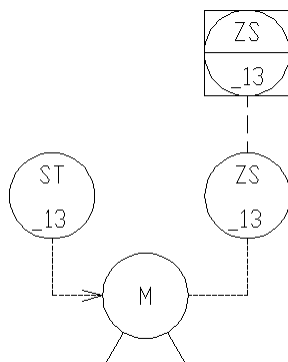


Figure 4.32 One DI One DO Pump

Details of program are shown below. It applies DIO-11M function block, and the upper computer interface can control DO via function block tag.

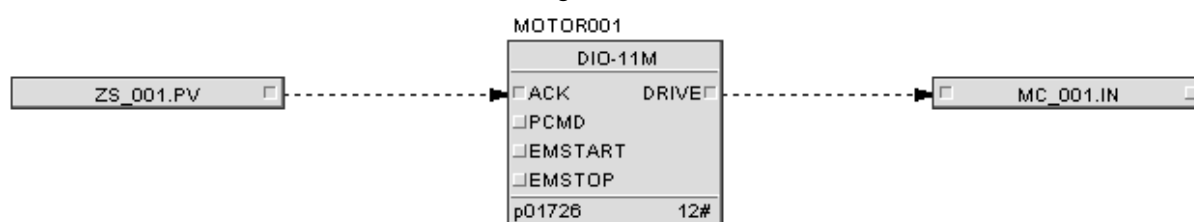


Figure 4.33 Program of One DI One DO Pump

Function block and example instructions are shown in the table below:

Table 4.52 Function Block and Example Instruction

O.	Example	Type	Instruction	Remark
001	ZS_001	DI Input	Frequency Conversion Feedback	
002	MC_001	DO Output	Frequency Conversion Control	
006	MOTOR001	Function Block Tag	Function Block Tag of Frequency Conversion	Supervision Tag

Parameter settings of DIO-11M:

- BOPT: ON
- PSWAM: OFF
- OPFLACK: OFF
- AUTOCLR: ON
- TRIPACK: OFF
- IGNORSTA: ON
- SAFE_OPT: OFF

Note: the settings of FBOPT and PSWAM can avoid wrong operation for Auto button on the panel. Other settings should be applied for auto control.

Alarm Settings:

- OPFL (running fault) alarm, when the status feedback of function block is different with its output, OPFL outputs alarm (OPFL=ON);
- If SAFE_OPT=ON, OPFL (running fault) alarm generates, and function block DRIVE=OFF;

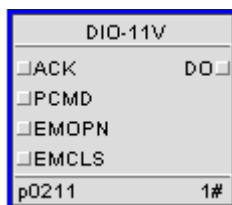
Note: whether to acknowledge fault is determined by the settings of operation parameter OPFLACK.

4.16 Single DI and Single DO Switch Function Block (DIO-11V)

There are two motor valve control function blocks in the the system, which are the MOTOR function block which mainly controls the motor and the VALVE function block which mainly controls the valve. The valve function block is mainly to realize the basic switch control and interlock protection of the equipment.

DIO-11V function block enables control and interlock protect to single DI feedback/single DO output equipment by last level sequence control command or operator by panel.

DIO-11V function block is complex function block, and its running time is 20μs.



4.16.1 Parameter Description

Table 4.53 Single DI and Single DO Switch Function Block parameter description

Panel Parameter Name			Function Block Parameter Name	Initial Value	Value Range	Application Instruction
Basic Parameters	Mode Setting	TOC	Device Runtime (Unit: s)	TRUE	Operation Parameter	-
		OPFLACK	Whether to Confirm Running Fault (ON=True)When OPFLACK=ON and the running fault should be confirmed. And the running fault will be the limit of inputting new command of manual command, and it	TRUE	Operation Parameter	-

Table 4.53 Single DI and Single DO Switch Function Block parameter description (continued)

Panel Parameter Name		Function Block Parameter Name	Initial Value	Value Range	Application Instruction
			will be invalid to the interlock command.		
		AUTOCLR	Whether to Eliminate Operation Failure Auto(ON=Auto)	TRUE	Operation Parameter -
		IGNORSTA	Output Command Ignore Feedback(OFF=NO)	TRUE	Operation Parameter -
		SAFE_OPT	Output Safety Mode Selection(OFF=Not Reset Output, ON=Reset Output)	TRUE	Operation Parameter -
		PCMD_OPT	PCMD mode (OFF=level trigger, ON=edge trigger)	TRUE	Operation Parameter -
Extended Parameters	Input Pin	ACK	Status Feedback (ON=Open OFF=Close)	-	Input Pin Measuring Point DI
		PCMD	Command Input (ON=Open OFF=Close)	-	Input Pin Upstream Output
		EMOPN	Interlock Open Command	-	Input Pin Upstream Interlock Input When EMOPN=ON, it will be shown in the process alarm.
		EMCLS	Interlock Close Command	-	Input Pin Upstream Interlock Input When EMCLS=ON, it will be shown in the process alarm.
		PSWAM	Program Manual and Auto Control Digital Input	-	Input Pin Upstream Output
		OPNPRM	Open Permission Signal	-	Input Pin Upstream Output
		CLSPRM	Close Permission Signal	-	Input Pin Upstream Output
		FBOPT	Manual-automatic Control Source	-	Input Pin Upstream Output

Table 4.53 Single DI and Single DO Switch Function Block parameter description (continued)

Panel Parameter Name			Function Block Parameter Name	Initial Value	Value Range	Application Instruction
			Switch(OFF=Panel)			
		PACK	Program Failure Confirm	-	Input Pin	Upstream Output
	Output Pin	DO	Output, reset as OFF when offline download.	-	Output Pin	Output DO
	Alarm Enabled and Suppress	AOF	Suppress Module Alarm	TRUE	Operation Parameter	-
		ENALM	Alarm Enabled	TRUE	Operation Parameter	-
		FLAG	Flag	-	Output Pin	-
	OOS SETTINGS	SWOOS	In OOS Status (ON=Prohibited)	TRUE	Operation Parameter	-
	Operation Parameter	MCMD	Manual Command(ON=Open OFF=Close)	-	Operation Parameter	-
		SWAM	Manual-automatic Switch(ON=Auto OFF=Manual)	-	Operation Parameter	-
		MACK	Manual Confirm	-	Operation Parameter	-
	Status	OPFL	Running Fault (ON=Fault)	-	Monitoring Parameter	-
		STAOPN	Device Running Status Indication(ON=Open)	-	Monitoring Parameter	-
		STACLS	Device Stop Status Indication(ON=Close)	-	Monitoring Parameter	-
		MODE	Device Mode(Observe)	-	Monitoring Parameter	-
		OPNFLAG	Open Command Output Process(Observe)	-	Monitoring Parameter	-
		CLSFLAG	Close Command Output Process(Observe)	-	Monitoring Parameter	-

Table 4.53 Single DI and Single DO Switch Function Block parameter description (continued)

Panel Parameter Name			Function Block Parameter Name	Initial Value	Value Range	Application Instruction
	Configuration Parameter	IVO	Output Invert Switch (ON: Air Closed. OFF: Air Open)	-	Configuration Parameter	Set by the air open and air closed features of controlled valve.

4.16.2 Work Flow

Input command process

The DIO-11V function block has the following four device modes arranged by priority: operation stop, interlock, manual and automatic. The following table shows the corresponding conditions when the function block enters different modes, and the validity check of input commands in different modes.

Table 4.54 Input command validity check

MODE	Condition	Input command validity check (output command trigger condition)
Computing stop (MODE=1)	SWOOS=ON	Output remains, don't respond to each input command;
Interlock (MODE=4)	SWOOS=OFF, EMOPN=ON or EMCLS=ON	DO=ON: EMOPN=OFF→ON (OPNPRM=ON); DO=OFF: EMCLS=OFF→ON (CLSPRM=ON);
Manual (MODE=5)	SWOOS=OFF, EMOPN=OFF and EMCLS=OFF, SWAM=OFF	DO=ON: MCMD=OFF→ON (OPNPRM=ON, OPFL=OFF); MCMD=OFF→ON (OPNPRM=ON, OPFLACK=OFF); DO=OFF: MCMD=ON→OFF (CLSPRM=ON, OPFL=OFF); MCMD=ON→OFF (CLSPRM=ON, OPFLACK=OFF);
Auto (MODE=6)	SWOOS=OFF, EMOPN=OFF and EMCLS=OFF, SWAM=ON	DO=ON: PCMD=OFF→ON (OPNPRM=ON, OPFL=OFF); PCMD=OFF→ON (OPNPRM=ON, OPFLACK=OFF); DO=OFF: PCMD=ON→OFF (CLSPRM=ON, OPFL=OFF); PCMD=ON→OFF (CLSPRM=ON, OPFLACK=OFF);

Illustration of each working mode

Note 1: Interlock

- If the interlock open command is triggered first and the interlock close command is triggered within the effective time of the interlock open, the interlock open command will be executed first, and the interlock close command will be executed immediately after the interlock close command is triggered.
- If the interlock close command is triggered first and the interlock open command is triggered within the effective time of the interlock close, the interlock close command will be executed first, and the interlock open command will be executed immediately after the interlock open command is triggered.

**ATTENTION:**

The valid time refers to the transition time from ON to OFF of interlock start/ stop commands.

Note 2: Manually automatic

- If the interlock open EMOPN is continuously ON, the manual close and automatic close commands are invalid.
- If EMCLS is continuously ON when the interlock is closed, the manual open and automatic open commands are invalid.

Note 3: Automatic switching by hand

- It can be automatically switched by FBOPT, SWAM, PSWAM.
- The function block defaults to SWAM=OFF, which is manual mode. On the contrary, when SWAM=ON is set, the function block is in automatic mode.
- When FBOPT=OFF, the manual automatic switching can be determined by the manual automatic button on the panel, and the SWAM status is synchronized with the manual or automatic status on the function block panel.
- When FBOPT=ON, the manual automatic switch is determined by the program input PSWAM, and the SWAM manual automatic switch is invalid. At this time, when PSWAM=OFF, it means that the program control is in manual mode, and the panel can be operated manually. When PSWAM=ON, the program control is automatic mode.

**ATTENTION:**

When the interlock is started, the output DO=ON, and when the interlock is stopped, the output DO=OFF.

Air on and air off

- **IVO=OFF: air on (that is, positive output)**
This mode is used for the control of air-to-open valves. When the effective input command is ON, the command is opened, the output is ON, and the air-open valve is opened; when the effective input command is OFF, the command is closed, and the output is OFF, and the air-open valve is closed.
- **IVO=ON: air off (that is, reverse output)**
This mode is used for the control of air-to-close valves. When the effective input command is ON, it is an open command, the output is OFF, and the air-shut valve is opened; when the effective input command is OFF, it is a close command, and the output is ON, and the air-shut valve is closed.
- **Cold start**
Regardless of the air-on or air-off modes, when the controller is cold-started, the function blocks will output OFF uniformly.

4.16.3 Fault Diagnosis and Solution

The function block has operation failure alarm OPFL and interlocking dual-input failure alarm DBEMCMD. The operation failure OPEL can be shielded by the OPFLACK parameter. The alarm detection in each mode is shown in the following table:

Table 4.55 Alarm detection in each mode

MODE	Alarm
Computing stop	It won't generate any alarm.
Interlock	If EMOPN=ON and EMCLS=ON. It doesn't respond interlock command but rather DBEMCMD alarm. Refer to fault alarm generation, refer to OPFL.
Manual	Refer to fault alarm generation, refer to OPFL.
Auto	

OPFL

- **Alarm generation**
After the output command is issued, if the corresponding feedback signal is not received within the travel time TOC, the operation failure alarm OPFL is set.
- **Acknowledgement and elimination of alarms**
When an operation failure occurs, the alarm can be eliminated through the panel "Alarm Elimination", or the program can input the confirmation signal PACK to eliminate the alarm.

Set AUTOCLR=ON, when the operation failure alarm OPFL is generated, if the status feedback signal is restored, the OPFL alarm will be automatically eliminated.

Set AUTOCLR=OFF, when the operation failure alarm OPFL is generated, even after the status feedback signal is restored, the OPFL alarm still needs to be confirmed by the panel before it can be eliminated.

- Restrictions on input commands

If OPFLACK=OFF is set, the operation fault does not need to be confirmed, and it is not used as a restriction condition for new command input.

Set OPFLACK=ON, the operation failure needs to be confirmed, which is one of the restrictive conditions of the new command input, the opponent's automatic command is valid, and the interlock command is invalid.

- Impact on output commands

When SAFE_OPT=ON, an operation failure alarm OPEL is generated, and the output DO=OFF.

4.16.4 Panel Parameter

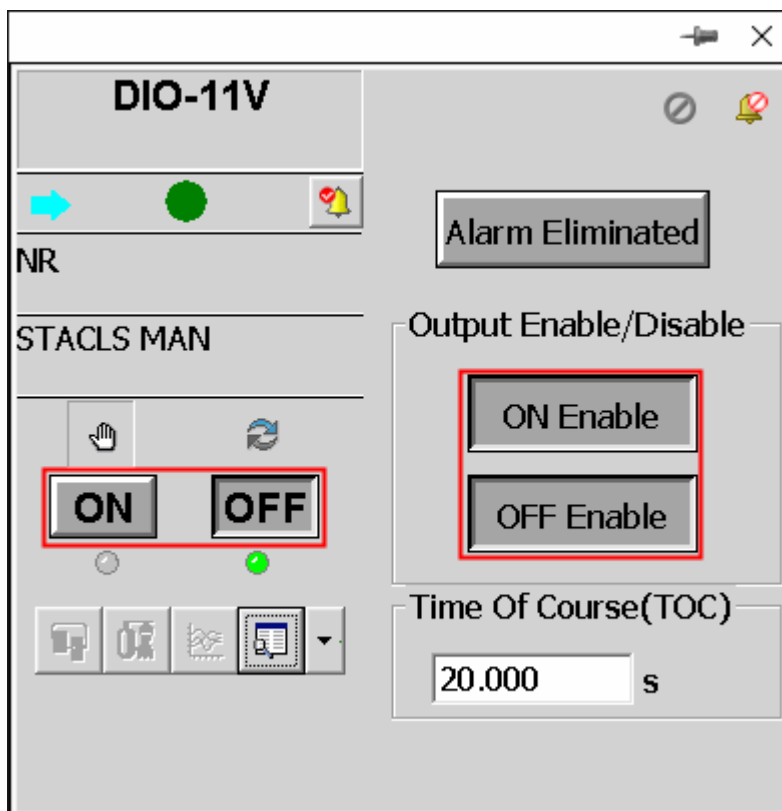


Figure 4.34 Panel of "DIO-11V"

As shown in the figure above, the button names in the red box can be modified in the macro parameters in the function blocks, the maximum length is from 0 to 64 characters (including Chinese characters, English letters, numbers and special characters). If users don't modify the

button names, the panel will display the default name. When the custom length exceeds the regulated display length, the custom description will not be completely displayed, but rather displayed in the regulated display length.

The indicator under the button "ON" and button "OFF" is used to indicate the status of the button.

- If the value of button is "ON", the indicator will be green.
- If the value of button is "OFF" or the communication bad, the indicator will be gray.

Table 4.56 Panel Parameters Instruction

Panel Parameter Name		Parameter Name	Initial Value	Value Range	Application Instruction
Alarm Eliminated		PACK	OFF	-	Eliminate the running alarm by panel or program input signal PACK.
Output Enable/Disable	On Enable	OPNPRM	ON	-	-
	Off Enable	CLSPRM	ON	-	-
Time of Course(s)		TOC	20.0000	-	-

4.16.5 Flag

Table 4.57 Flag list

Flag	Alarm	Description
D0	OOS	Disable
D3	EMOPN	Interlock Open
D4	EMCLS	Interlock Close
D5	MAN	Manual
D6	AUTO	Auto
D9	OPFL	Running Fault
D11	STAOPN	Devices All Open
D12	STACLS	Devices All Closed
D14	OPNPRO	Open Instruction Output Process
D15	CLSPRO	Close Instruction Output Process
D18	AOF	Suppress Alarm
D24	DBEMCMD	Interlock Double Input Fault

4.16.6 Application Example

To achieve the field-valve switch control as shown in Figure 4.35, and can be operated on flow chart. When valve running fault (if after running time, the status feedback and control output are different, generate the running fault alarm) occurs, no need to acknowledge.

One DI one DO valve refers to that the filed valve device is controlled by one DO signal, the valve status is shown by one DI signal feedbacks.

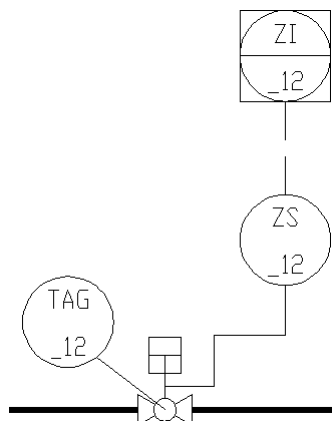


Figure 4.35 One DI One DO Valve

Details of program are shown below. It applies DIO-11V function block, and the upper computer interface can control DO via function block tag.

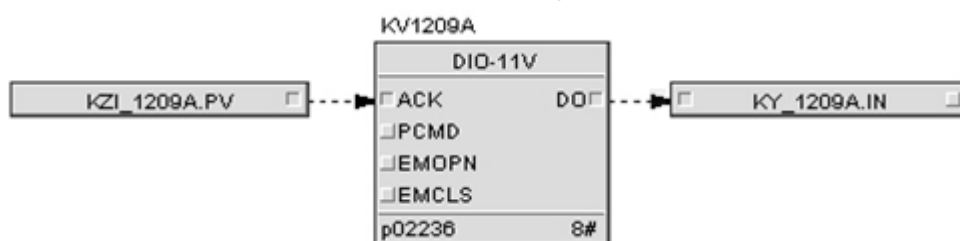


Figure 4.36 Program of One DI One DO Valve

Function block and example instructions are shown in the table below:

Table 4.58 Function Block and Example Instruction

NO.	Example	Type	Instruction	Remark
001	KY_1209A	DO Output	Valve Control	
002	KZI_1209A	DI Input	Valve Status Feedback	
006	KV1209A	Function Block	Valve Control Function Block Tag	Supervision Tag

Parameter settings of DIO-11V:

- FBOPT: ON
- PSWAM: OFF

- OPFLACK: OFF
- AUTOCLR: ON
- IGNORSTA: OFF
- SAFE_OPT: OFF

Note: the settings of FBOPT and PSWAM can avoid wrong operation for Auto button on the panel. Other settings should be applied for auto control.

Alarm Settings:

- OPFL: ON
- If SAFE_OPT=ON, OPFL (running fault) alarm generates, and function block DO=OFF;

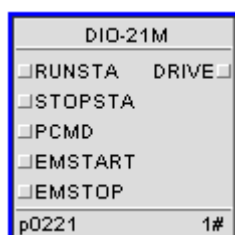
Note: whether to acknowledge fault is determined by the settings of operation parameter OPFLACK.

4.17 Dual DI and Single DO Start & Stop Function Block (DIO-21M)

There are two motor valve control function blocks in the system, which are the MOTOR function block which mainly controls the motor and the VALVE function block which mainly controls the valve. The motor function block is mainly to realize the basic start-stop control and interlock protection of the equipment.

DIO-21M function block enables control and interlock protect to dual-DI feedback/single DO output equipment by last level sequence control command or operator by panel.

DIO-21M function block is complex function block, and its running time is 20μs.



4.17.1 Parameter Description

Table 4.59 Dual-DI and Single DO Start& Stop Function Block parameter description

Name			Description	Upload	Properties	Application Reference
Basic Parameters	Mode Setting	TOC	Device Runtime (Unit: s)	TRUE	Operation Parameter	-
		OPFLACK	Whether to Confirm Running Fault (ON=True)	TRUE	Operation Parameter	-

Table 4.59 Dual-DI and Single DO Start& Stop Function Block parameter description (continued)

Name			Description	Upload	Properties	Application Reference
		AUTOCLR	Whether to Eliminate Operation Failure Auto(ON=Auto)	TRUE	Operation Parameter	-
		IGNORALM	Input Command Shield Alarm(OFF=NO)	TRUE	Operation Parameter	-
		IGNORSTA	Output Command Ignore Feedback(OFF=NO)	TRUE	Operation Parameter	-
		SAFE_OPT	Output Safety Mode Selection(OFF=Not Reset Output ON=Reset Output)	TRUE	Operation Parameter	-
		PCMD_OPT	PCMD mode (OFF=level trigger, ON=edge trigger)	TRUE	Operation Parameter	-
Extended Parameters	Input Pin	RUNSTA	Run Status Feedback	-	Input Pin	Measuring Point DI
		STOPSTA	Stop Status Feedback	-	Input Pin	Measuring Point DI
		PCMD	Command Input (ON=Start OFF=Stop)	-	Input Pin	Upstream Output
		EMSTART	Interlock Startup Command	-	Input Pin	Upstream Interlock Input When EMS-TART=ON, it will be shown in the process alarm.
		EMSTOP	Interlock Stop Command	-	Input Pin	Upstream Interlock Input When EMS-TOP=ON, it will be shown in the process alarm.

Table 4.59 Dual-DI and Single DO Start& Stop Function Block parameter description (continued)

Name			Description	Upload	Properties	Application Reference
		PSWAM	Program Manual and Auto Control Digital Input	-	Input Pin	Upstream Output
		RUNPRM	Start Command Enable Signal	-	Input Pin	Upstream Output
		STOPRM	Stop Command Enable Signal	-	Input Pin	Upstream Output
		FBOPT	Manual-automatic Control Source Switch(OFF=Panel)	-	Input Pin	Upstream Output
		PACK	Program Input Confirm Signal	-	Input Pin	Upstream Output
	Output Pin	DRIVE	Driver Output	-	Output Pin	Output DO
	Alarm Enabled and Suppress	AOF	Suppress Module Alarm	TRUE	Operation Parameter	-
		FLAG	Flag	-	Output Pin	-
	OOS SETTINGS	SWOOS	In OOS Status (ON=Prohibited)	TRUE	Operation Parameter	-
	Operation Parameters	MCMD	Manual Command(ON=Start OFF=Stop)	-	Operation Parameter	-
		SWAM	Manual-automatic Switch(ON=Auto OFF=Manual)	-	Operation Parameter	-
		MACK	Manual Confirm	-	Operation Parameter	-
	Status	FAIL	Device Fault(ON=Fault)	-	Monitoring Parameter	-
		OPFL	Running Fault (ON=Fault)	-	Monitoring Parameter	-
		STARUN	Device Running Status Indication(ON=Run)	-	Monitoring Parameter	-
		STASTOP	Device Stop Status Indication(ON=Prohibited)	-	Monitoring Parameter	-

Table 4.59 Dual-DI and Single DO Start& Stop Function Block parameter description (continued)

Name			Description	Upload	Properties	Application Reference
		MODE	Device Mode(Observable)	-	Monitoring Parameter	-
		RUNFLAG	Startup Command Output Process(Observable)	-	Monitoring Parameter	-
		STOPFLAG	Stop Command Output Process(Observable)	-	Monitoring Parameter	-

4.17.2 Logical Process

Working status

Function block status and priority: OOS>interlock>manual /auto selection.

- OOS(MODE=1)
When SWOOS=ON, function block is in OOS status and does not respond to command output. The output maintains.
- Interlock(interlock startup/interlock stop, MODE=4)
When function block is not in OOS status, and input interlock startup or interlock stop command, function block turns to interlock mode. Interlock command input adopts positive transmission check.
When both interlock startup, interlock stop commands are inputted, the system does not respond interlock command, and will generate DBEMCMD alarm.
When interlock startup command is inputted first and interlock stop command is inputted in effective time of interlock startup command, execute interlock startup command first and then interlock stop command after interlock startup command is over. And vice versa.
The validity of interlock command is restricted by start/stop enable (RUNPRM, STOPRM), device fault FAIL. FAIL limit can be shielded by IGNORALM.



ATTENTION:

When interlock startup, DRIVE = ON. When interlock stop, DRIVE = OFF.

- Man/auto (Man: MODE=5; Auto: MODE=6)
When function block is not in all statuses above, it is in manual /auto selection mode.
Manual status output instruction is by MCMD. When MCMD = ON, then DRIVE = ON. When MCMD = OFF, then DRIVE = OFF.

Automatic status output instruction is decided by PCMD. When PCMD = ON then DRIVE = ON. When PCMD = OFF, then DRIVE = OFF.

Man/auto command input adopts positive transmission check.

If interlock startup EMSTART is continuously ON, then manual stop and auto stop command disables.

If interlock stop EMSTOP is continuously ON, then manual startup and auto startup command disables.

The validity of man/auto command is restricted by start/stop enable (RUNPRM, STOPRM), device fault FAIL and running fault OPFL. Running fault limit can be shielded by OPFLACK. FAIL and OPFL limit can be shielded by IGNORAM.

Manual/Auto Switch

When OOS and interlock are not generated, the system turns to manual /auto mode.

It can be switched by FBOPT, SWAM and PSWAM.

When FBOPT=OFF, it is decided by panel.

When FBOPT=ON, the manual/auto mode is decided by program and not able to switched in panel. if PSWAM=OFF at this time, the program is in manual control, and the manul/auto mode can be switched in panel.

Running Fault

No responding feedback signal are received in runtime TOC after outputting the command, start up running fault alarm OPFL. When SAFE_OPT=ON, DRIVE=OFF.

When there is OPFL alarm, new command is not effective. And when OPFL alarm is eliminated, new command will be effective again.

Feedback Fault

When run status feedback RUNSTA and stop status feedback STOPSTA are both ON, feedback fault alarm FAIL will be started.

Power off Alarm

When it is not outputting instruction and has no running fault, if RUNSTA and STOPSTA are OFF together, set the power off alarm as POWOFF.

Alarm Confirmation

Eliminate the running alarm by panel or program input signal PACK.

Shield Alarm

IGNORALM=ON, respond to the new command no matter FAIL and OPFL alarms exist or not.

IGNORALM=OFF, not respond to the new command when FAIL alarm exists, OPFL is limited by OPFLACK.

Set OPFLACK=OFF, running fault does not need to be confirmed and is not considered as restricted condition of new command input.

Set OPFLACK=ON, running fault needs to be confirmed and is considered as restricted condition of new command input and is valid to manual/auto command and invalid to interlock command.

Set AUTOCLR=ON, running fault alarm OPFL will be eliminated automatically after status feedback signal is restored.

Set AUTOCLR=OFF, running fault alarm OPFL will be eliminated only after panel confirmation after status feedback signal is restored.

4.17.3 Panel Parameter

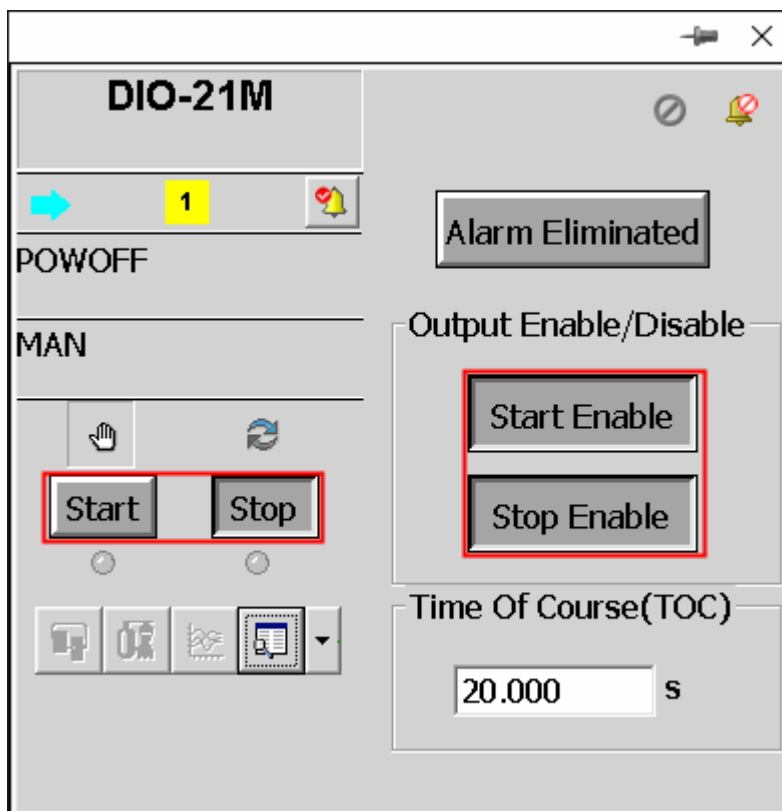


Figure 4.37 Panel of "DIO-21M"

As shown in the figure above, the button name in the red box can be modified in the macro parameters of the function block, and the maximum length is 0~64 characters (including Chinese, English, numbers and special characters). If the button name is not modified, the original default description will be displayed on the panel. When the length of the custom description exceeds the

actual length of the button on the panel, it will be truncated and displayed according to the actual length of the button.

The indicator under the button "Start" and button "Stop" is used to indicate the status of the button.

- If the value of button is "ON", the indicator will be green.
- If the value of button is "OFF" or the communication bad, the indicator will be gray.

Table 4.60 Table 4-60 Panel Parameter Instruction

Panel Parameter Name		Parameter Name	Initial Value	Value Range	Application Instruction
Alarm Eliminated		PACK	OFF	-	Eliminate the running alarm by panel or program input signal PACK.
Output Enable/Disable	Start Enable	RUNPRM	ON	-	-
	Stop Enable	STOPRM	ON	-	-
Time of Course(s)		TOC	20.0000	-	-

4.17.4 Flag

Table 4.61 Flag list

Flag	Alarm	Description
D0	OOS	Disable
D3	EMRUN	Interlock Startup
D4	EMSTOP	Interlock Stop
D5	MAN	Manual
D6	AUTO	Auto
D7	POWOFF	Power-OFF Alarm
D9	OPFL	Running Fault
D10	FAIL	Feedback Fault
D11	STARUN	Device Running Status
D12	STASTOP	Device Stop Status
D14	RUNPRO	Start Instruction Output Process
D15	STOPRO	Stop Instruction Output Process
D18	AOF	Suppress Alarm

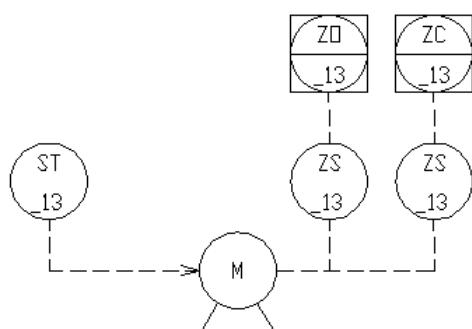
Table 4.61 Flag list (continued)

Flag	Alarm	Description
D24	DBEMCMD	Interlock Double Input Fault

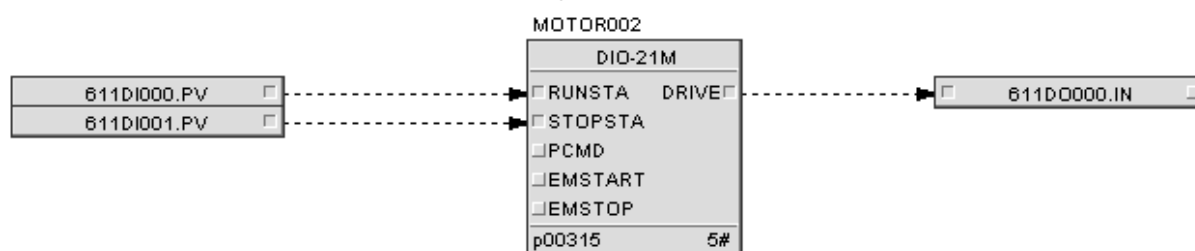
4.17.5 Application Example

To achieve the field-pump start and stop control as shown in Figure 4.38, and can be operated on flow chart. When pump running fault (if after running time, the status feedback and control output are different, generate the running fault alarm) occurs, no need to acknowledge.

Dual-DI one DO pump refers to that the filed pump device is controlled by one DO signal, the pump status is shown by dual-DI signal feedbacks. It is often used to control start and stop of pump.

**Figure 4.38 Dual-DI One DO Pump**

Details of program are shown below. It applies DIO-21M function block, and the upper computer interface can control DO via function block tag.

**Figure 4.39 Program of Dual-DI One DO Pump**

Function block and example instructions are shown in the table below:

Table 4.62 Function Block and Example Instruction

NO.	Example	Type	Instruction	Remark
001	611DI000	DI Input	Pump Running Status Feedback	
002	611DI001	DI Input	Pump Stop Status Feedback	
003	611DO000	DO Output	Pump Start and Stop	

Table 4.62 Function Block and Example Instruction (continued)

NO.	Example	Type	Instruction	Remark
004	MOTOR002	Function Block Tag	Pump Control Function Block Tag	Supervision Tag

Parameter settings of DIO-21M:

- FBOPT: ON
- PSWAM: OFF
- OPFLACK: OFF
- AUTOCLR: ON
- IGNORSTA: ON
- SAFE_OPT: OFF

Note: the settings of FBOPT and PSWAM can avoid wrong operation for Auto button on the panel. Other settings should be applied for auto control.

Alarm Settings:

- OPFL (running fault) alarm, when the status feedback of function block is different with its output, OPFL outputs alarm (OPFL=ON);
- If SAFE_OPT=ON, OPFL (running fault) alarm generates, and function block DRIVE=OFF;

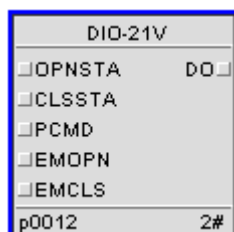
Note: whether to acknowledge fault is determined by the settings of operation parameter OPFLACK.

4.18 Dual DI and Single DO Switch Function Block (DIO-21V)

There are two motor valve control function blocks in the system, which are the MOTOR function block which mainly controls the motor and the VALVE function block which mainly controls the valve. The valve function block is mainly to realize the basic switch control and interlock protection of the equipment.

DIO-21V function block enables control and interlock protect to dual-DI feedback/single DO output equipment by last level sequence control command or operator by panel.

DIO-21V function block is complex function block, and its running time is 20μs.



4.18.1 Parameter Description

Table 4.63 Dual-DI and Single DO Switch Function Block parameter description

Name			Description	Upload	Properties	Application Reference
Basic Parameters	Mode Setting	TOC	Device Runtime (Unit: s)	TRUE	Operation Parameter	-
		OPFLACK	Whether to Confirm Running Fault (ON=True)When OPFLACK=ON and the running fault should be confirmed. And the running fault will be the limit of inputting new command of manual command, and it will be invalid to the interlock command.	TRUE	Operation Parameter	-
		AUTOCLR	Whether to Eliminate Operation Failure Auto(ON=Auto)	TRUE	Operation Parameter	-
		IGNORALM	Input Command Shield Alarm(OFF=NO)	TRUE	Operation Parameter	-
		IGNORSTA	Output Command Ignore Feedback(OFF=NO)	TRUE	Operation Parameter	-
		SAFE_OPT	Output Safety Mode Selection(OFF=Not Reset Output ON=Reset Output)	TRUE	Operation Parameter	-
		PCMD_OPT	PCMD mode (OFF=level trigger, ON=edge trigger)	TRUE	Operation Parameter	-
Extended Parameters	Input Pin	OPNSTA	Open Status Feedback	-	Input Pin	Measuring Point DI
		CLSSTA	Close Status Feedback	-	Input Pin	Measuring Point DI

Table 4.63 Dual-DI and Single DO Switch Function Block parameter description (continued)

Name			Description	Upload	Properties	Application Reference
		PCMD	Command Input (ON=Start OFF=Stop)	-	Input Pin	Upstream Output
		EMOPN	Interlock Open Command	-	Input Pin	Upstream Interlock Input When EMOPN=ON, it will be shown in the process alarm.
		EMCLS	Interlock Close Command	-	Input Pin	Upstream Interlock Input-When EMCLS=ON, it will be shown in the process alarm.
		PSWAM	Program Manual and Auto Control Digital Input	-	Input Pin	Upstream Output
		OPNPRM	Open Permission Signal	-	Input Pin	Upstream Output
		CLSPRM	Close Permission Signal	-	Input Pin	Upstream Output
		FBOPT	Manual-automatic Control Source Switch(OFF=Panel)	-	Input Pin	Upstream Output
		PACK	Program Input Confirm Signal	-	Input Pin	Upstream Output
	Output Pin	DO	Output, Reset as OFF When Download Offline	-	Output Pin	Output DO
	Alarm Enabled and Suppress	AOF	Suppress Module Alarm	TRUE	Operation Parameter	-
		ENALM	Alarm Enabled	TRUE	Operation Parameter	-
		FLAG	Flag	-	Output Pin	-
	OOS SETTINGS	SWOOS	In OOS Status (ON=Prohibited)	TRUE	Operation Parameter	-

Table 4.63 Dual-DI and Single DO Switch Function Block parameter description (continued)

Name			Description	Upload	Properties	Application Reference
	Operation Parameters	MCMD	Manual Command(ON=Start OFF=Stop)	-	Operation Parameter	-
		SWAM	Manual-automatic Switch(ON=Auto OFF=Manual)	-	Operation Parameter	-
		MACK	Manual Confirm	-	Operation Parameter	-
	Status	FAIL	Device Fault(ON=Fault)	-	Monitoring Parameter	-
		OPFL	Running Fault (ON=Fault)	-	Monitoring Parameter	-
		STAOPN	Device Running Status Indication(ON=Open)	-	Monitoring Parameter	-
		STACLS	Device Stop Status Indication(ON=Close)	-	Monitoring Parameter	-
		MODE	Device Mode(Observe)	-	Monitoring Parameter	-
		OPNFLAG	Open Command Output Process(Observe)	-	Monitoring Parameter	-
		CLSFLAG	Close Command Output Process(Observe)	-	Monitoring Parameter	-
	Configuration Parameter	IVO	Output Invert Switch (ON: air closed; OFF: air open)	-	Configuration Parameter	Set by the air open and closed features of controlled valve

Table 4.64 Macro parameter illustration

Macro Parameter	Initial Value	Description
MCMD_ON	Custom, corresponding to the "ON" button on the function block panel	Redefine the description of the manual ON command button on the panel

Table 4.64 Macro parameter illustration (continued)

Macro Parameter	Initial Value	Description
MCMD_OFF	Custom, corresponding to the "OFF" button on the function block panel	Users can redefine the description of the manual OFF command button on the panel
OPNPRM	Custom, corresponding to the "ON PRM" button on the function block panel	Users can redefine the description of the ON PRM command button on the panel
CLSPRM	Custom, corresponding to the "OFF PRM" button on the function block panel	Users can redefine the description of the OFF PRM command button on the panel

4.18.2 Logical Control

Function block status

Function block status and priority: OOS>interlock>>manual /auto selection.

- OOS(MODE=1)
When SWOOS=ON, function block is in OOS status and does not respond to command output. The output maintains.
- Interlock(interlock open/interlock stop, MODE=4)
When function block is not in OOS status, and input interlock open or interlock close command, function block turns to interlock mode. Interlock command input adopts positive transmission check.
When both interlock open, interlock close commands are inputted, the system does not respond to interlock command, and will generate DBEMCMD alarm.
When interlock open command is inputted first and interlock close command is inputted in effective time of interlock open command, execute interlock open command first and then interlock close command after interlock open command is over. And vice versa.
The validity of interlock command is restricted by open/close enable (OPNPRM, CLSPRM), device fault FAIL. FAIL limit can be shielded by IGNORALM.



ATTENTION:

When interlock startup, DO = ON. When interlock stop, DO = OFF.

- Man/auto (Man: MODE=5; Auto: MODE=6)
When function block is not in all statuses above, it is in manual /auto selection mode.
Manual status output instruction is decided by MCMD. When MCMD = ON, then DO = ON.
When MCMD = OFF, then DO = OFF.

Automatic status output instruction is decided by PCMD. When PCMD = ON then DO = ON. When PCMD = OFF, then DO = OFF.

Man/auto command input adopts positive transmission check.

If interlock open EMOPN is continuously ON, then manual close and auto close command disables.

If interlock close EMCLS is continuously ON, then manual open and auto open command disables.

The validity of man/auto command is restricted by open/close enable (OPNPRM, CLSPRM), device fault FAIL and running fault OPFL. Running fault limit can be shielded by OPFLACK. FAIL and OPFL limit can be shielded by IGNORAM.

Manual/Auto Switch

When OOS and interlock are not generated, the system turns to manual /auto mode.

It can be switched by FBOPT, SWAM and PSWAM.

When FBOPT=OFF, it is decided by panel.

When FBOPT=ON, the manual/auto mode is decided by program and not able to switched in panel. if PSWAM=OFF at this time, the program is in manual control, and the manul/auto mode can be switched in panel.

Running Fault

No responding feedback signal are received in runtime TOC after outputting the command, start up running fault alarm OPFL. When SAFE_OPT=ON, DO=OFF.

When there is OPFL alarm, new command is not effective. And when OPFL alarm is eliminated, new command will be effective again.

Feedback Fault

When open status feedback OPNSTA and close status feedback CLSSTA are both ON, feedback fault alarm FAIL will be started.

Power off Alarm

When it is not outputting instruction and has no running fault, if OPNSTA and CLSSTA are OFF together, set the power off alarm as POWOFF.

Alarm Confirmation

Eliminate the running alarm by panel or program input signal PACK.

Shield Alarm

IGNORALM=ON, respond to the new command no matter FAIL and OPFL alarms exist or not.

IGNORALM=OFF, not respond to the new command when FAIL alarm exists, OPFL is limited by OPFLACK.

Set OPFLACK=OFF, running fault does not need to be confirmed and is not considered as restricted condition of new command input.

Set OPFLACK=ON, running fault needs to be confirmed and is considered as restricted condition of new command input, it is valid to the manual/auto command and invalid to the interlock command.

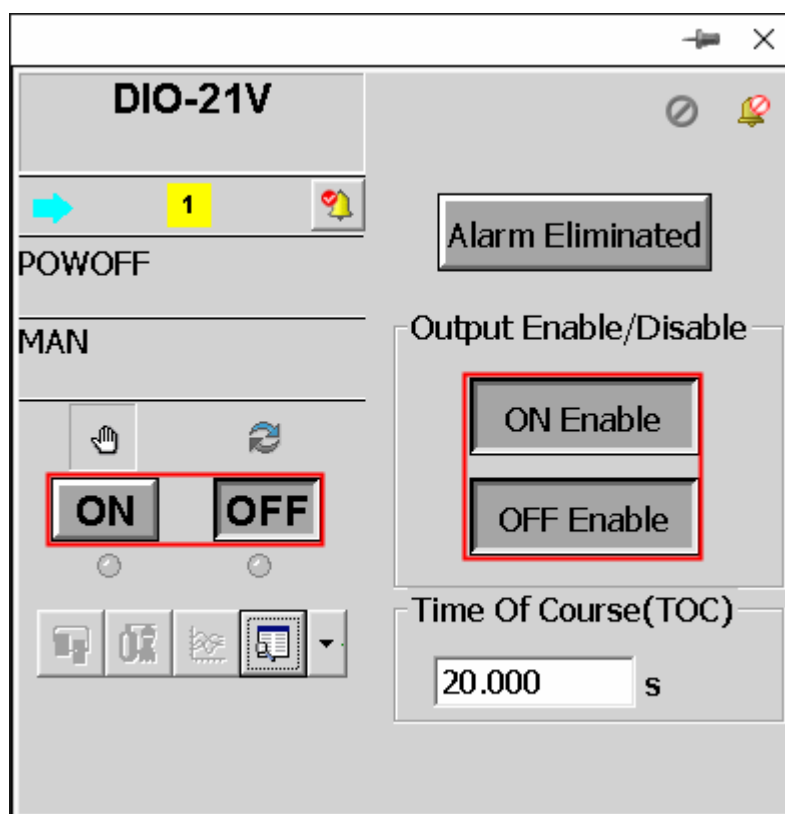
Set AUTOCLR=ON, valve check fault alarm OPFL will be eliminated automatically after status feedback signal is restored.

Set AUTOCLR=OFF, valve check fault alarm OPFL will be eliminated only after panel confirmation after status feedback signal is restored.

Air Open/ Closed Function

- IVO = OFF: air open
The mode can be used to control air open valve. When valid input command is ON, i.e. open command, output is ON, the air open valve is open. When valid input command is OFF, i.e. closed command, output is OFF, the air open valve is closed.
- IVO = ON: air closed
The mode can be used to control air closed valve. When valid input command is ON, i.e. open command, output is OFF, the air closed valve is open. When valid input command is OFF, i.e. closed command, output is ON, the air closed valve is closed.
- Cold Startup
No matter in air open or closed mode, function block outputs OFF when cold starting controller.

4.18.3 Panel Parameter



As shown in the figure above, the button name in the red box can be modified in the macro parameters of the function block, and the maximum length is 0~64 characters (including Chinese, English, numbers and special characters). If the button name is not modified, the original default description will be displayed on the panel. When the length of the custom description exceeds the actual length of the button on the panel, it will be truncated and displayed according to the actual length of the button.

The indicator under the button "ON" and button "OFF" is used to indicate the status of the button.

- If the value of button is "ON", the indicator will be green.
- If the value of button is "OFF" or the communication bad, the indicator will be gray.

Table 4.65 Table 4-65 Panel Parameter Instruction

Panel Parameter Name		Parameter Name	Initial Value	Value Range	Application Instruction
Alarm Eliminated		PACK	OFF	-	Eliminate the running alarm by panel or program input signal PACK.
Output Enable/Disable	On Enable	OPNPRM	ON	-	-
	Off Enable	CLSPRM	ON	-	-
Time of Course(s)		TOC	20.0000	-	-

4.18.4 Flag

Table 4.66 Flag list

Flag	Alarm	Description
D0	OOS	Disable
D3	EMOPN	Interlock Open
D4	EMCLS	Interlock Close
D5	MAN	Manual
D6	AUTO	Auto
D7	POWOFF	Power-OFF Alarm
D9	OPFL	Running Fault
D10	FAIL	Feedback Fault
D11	STAOPN	Devices All Open
D12	STACLS	Devices All Closed
D14	OPNPRO	Open Instruction Output Process
D15	CLSPRO	Close Instruction Output Process
D18	AOF	Suppress Alarm
D24	DBEMCMD	Interlock Double Input Fault

4.18.5 Application Example

To achieve the field-valve start and stop control as shown in Figure 4.40, and can be operated on flow chart. When valve running fault (if after running time, the status feedback and control output are different, generate the running fault alarm) occurs, no need to acknowledge.

Dual-DI one DO valve refers to that the filed valve device is controlled by one DO signal, the pump status is shown by dual-DI signal feedbacks.

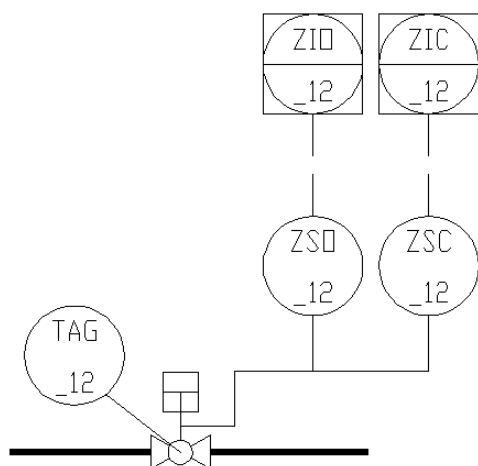


Figure 4.40 Dual-DI One DO Valve

Details of program are shown below. It applies DIO-21V function block, and the upper computer interface can control DO via function block tag.

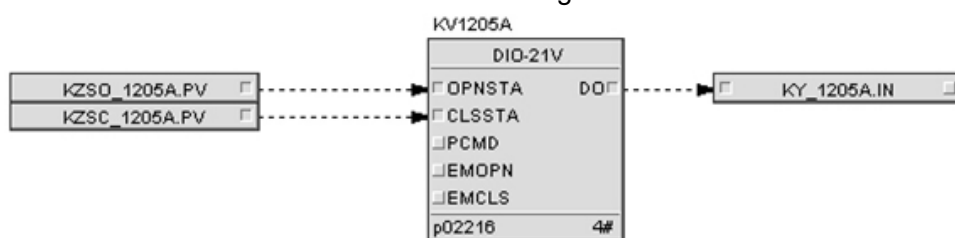


Figure 4.41 Program of Dual-DI One DO Valve

Function block and example instructions are shown in the table below:

Table 4.67 Function Block and Example Instruction

NO.	Example	Type	Instruction	Remark
001	KY_1205A	DO Output	Valve Control	
002	KZSO_1205A	DI Input	Valve Status Feedback	
002	KZSC_1205A	DI Input	Valve Status Feedback	
003	KV1205A	Function Block	Valve Control Function Block Tag	Supervision Tag

Parameter settings of DIO-21V:

- FBOPT: ON
- PSWAM: OFF
- OPFLACK: OFF
- AUTOCLR: ON
- IGNORSTA: OFF
- SAFE_OPT: OFF

Note: the settings of FBOPT and PSWAM can avoid wrong operation for Auto button on the panel. Other settings should be applied for auto control.

Alarm Settings:

- FAIL (device fault) alarm, when all function block switch status are ON, FAIL output alarm (FAIL=ON);
- OPFL (running fault) alarm, when the status feedback of function block is different with its output, OPFL outputs alarm (OPFL=ON);
- If SAFE_OPT=ON, OPFL (running fault) alarm generates, and function block DO=OFF.
- When the operation parameter IGNORALM in basic parameter (input shield parameter) is set as not shield (IGNORALM=OFF); when it is set as shield, FAIL, OPFL do not generate alarms.

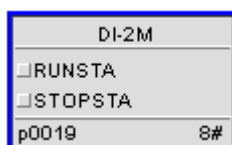
Note: whether to acknowledge fault is determined by the settings of operation parameter OPFLACK.

4.19 Dual DI Start/Stop Valve Observe Function Block (DI-2M)

There are two motor valve control function blocks in the system, which are the MOTOR function block which mainly controls the motor and the VALVE function block which mainly controls the valve. The motor function block is mainly to realize the basic start-stop control and interlock protection of the equipment.

DI-2M function block enables dual-DI feedback start/stop valve observe alarm.

DI-2M function block is complex function block, and its running time is 20μs.



4.19.1 Parameter Description

Table 4.68 Dual-DI Start/Stop Valve Observe Function Block Parameter Description

Name		Description	Upload	Properties	Application Reference
Input Pin	RUNSTA	Run Status Feed-back	TRUE	Input Pin	Measuring Point DI
	STOPSTA	Stop Status Feed-back	TRUE	Input Pin	Measuring Point DI
Operation Parameter	AOF	Suppress Module Alarm	TRUE	Operation Parameter	-

Table 4.68 Dual-DI Start/Stop Valve Observe Function Block Parameter Description (continued)

Name		Description	Upload	Properties	Application Reference
		AOF=ON, Do not Show Real-Time Alarm; AOF=OFF, Show Real-Time Alarm			
	SWOOS	In OOS Status(ON=Prohibited)	TRUE	Operation Parameter	When SWOOS=ON, function block is in OOS status and alarm is not generated.
	TOC	Device Runtime (Unit: s)	TRUE	Operation Parameter	-
	SWPWF	Power-Failure Alarm Enable/Disable	TRUE	Operation Parameter	-
Monitoring Parameter	FAIL	Device Fault(ON=Fault)	-	Monitoring Parameter	When run status feedback RUNSTA and stop status feedback STOPSTA are both ON, feedback fault FAIL=ON.
Output Pin	FLAG	Flag	-	Output Pin	-
Alarm enable	ENALM	Alarm enable	TRUE	Alarm Parameter	-

Note1: If power-failure check is required, when RUNSTA and STOPSTA are both OFF., it is in action process within the runtime (TOC) and power-failure alarm POWOFF will be generated while it is out of the runtime (TOC).

4.19.2 Panel Parameter

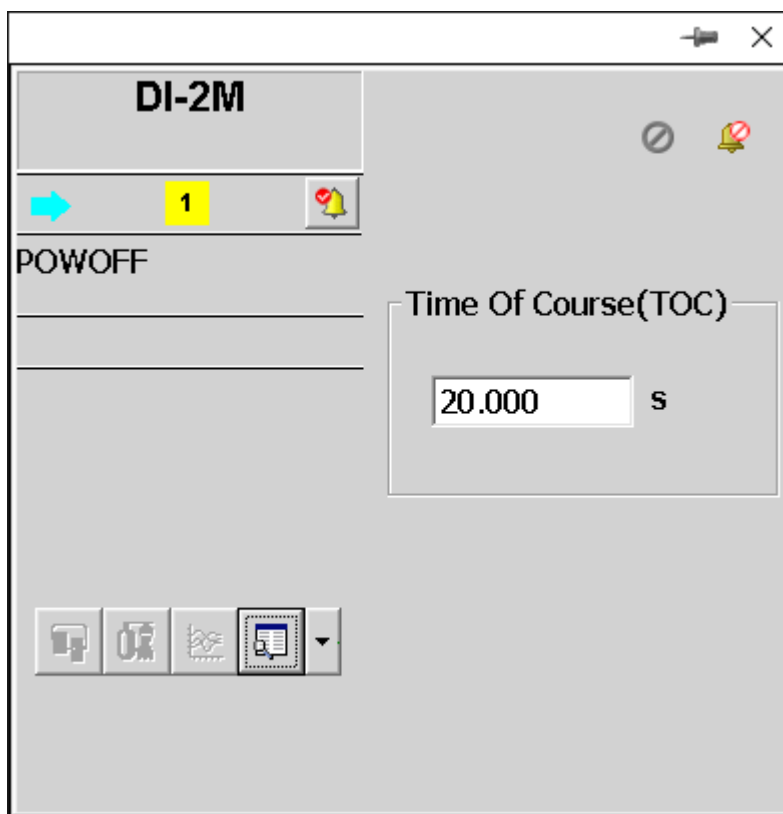


Table 4.69 Panel Parameter Instruction

Panel Parameter Name	Parameter Name	Initial Value	Value Range	Application Instruction
Time of Course(s)	TOC	20.0000	-	-

4.19.3 Flag

Table 4.70 Flag list

Flag	Alarm	Description
D0	OOS	Disable
D7	POWOFF	Power-OFF Alarm
D10	FAIL	Feedback Fault
D11	STARUN	Device Running Status
D12	STASTOP	Device Stop Status
D18	AOF	Suppress Alarm

4.20 Dual DI Switch Valve Observe Function Block (DI-2V)

There are two motor valve control function blocks in the system, which are the MOTOR function block which mainly controls the motor and the VALVE function block which mainly controls the valve. The valve function block is mainly to realize the basic switch control and interlock protection of the equipment.

DI-2V function block enables dual-DI feedback switch valve observe alarm.

DI-2V function block is complex function block, and its running time is 20μs.



4.20.1 Parameter Description

Table 4.71 Dual-DI Switch Valve Observe Function Block Parameter Description

Name		Description	Upload	Properties	Application Reference
Input Pin	OPNSTA	Open Status Feedback	-	Input Pin	Measuring Point DI
	CLSSTA	Close Status Feedback	-	Input Pin	Measuring Point DI
Operation Parameter	AOF	Suppress Module Alarm	TRUE	Operation Parameter	-
	SWOOS	In OOS Status(ON=Prohibited)	TRUE	Operation Parameter	When SWOOS=ON, function block is in OOS status and alarm is not generated.
	TOC	Device Runtime (Unit: s)	TRUE	Operation Parameter	-
	SWP-WF	Power-Failure Alarm Enable/Disable	TRUE	Operation Parameter	-
Monitoring Parameter	FAIL	Device Fault(ON=Fault)	-	Monitoring Parameter	When open status feedback OPNSTA and close status feedback CLSSTA are both ON, feedback fault FAIL=ON.
Output Pin	FLAG	Flag	-	Output Pin	-
Alarm enable	ENALM	Alarm enable	TRUE	Alarm Parameter	-

When OPNSTA and CLSSTA are both OFF, it is in action process within the runtime (TOC) and power-failure alarm POWOFF will be generated while it is out of the runtime (TOC).

4.20.2 Panel Parameter

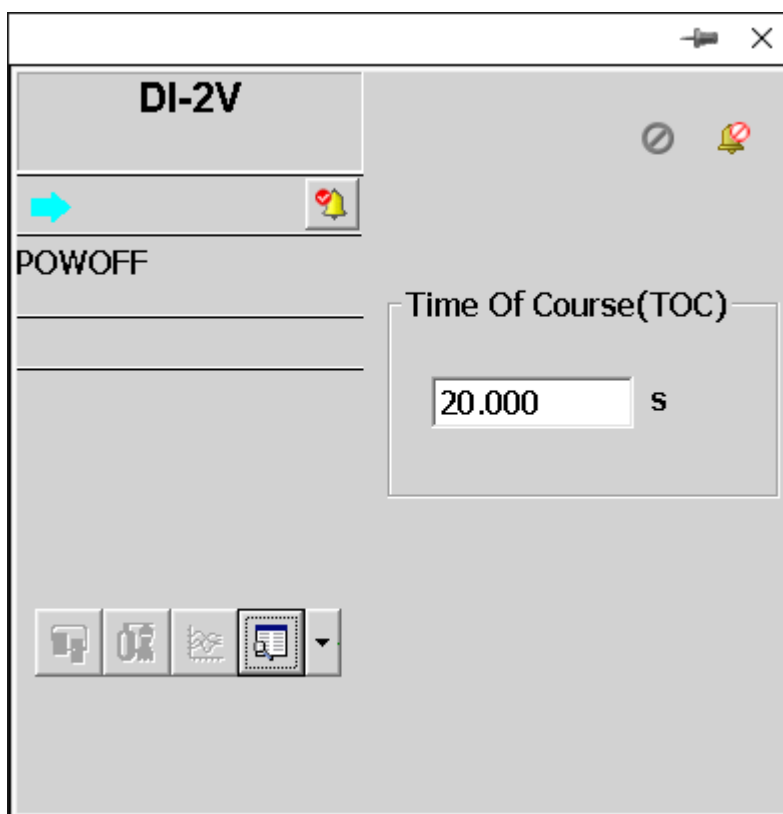


Table 4.72 Panel Parameter Instruction

panel parameter name	parameter name	Initial Value	Value Range	Application Instruction
Time of Course(s)	TOC	20.0000	-	-

4.20.3 Flag

Table 4.73 Flag list

Flag	Alarm	Description
D0	OOS	Disable
D7	POWOFF	Power-OFF Alarm
D10	FAIL	Feedback Fault
D11	OPNPRO	Open Instruction Output Process
D12	CLSPRO	Close Instruction Output Process
D18	AOF	Suppress Alarm

4.20.4 Application Example

To determine the fault alarm and power-off alarm of a pair input switch valves status.

Switch valve status detection is used to detect whether the valve switch status is normal. This part focuses on two-input switch valve detect alarm. The alarm content includes fault alarm and power-off alarm(note: valve running fault alarm is not included).

Via valve control module the running fault detect can be achieved. Details please refer to program guide of “one DI one DO valve” “dual-DI one DO valve” “dual-DI dual-DO valve”, etc.

Details of program are shown below. It applies DI-2V function block, and the upper computer interface can achieve valve detect alarm via function block tag.

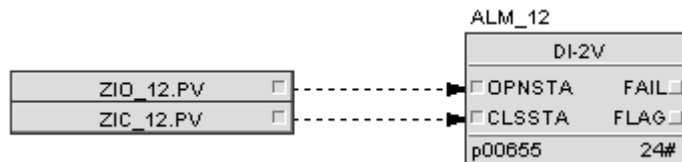


Figure 4.42 Program of Two Input Valve Detect Program

Function block and example instructions are shown in the table below:

Table 4.74 Function Block and Example Instruction

NO.	Example	Type	Instruction	Remark
001	ZIO_12	DI Input	Valve Open Feedback	-
002	ZIC_12	DI Input	Valve Closed Feedback	-
003	ALM_12	Function Block	Function Block Tag of Valve Detect Alarm	Supervision Tag

Parameter settings of DI-2V:

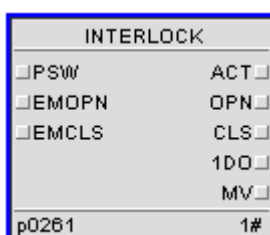
- TOC: 20
- SWPWF: ON

Note: DI-2V is mainly used to achieve valve detect alarm of upper computer (including valve fault and valve power-off), and may invoke FAIL and POWEROFF from the upper computer to achieve dynamic alarm.

4.21 Interlock Function Block (INTERLOCK)

INTERLOCK function block enables Interlock process.

INTERLOCK function block is complex function block, and its running time is 15μs.



4.21.1 Parameter Description

Table 4.75 Interlock Function Block parameter description

Name		Description	Upload	Properties	Application Reference
Input Pin	PSW	Interlock Switch Program Input. When the input of PSW is a positive transmission, then SW=ON. When the input of PSW is a negative transmission, then SW=OFF. Else the input of PSW has no effect to SW.	-	Input Pin	Connect to DI/Do or pulse signal.
	EMOPN	Interlock Open.The value of OPN is decided by SW and EMOPN.	-	Input Pin	Connect to DI/Do
	EMCLS	Interlock Closed.The value of CLS is decided by SW and EMCLS.	-	Input Pin	Connect to DI/Do
Output Pin	ACT	Interlock Output to indicate the status of interlock action.	-	Output Pin	Can be monitored in flow of real-time monitoring software.
	OPN	Interlock Open/Start.The value of 1DO is decided by OPN and CLS. Detail information refers to figure 3-55.	-	Output Pin	Refer to Table 4.80 Can be monitored in flow of real-time monitoring software.
	CLS	Interlock Close/Stop.The value of 1DO is decided by OPN and CLS. Detail information refers to figure 3-55.	-	Output Pin	Refer to Table 4.80 Can be monitored in flow of real-time monitoring software.
	1DO	Digital Interlock Output, detail information refers to Table 1	-	Output Pin	Connect to DO.
	MV	Adjustment Interlock Output, detail information refer to Table 4.80	-	Output Pin	Connect to AO
Monitoring Parameter	SWOOS	Function Block Enable/Disable(ON=Disable)	TRUE	Monitoring Parameter	-
	SW	Interlock Switch, and can be modify manually. When SW=ON, MV can be modify. When SW=OFF, MV will not be modify.	TRUE	Monitoring Parameter	-
	FLAG	Flag	-	Monitoring Parameter	-

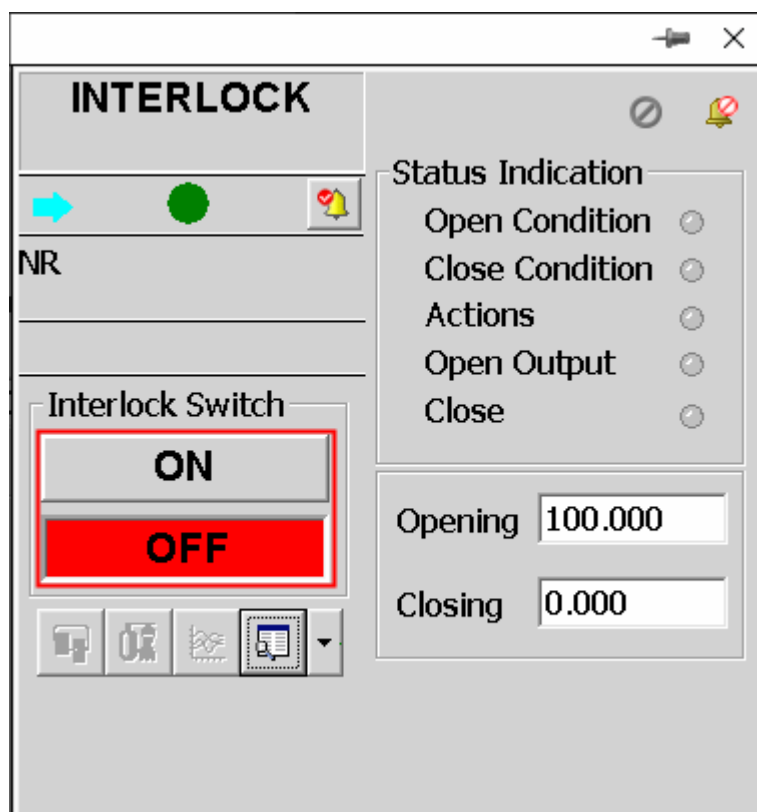
Table 4.75 Interlock Function Block parameter description (continued)

Name	Description		Upload	Properties	Application Reference
	AOF	Suppress Module Alarm	TRUE	Monitoring Parameter	-
Operation Parameter	KOPN	Interlock Opening Settings	TRUE	Operation Parameter	-
	KCLS	Interlock Closing Settings	TRUE	Operation Parameter	-

Table 4.76 Macro Parameter Illustration

Macro Parameter	Initial Value	Description
SW_ON	Custom, corresponding to the "ON" button on the function block panel	Users can redefine the description of the ON button on the panel
SW_OFF	Custom, corresponding to the "OFF" button on the function block panel	Users can redefine the description of the OFF button on the panel

4.21.2 Panel Parameter



As shown in the figure above, the button names in the red box can be modified in the macro parameters of the function block, and the maximum length is 0~64 characters (including Chinese, English, numbers and special characters). If the button name is not modified, the original default description will be displayed on the panel. When the length of the custom description exceeds the actual length of the button on the panel, it will be truncated and displayed according to the actual length of the button.

Table 4.77 Panel Parameter Instruction

Panel Parameter Name	Parameter Name	Initial Value	Value Range	Application Instruction
Open condition	EMOPN	OFF	-	-
Close	EMCLS	OFF	-	-
Actions	ACT	OFF	-	-
Open Output	OPN	OFF	-	-
Close Output	CLS	OFF	-	-
Opening	KOPN	100.0000	-	-
Closing	KCLS	0.0000	-	-

4.21.3 Logic Time Sequencing

When the input of PSW is a positive transmission, then SW=ON.

When the input of PSW is a negative transmission, then SW=OFF.

Else the input of PSW has no effect to SW.

The value of OPN is decided by SW and EMOPN.

The value of CLS is decided by SW and EMCLS.

The value of MV is decided by SW, EMOPN and EMCLS.

Table 4.78 Output Logical of MV

Condition			Output		
SW	EMOPN	EMCLS	OPN	CLS	MV
ON	ON	OFF	ON	OFF	=KOPN
ON	OFF	ON	OFF	ON	=KCLS
ON	ON	ON	ON	ON	=KCLS
ON	OFF	OFF	OFF	OFF	MV will hold on.
OFF	-	-	OFF	OFF	MV will hold on.

The value of 1DO and the value of ACT are both decided by OPN and CLS.

Table 4.79 Output Logical of 1DO and ACT

Condition		Output	
OPN	CLS	1DO	ACT
ON	OFF	ON	ON
OFF	ON	OFF	ON
OFF	OFF	Hold	OFF
ON	ON	Hold	ON

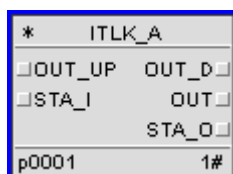
4.21.4 Flag

Table 4.80 Flag list

Flag	Alarm	Description
D0	OOS	Disable
D8	AOF	Suppress Alarm

4.22 Analog Signal Interlock Function Block (ITLK_A)

ITLK_A Function Block is used for interlock control and output analogic interlock signal.



4.22.1 Parameter Description

Parameter Name		Description	Parameter Type	Application for Reference
Input Pin	OUT_UP	Interlock Input	REAL	-
	STA_I	Status Input	UDINT	-
	BKIN	Back Calculation Input	BOOL	Connect to the BKOUT in the downstream
	BKINERR	Back Calculation Input Status	BOOL	connect to the BKOUTERR in the downstream

Parameter Name		Description	Parameter Type	Application for Reference
Output Pin	OUT_D	Output Command(0=No Interlock, 1=LMAN, 2=LTR)	USINT	0=no interlock signal, 1=manual interlock, 2=track
	OUT	Output Value	REAL	-
	FRSTOUT	Firstout Index	UINT	-
	PCKOUT	Interlock command packed output	UINT	-
	VLDOUT	Interlock output command index	UINT	-
	STA_O	Status Output	UDINT	-
Operational Parameter	SN	Serial Number	USINT	-
	RST_OPT	Reset Optional	BOOL	-
	CAN_RST	Can be Reset	BOOL	-
Interlock Status Settings	HYS	Hysteresis Value	REAL	-
Configuration Parameter	DLEN	Decimal digit [0,5]	USINT	-

4.22.2 Other Parameters

Parameter Name	Type	Original Value	Description	Default Permission	Permission is allowed to modify	Parameter upload	Property
External Condition Input							
CND1	BOOL	OFF	Interlock condition1	0	FALSE	FALSE	Monitoring parameter
CND2	BOOL	OFF	Interlock condition2	0	FALSE	FALSE	Monitoring parameter
CND3	BOOL	OFF	Interlock condition3	0	FALSE	FALSE	Monitoring parameter
CND4	BOOL	OFF	Interlock condition4	0	FALSE	FALSE	Monitoring parameter
CND5	BOOL	OFF	Interlock condition5	0	FALSE	FALSE	Monitoring parameter
CND6	BOOL	OFF	Interlock condition6	0	FALSE	FALSE	Monitoring parameter

Parameter Name	Type	Original Value	Description	Default Permission	Permission is allowed to modify	Parameter upload	Property
CND7	BOOL	OFF	Interlock condition7	0	FALSE	FALSE	Monitoring parameter
CND8	BOOL	OFF	Interlock condition8	0	FALSE	FALSE	Monitoring parameter
Operational Parameter							
CAN_RST	BOOL	OFF	Reset is allowable	5	TRUE	TRUE	Operational parameter
RESET	BOOL	OFF	Reset switch	5	TRUE	FALSE	Operational parameter
Interlock Bypass Setting							
ENBP1	BOOL	OFF	Enable bypass1	5	TRUE	TRUE	Operational parameter
BP1	BOOL	OFF	Bypass1	5	TRUE	FALSE	Operational parameter
ENBP2	BOOL	OFF	Enable bypass2	5	TRUE	TRUE	Operational parameter
BP2	BOOL	OFF	Bypass2	5	TRUE	FALSE	Operational parameter
ENBP3	BOOL	OFF	Enable bypass3	5	TRUE	TRUE	Operational parameter
BP3	BOOL	OFF	Bypass3	5	TRUE	FALSE	Operational parameter
ENBP4	BOOL	OFF	Enable bypass4	5	TRUE	TRUE	Operational parameter
BP4	BOOL	OFF	Bypass4	5	TRUE	FALSE	Operational parameter
ENBP5	BOOL	OFF	Enable bypass5	5	TRUE	TRUE	Operational parameter
BP5	BOOL	OFF	Bypass5	5	TRUE	FALSE	Operational parameter

Parameter Name	Type	Original Value	Description	Default Permission	Permission is allowed to modify	Parameter upload	Property
ENBP6	BOOL	OFF	Enable by-pass6	5	TRUE	TRUE	Operational parameter
BP6	BOOL	OFF	Bypass6	5	TRUE	FALSE	Operational parameter
ENBP7	BOOL	OFF	Enable by-pass7	5	TRUE	TRUE	Operational parameter
BP7	BOOL	OFF	Bypass7	5	TRUE	FALSE	Operational parameter
ENBP8	BOOL	OFF	Enable by-pass8	5	TRUE	TRUE	Operational parameter
BP8	BOOL	OFF	Bypass8	5	TRUE	FALSE	Operational parameter
Manual settings of interlock							
TOMAN1	BOOL	OFF	Interlock manual switch1	5	TRUE	TRUE	Operational parameter
TOMAN2	BOOL	OFF	Interlock manual switch2	5	TRUE	TRUE	Operational parameter
TOMAN3	BOOL	OFF	Interlock manual switch3	5	TRUE	TRUE	Operational parameter
TOMAN4	BOOL	OFF	Interlock manual switch4	5	TRUE	TRUE	Operational parameter
TOMAN5	BOOL	OFF	Interlock manual switch5	5	TRUE	TRUE	Operational parameter
TOMAN6	BOOL	OFF	Interlock manual switch6	5	TRUE	TRUE	Operational parameter
TOMAN7	BOOL	OFF	Interlock manual switch7	5	TRUE	TRUE	Operational parameter
TOMAN8	BOOL	OFF	Interlock manual switch8	5	TRUE	TRUE	Operational parameter

Parameter Name	Type	Original Value	Description	Default Permission	Permission is allowed to modify	Parameter upload	Property
Interlock Latching Settings							
EN-LATCH1	BOOL	OFF	Enable Latch1	5	TRUE	TRUE	Operational parameter
EN-LATCH2	BOOL	OFF	Enable Latch2	5	TRUE	TRUE	Operational parameter
EN-LATCH3	BOOL	OFF	Enable Latch3	5	TRUE	TRUE	Operational parameter
EN-LATCH4	BOOL	OFF	Enable Latch4	5	TRUE	TRUE	Operational parameter
EN-LATCH5	BOOL	OFF	Enable Latch5	5	TRUE	TRUE	Operational parameter
EN-LATCH6	BOOL	OFF	Enable Latch6	5	TRUE	TRUE	Operational parameter
EN-LATCH7	BOOL	OFF	Enable Latch7	5	TRUE	TRUE	Operational parameter
EN-LATCH8	BOOL	OFF	Enable Latch8	5	TRUE	TRUE	Operational parameter
Interlock latching settings							
LATCH1	BOOL	OFF	Whether or not in latch1	0	FALSE	FALSE	Monitoring parameter
LATCH2	BOOL	OFF	Whether or not in latch2	0	FALSE	FALSE	Monitoring parameter
LATCH3	BOOL	OFF	Whether or not in latch3	0	FALSE	FALSE	Monitoring parameter
LATCH4	BOOL	OFF	Whether or not in latch4	0	FALSE	FALSE	Monitoring parameter
LATCH5	BOOL	OFF	Whether or not in latch5	0	FALSE	FALSE	Monitoring parameter
LATCH6	BOOL	OFF	Whether or not in latch6	0	FALSE	FALSE	Monitoring parameter
LATCH7	BOOL	OFF	Whether or not in latch7	0	FALSE	FALSE	Monitoring parameter

Parameter Name	Type	Original Value	Description	Default Permission	Permission is allowed to modify	Parameter upload	Property
LATCH8	BOOL	OFF	Whether or not in latch8	0	FALSE	FALSE	Monitoring parameter
RSTREQ1	BOOL	OFF	Interlock condition1 allows to reset (ON=allow)	0	FALSE	FALSE	Monitoring parameter
RSTREQ2	BOOL	OFF	Interlock condition2 allows to reset (ON=allow)	0	FALSE	FALSE	Monitoring parameter
RSTREQ3	BOOL	OFF	Interlock condition3 allows to reset (ON=allow)	0	FALSE	FALSE	Monitoring parameter
RSTREQ4	BOOL	OFF	Interlock condition4 allows to reset (ON=allow)	0	FALSE	FALSE	Monitoring parameter
RSTREQ5	BOOL	OFF	Interlock condition5 allows to reset (ON=allow)	0	FALSE	FALSE	Monitoring parameter
RSTREQ6	BOOL	OFF	Interlock condition6 allows to reset (ON=allow)	0	FALSE	FALSE	Monitoring parameter
RSTREQ7	BOOL	OFF	Interlock condition7 allows to reset (ON=allow)	0	FALSE	FALSE	Monitoring parameter
RSTREQ8	BOOL	OFF	Interlock condition8 allows to reset (ON=allow)	0	FALSE	FALSE	Monitoring parameter
TOUT1	BOOL	OFF	The output after the timing processing of Interlock condition1	0	FALSE	FALSE	Monitoring parameter
TOUT2	BOOL	OFF	The output after the timing processing of Interlock condition2	0	FALSE	FALSE	Monitoring parameter

Parameter Name	Type	Original Value	Description	Default Permission	Permission is allowed to modify	Parameter upload	Property
TOUT3	BOOL	OFF	The output after the timing processing of Interlock condition3	0	FALSE	FALSE	Monitoring parameter
TOUT4	BOOL	OFF	The output after the timing processing of Interlock condition4	0	FALSE	FALSE	Monitoring parameter
TOUT5	BOOL	OFF	The output after the timing processing of Interlock condition5	0	FALSE	FALSE	Monitoring parameter
TOUT6	BOOL	OFF	The output after the timing processing of Interlock condition6	0	FALSE	FALSE	Monitoring parameter
TOUT7	BOOL	OFF	The output after the timing processing of Interlock condition7	0	FALSE	FALSE	Monitoring parameter
TOUT8	BOOL	OFF	The output after the timing processing of Interlock condition8	0	FALSE	FALSE	Monitoring parameter
BOUT1	BOOL	OFF	The output after the bypass processing of interlock condition1	0	FALSE	FALSE	Monitoring parameter
BOUT2	BOOL	OFF	The output after the bypass processing of interlock condition2	0	FALSE	FALSE	Monitoring parameter
BOUT3	BOOL	OFF	The output after the by-	0	FALSE	FALSE	Monitoring parameter

Parameter Name	Type	Original Value	Description	Default Permission	Permission is allowed to modify	Parameter upload	Property
			pass processing of interlock condition3				
BOUT4	BOOL	OFF	The output after the bypass processing of interlock condition4	0	FALSE	FALSE	Monitoring parameter
BOUT5	BOOL	OFF	The output after the bypass processing of interlock condition5	0	FALSE	FALSE	Monitoring parameter
BOUT6	BOOL	OFF	The output after the bypass processing of interlock condition6	0	FALSE	FALSE	Monitoring parameter
BOUT7	BOOL	OFF	The output after the bypass processing of interlock condition7	0	FALSE	FALSE	Monitoring parameter
BOUT8	BOOL	OFF	The output after the bypass processing of interlock condition8	0	FALSE	FALSE	Monitoring parameter
LOUT1	BOOL	OFF	The output after latching processing of interlock condition1	0	FALSE	FALSE	Monitoring parameter
LOUT2	BOOL	OFF	The output after latching processing of interlock condition2	0	FALSE	FALSE	Monitoring parameter
LOUT3	BOOL	OFF	The output after latching processing of interlock condition3	0	FALSE	FALSE	Monitoring parameter

Parameter Name	Type	Original Value	Description	Default Permission	Permission is allowed to modify	Parameter upload	Property
LOUT4	BOOL	OFF	The output after latching processing of interlock condition4	0	FALSE	FALSE	Monitoring parameter
LOUT5	BOOL	OFF	The output after latching processing of interlock condition5	0	FALSE	FALSE	Monitoring parameter
LOUT6	BOOL	OFF	The output after latching processing of interlock condition6	0	FALSE	FALSE	Monitoring parameter
LOUT7	BOOL	OFF	The output after latching processing of interlock condition7	0	FALSE	FALSE	Monitoring parameter
LOUT8	BOOL	OFF	The output after latching processing of interlock condition8	0	FALSE	FALSE	Monitoring parameter
Interlock status settings							
IVAL1	REAL	0	Tracking value1	5	TRUE	TRUE	Operating parameter
IVAL2	REAL	0	Tracking value2	5	TRUE	TRUE	Operating parameter
IVAL3	REAL	0	Tracking value3	5	TRUE	TRUE	Operating parameter
IVAL4	REAL	0	Tracking value4	5	TRUE	TRUE	Operating parameter
IVAL5	REAL	0	Tracking value5	5	TRUE	TRUE	Operating parameter
IVAL6	REAL	0	Tracking value6	5	TRUE	TRUE	Operating parameter
IVAL7	REAL	0	Tracking value7	5	TRUE	TRUE	Operating parameter
IVAL8	REAL	0	Tracking value8	5	TRUE	TRUE	Operating parameter

Parameter Name	Type	Original Value	Description	Default Permission	Permission is allowed to modify	Parameter upload	Property
HYS	REAL	0	Hysteresis value	5	TRUE	TRUE	Operating parameter
Interlock time							
TON1	REAL	0	Interlock1 delay generation (s)	5	TRUE	TRUE	Operating parameter
TOFF1	REAL	0	Interlock1 delay elimination(s)	5	TRUE	TRUE	Operating parameter
TON2	REAL	0	Interlock2 delay generation(s)	5	TRUE	TRUE	Operating parameter
TOFF2	REAL	0	Interlock2 delay elimination(s)	5	TRUE	TRUE	Operating parameter
TON3	REAL	0	Interlock3 delay generation(s)	5	TRUE	TRUE	Operating parameter
TOFF3	REAL	0	Interlock3 delay elimination(s)	5	TRUE	TRUE	Operating parameter
TON4	REAL	0	Interlock4 delay generation(s)	5	TRUE	TRUE	Operating parameter
TOFF4	REAL	0	Interlock4 delay elimination(s)	5	TRUE	TRUE	Operating parameter
TON5	REAL	0	Interlock5 delay generation(s)	5	TRUE	TRUE	Operating parameter
TOFF5	REAL	0	Interlock5 delay elimination(s)	5	TRUE	TRUE	Operating parameter
TON6	REAL	0	Interlock6 delay generation(s)	5	TRUE	TRUE	Operating parameter
TOFF6	REAL	0	Interlock6 delay elimination(s)	5	TRUE	TRUE	Operating parameter
TON7	REAL	0	Interlock7 delay generation(s)	5	TRUE	TRUE	Operating parameter

Parameter Name	Type	Original Value	Description	Default Permission	Permission is allowed to modify	Parameter upload	Property
TOFF7	REAL	0	Interlock7 delay elimination(s)	5	TRUE	TRUE	Operating parameter
TON8	REAL	0	Interlock8 delay generation(s)	5	TRUE	TRUE	Operating parameter
TOFF8	REAL	0	Interlock8 delay elimination(s)	5	TRUE	TRUE	Operating parameter
ET1	REAL	0	Interlock conditon1 time setting(s)	0	FALSE	FALSE	Operating parameter
ET2	REAL	0	Interlock conditon2 time setting(s)	0	FALSE	FALSE	Operating parameter
ET3	REAL	0	Interlock conditon3 time setting(s)	0	FALSE	FALSE	Operating parameter
ET4	REAL	0	Interlock conditon4 time setting(s)	0	FALSE	FALSE	Operating parameter
ET5	REAL	0	Interlock conditon5 time setting(s)	0	FALSE	FALSE	Operating parameter
ET6	REAL	0	Interlock conditon16time setting(s)	0	FALSE	FALSE	Operating parameter
ET7	REAL	0	Interlock conditon7 time setting(s)	0	FALSE	FALSE	Operating parameter
ET8	REAL	0	Interlock conditon8 time setting(s)	0	FALSE	FALSE	Operating parameter
OOS setting							
SWOOS	BOOL	OFF	Disable function	5	TRUE	FALSE	Operating parameter

Parameter Name	Type	Original Value	Description	Default Permission	Permission is allowed to modify	Parameter upload	Property
			block(ON=disable)				
Enable or shield alarm							
AOF	BOOL	OFF	Module alarm shielding(ON=shielding)	5	TRUE	FALSE	Operating parameter
Interlock configuration							
ENCND1	BOOL	OFF	Enable interlock condition1	0	FALSE	FALSE	Configuration parameter
ENCND2	BOOL	OFF	Enable interlock condition2	0	FALSE	FALSE	Configuration parameter
ENCND3	BOOL	OFF	Enable interlock condition3	0	FALSE	FALSE	Configuration parameter
ENCND4	BOOL	OFF	Enable interlock condition4	0	FALSE	FALSE	Configuration parameter
ENCND5	BOOL	OFF	Enable interlock condition5	0	FALSE	FALSE	Configuration parameter
ENCND6	BOOL	OFF	Enable interlock condition6	0	FALSE	FALSE	Configuration parameter
ENCND7	BOOL	OFF	Enable interlock condition7	0	FALSE	FALSE	Configuration parameter
ENCND8	BOOL	OFF	Enable interlock condition8	0	FALSE	FALSE	Configuration parameter
Status indication							
FLAG	UDINT	0	Flag code	0	FALSE	FALSE	Configuration parameter

4.22.3 Flag

Table 4.81 Flag Code List

Flag (flag code)	Alarm code	Description	Type
D0	OOS	disable	Status
D4	AUTO	automation	Status
D8	IN_BP	Its cascaded function block is in bypass state	Status
D9	IN_FRST	Its cascaded function block is in first-out state	Status
D10	IN_ITLC	Its cascaded function block is in interlock state	Status
D11	BP_C	The function block is in bypass state	Status
D12	ITLK_C	The function block is in interlock state	Status
D13	FRST_C	The function block is in first-out state	Status
D25	AOF	Alarm Shielding	Status

4.22.4 Configuration

ITLK_A configuration property interface adds “interlock”, “reference table” and “macro”. Other methods is as the same as other complicated function blocks.

Configure “interlock” parameter

In addition to the parameter pages of ordinary function blocks, ITLK_A also adds a “interlock” configuration page. An ITLK_A function block can be configured with 8 interlocking conditions. In the editing interface shown in the figure below, you can configure whether the interlock is valid, the interlock condition, the description of the interlock condition, the generation delay, the elimination delay, the latch, the output value, the switching manual auto, and enabling the bypass.

No.	Valid	Condition	Description	TON	TOFF	Latches	Value	Switch...	Bypass...
1	<input type="checkbox"/>			0.00	0.00	<input type="checkbox"/>	0.00	OFF	<input checked="" type="checkbox"/>
2	<input type="checkbox"/>			0.00	0.00	<input type="checkbox"/>	0.00	OFF	<input checked="" type="checkbox"/>
3	<input type="checkbox"/>			0.00	0.00	<input type="checkbox"/>	0.00	OFF	<input checked="" type="checkbox"/>
4	<input type="checkbox"/>			0.00	0.00	<input type="checkbox"/>	0.00	OFF	<input checked="" type="checkbox"/>
5	<input type="checkbox"/>			0.00	0.00	<input type="checkbox"/>	0.00	OFF	<input checked="" type="checkbox"/>
6	<input type="checkbox"/>			0.00	0.00	<input type="checkbox"/>	0.00	OFF	<input checked="" type="checkbox"/>
7	<input type="checkbox"/>			0.00	0.00	<input type="checkbox"/>	0.00	OFF	<input checked="" type="checkbox"/>
8	<input type="checkbox"/>			0.00	0.00	<input type="checkbox"/>	0.00	OFF	<input checked="" type="checkbox"/>

Figure 4.43 The configuration interface of ITLK_A interlock condition

Configure the interlock condition of ITLK_A according to the table below.

Parameter	Function	Configuration Illustration
Valid or not	It is used to enable or disable the interlock condition.	Checking it means to enable this function, otherwise it means disable.
Condition	It is used to configure the trigger expression of the interlock condition.	Double click it, the “condition” dialog box will pop up. The condition supports ST language, supports the tags in the referenced table but doesn’t support cells.
Description	It is used to specify the description of the interlock condition.	Input it in the text box after clicking it.
Generation delay	It is used to specify the generation delay of the interlock condition.	Input it in the text box after clicking it.
Elimination delay	It is used to specify the elimination delay of the interlock condition.	Input it in the text box after clicking it.
Latching	It is used to enable or disable the latching function fo the interlock condition.	Checking it means to enable this function otherwise it means to disable this function.
Value	It is the output of the corresponding IVALn as the interlock condition is met.	Input it in the text box after clicking it.

Parameter	Function	Configuration Illustration
Switch to manual	It is used to configure interlock manual or interlock track.	Select in the drop-down menu. ON means manual interlock, OFF means interlock tracking.
Bypass enable	It is used to enable or disable the bypass function of the interlock condition.	Checking it means to enable this function otherwise it means to disable this function.

When configuring the "Interlock" tab of the ITLK_A function block, operations such as copying and pasting can be used to simplify the configuration.

- **Copy/Paste**
Only "Description", "Generate Delay", "Remove Delay", and "Value" support copy and paste.
- **Delete**
Except for the "condition" column that cannot be directly deleted, the rest of the columns can be deleted through the Delete key. among them:
After the "Manually cut" column is deleted, the ON will be changed to OFF, and there will be no change when deleting OFF.
the "Valid", "Latching" and "Bypass Enable" columns are deleted, the check boxes will be unchecked.

Configure Refer Table

The tag that needs to be referenced in the ITLK_A interlocking condition should be added to its "refer table" before it is used in the interlocking condition. In the configuration interface shown in the figure below, the reference tag of the ITLK_A function block can be added.

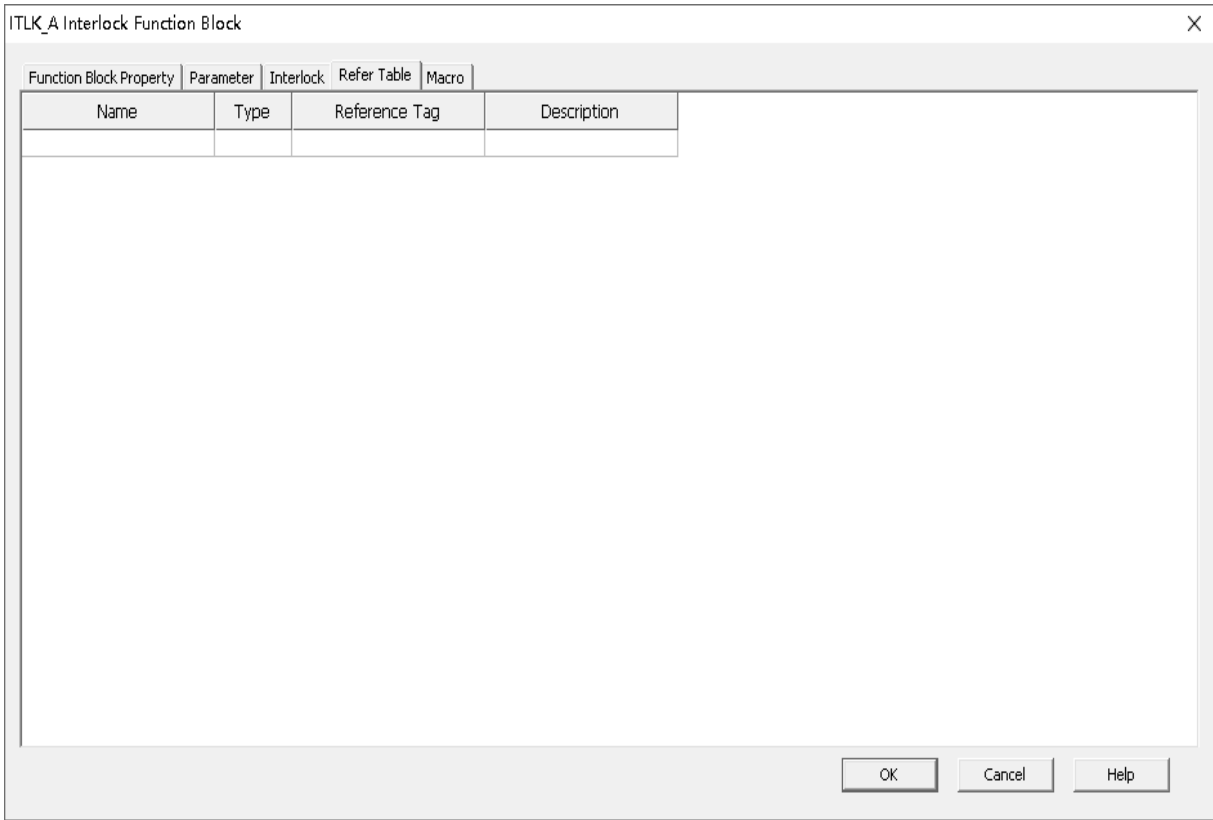


Figure 4.44 The configuration interface of ITLK_A refer table

Macro configuration

"Macro" tab is used to configure the interlock tag of the current function block. The rules for writing the interlock tag in are that the upstream function block is filled in by the downstream function block. As shown in the figure below, 3 ITLK_A are connected in cascade and the names are respectively ITLK1, ITLK2 and ITLK3. "ITLK1" should be configured to the interlock tag of ITLK2.

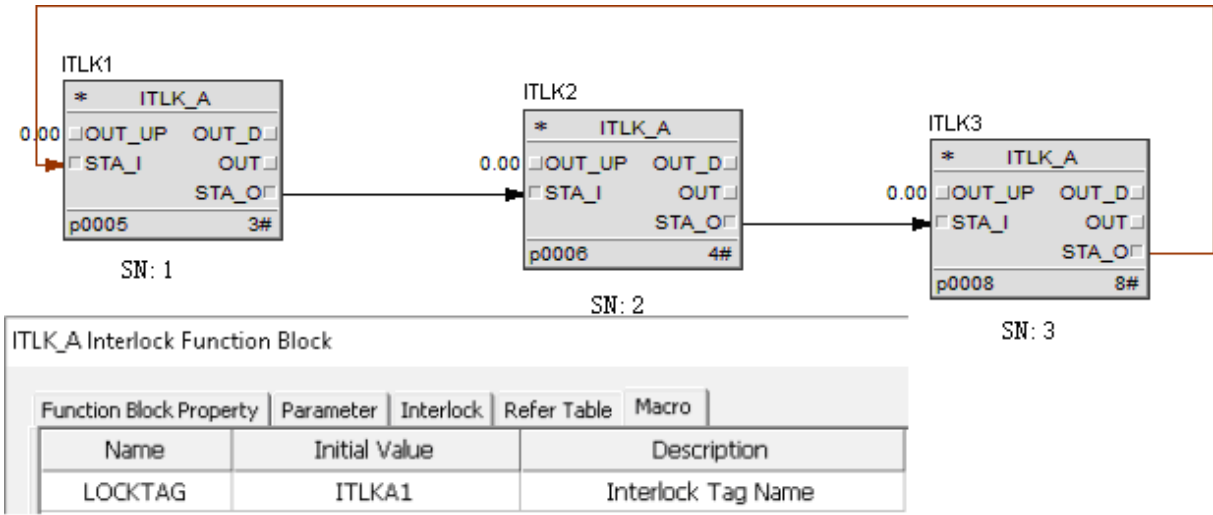


Figure 4.45 The interface of the macro configuration of ITLK_A function block

4.22.5 Logical Illustration

The holistic calculation logic of the function block ITLK_A is shown in the figure below.

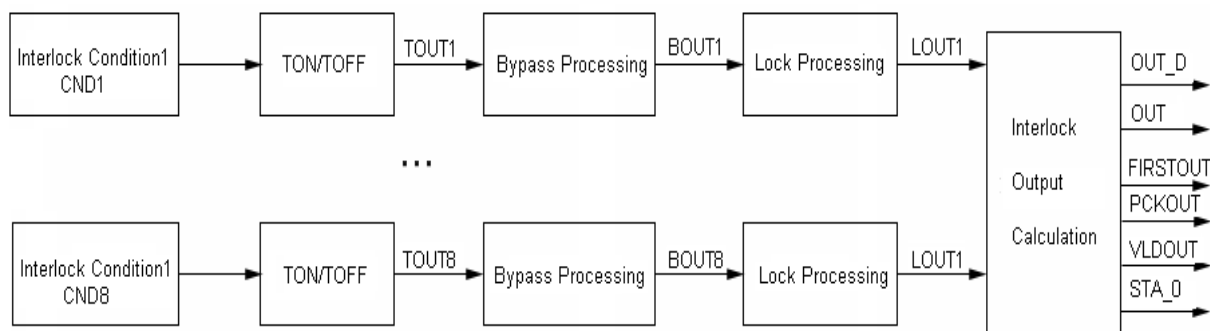


Figure 4.46 The calculation logic graph of ITLK_A

Interlock condition

Whether the expression of the interlocking condition is satisfied, the corresponding CNDn = ON, anyway, CNDn = OFF.

TON/TOFF(delay delay)

Each condition can be set to generate delay (corresponding TONn) and eliminate delay (corresponding TOFFn), as shown in the following figure.

No.	Valid	Condition	Description	TON	TOFF	Latches	Value	Switch Ma...	Bypass...
1	<input checked="" type="checkbox"/>	TI001.PV>80		5.00	2.00	<input checked="" type="checkbox"/>	100.00	OFF	<input checked="" type="checkbox"/>
2	<input checked="" type="checkbox"/>	PI 001.PV>4.2		0.00	4.00	<input type="checkbox"/>	0.00	ON	<input checked="" type="checkbox"/>
3	<input checked="" type="checkbox"/>	DI001.PV=ON		3.00	0.00	<input checked="" type="checkbox"/>	0.00	OFF	<input type="checkbox"/>
4	<input type="checkbox"/>			0.00	0.00	<input type="checkbox"/>	0.00	OFF	<input type="checkbox"/>
5	<input type="checkbox"/>			0.00	0.00	<input type="checkbox"/>	0.00	OFF	<input type="checkbox"/>
6	<input type="checkbox"/>			0.00	0.00	<input type="checkbox"/>	0.00	OFF	<input type="checkbox"/>
7	<input type="checkbox"/>			0.00	0.00	<input type="checkbox"/>	0.00	OFF	<input type="checkbox"/>
8	<input type="checkbox"/>			0.00	0.00	<input type="checkbox"/>	0.00	OFF	<input type="checkbox"/>

Figure 4.47 The case of configuring the generation delay and elimination delay of ITLK_A function block



Figure 4.48 The sequence diagram of ITLK_A function block as generating or eliminating delay

Bypass processing

When the configuration of “Bypass Enable” of a certain channel is checked, ENBPn = ON, and the bypass is allowed on the panel. When the configuration of “Bypass Enable” of a certain channel is not checked, then ENBPn = OFF, the bypass is not allowed on the panel, BOUTn = TOUTn.

When BPn = ON, no matter what the value of TOUTn is, BOUTn = OFF. When BPn = OFF, then BOUTn = TOUTn.

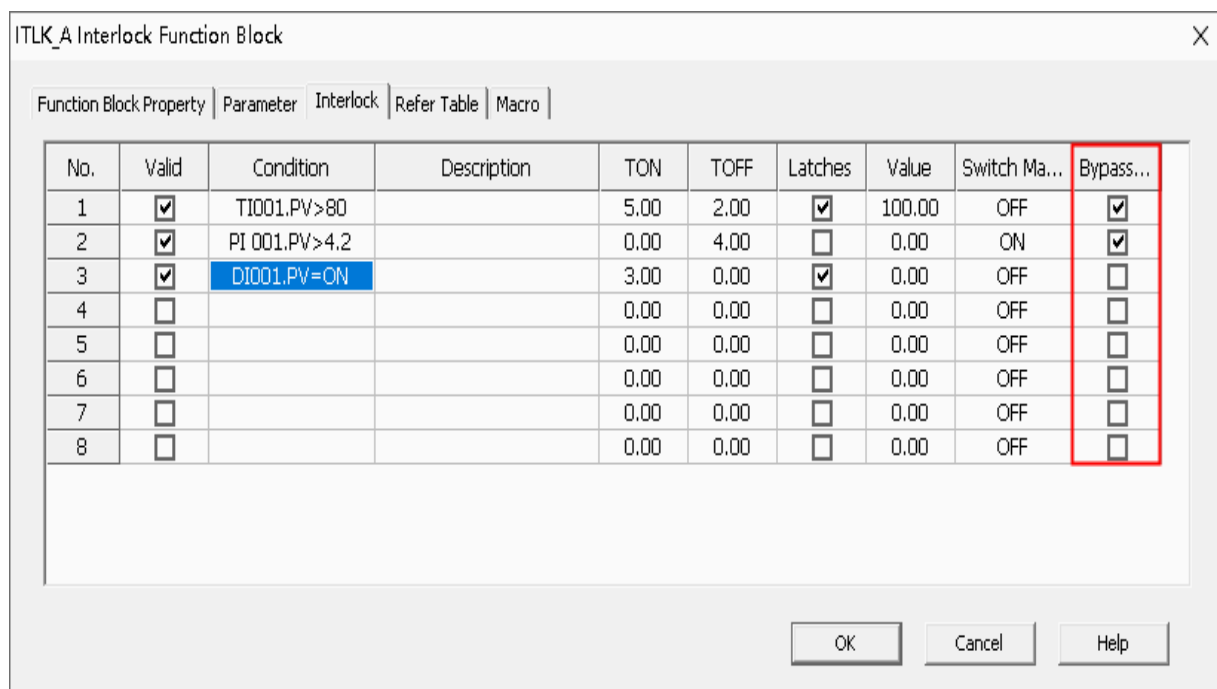


Figure 4.49 The case of configuring the bypass of ITLK_A function block

When the latch function is not configured, then LOUTn = BOUTn.

Latching calculation

When “Latch” is ticked in a certain configuration, ie ENLATCHn = ON, the latch function is enabled.

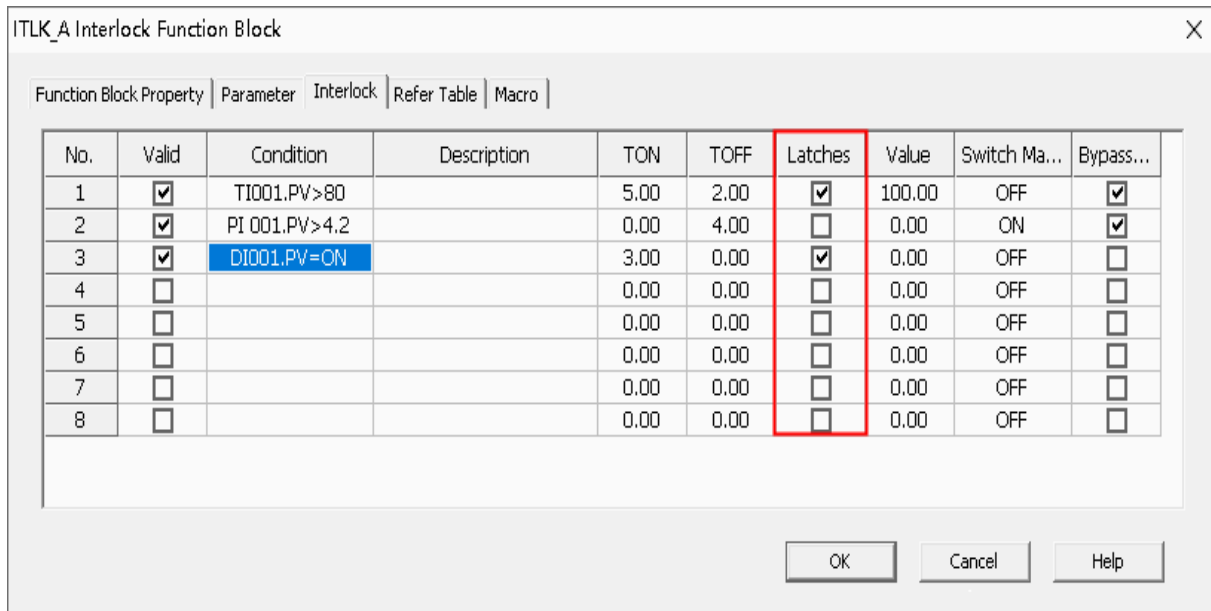


Figure 4.50 The case of configuring latching of ITLK_A function block

When the latch function is enabled:

- When BOUTn = ON, if BKINERR=ON or BKIN > OUT + HYS or BKIN < OUT-HYS, then LOUTn = ON, enter the latch status LATCHn = ON.
- After entering the latched status (LATCHn = ON), even if BOUTn = OFF or BKIN ≤ OUT + HYS or BKIN > = OUT-HYS, then it is still in the latched status.
- If it is in the latched status (LATCHn = ON), then LOUTn = ON.
- If it is not in the latched status (LATCHn = OFF), then LOUTn = BOUTn.
- When BOUTn = OFF, if it is in the latched status (LATCHn = ON), then the corresponding RSTREQn = ON, can be reset by RESET to make LATCHn = OFF, LOUTn = OFF.

Interlock output calculation

- Calculate the package output:
If LOUT is ON, the n-1 bit of the corresponding PACKOUT is 1. If L_OUTn is OFF, the n-1 bit of the corresponding PACKOUT is 0.
- Priority calculation:
The lowest sequence number has the highest priority, and the lowest sequence number where LOUTn is currently ON is output.
- First out calculation:
When ENFIRST = ON, the first out calculation is performed
If there is currently the first output, the current output is maintained.
If there is no first output at present, and the first serial number is the lowest serial number of LOUTn = ON.
- Interlock and first-out reset function

When RST_OPT = ON, it is necessary to reset the interlock latch signal and first output signal when all input conditions are not satisfied.

When RST_OPT = OFF, you can reset the interlock latch signal and the first output signal at any time.

When there is no LOUTn = ON, if BKINERR = OFF, and OUT-BKIN > HYS or OUT-BKIN < -HYS, the first output signal is automatically reset.

- Output selection

The current output OUT is the IVAL value corresponding to the lowest serial number of LOUTn = ON.

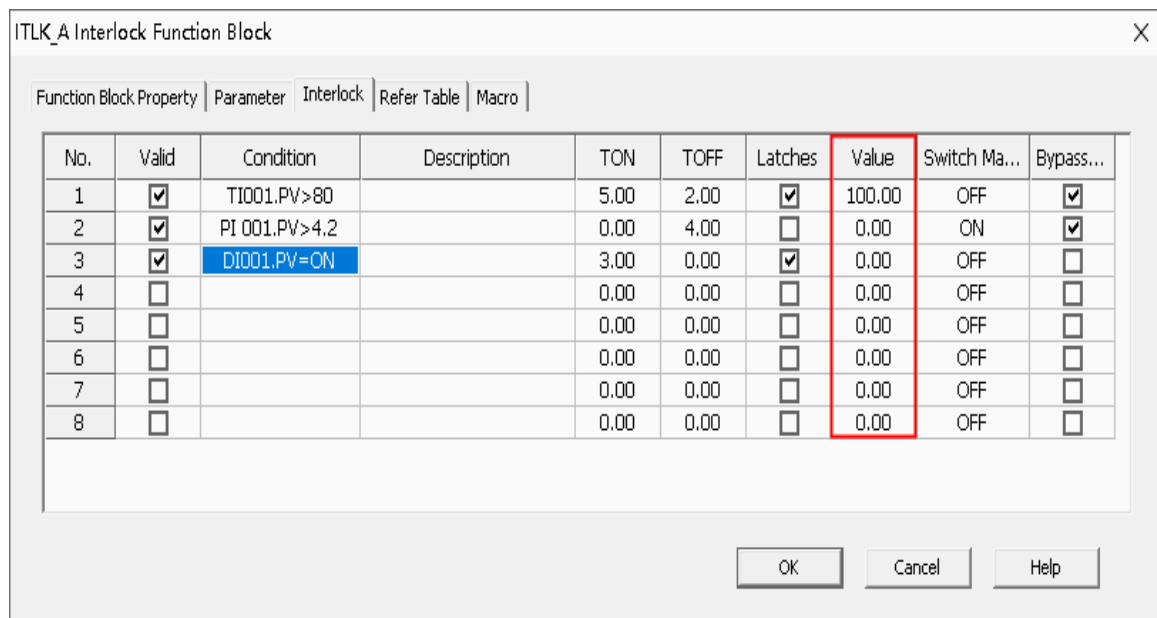


Figure 4.51 The case of configuring values of ITLK_A function block

- OUT_D output

If the current LOUTn = ON corresponds to the lowest TOMANn = ON (that is, manually tick), OUT_D = 1.

If TOMANn = OFF corresponding to the lowest serial number of current LOUTn = ON (that is, it is not ticked manually), OUT_D = 2. If there is no valid serial number, OUT_D = 0.

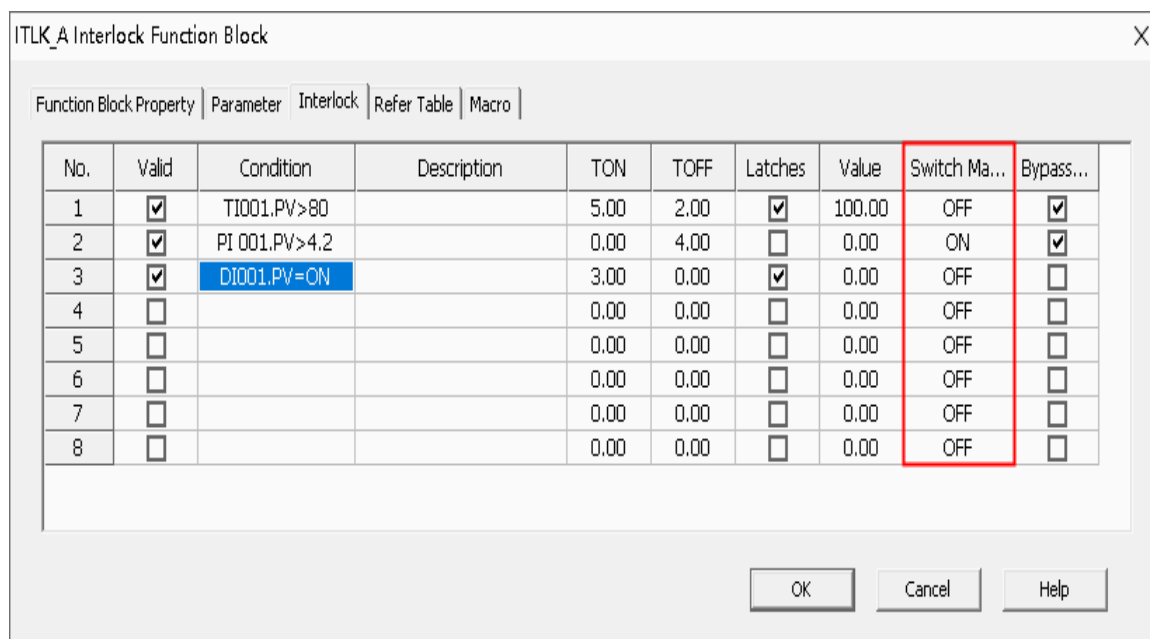


Figure 4.52 The case of manual switching configuration of ITLK_A function block

4.22.6 Panel Parameter

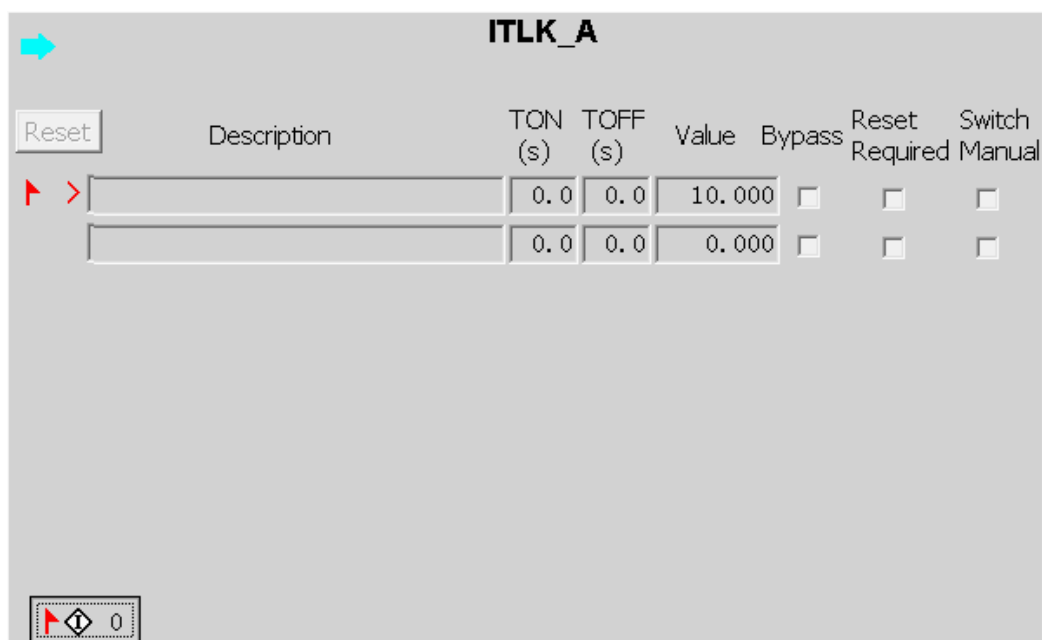












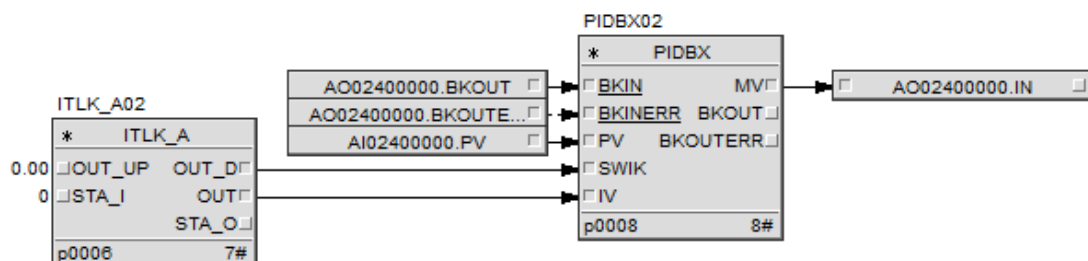
Figure 4.53 ITLK_A Function Block Parameter Panel

Table 4.82 ITLK_A Function Block Panel Parameter Table

Panel Display		Parameter Name	Initial Value	Assignment	Remark
		This icon means it is first-out.			
		 means the condition is tenable as shown in the figure above.  means the condition is latched, but it is still in a delay status.			
		If  appears, it means interlock occurs without being bypassed. If  appears, it means there is no interlock without being bypassed.			
		If  appears, it means interlock occurs with being bypassed. If  appears, it means there is no interlock with being bypassed.			
Inter-lock	Reset	RESET	OFF	Writable	Reset command
	TON(s)	TON1- TON8	0.0	-	Ton of Interlock 1-8
	TOFF(s)	TOFF1- TOFF8	0.0	-	Toff of Interlock 1-8
	Value	IVAL1- IVAL8	0.0	-	Tracking value 1-8
	Bypass	BP1-BP8	OFF	Writable	Bypass switch1-8
	Switch Manual	TOMAN1- TOMAN8	OFF	Writable	Manual Interlock Switch 1-8
	Reset Required	CAN_RST	OFF	Writable	Allow to Reset

4.22.7 Application Illustration

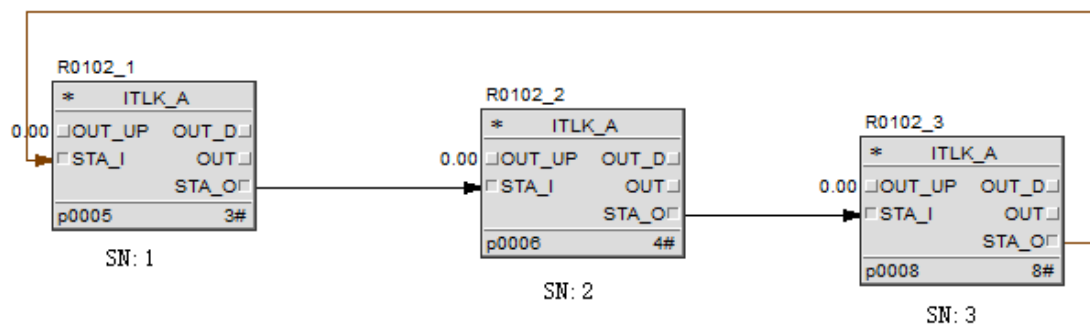
Connect to PID



- When SWIK=1 is satisfied, PID is forced into the interlock manual status and the output value follows the change of the OUT of ITLK_A and cannot be operated on the panel.
- When SWIK=2 is satisfied, PID is forced into the interlock following status and the output value follows the change of the OUT of ITLK_A and cannot be operated on the panel.

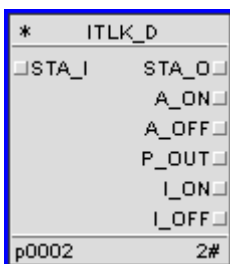
In Cascade

They can be connected to each other by STA_I and STA_O and also can be used in cascade mode. Up to 8 modules can be in one cascade and the sequence number has to start from 1.



4.23 Digital Signal Interlock Function Block (ITLK_D)

ITLK_D Function Block is used for interlock control and output digital interlock signal.



4.23.1 Parameter Description

Parameter Name	Description	Parameter Type	Application
Input Pin	CMD_IN	Input Feedback command	BOOL
	STA_I	Status Input	UDINT
Output Parameter	STA_O	Status Output	UDINT
	A_ON	Automaticly start/operate the output	BOOL
	A_OFF	Automaticly end/stop output	BOOL

Parameter Name		Description	Parameter Type	Application
	I_ON	Interlock start/operate output	BOOL	
	I_OFF	Interlock end/stop output	BOOL	
	P_OUT	Allow to output	BOOL	-
	FIRSTOUT	It displays the pin number which firstly jumps	UINT	
	A_PCKOUT	Automaticly output in package	UINT	
	A_VLDOUT	Automaticly output the sequence number at present	UINT	
	I_PCKOUT	Interlock output in package	UINT	
	I_VLDOUT	The current interlock sequence number	UINT	
	P_PCKOUT	Allows to output in package	UINT	-
	P_VLDOUT	The allowed sequence number at present	UINT	-
Operational Parameters	SN	Serial Number	USINT	-
	OUT_OPT	Output Mode(0:I_ON=ON,I_OFF=ON;1:I_ON=OFF,I_OFF=OFF;2:I_ON=ON,I_OFF=OFF;Others:I_ON=OFF,I_OFF=ON)	USINT	-
	RST_OPT	Reset Optional	BOOL	-
	ENFIRST	Enable Fisrt out	BOOL	
Permissive configuration	PRM_MODE	Calculation of permissive mode:0=or, 1=and	USINT	
Configuration Parameter	DLEN	Decimal Digits[0,5]	USINT	-

4.23.2 Other Parameters

Parameter Name	Type	Original Value	Description	Default permission	Modify permission	Parameter Upload	Default Pin	Property
Input external condition								
CND1	BOOL	OFF	Interlock condition1	0	FALSE	FALSE		Monitoring parameters
CND2	BOOL	OFF	Interlock condition2	0	FALSE	FALSE		Monitoring parameters

Parameter Name	Type	Original Value	Description	Default permission	Modify permission	Parameter Upload	Default Pin	Property
CND3	BOOL	OFF	Interlock condition3	0	FALSE	FALSE		Monitoring parameters
CND4	BOOL	OFF	Interlock condition4	0	FALSE	FALSE		Monitoring parameters
CND5	BOOL	OFF	Interlock condition5	0	FALSE	FALSE		Monitoring parameters
CND6	BOOL	OFF	Interlock condition6	0	FALSE	FALSE		Monitoring parameters
CND7	BOOL	OFF	Interlock condition7	0	FALSE	FALSE		Monitoring parameters
CND8	BOOL	OFF	Interlock condition8	0	FALSE	FALSE		Monitoring parameters
PRM1	BOOL	OFF	Permissive condition1	0	FALSE	FALSE		Monitoring parameters
PRM2	BOOL	OFF	Permissive condition2	0	FALSE	FALSE		Monitoring parameters
PRM3	BOOL	OFF	Permissive condition3	0	FALSE	FALSE		Monitoring parameters
PRM4	BOOL	OFF	Permissive condition4	0	FALSE	FALSE		Monitoring parameters
AUT1	BOOL	OFF	Auto condition1	0	FALSE	FALSE		Monitoring parameters
AUT2	BOOL	OFF	Auto condition2	0	FALSE	FALSE		Monitoring parameters
AUT3	BOOL	OFF	Auto condition3	0	FALSE	FALSE		Monitoring parameters
AUT4	BOOL	OFF	Auto condition4	0	FALSE	FALSE		Monitoring parameters
Other operational parameters								
CAN_-RST	BOOL	OFF	Can be reset	5	TRUE	TRUE		Operational parameters
RESET	BOOL	OFF	Reset switch	5	TRUE	FALSE		Operational parameters
Interlock bypass settings								
ENI_BP1	BOOL	OFF	Interlock bypass1 enable	5	TRUE	TRUE		Operational parameters

Parameter Name	Type	Original Value	Description	Default permission	Modify permission	Parameter Upload	Default Pin	Property
I_BP1	BOOL	OFF	Interlock bypass switch1	5	TRUE	FALSE		Operational parameters
ENI_BP2	BOOL	OFF	Interlock bypass2 enable	5	TRUE	TRUE		Operational parameters
I_BP2	BOOL	OFF	Interlock bypass switch2	5	TRUE	FALSE		Operational parameters
ENI_BP3	BOOL	OFF	Interlock bypass3 enable	5	TRUE	TRUE		Operational parameters
I_BP3	BOOL	OFF	Interlock bypass switch3	5	TRUE	FALSE		Operational parameters
ENI_BP4	BOOL	OFF	Interlock bypass4 enable	5	TRUE	TRUE		Operational parameters
I_BP4	BOOL	OFF	Interlock bypass switch4	5	TRUE	FALSE		Operational parameters
ENI_BP5	BOOL	OFF	Interlock bypass5 enable	5	TRUE	TRUE		Operational parameters
I_BP5	BOOL	OFF	Interlock bypass switch5	5	TRUE	FALSE		Operational parameters
ENI_BP6	BOOL	OFF	Interlock bypass6 enable	5	TRUE	TRUE		Operational parameters
I_BP6	BOOL	OFF	Interlock bypass switch6	5	TRUE	FALSE		Operational parameters
ENI_BP7	BOOL	OFF	Interlock bypass7 enable	5	TRUE	TRUE		Operational parameters
I_BP7	BOOL	OFF	Interlock bypass switch7	5	TRUE	FALSE		Operational parameters
ENI_BP8	BOOL	OFF	Interlock bypass8 enable	5	TRUE	TRUE		Operational parameters

Parameter Name	Type	Original Value	Description	Default permission	Modify permission	Parameter Upload	Default Pin	Property
I_BP8	BOOL	OFF	Interlock bypass switch8	5	TRUE	FALSE		Operational parameters
Interlock latching settings								
EN-LATCH1	BOOL	OFF	Enable latching1	5	TRUE	TRUE		Operational parameters
EN-LATCH2	BOOL	OFF	Enable latching2	5	TRUE	TRUE		Operational parameters
EN-LATCH3	BOOL	OFF	Enable latching3	5	TRUE	TRUE		Operational parameters
EN-LATCH4	BOOL	OFF	Enable latching4	5	TRUE	TRUE		Operational parameters
EN-LATCH5	BOOL	OFF	Enable latching5	5	TRUE	TRUE		Operational parameters
EN-LATCH6	BOOL	OFF	Enable latching6	5	TRUE	TRUE		Operational parameters
EN-LATCH7	BOOL	OFF	Enable latching7	5	TRUE	TRUE		Operational parameters
EN-LATCH8	BOOL	OFF	Enable latching8	5	TRUE	TRUE		Operational parameters
Interlock status settings								
IVAL1	BOOL	OFF	Interlock value1	5	TRUE	TRUE		Operational parameters
IVAL2	BOOL	OFF	Interlock value2	5	TRUE	TRUE		Operational parameters
IVAL3	BOOL	OFF	Interlock value3	5	TRUE	TRUE		Operational parameters
IVAL4	BOOL	OFF	Interlock value4	5	TRUE	TRUE		Operational parameters
IVAL5	BOOL	OFF	Interlock value5	5	TRUE	TRUE		Operational parameters
IVAL6	BOOL	OFF	Interlock value6	5	TRUE	TRUE		Operational parameters
IVAL7	BOOL	OFF	Interlock value7	5	TRUE	TRUE		Operational parameters
IVAL8	BOOL	OFF	Interlock value8	5	TRUE	TRUE		Operational parameters
Interlock time								

Parameter Name	Type	Original Value	Description	Default permission	Modify permission	Parameter Upload	Default Pin	Property
I_TON1	REAL	0	Interlock1 generation delay (s)	5	TRUE	TRUE		Operational parameters
I_TOFF1	REAL	0	Interlock1 elimination delay (s)	5	TRUE	TRUE		Operational parameters
I_TON2	REAL	0	Interlock2 generation delay (s)	5	TRUE	TRUE		Operational parameters
I_TOFF2	REAL	0	Interlock2 elimination delay (s)	5	TRUE	TRUE		Operational parameters
I_TON3	REAL	0	Interlock3 generation delay (s)	5	TRUE	TRUE		Operational parameters
I_TOFF3	REAL	0	Interlock3 elimination delay (s)	5	TRUE	TRUE		Operational parameters
I_TON4	REAL	0	Interlock4 generation delay (s)	5	TRUE	TRUE		Operational parameters
I_TOFF4	REAL	0	Interlock4 elimination delay (s)	5	TRUE	TRUE		Operational parameters
I_TON5	REAL	0	Interlock5 generation delay (s)	5	TRUE	TRUE		Operational parameters
I_TOFF5	REAL	0	Interlock5 elimination delay (s)	5	TRUE	TRUE		Operational parameters
I_TON6	REAL	0	Interlock6 generation delay (s)	5	TRUE	TRUE		Operational parameters
I_TOFF6	REAL	0	Interlock6 elimination delay (s)	5	TRUE	TRUE		Operational parameters
I_TON7	REAL	0	Interlock7 generation delay (s)	5	TRUE	TRUE		Operational parameters
I_TOFF7	REAL	0	Interlock7 elimination delay (s)	5	TRUE	TRUE		Operational parameters

Parameter Name	Type	Original Value	Description	Default permission	Modify permission	Parameter Upload	Default Pin	Property
I_TON8	REAL	0	Interlock8 generation delay (s)	5	TRUE	TRUE		Operational parameters
I_TOFF8	REAL	0	Interlock8 elimination delay (s)	5	TRUE	TRUE		Operational parameters
I_ET1	REAL	0	Interlock condition1 time setting (s)	0	FALSE	FALSE		Monitoring parameters
I_ET2	REAL	0	Interlock condition2 time setting (s)	0	FALSE	FALSE		Monitoring parameters
I_ET3	REAL	0	Interlock condition3 time setting (s)	0	FALSE	FALSE		Monitoring parameters
I_ET4	REAL	0	Interlock condition4 time setting (s)	0	FALSE	FALSE		Monitoring parameters
I_ET5	REAL	0	Interlock condition5 time setting (s)	0	FALSE	FALSE		Monitoring parameters
I_ET6	REAL	0	Interlock condition6 time setting (s)	0	FALSE	FALSE		Monitoring parameters
I_ET7	REAL	0	Interlock condition7 time setting (s)	0	FALSE	FALSE		Monitoring parameters
I_ET8	REAL	0	Interlock condition8 time setting (s)	0	FALSE	FALSE		Monitoring parameters
Enable Bypass								
ENP_BP1	BOOL	OFF	Enable permissive bypass1	5	TRUE	TRUE		Operational parameters
P_BP1	BOOL	OFF	Permissive bypass switch1	5	TRUE	FALSE		Operational parameters

Parameter Name	Type	Original Value	Description	Default permission	Modify permission	Parameter Upload	Default Pin	Property
ENP_BP2	BOOL	OFF	Enable permissive bypass2	5	TRUE	TRUE		Operational parameters
P_BP2	BOOL	OFF	Permissive bypass switch2	5	TRUE	FALSE		Operational parameters
ENP_BP3	BOOL	OFF	Enable permissive bypass3	5	TRUE	TRUE		Operational parameters
P_BP3	BOOL	OFF	Permissive bypass switch3	5	TRUE	FALSE		Operational parameters
ENP_BP4	BOOL	OFF	Enable permissive bypass4	5	TRUE	TRUE		Operational parameters
P_BP4	BOOL	OFF	Permissive bypass switch4	5	TRUE	FALSE		Operational parameters
Permissive time								
P_TON1	REAL	0	Allow 1 generation delay(s)	5	TRUE	TRUE		Operational parameters
P_TOFF1	REAL	0	Allow 1 elimination delay (s)	5	TRUE	TRUE		Operational parameters
P_TON2	REAL	0	Allow 2 generation delay(s)	5	TRUE	TRUE		Operational parameters
P_TOFF2	REAL	0	Allow 2 elimination delay (s)	5	TRUE	TRUE		Operational parameters
P_TON3	REAL	0	Allow 3 generation delay(s)	5	TRUE	TRUE		Operational parameters
P_TOFF3	REAL	0	Allow 3 elimination delay (s)	5	TRUE	TRUE		Operational parameters
P_TON4	REAL	0	Allow 4 generation delay(s)	5	TRUE	TRUE		Operational parameters
P_TOFF4	REAL	0	Allow 4 elimination delay (s)	5	TRUE	TRUE		Operational parameters

Parameter Name	Type	Original Value	Description	Default permission	Modify permission	Parameter Upload	Default Pin	Property
P_ET1	REAL	0	permissive condition1 time setting (s)	0	FALSE	FALSE		Monitoring parameters
P_ET2	REAL	0	permissive condition2 time setting (s)	0	FALSE	FALSE		Monitoring parameters
P_ET3	REAL	0	permissive condition3 time setting (s)	0	FALSE	FALSE		Monitoring parameters
P_ET4	REAL	0	permissive condition4 time setting (s)	0	FALSE	FALSE		Monitoring parameters
Auto bypass settings								
ENA_BP1	BOOL	OFF	Enable auto bypass1	5	TRUE	TRUE		Operational parameters
A_BP1	BOOL	OFF	Auto bypass switch1	5	TRUE	FALSE		Operational parameters
ENA_BP2	BOOL	OFF	Enable auto bypass2	5	TRUE	TRUE		Operational parameters
A_BP2	BOOL	OFF	Auto bypass switch2	5	TRUE	FALSE		Operational parameters
ENA_BP3	BOOL	OFF	Enable auto bypass3	5	TRUE	TRUE		Operational parameters
A_BP3	BOOL	OFF	Auto bypass switch3	5	TRUE	FALSE		Operational parameters
ENA_BP4	BOOL	OFF	Enable auto bypass4	5	TRUE	TRUE		Operational parameters
A_BP4	BOOL	OFF	Auto bypass switch4	5	TRUE	FALSE		Operational parameters
Auto status settings								
AVAL1	BOOL	OFF	Auto value1	5	TRUE	TRUE		Operational parameters
AVAL2	BOOL	OFF	Auto value2	5	TRUE	TRUE		Operational parameters

Parameter Name	Type	Original Value	Description	Default permission	Modify permission	Parameter Upload	Default Pin	Property
AVAL3	BOOL	OFF	Auto value3	5	TRUE	TRUE		Operational parameters
AVAL4	BOOL	OFF	Auto value4	5	TRUE	TRUE		Operational parameters
Auto time								
A_TON1	REAL	0	Auto1 generation delay(s)	5	TRUE	TRUE		Operational parameters
A_TON2	REAL	0	Auto2 generation delay(s)	5	TRUE	TRUE		Operational parameters
A_TON3	REAL	0	Auto3 generation delay(s)	5	TRUE	TRUE		Operational parameters
A_TON4	REAL	0	Auto4 generation delay(s)	5	TRUE	TRUE		Operational parameters
A_ET1	REAL	0	Auto condition1 time setting(s)	0	FALSE	FALSE		Monitoring parameters
A_ET2	REAL	0	Auto condition2 time setting(s)	0	FALSE	FALSE		Monitoring parameters
A_ET3	REAL	0	Auto condition3 time setting(s)	0	FALSE	FALSE		Monitoring parameters
A_ET4	REAL	0	Auto condition4 time setting(s)	0	FALSE	FALSE		Monitoring parameters
OOS settings								
SWOOS	BOOL	OFF	Function block disable (ON=disable)	5	TRUE	FALSE		Operational parameters
Enable and shield alarm								
AOF	BOOL	OFF	Module alarm shield (ON=shield)	5	TRUE	FALSE		Operational parameters
Status indication								

Parameter Name	Type	Original Value	Description	Default permission	Modify permission	Parameter Upload	Default Pin	Property
FLAG	UDINT	0	Flag code	0	FALSE	FALSE		Monitoring parameters
Interlock monitoring of each status								
LATCH1	BOOL	OFF	Whether in the latching status1	0	FALSE	FALSE		Monitoring parameters
LATCH2	BOOL	OFF	Whether in the latching status2	0	FALSE	FALSE		Monitoring parameters
LATCH3	BOOL	OFF	Whether in the latching status3	0	FALSE	FALSE		Monitoring parameters
LATCH4	BOOL	OFF	Whether in the latching status4	0	FALSE	FALSE		Monitoring parameters
LATCH5	BOOL	OFF	Whether in the latching status5	0	FALSE	FALSE		Monitoring parameters
LATCH6	BOOL	OFF	Whether in the latching status6	0	FALSE	FALSE		Monitoring parameters
LATCH7	BOOL	OFF	Whether in the latching status7	0	FALSE	FALSE		Monitoring parameters
LATCH8	BOOL	OFF	Whether in the latching status8	0	FALSE	FALSE		Monitoring parameters
RSTREQ1	BOOL	OFF	Interlock condition1 allows the resetting (ON=allow)	0	FALSE	FALSE		Monitoring parameters
RSTREQ2	BOOL	OFF	Interlock condition2 allows the resetting (ON=allow)	0	FALSE	FALSE		Monitoring parameters
RSTREQ3	BOOL	OFF	Interlock condition3 allows the resetting (ON=allow)	0	FALSE	FALSE		Monitoring parameters
RSTREQ4	BOOL	OFF	Interlock condition4 allows the	0	FALSE	FALSE		Monitoring parameters

Parameter Name	Type	Original Value	Description	Default permission	Modify permission	Parameter Upload	Default Pin	Property
			resetting (ON=allow)					
RSTREQ5	BOOL	OFF	Interlock condition5 allows the resetting (ON=allow)	0	FALSE	FALSE		Monitoring parameters
RSTREQ6	BOOL	OFF	Interlock condition6 allows the resetting (ON=allow)	0	FALSE	FALSE		Monitoring parameters
RSTREQ7	BOOL	OFF	Interlock condition7 the resetting (ON=allow)	0	FALSE	FALSE		Monitoring parameters
RSTREQ8	BOOL	OFF	Interlock condition8 allows the resetting (ON=allow)	0	FALSE	FALSE		Monitoring parameters
I_TOUT1	BOOL	OFF	The output of Interlock condition1 after the time setting processing	0	FALSE	FALSE		Monitoring parameters
I_TOUT2	BOOL	OFF	The output of Interlock condition2 after the time setting processing	0	FALSE	FALSE		Monitoring parameters
I_TOUT3	BOOL	OFF	The output of Interlock condition3 after the time setting processing	0	FALSE	FALSE		Monitoring parameters
I_TOUT4	BOOL	OFF	The output of Interlock condition4 after the time setting processing	0	FALSE	FALSE		Monitoring parameters

Parameter Name	Type	Original Value	Description	Default permission	Modify permission	Parameter Upload	Default Pin	Property
I_TOUT5	BOOL	OFF	The output of Interlock condition5 after the time setting processing	0	FALSE	FALSE		Monitoring parameters
I_TOUT6	BOOL	OFF	The output of Interlock condition6 after the time setting processing	0	FALSE	FALSE		Monitoring parameters
I_TOUT7	BOOL	OFF	The output of Interlock condition7 after the time setting processing	0	FALSE	FALSE		Monitoring parameters
I_TOUT8	BOOL	OFF	The output of Interlock condition8 after the time setting processing	0	FALSE	FALSE		Monitoring parameters
I_BOUT1	BOOL	OFF	The Output of interlock condition1at the bypass	0	FALSE	FALSE		Monitoring parameters
I_BOUT2	BOOL	OFF	The Output of interlock condition2 at the bypass	0	FALSE	FALSE		Monitoring parameters
I_BOUT3	BOOL	OFF	The Output of interlock condition3 at the bypass	0	FALSE	FALSE		Monitoring parameters
I_BOUT4	BOOL	OFF	The Output of interlock condition4 at the bypass	0	FALSE	FALSE		Monitoring parameters
I_BOUT5	BOOL	OFF	The Output of interlock condition5	0	FALSE	FALSE		Monitoring parameters

Parameter Name	Type	Original Value	Description	Default permission	Modify permission	Parameter Upload	Default Pin	Property
			at the by-pass					
I_BOUT6	BOOL	OFF	The Output of interlock condition6 at the by-pass	0	FALSE	FALSE		Monitoring parameters
I_BOUT7	BOOL	OFF	The Output of interlock condition7 at the by-pass	0	FALSE	FALSE		Monitoring parameters
I_BOUT8	BOOL	OFF	The Output of interlock condition8 at the by-pass	0	FALSE	FALSE		Monitoring parameters
I_LOUT1	BOOL	OFF	The Output of interlock condition1 after latching processing	0	FALSE	FALSE		Monitoring parameters
I_LOUT2	BOOL	OFF	The Output of interlock condition2 after latching processing	0	FALSE	FALSE		Monitoring parameters
I_LOUT3	BOOL	OFF	The Output of interlock condition3 after latching processing	0	FALSE	FALSE		Monitoring parameters
I_LOUT4	BOOL	OFF	The Output of interlock condition4 after latching processing	0	FALSE	FALSE		Monitoring parameters
I_LOUT5	BOOL	OFF	The Output of interlock condition5 after latching processing	0	FALSE	FALSE		Monitoring parameters
I_LOUT6	BOOL	OFF	The Output of interlock condition6 af	0	FALSE	FALSE		Monitoring parameters

Parameter Name	Type	Original Value	Description	Default permission	Modify permission	Parameter Upload	Default Pin	Property
			ter latching processing					
I_LOUT7	BOOL	OFF	The Output of interlock condition7 after latching processing	0	FALSE	FALSE		Monitoring parameters
I_LOUT8	BOOL	OFF	The Output of interlock condition8 after latching processing	0	FALSE	FALSE		Monitoring parameters
Allow monitoring of each status								
P_TOUT1	BOOL	OFF	The Output of permissive condition1 after time setting processing	0	FALSE	FALSE		Monitoring parameters
P_TOUT2	BOOL	OFF	The Output of permissive condition2 after time setting processing	0	FALSE	FALSE		Monitoring parameters
P_TOUT3	BOOL	OFF	The Output of permissive condition3 after time setting processing	0	FALSE	FALSE		Monitoring parameters
P_TOUT4	BOOL	OFF	The Output of permissive condition4 after time setting processing	0	FALSE	FALSE		Monitoring parameters
P_BOUT1	BOOL	OFF	The output of permissive condition1 after the bypass processing	0	FALSE	FALSE		Monitoring parameters
P_BOUT2	BOOL	OFF	The output of permis-	0	FALSE	FALSE		Monitoring parameters

Parameter Name	Type	Original Value	Description	Default permission	Modify permission	Parameter Upload	Default Pin	Property
			sive condition2 after the bypass processing					
P_BOUT3	BOOL	OFF	The output of permissive condition3 after the bypass processing	0	FALSE	FALSE		Monitoring parameters
P_BOUT4	BOOL	OFF	The output of permissive condition4 after the bypass processing	0	FALSE	FALSE		Monitoring parameters
Auto monitoring of each status								
A_TOUT1	BOOL	OFF	The output of auto condition 1 after the time setting processing	0	FALSE	FALSE		Monitoring parameters
A_TOUT2	BOOL	OFF	The output of auto condition 2 after the time setting processing	0	FALSE	FALSE		Monitoring parameters
A_TOUT3	BOOL	OFF	The output of auto condition 3 after the time setting processing	0	FALSE	FALSE		Monitoring parameters
A_TOUT4	BOOL	OFF	The output of auto condition 4 after the time setting processing	0	FALSE	FALSE		Monitoring parameters
A_BOUT1	BOOL	OFF	The output of auto condition1 after bypass processing	0	FALSE	FALSE		Monitoring parameters

Parameter Name	Type	Original Value	Description	Default permission	Modify permission	Parameter Upload	Default Pin	Property
A_BOUT2	BOOL	OFF	The output of auto conditon2 after by-pass processing	0	FALSE	FALSE		Monitoring parameters
A_BOUT3	BOOL	OFF	The output of auto conditon3 after by-pass processing	0	FALSE	FALSE		Monitoring parameters
A_BOUT4	BOOL	OFF	The output of auto conditon4 after by-pass processing	0	FALSE	FALSE		Monitoring parameters
Interlock configuration								
ENCND1	BOOL	OFF	Enable interlock condition1	0	FALSE	FALSE		Configuration parameters
ENCND2	BOOL	OFF	Enable interlock condition2	0	FALSE	FALSE		Configuration parameters
ENCND3	BOOL	OFF	Enable interlock condition3	0	FALSE	FALSE		Configuration parameters
ENCND4	BOOL	OFF	Enable interlock condition4	0	FALSE	FALSE		Configuration parameters
ENCND5	BOOL	OFF	Enable interlock condition5	0	FALSE	FALSE		Configuration parameters
ENCND6	BOOL	OFF	Enable interlock condition6	0	FALSE	FALSE		Configuration parameters
ENCND7	BOOL	OFF	Enable interlock condition7	0	FALSE	FALSE		Configuration parameters
ENCND8	BOOL	OFF	Enable interlock condition8	0	FALSE	FALSE		Configuration parameters
Permissive configuration								

Parameter Name	Type	Original Value	Description	Default permission	Modify permission	Parameter Upload	Default Pin	Property
ENPRM1	BOOL	OFF	Enable permissive conditon1	0	FALSE	FALSE		Configura- tion para- meters
ENPRM2	BOOL	OFF	Enable permissive conditon2	0	FALSE	FALSE		Configura- tion para- meters
ENPRM3	BOOL	OFF	Enable permissive conditon3	0	FALSE	FALSE		Configura- tion para- meters
ENPRM4	BOOL	OFF	Enable permissive conditon4	0	FALSE	FALSE		Configura- tion para- meters
PRM_- MODE	USINT	1	Permissice calculation method: 0=or, 1=and	0	FALSE	FALSE		Configura- tion para- meters
Auto configuration								
ENAUT1	BOOL	OFF	Enable au- to condi- ton1	0	FALSE	FALSE		Configura- tion para- meters
ENAUT2	BOOL	OFF	Enable au- to condi- ton2	0	FALSE	FALSE		Configura- tion para- meters
ENAUT3	BOOL	OFF	Enable au- to condi- ton3	0	FALSE	FALSE		Configura- tion para- meters
ENAUT4	BOOL	OFF	Enable au- to condi- ton4	0	FALSE	FALSE		Configura- tion para- meters

4.23.3 Flag

Table 4.83 Flag code list

Flag (flag code)	Alarm code	Description	Type
D0	OOS	Disable	Status
D4	AUTO	Auto	Status
D8	IN_BP	In bypass state	Status
D9	IN_FRST	In first-out state	Status
D10	IN_ITLC	In interlock state	Status

Table 4.83 Flag code list (continued)

Flag (flag code)	Alarm code	Description	Type
D11	IN_PRM	In permissive state	Status
D12	IN_AUT	In auto state	Status
D13	PRM_BP	In bypass permissive state	Status
D14	AUT_BP	In bypass auto state	Status
D15	BP_C	Current block in bypass state	Status
D16	ITLK_C	Current block in interlock state	Status
D17	PRM_C	Current block in permissive state	Status
D18	AUT_C	Current block in auto state	Status
D19	PRM_BP_C	Current block in bypass permissive state	Status
D20	AUT_BP_C	Current block in bypass auto state	Status
D21	FRST_C	Current block in first-out state	Status
D22	CFGERR	Configuration error	Status
D25	AOF	Suppress Alarm	Status

4.23.4 Configuration

“Interlock”, “Allow”, “Automatic”, “Refer” and “Macro” are added to the configuration property interface of ITLK_D. Other methods are the same as other complex function blocks.

Configure Refer Table

If you want to reference a tag using interlock conditions of ITLK_D, add it to the refer table first. The figure below shows the configuration window in the system configuration software. The refer table supports up to 200 tags, either general tags, variables, or global function block tags.

ITLK_D Interlock Function Block

Function Block Property Parameter Interlock Permit Automatic Refer Table Macro			
Name	Type	Reference Tag	Description
LD01	ND	ND00020000	Standby
LD02	ND	ND00020001	Standby
LD03	ND	ND00020002	Standby

Figure 4.54 Refer table

Configure “Interlock” parameters

In addition to the parameter pages of ordinary function blocks, ITLK_D has also added a "interlock" configuration page. An ITLK_D function block can be configured with 8 interlocking conditions. In the editing interface shown in the figure below, you can configure whether the interlock is valid, the interlock condition, the description of the interlock condition, the generation delay, the elimination delay, the latch, the output value, the switching manual auto, and the bypass enable.

No.	Valid	Condition	Description	TON	TOFF	Latc...	Value	Bypass...
1	<input checked="" type="checkbox"/>		D10002000.PV=ON	0.00	3.00	<input type="checkbox"/>	OFF	<input checked="" type="checkbox"/>
2	<input checked="" type="checkbox"/>		D10002001.PV=ON	0.00	3.00	<input type="checkbox"/>	OFF	<input checked="" type="checkbox"/>
3	<input type="checkbox"/>			0.00	0.00	<input type="checkbox"/>	OFF	<input checked="" type="checkbox"/>
4	<input type="checkbox"/>			0.00	0.00	<input type="checkbox"/>	OFF	<input checked="" type="checkbox"/>
5	<input type="checkbox"/>			0.00	0.00	<input type="checkbox"/>	OFF	<input checked="" type="checkbox"/>
6	<input type="checkbox"/>			0.00	0.00	<input type="checkbox"/>	OFF	<input checked="" type="checkbox"/>
7	<input type="checkbox"/>			0.00	0.00	<input type="checkbox"/>	OFF	<input checked="" type="checkbox"/>
8	<input type="checkbox"/>			0.00	0.00	<input type="checkbox"/>	OFF	<input checked="" type="checkbox"/>

Figure 4.55 The interface of configuring ITLK_D interlock condition

Configure the interlock condition of ITLK_D according to the table below.

Parameter	Function	Configuration Illustration
Valid or not	It is used to enable to disable the interlock condition.	Checking it means to enable this function, otherwise it means disable.
Condition	It is used to configure the trigger expression of the interlock condition.	Double click it, the “condition” dialog box will pop up. The condition supports ST language and the tags in the referenced table. During configuration, you should adopt if expression, multiple expressions in a single editing cell can support AND, MOD, OR,XOR and “()” operators. One single expression can support >, >=, <, <=, <> and =. Operators should be upper-case letters. For example, TAG1.PV>10.0 AND TAG2.PV>10.0
Description	It is used to specify the description of the interlock condition.	Input it in the text box after clicking it.
Generation delay	It is used to specify the generation delay of the interlock condition.	Input it in the text box after clicking it.
Elimination delay	It is used to specify the elimination delay of the interlock condition.	Input it in the text box after clicking it.

Parameter	Function	Configuration Illustration
Latching	It is used to enable or disable the latching function of the interlock condition.	Checking it means to enable this function otherwise it means to disable this function.
Value	It is the output of the corresponding IVALn as the interlock condition is met.	Input it in the text box after clicking it.
Switch to manual	It is used to configure interlock manual or interlock track.	Select in the drop-down menu. ON means manual interlock, OFF means interlock tracking.
Bypass enable	It is used to enable or disable the bypass function of the interlock condition.	Checking it means to enable this function otherwise it means to disable this function.

When configuring the "Interlock" tab of the ITLK_D function block, you can copy and paste operations to simplify the configuration.

- Copy/Paste
Only "Description", "Generate Delay", "Remove Delay", and "Value" support copy and paste.
- Delete
Except for the "condition" column that cannot be directly deleted, the rest of the columns can be deleted through the Delete key. among them:
After the "Valid", "Latching" and "Bypass Enable" columns are deleted, the check boxes will be unchecked.

Macro configuration

"Macro" tab is used to configure the interlock tag of the current function block. The rule for writing the interlock tag in is that the upstream function block is filled in by the downstream function block. As shown in the figure below, 3 ITLK_D are connected in cascade and the names are respectively ITLKD1, ITLKD2 and ITLKD3. "ITLKD2" should be configured to the interlock tag of ITLKD1.

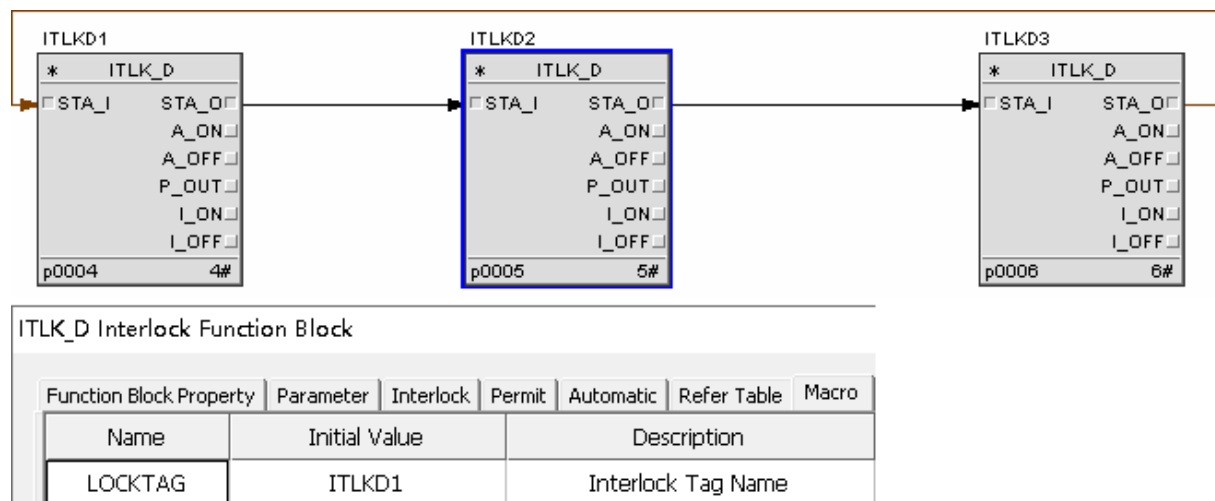


Figure 4.56 The interface of configuring the macro of ITLK_D function block

Configure “Permissive” Conditions

When the ITLK_D function block is used together with the HVFC function block, the “permissive” condition configured in the ITLK_D function block is output to the PRM pin of the HVFC. In the editing interface shown in the figure below, you can configure whether the permissive condition is valid, the permissive condition expression, the permissive condition description, the generation delay, the elimination delay, and the bypass enable.

The screenshot shows the 'ITLK_D Interlock Function Block' configuration window with the 'Permit' tab selected. The window contains a table with 7 columns: No., Valid, Condition, Description, TON, TOFF, and Bypass... There are 4 rows of data. Row 1: No. 1, Valid checked, Condition empty, Description 'ND00200000.VALUE=ON', TON 2.00, TOFF 0.00, Bypass... unchecked. Row 2: No. 2, Valid checked, Condition empty, Description 'DI00020002.PV=ON', TON 0.00, TOFF 3.00, Bypass... unchecked. Row 3: No. 3, Valid unchecked, Condition empty, Description empty, TON 0.00, TOFF 0.00, Bypass... checked. Row 4: No. 4, Valid unchecked, Condition empty, Description empty, TON 0.00, TOFF 0.00, Bypass... checked. At the bottom are 'OK', 'Cancel', and 'Help' buttons.

No.	Valid	Condition	Description	TON	TOFF	Bypass...
1	<input checked="" type="checkbox"/>		ND00200000.VALUE=ON	2.00	0.00	<input type="checkbox"/>
2	<input checked="" type="checkbox"/>		DI00020002.PV=ON	0.00	3.00	<input type="checkbox"/>
3	<input type="checkbox"/>			0.00	0.00	<input checked="" type="checkbox"/>
4	<input type="checkbox"/>			0.00	0.00	<input checked="" type="checkbox"/>

Figure 4.57 The interface of configuring the permissive condition of ITLK_D

Configure “AUTO” conditions

When the ITLK_D function block is used together with the HVFC function block, the "automatic" condition configured in the ITLK_D function block will be output to the HVFC. In the editing interface shown in the figure below, you can configure whether the automatic condition is valid, the expression of the automatic condition, the description of the automatic condition, the generation delay, the value, and enabling bypass.

The screenshot shows the 'ITLK_D Interlock Function Block' configuration window with the 'Automatic' tab selected. The window contains a table with 7 columns: No., Valid, Condition, Description, TON, Value, and Bypass... There are 4 rows of data. Row 1: No. 1, Valid checked, Condition empty, Description 'II00020003.PV=ON', TON 0.00, Value OFF, Bypass... unchecked. Row 2: No. 2, Valid unchecked, Condition empty, Description empty, TON 0.00, Value OFF, Bypass... checked. Row 3: No. 3, Valid unchecked, Condition empty, Description empty, TON 0.00, Value OFF, Bypass... checked. Row 4: No. 4, Valid unchecked, Condition empty, Description empty, TON 0.00, Value OFF, Bypass... checked. At the bottom are 'OK', 'Cancel', and 'Help' buttons.

No.	Valid	Condition	Description	TON	Value	Bypass...
1	<input checked="" type="checkbox"/>		II00020003.PV=ON	0.00	OFF	<input type="checkbox"/>
2	<input type="checkbox"/>			0.00	OFF	<input checked="" type="checkbox"/>
3	<input type="checkbox"/>			0.00	OFF	<input checked="" type="checkbox"/>
4	<input type="checkbox"/>			0.00	OFF	<input checked="" type="checkbox"/>

Figure 4.58 The interface of configuring the auto conditions of ITLK_D

4.23.5 Logical Illustration

Interlock ITLK_D function block conducts the internal calculation as per the logic figure shown in the figure below.

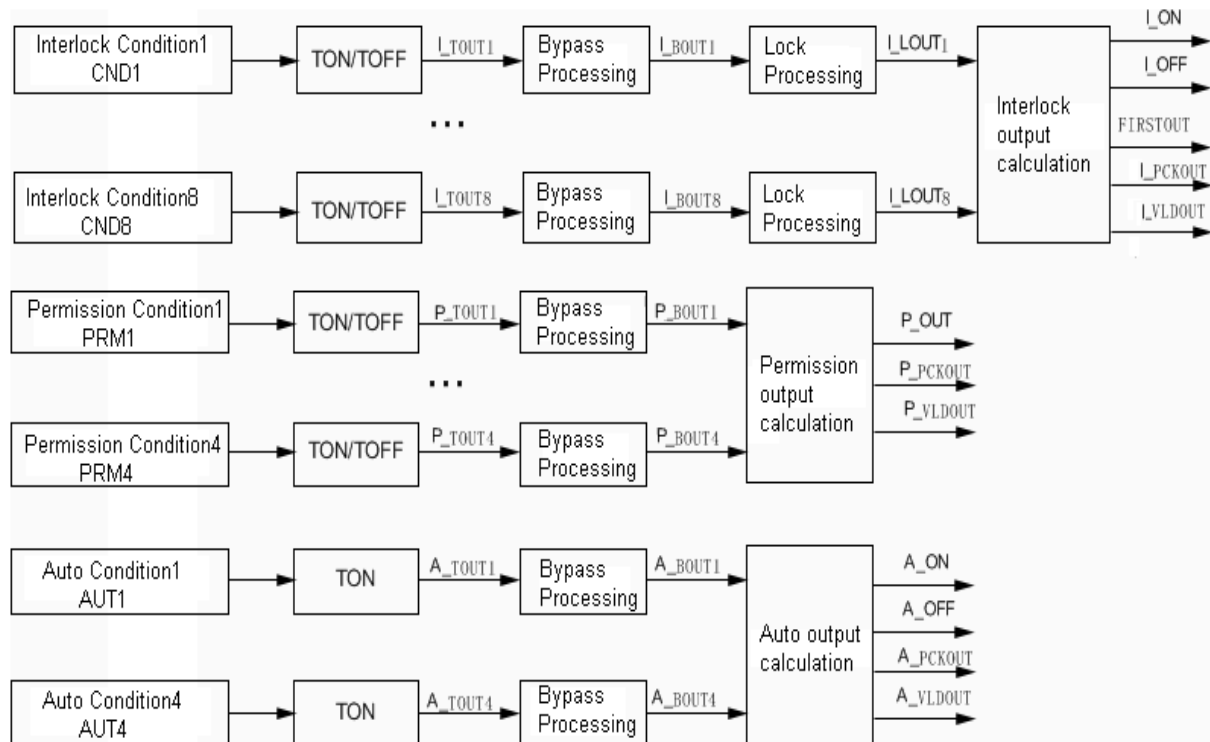
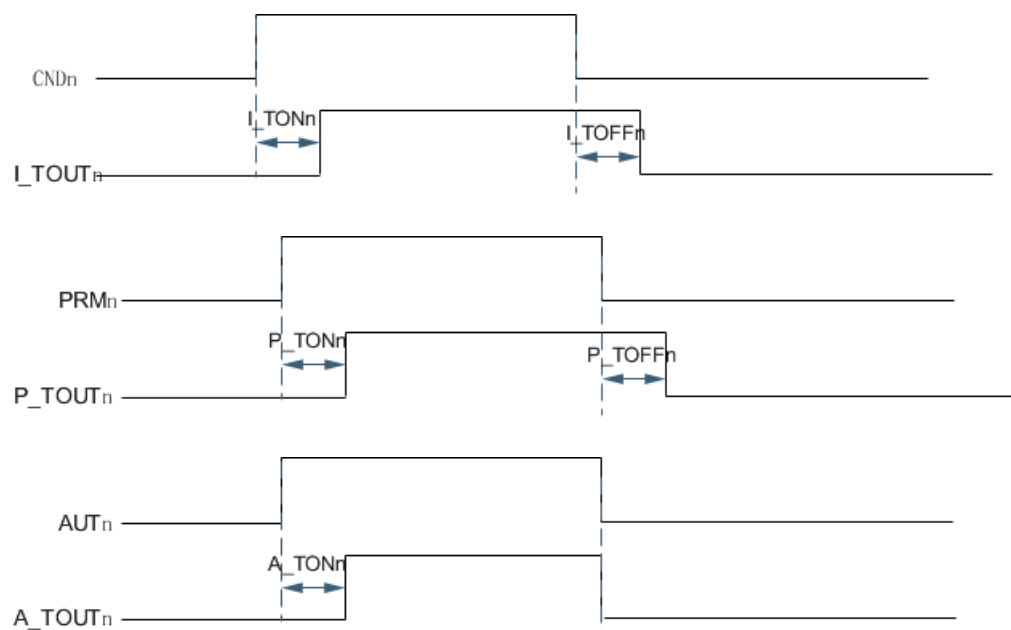


Figure 4.59 The calculation logic figure of ITLK_D function block

Interlock conditions

If all conditions of the interlock expression are met, CNDn=ON; otherwise, CNDn=OFF.

TON/TOFF



Bypass Processing

- If ENI_BPn=ON, the panel allows to bypass this circuit.
 When I_BPn=ON, whatever the value of I_TOUTn is, I_BOUTn=OFF.
 When I_BPn=OFF, I_BOUTn=I_TOUTn.
 When P_BPn=ON, whatever the value of P_TOUTn is, P_BOUTn=OFF.
 When P_BPn=OFF, P_BOUTn=P_TOUTn.
 When A_BPn=ON, whatever the value of A_TOUTn is, A_BOUTn=OFF.
 When A_BPn=OFF, A_BOUTn=A_TOUTn.
- If ENI_BPn=OFF, the panel doesn't allow to bypass this circuit.
 I_BOUTn=I_TOUTn.
 P_BOUTn=P_TOUTn.
 A_BOUTn=A_TOUTn.

Latching calculation

When the latching of the configuration of one certain circuit is checked, ENLATCHn=ON. The latching function is enabled and shown in the figure below.

Function Block Property		Parameter	Interlock	Permit	Automatic	Refer Table	Macro					
No.	Valid	Condition			Description			TON	TOFF	Latc...	Value	Bypass...
1	<input checked="" type="checkbox"/>	NA02400010.VALUE>97						5.00	5.00	<input checked="" type="checkbox"/>	OFF	<input checked="" type="checkbox"/>
2	<input checked="" type="checkbox"/>							0.00	0.00	<input type="checkbox"/>	OFF	<input checked="" type="checkbox"/>

Under the condition of the latching function being enabled:

- When I_BOUTn = ON, if CMD_IN is not equal to the current interlock output value, then I_LOUTn = ON, enter the latch status LATCHn = ON.
- After entering the latched status (LATCHn = ON), if CMD_IN is equal to the current interlock output value, then continue to be in the latched status.
 - If it is in the latched status (LATCHn = ON), then I_LOUTn = ON.
 - If it is not in the latched status (LATCHn = OFF), then I_LOUTn = I_BOUTn.
- When I_BOUTn = OFF, if it is in the latched status (LATCHn = ON), then the corresponding RSTREQn = ON, can be reset by RESET to make LATCHn = OFF, I_LOUTn = OFF.
- When the latch function is not configured, then I_LOUTn = I_BOUTn.

Interlock output calculation

If the current output after the interlocking is ON, the L_VALn corresponding to the lowest serial number is selected.

- If L_VALn = ON (indicating that the output is activated),
 - OUT_OPT = 0, then I_ON = ON; I_OFF = ON;
 - OUT_OPT = 1 then I_ON = OFF; I_OFF = OFF;
 - OUT_OPT = 2 then I_ON = ON; I_OFF = OFF;
 - OUT_OPT = others, I_ON = OFF; I_OFF = ON;
- If L_VALn = OFF (indicating that the output is stopped),
 - OUT_OPT = 0, then I_ON = OFF; I_OFF = OFF;
 - OUT_OPT = 1 then I_ON = ON; I_OFF = ON;
 - OUT_OPT = 2 then I_ON = OFF; I_OFF = ON;
 - OUT_OPT = others, I_ON = ON; I_OFF = OFF;
- If there is no current interlock and the output is ON,
 - OUT_OPT = 0, then I_ON = OFF; I_OFF = ON;
 - OUT_OPT = 1 then I_ON = ON; I_OFF = OFF;
 - OUT_OPT = 2 then I_ON = OFF; I_OFF = OFF;
 - OUT_OPT = others, I_ON = ON; I_OFF = ON;

First-out Calculation

When ENFIRST=ON is satisfied, the first-out calculation would be executed:

- If the first-out has already been output currently, the output is kept unchanged.
- If there isn't any first-out output, the first-out sequence number is the minimum sequence number.

Interlock and the first-out reset functions

- When the reset and option function (RST_OPT=ON) is enabled, and all the input conditions are not satisfied, the latching and first-out signals can be reset and interlocked.
- When the reset and option function (RST_OPT=OFF) is disabled, the latching and first-out signals all can be reset and interlocked anytime.

Forced Output Calculation

- If the current output after the forced bypass processing is ON, it selects the F_VALn corresponding to the lowest sequence number.
 - If F_VALn=ON (means that the output starts), F_ON=ON; F_OFF=OFF;
 - If F_VALn=OFF (means that the output stops), F_ON=OFF; F_OFF=ON;
- If any current output after the forced bypass processing is not ON, F_ON=OFF; F_OFF=OFF;

Permissive Output Calculation

- When the Allow output calculation mode is ON, P_OUT="P_OUT after the bypass processing" AND "the output value after interlock and NOR processing".
- When the Allow output calculation mode is OFF, P_OUT="ENP_BPn after NOR processing" AND "the output value after interlock and NOR processing".

4.23.6 Panel Parameter

Description	TON (s)	TOFF (s)	Value	Bypass	Reset Required
DI00020000.PV=ON	0.0	0.0	OFF	<input type="checkbox"/>	<input type="checkbox"/>
DI00020001.PV=ON	0.0	0.0	OFF	<input type="checkbox"/>	<input type="checkbox"/>

ITLK

Interlock Permit Automatic

Description	TON (s)	TOFF (s)	Bypass
ND00020000. VALUE=ON	0.0	0.0	<input type="checkbox"/>
DI00020002. PV=ON	0.0	0.0	<input type="checkbox"/>

0

ITLK

Interlock Permit Automatic

Description	TON (s)	Value	Bypass
DI00020003. PV=ON	0.0	OFF	<input type="checkbox"/>

0

Figure 4.60 ITLK_D Function Block Panel Parameter Diagram

In ITLK_D panel, “Interlock” tab contains first out and interlock status markers and SN number. “Permit” tab contains permissive output status and SN number. “Automatic” tab contains the SN number of the current function block.

Table 4.84 Function Block Parameter Table

















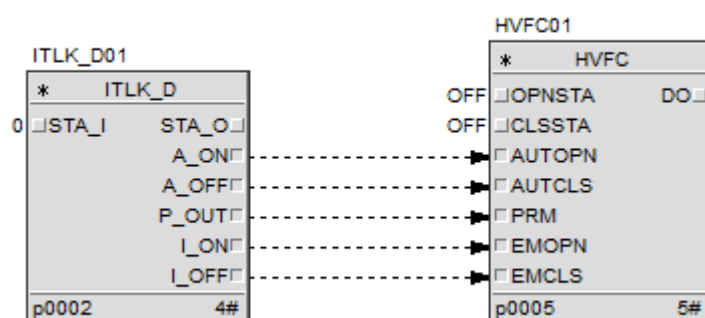
Panel Display		Parameter Name	Initial Value	Assignment	Remark
			It is displayed at the left side of the description, meaning first-out.		
			 means the condition is tenable as shown in the figure above.  means the condition is tenable, but it is still in a delay status.		
			If  appears, it means interlock occurs without being bypassed. If  appears, it means there is no interlock without being bypassed.		
			If  appears, it means interlock occurs with being bypassed. If  appears, it means there is no interlock with being bypassed.		
			If  appears, it means no permissive output is established and no bypass is activated. If  appears, it means no permissive output is established, but bypass is activated.		
			If  appears, it means permissive output is established and bypass is not activated. If  appears, it means permissive output is established and bypass is activated.		
InterLock	Reset	RESET	OFF	Writable	Reset command
	TON(s)	I_TON1- I_-TON8	0.0	-	Ton of Interlock Sn.1-8 command(s)
	TOF-F(s)	I_TOFF1- I_-TOFF8	0.0	-	Toff of Interlock Sn.1-8 command(s)
	Value	IVAL1- IVAL8	OFF	-	Status of Interlock Sn.1-8
	By-pass	I_BP1- I_BP8	OFF	Writable	Enable Bypass Interlock Sn.1-8
	Reset Required	CAN_RST	OFF	Writable	Can be Rese
Permit	TON(s)	P_TON1- P_-TON4	0.0	-	Ton of Permissive Sn.1-4 command(s)
	TOF-F(s)	P_TOFF1-P_-TOFF4	0.0	-	Toff of Permissive Sn.1-4 command(s)
	By-pass	P_BP1-P_BP4	OFF	Writable	Bypass Permissive Sn.1-4

Table 4.84 Function Block Parameter Table (continued)

Panel Display		Parameter Name	Initial Value	Assignment	Remark
Automatic	TON(s)	A_TON1- A_-TON4	0.0	-	Ton of Automatic Sn.1-4 command(s)
	Value	AVAL1- AVAL4	OFF	-	Status of Automatic Sn.1-4
	By-pass	A_BP1- A_-BP4	OFF	Writable	Enable Bypass Automatic command Sn.1-4

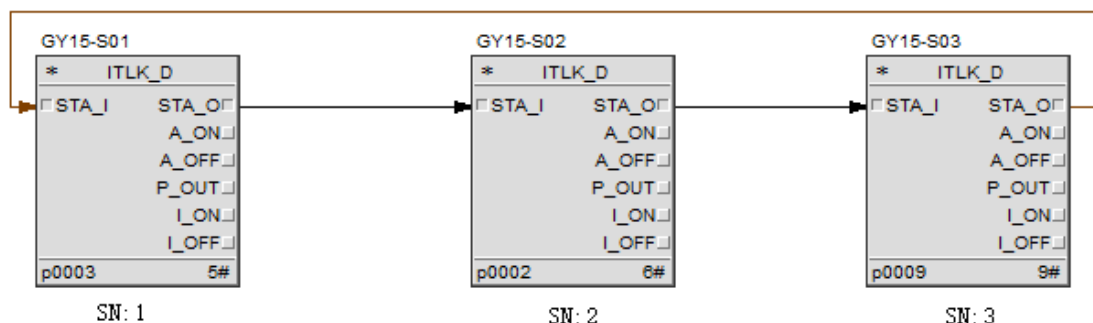
4.23.7 Application

Connect with HFVC



In cascade

They can be connected to each other by STA_I and STA_O and also can be used in cascade mode. Up to 16 modules can be in one cascade and the sequence number has to start from 1.



4.24 Digital Setting Function Block (DSET_DI_EP)

DSET_DI_EP function block outputs a BOOL type data, which will be used in downstream function blocks. Operator can operate it directly. Each function block output can be set as the following types: hold type, pulse type and flip type.

DSET_DI_EP function block is complex function block, and its running time is 30μs.



4.24.1 Parameter Description

Table 4.85 Table 4-85 Digital setting function block parameter description

Name		Description	Upload	Properties	Application Reference
Input Pin	TV	Track Value	-	Input Pin	-
	TR	Track Switch	-	Input Pin	-
Output Pin	OUT	Output Value	-	Output Pin	-
	FLAG	Flag	-	Output Pin	-
Operation Parameter	SWOOS	Function Block Enable/Disable(ON=Disable)	TRUE	Operation Parameter	-
	IN	Operation Value	-	Operation Parameter	-
	AOF	Suppress Module Alarm	TRUE	Operation Parameter	-
	TP	Pulse Time(s)	TRUE	Operation Parameter	-
	MODE	0=Hold Type 1=Pulse Type 2=Flip Type	TRUE	Operation Parameter	-

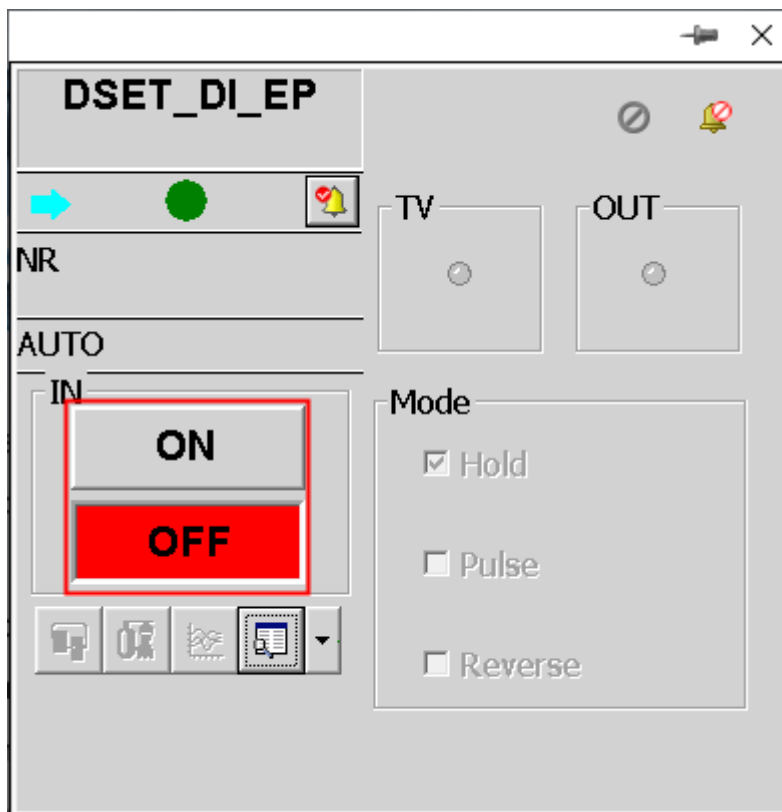
Table 4.86 Macro parameter illustration

Macro Parameter	Initial Value	Description
IN_ON	Custom, corresponding to the "ON" button on the function block panel	Users can redefine the description of the "ON" button on the panel
IN_OFF	Custom, corresponding to the "OFF" button on the function block panel	Users can redefine the description of the "OFF" button on the panel

4.24.2 Logic Time Sequencing

- When SWOOS=ON, function block is in OOS status. Algorithm will not be executed and output can be assigned in debug window.
- When SWOOS=OFF and TR=ON, function block is in track status and output value=TV,
- When SWOOS=OFF and TR=OFF, function block is in auto status and in this case:
 Hold Type
 OUT=IN;
 Pulse Type
 If a positive transmission is made in IN, OUT outputs a pulse with lasting time of TP, and IN=OFF at the same time.
 Flip Type
 If a positive transmission is made in IN, OUT will be reversed. For example, OUT=OFF after the positive transmission if OUT turns to ON at first, and IN= OFF at the same time.

4.24.3 Panel Parameter



As shown in the figure above, the button name can be modified in the macro parameters of the function block, and the maximum length is 0~64 characters (including Chinese, English, numbers and special characters). If the button name is not modified, the original default description will be displayed on the panel. When the length of the custom description exceeds the actual length of the button on the panel, it will be truncated and displayed according to the actual length of the button.

Table 4.87 Panel Parameter

Panel Parameter Name		Parameter Name	Initial Value	Value Range	Application Instruction
TV		TV	OFF	-	-
OUT		TR	OFF	-	-
Mode	Hold Type	MODE	0=Hold Type	-	-
	Pulse Type				
	Flip Type				

4.24.4 Flag

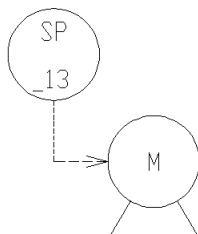
Table 4.88 Flag list

Flag	Alarm	Description
D0	OOS	Disable
D1	TR	Track
D2	AUTO	Auto
D5	AOF	Suppress Alarm

4.24.5 Example Application

To achieve the field-pump stop pump control as shown in Figure 4.61, and can be operated on flow chart.

One DO stop pump control refers to that the filed pump device is controlled by one DO signal and only can achieve stop pump control. Pump start is performed in filed or electric room. Pump status is only used for monitoring and has nothing to do with stop logic. It is often used for the stop pump control of filed pump.

**Figure 4.61 One DO Pump Stop Pump Diagram**

Details of program are shown below. It applies DSET_DI_EP function block, and the upper computer interface can control DO via function block tag.

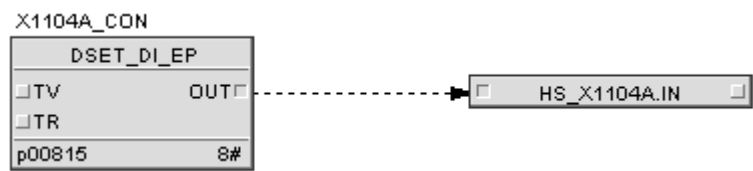


Figure 4.62 Program of One DO Stop Pump

Function block and example instructions are shown in the table below:

Table 4.89 Function Block and Example Instruction

NO.	Example	Type	Instruction	Remark
001	HS_X1104A	DO Output	Pump Stop Control	
006	X1104A_CON	Function Block Tag	Pump Control Function Block Tag	Supervision Tag

Parameter settings of DSET_DI_EP:

Pulse Control:

- TP: 3.000
- MODE:1

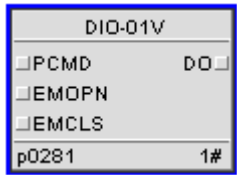
Long Signal Control:

- MODE:0

4.25 Control Function Block for Single Output (DIO-01V)

DIO-01V function block enables control and interlock protect to single DO output equipment by last level sequence control command or operator by panel.

DIO-01V function block is complex function block, and its running time is 20μs.



4.25.1 Parameter Description

Table 4.90 Control function block for single output parameter description

Name		Description	Upload	Properties	Application Reference
Input Pin	PCMD	Command Input (ON=Open, OFF=Close)	-	Input Pin	Upstream Output
	EMOPN	Interlock Open Command	-	Input Pin	Upstream Interlock Input When

Table 4.90 Control function block for single output parameter description (continued)

Name		Description	Upload	Properties	Application Reference
					EMOPN=ON, it will be shown in the process alarm.
	EMCLS	Interlock Close Command	-	Input Pin	Upstream interlock Input When EMCLS=ON, it will be shown in the process alarm.
	PSWAM	Program Manual and Auto Control Digital Input	-	Input Pin	Upstream Output
	FBOPT	Manual-automatic Control Source Switch(OFF=Panel)	-	Input Pin	Upstream Output
	OPNPRM	Open Permission Signal	-	Input Pin	Upstream Output
	CLSPRM	Close Permission Signal	-	Input Pin	Upstream Output
Output Pin	DO	Output, reset as OFF when download offline	-	Output Pin	Output DO
OOS SETTINGS	SWOOS	In OOS Status	TRUE	Operation Parameter	-
Operation Parameter	MCMD	Manual Command(ON=Open, OFF=Close)	-	Operation Parameter	-
	SWAM	Manual-automatic Switch(ON=Auto OFF=Manual)	-	Operation Parameter	-
	MODE	Device Mode(Observe)	-	Monitoring Parameter	-
Alarm Enabled and Shield	AOF	Shield Module Alarm	TRUE	Operation Parameter	-
	FLAG	Flag	-	Output Parameter	-
Configuration Parameter	IVO	Output Invert Switch (ON: air closed; OFF: air open)	-	Configuration Parameter	Set by the air open and closed features of controlled valve

Table 4.91 Macro Parameter Illustration

Macro Parameter	Initial Value	Description
MCMD_ON	Custom, corresponding to the "ON" button on the function block panel	Users can redefine the description of the manual ON command button on the panel.

Table 4.91 Macro Parameter Illustration (continued)

Macro Parameter	Initial Value	Description
MCMD_OFF	Custom, corresponding to the "OFF" button on the function block panel	Users can redefine the description of the manual OFF command button on the panel.
OPNPRM	Custom, corresponding to the "ON PRM" button on the function block panel	Users can redefine the description of the manual ON PRM button on the panel.
CLSPRM	Custom, corresponding to the "OFF PRM" button on the function block panel	Users can redefine the description of the manual OFF PRM button on the panel.

4.25.2 Logic Time Sequencing

Function block status

Function block status and priority: OOS>interlock>>manual /auto selection.

- OOS(MODE=1)
When SWOOS=ON, function block is in OOS status. Algorithm will not be executed and output can be assigned in debug window.
- Interlock(interlock open/interlock close, MODE=4)
When function block is not in OOS status, and input interlock open or interlock close command, function block turns to interlock mode. Interlock command input adopts positive transmission check.
When both interlock open, interlock close commands are inputted, the system does not respond interlock command, and will generate DBEMCMD alarm.
When interlock open command is inputted first and interlock close command is inputted in effective time of interlock open command, execute interlock open command first and then interlock close command after interlock open command is over. And vice versa.
The validity of interlock command is restricted by open/close enable (OPNPRM, CLSPRM).
- Man/auto (Man: MODE=5; Auto: MODE=6)
When function block is not in all statuses above, it is in manual /auto selection mode.
Automatic status output instruction is decided by PCMD and manual status output instruction is by MCMD.
Man/auto command input adopts positive transmission check.
If interlock open EMOPN is continuously ON, then manual close and auto close command disables.
If interlock close EMCLS is continuously ON, then manual open and auto open command disables.
The validity of man/auto command is restricted by open/close enable (OPNPRM, CLSPRM),

- Manual/auto switch

When OOS and interlock are not generated, the system turns to manual /auto mode.

It can be switched by FBOPT, SWAM and PSWAM.

When FBOPT=OFF, it is decided by panel.

When FBOPT=ON, it is decided by program input PSWAM.

Air Open/ Closed Function

- IVO = OFF: air open

The mode can be used to control air open valve. When valid input command is ON, i.e. open command, output is ON, the air open valve is open. When valid input command is OFF, i.e. closed command, output is OFF, the air open valve is closed.

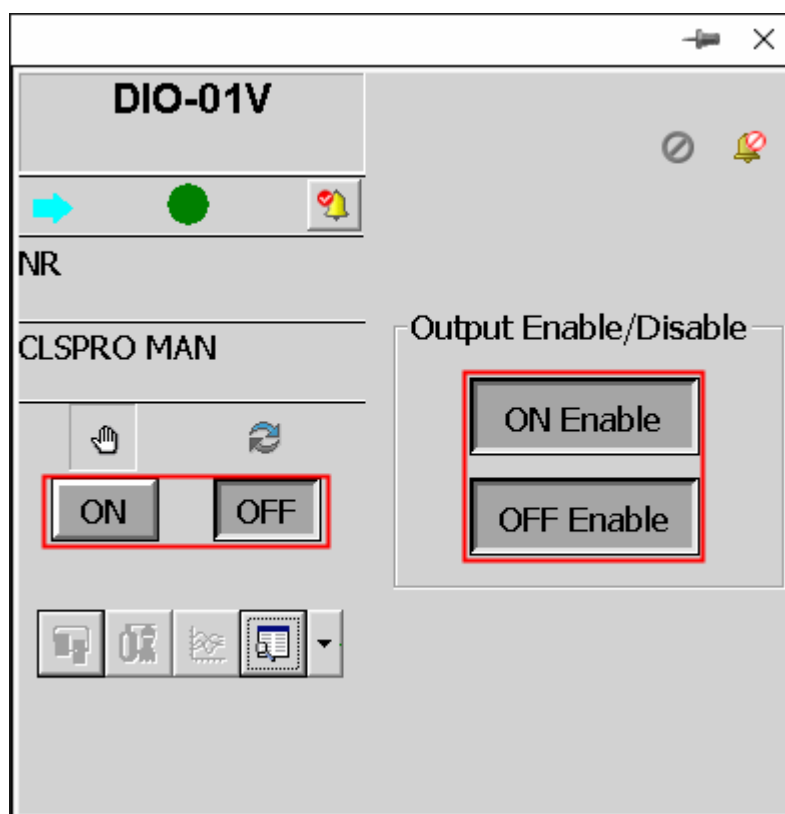
- IVO = ON: air closed

The mode can be used to control air closed valve. When valid input command is ON, i.e. open command, output is OFF, the air closed valve is open. When valid input command is OFF, i.e. closed command, output is ON, the air closed valve is closed.

- Cold Startup

No matter in air open or closed mode, function block outputs OFF when cold starting controller.

4.25.3 Panel Parameter



As shown in the figure above, the button name in the red box can be modified in the macro parameters of the function block, and the maximum length is 0~64 characters (including Chinese, English, numbers and special characters). If the button name is not modified, the original default description will be displayed on the panel. When the length of the custom description exceeds the actual length of the button on the panel, it will be truncated and displayed according to the actual length of the button.

Table 4.92 Panel Parameter Instruction

Panel Parameter Name		Parameter Name	Initial Value	Value Range	Application Instruction
Output Enable/Disable	ON Enable	OPNPRM	ON	-	-
	OFF Enable	CLSPRM	ON	-	-

4.25.4 Flag

Table 4.93 Flag list

Flag	Supervision Assignment	Description
D0	OOS	Disable
D3	EMOPN	Interlock Open

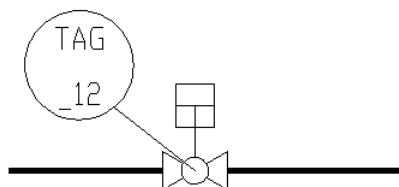
Table 4.93 Flag list (continued)

Flag	Supervision Assignment	Description
D4	EMCLS	Interlock Close
D5	MAN	Manual
D6	AUTO	Auto
D14	OPNPRO	Open Instruction Output Process
D15	CLSPRO	Close Instruction Output Process
D18	AOF	Suppress Alarm
D24	DBEMCMD	Interlock Double Input Fault

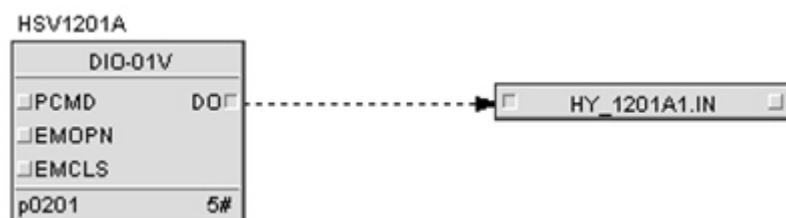
4.25.5 Example Application

To achieve the field-electricmagnetic valve switch control as shown in Figure 4.63, and can be operated on flow chart.

One DO valve refers to that the filed valve device is controlled by one DO signal and has no related valve status feedback.

**Figure 4.63 One DO Pump Stop Pump Diagram**

Details of program are shown below. It applies DIO-01V function block, and the upper computer interface can control DO via function block tag.

**Figure 4.64 Program of One DO Valve**

Function block and example instructions are shown in the table below:

Table 4.94 Function Block and Example Instruction

NO.	Example	Type	Instruction	Remark
001	HY_1201A1	DO Output	Valve Switch Control	-

Table 4.94 Function Block and Example Instruction (continued)

NO.	Example	Type	Instruction	Remark
002	HSV1201A	Function Block Tag	Valve Control Function Block Tag	Supervision Tag

Parameter settings of DIO-01:

- FBOPT: ON
- PSWAM: OFF

Note: the settings above can avoid wrong operation for Auto button on the panel. Other settings should be applied for auto control.

4.26 Digital Interlock Function Block (LOCK16)

LOCK16 function block interlocks 16 channels of input BOOL data so that only one of current 16 corresponding outputs can be output. Block cascade function is also available.

LOCK16 function block is simple function block, and its running time is 15μs.

LOCK16	
<input type="checkbox"/> CASLOCK	OUT1 <input type="checkbox"/>
<input type="checkbox"/> ENABLE	OUT2 <input type="checkbox"/>
<input type="checkbox"/> IN1	OUT3 <input type="checkbox"/>
<input type="checkbox"/> IN2	OUT4 <input type="checkbox"/>
<input type="checkbox"/> IN3	OUT5 <input type="checkbox"/>
<input type="checkbox"/> IN4	OUT6 <input type="checkbox"/>
<input type="checkbox"/> IN5	OUT7 <input type="checkbox"/>
<input type="checkbox"/> IN6	OUT8 <input type="checkbox"/>
<input type="checkbox"/> IN7	OUT9 <input type="checkbox"/>
<input type="checkbox"/> IN8	OUT10 <input type="checkbox"/>
<input type="checkbox"/> IN9	OUT11 <input type="checkbox"/>
<input type="checkbox"/> IN10	OUT12 <input type="checkbox"/>
<input type="checkbox"/> IN11	OUT13 <input type="checkbox"/>
<input type="checkbox"/> IN12	OUT14 <input type="checkbox"/>
<input type="checkbox"/> IN13	OUT15 <input type="checkbox"/>
<input type="checkbox"/> IN14	OUT16 <input type="checkbox"/>
<input type="checkbox"/> IN15	LOCK1 <input type="checkbox"/>
<input type="checkbox"/> IN16	LOCK2 <input type="checkbox"/>
	LOCK3 <input type="checkbox"/>
	LOCK4 <input type="checkbox"/>
	LOCK5 <input type="checkbox"/>
	LOCK6 <input type="checkbox"/>
	LOCK7 <input type="checkbox"/>
	LOCK8 <input type="checkbox"/>
	LOCK9 <input type="checkbox"/>
	LOCK10 <input type="checkbox"/>
	LOCK11 <input type="checkbox"/>
	LOCK12 <input type="checkbox"/>
	LOCK13 <input type="checkbox"/>
	LOCK14 <input type="checkbox"/>
	LOCK15 <input type="checkbox"/>
	LOCK16 <input type="checkbox"/>
	LOCKNEXT <input type="checkbox"/>
	NUMIND <input type="checkbox"/>
p0291	1#

4.26.1 Parameter Description

Table 4.95 Parameter description of LOCK16

Name		Description	Upload	Properties	Application Reference
Input Pin	CASLOCK	Cascade Interlock Input(OF-F=Upstream Unlocked, ON=Upstream Locked)	-	Input Pin	-
	ENABLE	Interlock Enable	-	Input Pin	-
	IN1	Input 1	-	Input Pin	-
	IN2	Input 2	-	Input Pin	-
	IN3	Input 3	-	Input Pin	-
	IN4	Input 4	-	Input Pin	-

Table 4.95 Parameter description of LOCK16 (continued)

Name		Description	Upload	Properties	Application Reference
	IN5	Input 5	-	Input Pin	-
	IN6	Input 6	-	Input Pin	-
	IN7	Input 7	-	Input Pin	-
	IN8	Input 8	-	Input Pin	-
	IN9	Input 9	-	Input Pin	-
	IN10	Input 10	-	Input Pin	-
	IN11	Input 11	-	Input Pin	-
	IN12	Input 12	-	Input Pin	-
	IN13	Input 13	-	Input Pin	-
	IN14	Input 14	-	Input Pin	-
	IN15	Input 15	-	Input Pin	-
	IN16	Input 16	-	Input Pin	-
Out- put Pin	OUT1	Output 1	-	Output Pin	-
	OUT2	Output 2	-	Output Pin	-
	OUT3	Output 3	-	Output Pin	-
	OUT4	Output 4	-	Output Pin	-
	OUT5	Output 5	-	Output Pin	-
	OUT6	Output 6	-	Output Pin	-
	OUT7	Output 7	-	Output Pin	-
	OUT8	Output 8	-	Output Pin	-
	OUT9	Output 9	-	Output Pin	-
	OUT10	Output 10	-	Output Pin	-
	OUT11	Output 11	-	Output Pin	-
	OUT12	Output 12	-	Output Pin	-
	OUT13	Output 13	-	Output Pin	-
	OUT14	Output 14	-	Output Pin	-
	OUT15	Output 15	-	Output Pin	-

Table 4.95 Parameter description of LOCK16 (continued)

Name		Description	Upload	Properties	Application Reference
	OUT16	Output 16	-	Output Pin	-
	LOCK1	Output 1 was interlocked (ON=Locked)	-	Output Pin	-
	LOCK2	Output 2 was interlocked (ON=Locked)	-	Output Pin	-
	LOCK3	Output 3 was interlocked (ON=Locked)	-	Output Pin	-
	LOCK4	Output 4 was interlocked (ON=Locked)	-	Output Pin	-
	LOCK5	Output 5 was interlocked (ON=Locked)	-	Output Pin	-
	LOCK6	Output 6 was interlocked (ON=Locked)	-	Output Pin	-
	LOCK7	Output 7 was interlocked (ON=Locked)	-	Output Pin	-
	LOCK8	Output 8 was interlocked (ON=Locked)	-	Output Pin	-
	LOCK9	Output 9 was interlocked (ON=Locked)	-	Output Pin	-
	LOCK10	Output 10 was interlocked (ON=Locked)	-	Output Pin	-
	LOCK11	Output 11 was interlocked (ON=Locked)	-	Output Pin	-
	LOCK12	Output 12 was interlocked (ON=Locked)	-	Output Pin	-
	LOCK13	Output 13 was interlocked (ON=Locked)	-	Output Pin	-
	LOCK14	Output 14 was interlocked (ON=Locked)	-	Output Pin	-
	LOCK15	Output 15 was interlocked (ON=Locked)	-	Output Pin	-
	LOCK16	Output 16 was interlocked (ON=Locked)	-	Output Pin	-
	LOCKNEXT	Output Cascade Interlocked(ON=Downstream Block was Locked)	-	Output Pin	-
	NUMIND	Current Channel ID	-	Output Pin	-

4.26.2 Logic Time Sequencing

1. Shield interlock function

When shield switch ENABLE=OFF, OUTn=INn, NUMIND=0.

When shield switch ENABLE=ON, digital interlock function is enabled.

2. Digital interlock

When anyone of the 16 channels of input INn=ON, the corresponding output OUTn=ON, LOCKn=OFF.

If two channels or more are ON at the same time, input would be invalid and the corresponding output OUTn=OFF.

3. Cascade

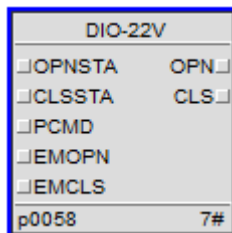
When two LOCK16 blocks are cascaded, any channel can be output. The first block has a higher priority than the follow-up.

4. LOCKNEXT of the first LOCK16 block is connected to CASLOCK of the next.

4.27 Dual-DI/ Dual-DO Switch Control Function Block (DIO-22V)

This function can achieve the basic control and interlock protection for device of dual-DI feedback and dual-DO output, and control and operate the single controlled device via sequence control instruction of higher level or operator by panel.

It is a complex function block with running time of 20μs.



4.27.1 Parameter Description

Table 4.96 Parameter instruction of function block

Parameter Name			Description	Parameter Upload	Parameter Properties	Application Reference
Basic Parameter	Mode Settings	TOC	Device Process Time (s)	TRUE	Operation Parameter	-
		OPFLACK	Whether the running fault needs to be acknowledged (ON=	TRUE	Operation Parameter	-

Table 4.96 Parameter instruction of function block (continued)

Parameter Name			Description	Parameter Upload	Parameter Properties	Application Reference
			True)When OPFLACK=ON and the running fault should be confirmed. And the running fault will be the limit of inputting new command of manual command, and it will be invalid to the interlock command.			
		AUTO-CLR	Whether the running fault can be eliminated automatically (ON= True)	TRUE	Operation Parameter	-
		IGNORALM	Input Command Shield Alarm (OFF= Not Shield)	TRUE	Operation Parameter	-
		IGNORSTA	Output Instruction Ignore Feedback (OFF= Not Ignore)	TRUE	Operation Parameter	-
		SAFE_-OPT	Select Output Safe Mode (OFF= Output not Reset, ON= Output Reset)	TRUE	Operation Parameter	-
Extended Parameter	Input Pin	OPNSTA	Open Status Feedback	-	Input Pin	Test Point DI
		CLSSTA	Close Status Feedback	-	Input Pin	Test Point DI
		PCMD	Program Command Input (ON= Program Open, OFF= Program Closed)	-	Input Pin	Upstream Output
		EMOPN	Interlock Open	-	Input Pin	Upstream Interlock Input When EMOPN=ON, it will be shown in the process alarm.
		EMCLS	Interlock Closed	-	Input Pin	Upstream Interlock InputWhen EMCLS=ON,

Table 4.96 Parameter instruction of function block (continued)

Parameter Name			Description	Parameter Upload	Parameter Properties	Application Reference
						it will be shown in the process alarm.
		PSWAM	Program Man/ Auto Control Switch	-	Input Pin	Upstream Output
		OPN-PRM	Open Instruction Allow Signal	-	Input Pin	Upstream Output
		CLSPRM	Closed Instruction Allow Signal	-	Input Pin	Upstream Output
		FBOPT	Select Man/Auto Control Source (OFF= Panel Control)	-	Input Pin	Upstream Output
		PACK	Program Input Confirm Signal	-	Input Pin	Upstream Output
	Output Pin	OPN	Open Output	-	Output Pin	Output DO
		CLS	Closed Output	-	Output Pin	Output DO
	Alarm Enable and Shield	AOF	Module Alarm Shield	TRUE	Operation Parameter	-
		ENALM	Alarm Enabled	TRUE	Operation Parameter	-
		FLAG	Flag	-	Output Pin	-
	OOS Settings	SWOOS	Disable Function Block (ON= Disable)	TRUE	Operation Parameter	-
	Operation parameter	MOPN	Manual Open	-	Operation Parameter	-
		MCLS	Manual Close	-	Operation Parameter	-
		SWAM	Man/ Auto Select Switch: OFF= Manual, ON= Auto	-	Operation Parameter	-

Table 4.96 Parameter instruction of function block (continued)

Parameter Name			Description	Parameter Upload	Parameter Properties	Application Reference
		MACK	Manual Acknowledge	-	Operation Parameter	-
		RST	Reset Instruction	-	Operation Parameter	-
	Status Indication	FAIL	Device Fault (ON= Fault)	-	Monitoring Parameter	-
		OPFL	Running Fault (ON= Fault)	-	Monitoring Parameter	-
		STAOPN	Device Open Status Indication (ON= Open)	-	Monitoring Parameter	-
		STACLS	Device Closed Status Indication (ON= Closed)	-	Monitoring Parameter	-
		MODE	Device Mode (Observe)	-	Monitoring Parameter	-
		OPN-FLAG	Open Command Output Process (Observe)	-	Monitoring Parameter	-
		CLSFLAG	Close Command Output Process (Observe)	-	Monitoring Parameter	-

Table 4.97 Macro Parameters

Macro Parameter	Initial Value	Description
MOPN	Custom, corresponding to the "ON" button on the function block panel	Users can redefine the description of the manual ON command button on the panel
MCLS	Custom, corresponding to the "OFF" button on the function block panel	Users can redefine the description of the manual OFF command button on the panel
OPNPRM	Custom, corresponding to the "ON PRM" button on the function block panel	Users can redefine the description of the manual ON PRM command button on the panel
CLSPRM	Custom, corresponding to the "OFF PRM" button on the function block panel	Users can redefine the description of the manual OFF PRM command button on the panel

4.27.2 Logic Control

Work Status of Function Block

Function block status and priority: OOS> Interlock> Man/Auto

- OOS (MODE=1)
When SWOOS=ON, function block is in OOS status, not respond to commands output, output hold.
- Interlock (Interlock Open, Interlock Close, MODE=4)
When it is not OOS, enters into interlock mode when inputting interlock open/ close commands. Interlock command input applies up jump check.
If interlock open/ close commands come together, not respond to interlock command, generate DBEMCMD alarm.
If interlock open command comes first, while in its valid time interlock close command comes too, perform interlock open first, and perform interlock close as soon as it comes.
If interlock close command comes first, while in its valid time interlock open command comes too, perform interlock close first, and perform interlock open as soon as it comes.
Validity of interlock command input is limited by open/ close permit (OPNPRM, CLSPRM), device fault FAIL. And FAIL limits can be shielded by input command shield alarm IGNORALM.



ATTENTION:

Output OPN = ON and CLS=OFF when interlock start. Output OPN = OFF and CLS=ON when interlock stop.

- Man/auto (Man: MODE=5; Auto: MODE=6)
When OOS and interlock do not happen, it is in manual /auto mode.
Manual status output instruction is decided by manual command MOPN and MCLS. MOPN and MCLS parameters track the current output command.
Automatic status output instruction is decided by program command input PCMD. When PCMD = ON, output: OPN=ON and CLS=OF. When PCMD = OFF, output: OPN=OFF and CLS=ON.
Man/auto command input adopts jump check.
If interlock open EMOPN is continuously ON, then manual close and auto close command are disabled.

If interlock close EMCLS is continuously ON, then manual open and auto open command disabled.

The validity of man/auto command is restricted by open/close enable (OPNPRM, CLSPRM), device fault FAIL and running fault OPFL. Running fault limit can be shielded by OPFLACK. FAIL and OPFL limit can be shielded by input command shield alarm IGNORAM.

Manual/Auto Switch

When OOS and interlock are not generated, the system turns to manual /auto mode.

It can be switched by FBOPT, SWAM and PSWAM.

When FBOPT=OFF, it is decided by panel.

When FBOPT=ON, it is decided by program input PSWAM.

Power off Alarm

When it is not outputting instruction and has no running fault, if OPNSTA and CLSSTA are OFF together, set the power off alarm as POWOFF.

Running Fault

When the status feedback IGNORSTA=ON is ignored, OPN and CLS maintain output.

When no responding feedback signal are received in runtime TOC after outputting the command, set running fault alarm OPFL. When SAFE_OPT=ON, OPN=OFF, CLS=OFF.

When there is OPFL alarm, new command is not effective. And when OPFL alarm is eliminated, new command input will be valid.

Feedback Fault

When open status feedback OPNSTA and close status feedback CLSSTA are both ON, feedback fault alarm FAIL will be started.

Alarm Confirmation

Eliminate the running alarm by panel or program input signal PACK.

Shield Alarm

Set OPFLACK=OFF, running fault does not need to be confirmed and is not considered as restricted condition of new command input.

Set OPFLACK=ON, running fault needs to be confirmed and is considered as restricted condition of new command input, it is valid to the manual/auto command and invalid to the interlock command.

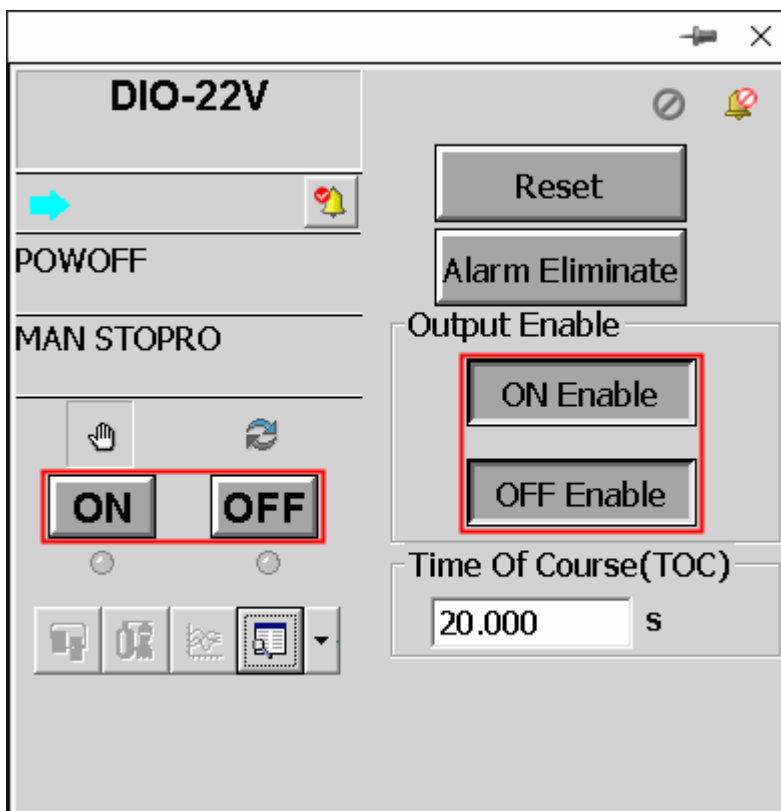
Set AUTOCLR=ON, valve check fault alarm OPFL will be eliminated automatically after status feedback signal is restored.

Set AUTOCLR=OFF, valve check fault alarm OPFL will be eliminated only after panel confirmation after status feedback signal is restored.

Output Reset

In manual mode, if interlink input command doesn't exist, reset output via RST. This function can support valve control of command lock, and reset output to save gas source after feedback reached.

4.27.3 Panel Parameter



As shown in the figure above, the button name in the red box can be modified in the macro parameters of the function block, and the maximum length is 0~64 characters (including Chinese, English, numbers and special characters). If the button name is not modified, the original default description will be displayed on the panel. When the length of the custom description exceeds the

actual length of the button on the panel, it will be truncated and displayed according to the actual length of the button.

Table 4.98 Table 4-98 Panel parameter instruction of DIO-22V

Panel Parameter		Parameter	Initial Value	Value Range	Application Instruction
Alarm Eliminate		PACK	OFF	-	The running fault can be eliminated via "Eliminate Alarm" on panel.
Enable Output	Open Permission	OPN-PRM	ON	-	-
	Close Permission	CLSPRM	ON	-	-
Runtime (TOC) (s)		TOC	20.0000	-	-
Reset		RST	OFF	-	Reset output command in manual mode after feedback reached.

4.27.4 Flag

Table 4.99 Flag list

Flag	Monitoring Assignment	Instruction
D0	OOS	Disable
D3	EMOPN	Interlock Open
D4	EMCLS	Interlock Close
D5	MAN	Manual
D6	AUTO	Auto
D7	POWOFF	Power-OFF Alarm
D9	OPFL	Running Fault
D10	FAIL	Feedback Fault
D11	STAOPN	Devices All Open
D12	STACLS	Devices All Closed
D14	OPNPRO	Open Instruction Output Process
D15	CLSPRO	Close Instruction Output Process
D18	AOF	Suppress Alarm

Table 4.99 Flag list (continued)

Flag	Monitoring Assignment	Instruction
D24	DBEMCMD	Interlock Double Input Fault
D25	STOPRO	Stop Instruction Output Process

5 Analog Processing Function Block Library

The analog processing function block has totally of 36 function blocks, including eight complicated function blocks and 28 simple function blocks. As a complicated function blocks, each function block are the corresponding panel, operating in the monitor screen function block parameters in the panel.

5.1 ACCUM_E

This function block is used to accumulate the main steam energy of incinerator and oil consumption of aux burner, and output the accumulation.

* ACCUM_E	
IPV	OUT
ISTART	ERR
IRST	TOUT
p0007	3#

5.1.1 Parameter Description

Table 5.1 Parameter Description of ACCUM_E Function Block

Parameter		Description	Upload	Reference
Basic Parameter	Input Pin	PV	Input Value	-
		START	start and stop control ON means starting to accumulate, OFF means stopped to accumulate.	-
		RST	Reset the accumulate as 0. Reset at the rising edge.	-
	Output Pin	OUT	The accumulate result.	-
		ERR	ERR	-
		TOUT	Whether the accumulate time is up.	If TOUT=ON, that means the accumulate time is not up.
	Operation Parameter	TCNT	Accumulate Time	No less than 0.0(unit: hour)
		TUPDATE	Update Time	No less than 0.0(unit: Second)
		TC	Sample Time	No less than 0.0(unit: Second)
		KFCT	Coefficient	-

The main steam energy is counted by the flow, pressure and temperature of main steam.

TCNT can be set as one hour, one and half of an hour, two hours, and TCNT is based on the current time. TUPDATE can be set as one minute, two minutes, and so on.

5.1.2 Operation Illustration

When START=OFF, stop to accumulate and the accumulate result holding.

When START=ON, start to accumulate.

When there is a rising edge happened to RST, OUT will be set as 0.

5.1.3 Abnormal Operation Instruction

- If the valid data in the buffer is less than the TCNT. For example, TCNT configured as 1 hour and the valid data is 0.5 hour, TOUT will be set as ON and OUT will be set as the accumulate result of valid date.
- If TC is less than the control cycle, ERR will be set as ON.
- If TUPDATE is less than TC, ERR will be set as ON.
- If TCNT is less than TUPDATE/3600, ERR will be set as ON.
- If KFCT is less than 0, ERR will be set as ON.
- If TUPDATE/TC > 127, ERR will be set as ON.
- If TCNT*3600/TUPDATE > 127, ERR will be set as ON.

5.2 ACCUM_T

This function block is used to accumulate the cycle time of feeder in the specified time.

* ACCUM_T	
<input type="checkbox"/> PV	OUT <input type="checkbox"/>
<input type="checkbox"/> START	ERR <input type="checkbox"/>
<input type="checkbox"/> RST	TOUT <input type="checkbox"/>
<input type="checkbox"/> CMD_B	
<input type="checkbox"/> CMD_F	
p0006	2#

Parameter Instruction

Table 5.2 Parameter Instruction of ACCUM_T Function Block

Parameter Name			Description	Upload	Reference
Basic parameter	Input Pin	PV	Input Value	-	-

Table 5.2 Parameter Instruction of ACCUM_T Function Block (continued)

Parameter Name			Description	Upload	Reference
me- ter		START	start and stop control	-	ON means starting to accumulate, OFF means stopped to accumulate.
		RST	Reset the accumulate as 0.	-	Reset at the rising edge.
		CMD_B	Command to backward.	-	-
		CMD_F	Command to forward.	-	-
	Out- put Pin	OUT	The accumulate result.	-	-
		ERR	ERR	-	ON means that there is parameter set- ting error.
		TOUT	Whether the accumulate time is up.	-	If TOUT=ON, that means the accumu- late time is not up.
	Op- era- tion Pa- ra- me- ter	TCNT	Accumulate Time	-	No less than 0.0(unit: hour)
		TUPDATE	Update Time	-	No less than 0.0(unit: Second)
		TC	Sample Time	-	No less than 0.0(unit: Second)
		DB	Dead zone	-	percent variable
		MODE	0=Travel Mode,1=Command	-	-

TCNT can be set as one hour, one and half of an hour, two hours, and TCNT is based on the current time. TUPDATE can be set as one minute, two minutes, and so on.

Operation Instruction

When START=OFF, stop to accumulate and the accumulate result holding.

When START=ON, start to accumulate.

When there is a rising edge happened to RST, OUT will be set as 0.

Abnormal Operation Instruction

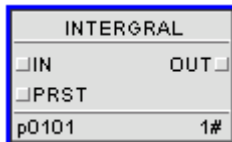
- If the valid data in the buffer is less than the TCNT. For example, TCNT configured as 1 hour and the valid data is 0.5 hour, TOUT will be set as ON and OUT will be set as the accumulate result of valid date.
- If TC is less than the control cycle, ERR will be set as ON.
- If TUPDATE is less than TC, ERR will be set as ON.
- If TCNT is less than TUPDATE/3600, ERR will be set as ON.
- If DB is less than 0, ERR will be set as ON.

- If MODE is not 0 or 1, ERR will be set as ON.
- If PVSCH is not more than PVSCL, ERR will be set as ON.
- If TUPDATE/TC > 127, ERR will be set as ON.
- If CNT *3600/TUPDATE> 127, ERR will be set as ON.

5.3 Integral Function Block (INTEGRAL)

Integral function block can make integral action to the input, and used in cumulation calculation.

This function block is a complicated function block, the running time is 30μs.



5.3.1 Parameter Description

Table 5.3 Integral function block parameter description

Name			Description	Upload	Properties	Application Reference
Basic Parameters	Gain Settings	GAIN	GAIN, Achieve Equivalent Coefficient	TRUE	Operation Parameter	-
	Output Limits-Note2	OUTL	Output Low Limit Value	TRUE	Operation Parameter	Value Range[INSCL,INSCH]
		OUTH	Output High Limit Value	TRUE	Operation Parameter	Value Range[INSCL,INSCH]
	Ranges Settings-Note1	INSCH	Input High Limit Value of Range	-	Configuration Parameter	-
		INSCL	Input Low Limit Value of Range	-	Configuration Parameter	-
		INEU	Input Unit	-	Configuration Parameter	-
		OUTEU	Output Unit	-	Configuration Parameter	-
		INDLEN	IN Decimal Digits [0,5]	-	Configuration Parameter	Used for Data Displayed on Function Block Panel (Equal to 3 as Default)

Table 5.3 Integral function block parameter description (continued)

Name			Description	Upload	Properties	Application Reference
		OUTDLEN	OUT Decimal Digits [0,5]	-	Configuration Parameter	Used for Data Displayed on Function Block Panel (Equal to 3 as Default)
Extended Parameters	Input Pin	IN	Calculation Input Value	-	Input Pin	Connect to AI and function block
		INERR	Calculation Input Value Status ^{Note3}	-	Input Pin	Connect the Error status of previous module. Can not connect
		PRST	Program Reset Switch(ON= Reset)	-	Input Pin	Connect to digital, Related RST_OPT
		PHOLD	Program Pause Switch(ON=Keep)	-	Input Pin	Connect to digital, Related HOLD_OPT
		RST_OPT	Select Reset Control Source(ON=Program Control, OFF=Panel Control) ^{Note4}	-	Input Pin	Connect to digital, Related PRST/RST
		HOLD_OPT	Select Pause Control Source(ON=Program Control, OFF=Panel Control) ^{Note5}	-	Input Pin	Related Parameter PHOLD/HOLD
	Output Pin	OUT	Calculation Output Value ^{Note6}	-	Output Pin	Related MODE.If there's a float abnormal happened to the OUT value, the OUT will be set as lower limit. Please refer to "Application Illustration" for details.
		ERR	Block Alarm, ERR=ON	-	Output Pin	-
	OOS Settings	SWOOS	Function Block Disable(ON=Disable)	TRUE	Operation Parameter	-
	Run Control	HOLD	Panel Retention (ON=Keep)	TRUE	Operation Parameter	Related HOLD_OPT
		RST	Panel Reset (ON=Reset), keep ON for a period after executing	TRUE	Operation Parameter	Related RST_OPT

Table 5.3 Integral function block parameter description (continued)

Name			Description	Upload	Properties	Application Reference
	Calculation Status Monitor		command, then reset as OFF			
		FINISH	Output Reach High Limit, FINISH= ON		Monitoring Parameter	-
		OUT_LT	Preceding Reset Cumulation Value	TRUE	Operation Parameter	-
	Alarm Enabled and Suppress	AOF	Suppress Module Alarm AOF=ON, Real-Time Alarm Do not Show; AOF=OFF, Real-Time Alarm Show	TRUE	Operation Parameter	-
		ENALM	Parameter Alarm Enable (Set parameter via select the "Settings "or not)	TRUE	Operation Parameter	-
		FLAG	Flag Code	-	Output Pin	Refer to Flag
	Input Alarm Settings	INHH	Input HH Alarm Value	TRUE	Operation Parameter	-
		INH	Input High Limit Alarm Value	TRUE	Operation Parameter	-
		INL	Input Low Limit Alarm Value	TRUE	Operation Parameter	-
		INLL	Input LL Alarm Value	TRUE	Operation Parameter	-
		INHYS	Input Hysteresis(≥ 0.0)	TRUE	Operation Parameter	-
	Mode Settings	MODE	Select Mode: 0=Amplitude Limiting, 1=Auto Reset, 2=No Stop Cumulation ^{Note7}	-	Configuration Parameter	Configuration set in the Program Properties

Note 1: Input High Limit Value must be more or equals to Input Low Limit Value. Otherwise, range threshold overturn alarm occurs and ERR=ON.

Note 2: Output High Limit Value must be more or equals to Output Low Limit Value. Otherwise, range threshold overturn alarm occurs and ERR=ON. When integral is less than low limit, the program forces it to be equal to low limit and restart cumulation from the low limit. When output value reaches the high limit, FINISH=ON.

Note 3: When INERR=ON surpasses half of times of status of function block, ERR=ON.

Note 4: When integral function block is in restore status, the output value equals to output low limit and status statistic value will be reset. The priority of restore is higher than that of hold, that is, restore when restore command occurs in hold status.

Note 5: When integral function block is in hold status, the output value and status statistic value (run time of function block and time of INERR=ON) remain the same with last week. Only function block is in neither hold nor restore status, start the cumulation.

Note 6: $\text{Output} = \text{output value of last period} + \text{input} * \text{run period} * \text{GAIN}$ When cold-starting, do not restore cumulation value.

Note 7: Users can choose to use integral limit function or not. When MODE=0, it is in integral limit status mode and output value will be restricted in high limit when it reaches the high limit. When MODE=1, it is in automatically restore status, output value will restore to the low limit when it reaches the high limit. When MODE=2, it is in the stop status, cumulation output will continue until it is overflowed when output value reaches the high limit.

5.3.2 Application Illustraton

The float abnormal of output values means that the output values are not float format, or a meaningless output value is produced in a calculation that performs a divide-by-zero operation. When float abnormal happened, the function block is processed according to the following rules:

Output values

- The output value OUT is equal to the lower range limit.
- ERR: the alarm value turns ON.

5.3.3 Panel Parameter

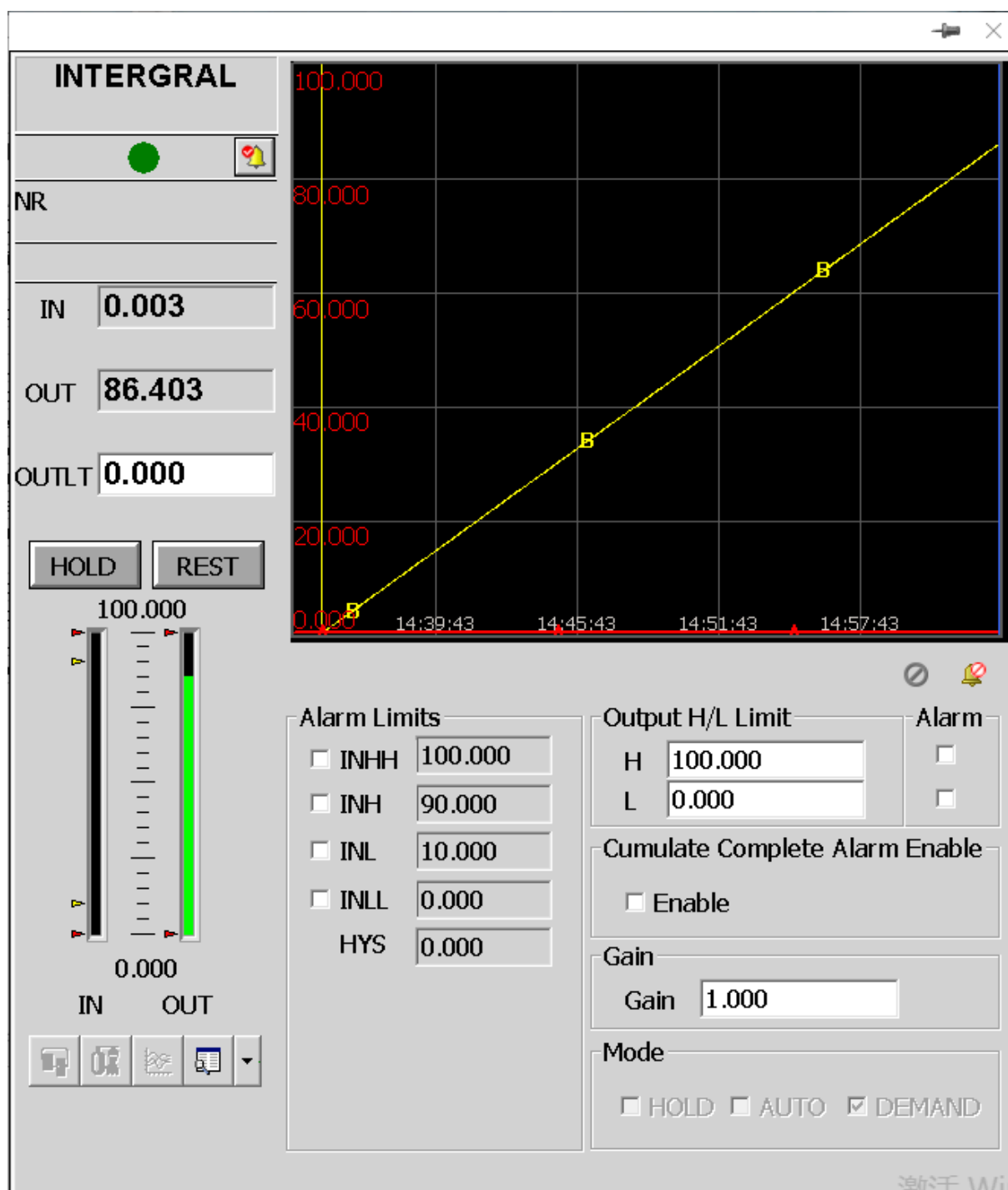


Table 5.4 Function Block Panel Parameter

Panel Parameter Name		Function Block Parameter Name	Initial Value	Value Range	Application Instruction
Alarm Limits	INHH	INHH	100.0000	[INSCL,INSCH]	Input HH Alarm Value Setting (the option selected alarm, otherwise invalid)
	INH	INH	90.0000	[INSCL,INSCH]	Input High Limit Alarm Value Setting (the option

Table 5.4 Function Block Panel Parameter (continued)

Panel Parameter Name	Function Block Parameter Name	Initial Value	Value Range	Application Instruction
				selected alarm, otherwise invalid)
	INL	INL	10.0000	[INSCL,INSCH] Input Low Limit Alarm Value setting (the option selected alarm, otherwise invalid)
	INLL	INLL	0.0000	[INSCL,INSCH] Input LL Alarm Value setting (the option selected alarm, otherwise invalid)
	INHYS	INHYS	0.0000	- Input Hysteresis
OUT Limits	OUTH	OUTH	100.0000	- Output High Limit Value (the option selected alarm, otherwise invalid)
	OUTL	OUTL	0.0000	- Output Low Limit Value (the option selected alarm, otherwise invalid)
Camulate Complete Alarm Enable	ENALM	ENALM	OFF	-
Gain	GAIN	GAIN	1.0000	-
Mode	HOLD, AUTO, DEMAND	MODE	2(No Stop Cumulation)	- Read-only, can be set in the Function Block Properties window.

5.3.4 Flag

Table 5.5 Flag list

Flag	Alarm	Description
D0	OOS	Disable
D1	HOLD	Hold
D2	RESET	Reset
D3	FIN	Finish
D4	ERR	Fault
D5	INHH	Input HH Limit Alarm

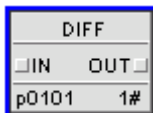
Table 5.5 Flag list (continued)

Flag	Alarm	Description
D6	INH	Input H Limit Alarm
D7	INL	Input L Limit Alarm
D8	INLL	Input LL Limit Alarm
D9	OUTH	Output H Limit Alarm
D10	OUTL	Output L Limit Alarm
D12	REVSCL	Span H/L Limit Reverse or output value float abnormal
D13	CFGERR	Configuration Error
D14	AOF	Suppress Alarm

5.4 Differential Function Block (DIFF)

This function block realizes differential function and regularly for calculating the change rate.

This function block is a simple function block, the running time is 10μs.

**Table 5.6 Differential function block parameter instruction**

Name		Description	Upload	Properties	Application Reference
Input Pin	IN	Input Value	-	Input Pin	Connect AI and Function Block
Output Pin	OUT	Output Value	-	Output Pin	<p>If there's a float abnormal happened to the OUT value, the OUT will be set as the value of previous period or 0. Please refer to "Note 1: The output OUT of the DIFF function block = (GAIN * TD * (IN - IN_LT) + TD * OUT_LT) / (TS + TD); where: IN_LT is the input value of the last period, OUT_LT is the output value of the last period, and TS is The scheduling period.Application" for details.</p>

Table 5.6 Differential function block parameter instruction (continued)

Name		Description	Upload	Properties	Application Reference
Operation Parameter	GAIN	Gain	TRUE	Operation Parameter	-
	TD	Derivative Time Constant (S)	TRUE	Operation Parameter	-

Note: The output OUT of the DIFF function block = (GAIN * TD * (IN - IN_LT) + TD * OUT_LT) / (TS + TD); where: IN_LT is the input value of the last period, OUT_LT is the output value of the last period, and TS is The scheduling period.

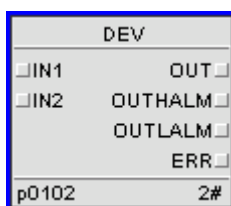
Application

The float abnormal of output values means that the output values are not float format, or a meaningless output value is produced in a calculation that performs a divide-by-zero operation. When float abnormal happened, the function block is processed according to the following rules:

- If there's the normal value of previous period, OUT outputs the value of previous period.
- If there's the abnormal value of previous period or no previous period value, OUT outputs 0.

5.5 Nonlinear Error Calculation Function Block (DEV)

This function block realizes nonlinear EI calculation. This function block is a simple function block, the running time is 10μs.

**Table 5.7 Nonlinear error calculation function block parameter instruction**

Name		Description	Upload	Properties	Application Reference
Input Pin	IN1	Input Value 1	-	Input Pin	Connect AI and Function Block
	IN2	Input Value 2	-	Input Pin	Connect AI and Function Block
Output Pin	OUT ^{Note1}	EI Output Value	-	Output Pin	-
	OUTHALM	High Alarm ^{Note2}	-	Output Pin	Associate OUTH

Table 5.7 Nonlinear error calculation function block parameter instruction (continued)

Name		Description	Upload	Properties	Application Reference
	OUTLALM	Low Alarm ^{Note3}	-	Output Pin	Associate OUTL
	ERR ^{Note4}	Block Alarm	-	Output Pin	Connect INERR of the next module
Operation Parameter	K1	Input 1 Gain	TRUE	Operation Parameter	-
	K2	Input 2 Gain	TRUE	Operation Parameter	-
	C1	Input 1 Bias	TRUE	Operation Parameter	-
	C2	Input 2 Bias	TRUE	Operation Parameter	-
	OUTH	Output High Limit	TRUE	Operation Parameter	Associate OUTHALM
	OUTL	Output Low Limit	TRUE	Operation Parameter	Associate OUTHALM
	DB	Input Deadband	TRUE	Operation Parameter	-
	ALMHYS	Alarm Hysteresis	TRUE	Operation Parameter	-

Note 1: The Output logic of bias is shown as follows.

- EI calculation

$$EI = (IN1 * K1 + C1) - (IN2 * K2 + C2);$$
- Output logic
 When $EI \geq OUTH + DB$, $OUT = OUTH$;
 When $DB < EI < OUTH + DB$, $OUT = EI - DB$;
 When $-DB \leq EI \leq DB$, $OUT = 0.0$;
 When $OUTL - DB < EI < -DB$, $OUT = EI + DB$;
 When $EI \leq OUTL - DB$, $OUT = OUTL$.

Note 2: High limit alarm logic is shown as follows

When $EI \geq OUTH + DB + ALMHYS$, $OUTHALM = ON$;

When $EI < OUTH + DB - ALMHYS$, $OUTHALM = OFF$;

When $OUTH + DB - ALMHYS \leq EI < OUTH + DB + ALMHYS$, $OUTHALM$ holds.

Note 3: Low limit alarm logic s shown as follows

When $EI \leq OUTL - DB - ALMHYS$, $OUTLALM = ON$;

When $EI > OUTL - DB + ALMHYS$, $OUTLALM = OFF$;

When $OUTL - DB - ALMHYS < EI \leq OUTL - DB + ALMHYS$, $OUTLALM$ holds.

Note 4: Block alarm is shown as follows

When high limit alarm or low limit alarm occurs, block alarm $ERR = ON$.

Input High Limit Value must be more or equals to Input Low Limit Value. Otherwise, range threshold overturn alarm occurs and $ERR=ON$.

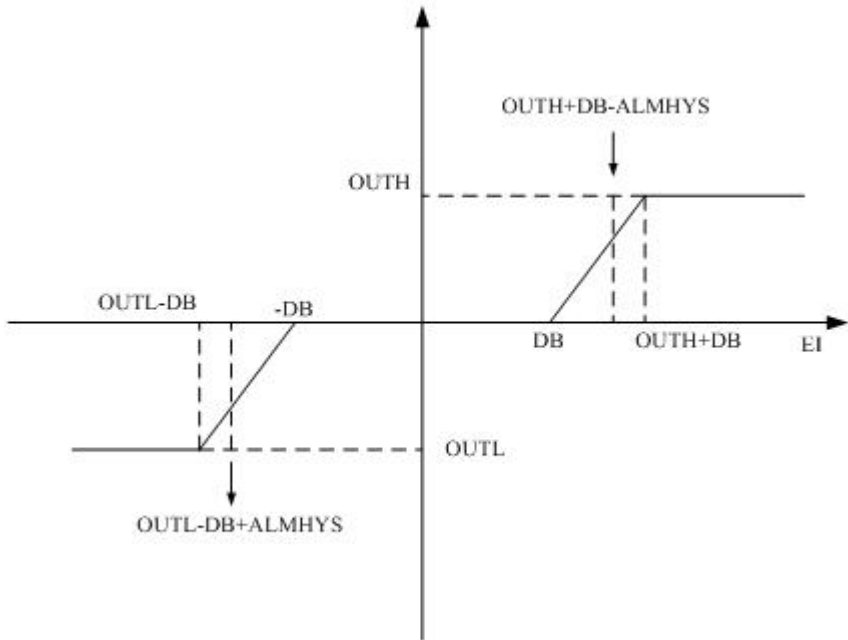


Figure 5.1 Nonlinear EI calculation function block Algorithm sketch map

5.6 H Limit Alarm Function Block (HIGHMON)

This function block checks one- side high limit alarm and hysteresis judges the alarm. This function block is a simple function block, the running time is 10μs.



Table 5.8 limit alarm function block parameter instruction

Name		Name	Upload	Properties	Application Reference
Input Pin	IN	Input Value	-	Input Pin	Connect AI and Function Block

Table 5.8 limit alarm function block parameter instruction (continued)

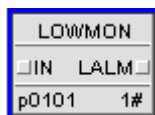
Name		Name	Upload	Properties	Application Reference
	INH	H Limit Value	TRUE	Operation Parameter	-
Output Pin	HALM-Note1	Output Value	-	Output Pin	-
Operation Parameter	HYS	Hysteresis	TRUE	Operation Parameter	-

Note 1: The Output logic is shown as follows.

- When $IN \geq INH$, HALM = ON
- When $IN < INH - HYS$, HALM=OFF
- When $INH - HYS \leq IN < INH$, HALM holds

5.7 L Limit Alarm Function Block (LOWMON)

This function checks one-side low limit alarm and hysteresis judges the alarm. This function block is a simple function block, the running time is 10μs.

**Table 5.9 L limit alarm function block parameter instruction**

Name		Name	Upload	Properties	Application Reference
Input Pin	IN	Input Value	-	Input Pin	Connect AI and Function Block
	INL	H Limit Value	TRUE	Operation Parameter	-
Output Pin	LALMNote1	Output Value	-	Output Pin	-
Operation Parameter	HYS	Hysteresis	TRUE	Operation Parameter	-

Note 1: The Output logic is shown as follows.

- When $IN \leq INL$, LALM = ON
- When $IN > INL + HYS$, LALM = OFF
- When $INL < IN \leq INL + HYS$, LALM holds

5.8 H/L Limit Delay Alarm Function Block (HLMON)

This function block checks high and low limit alarm of input point and alarm check has functions like time-lapse and hysteresis. This function block is a simple function block, the running time is 10μs.

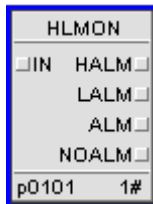


Table 5.10 H/L limit delay alarm function block parameter instruction

Name		Description	Upload	Properties	Application Reference
Input Pin	IN	Input Value	-	Input Pin	Connect AI and Function Block
	SVH	SV High Limit Value	TRUE	Operation Parameter	-
	SVL	SV Low Limit Value	TRUE	Operation Parameter	-
Output Pin	HALM ^{Note1}	High Limit Alarm	-	Output Pin	Associate SVH , TSH and HYSH
	LALM ^{Note1}	Low Limit Alarm	-	Output Pin	Associate SVH , TSH and HYSH
	ALM ^{Note2}	Alarm	-	Output Pin	-
	NOALM- ^{Note2}	No Alarm	-	Output Pin	-
Operation Parameter	TSH	Ultra-High Limit Delayed Time, the unit is second	TRUE	Operation Parameter	-
	TSL	Ultra-Low Limit Delayed Time, the unit is second	TRUE	Operation Parameter	-
	HYSH	High Limit Hysteresis	TRUE	Operation Parameter	-
	HYSL	Low Limit Hysteresis	TRUE	Operation Parameter	-

Note 1: The logic of function block is shown as follows.

- When input value IN surpasses high limit SVH, and the lasting time more than TSH, high limit alarm occurs (HALM=ON);
- When input value IN is less than low limit SVH, and the lasting time more than TSL, low limit alarm occurs (LALM=ON);
- When high limit alarm occurs, it can be reset only when IN is less than SVH-HYSH;
- When low limit alarm occurs, it can be reset only when IN is more than SVL+HYSL.

Note 2: When high limit alarm or low limit alarm occurs, ALM=ON, NOALM=OFF; When neither of them occurs, ALM=OFF, NOALM=ON.

Figures below show the relation between input and high and low limit alarm.

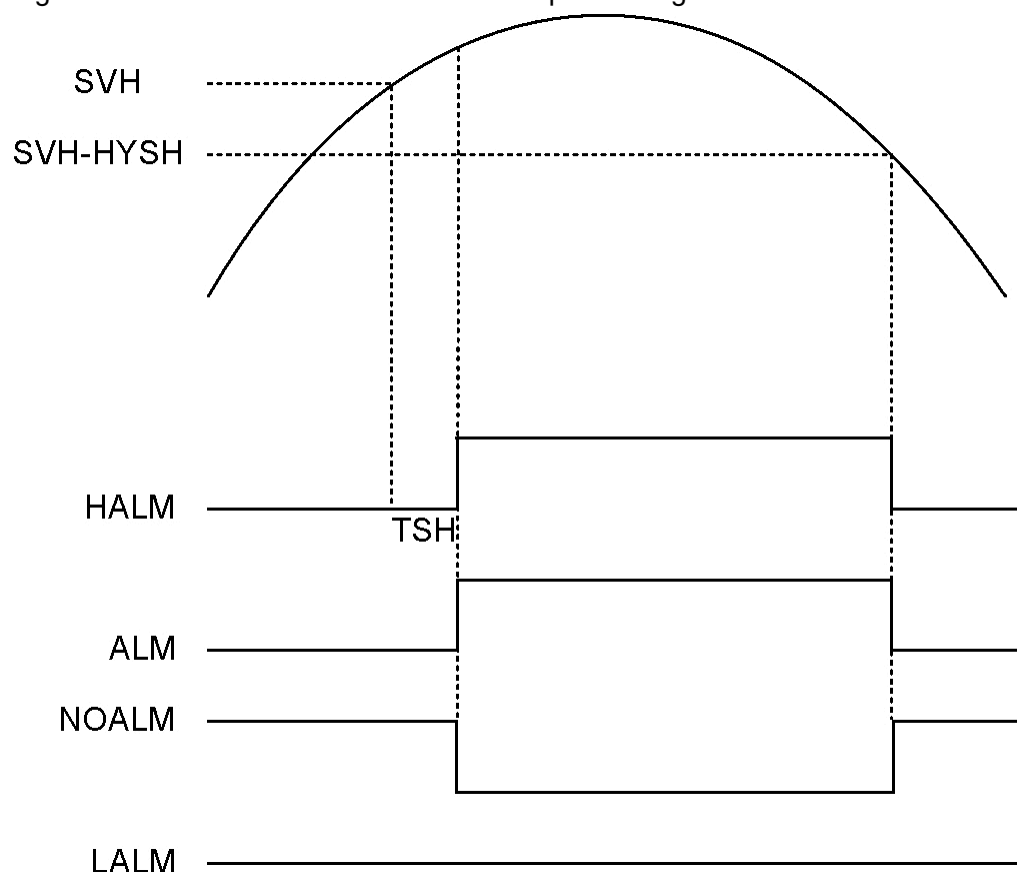


Figure 5.2 Relation between input and high limit alarm

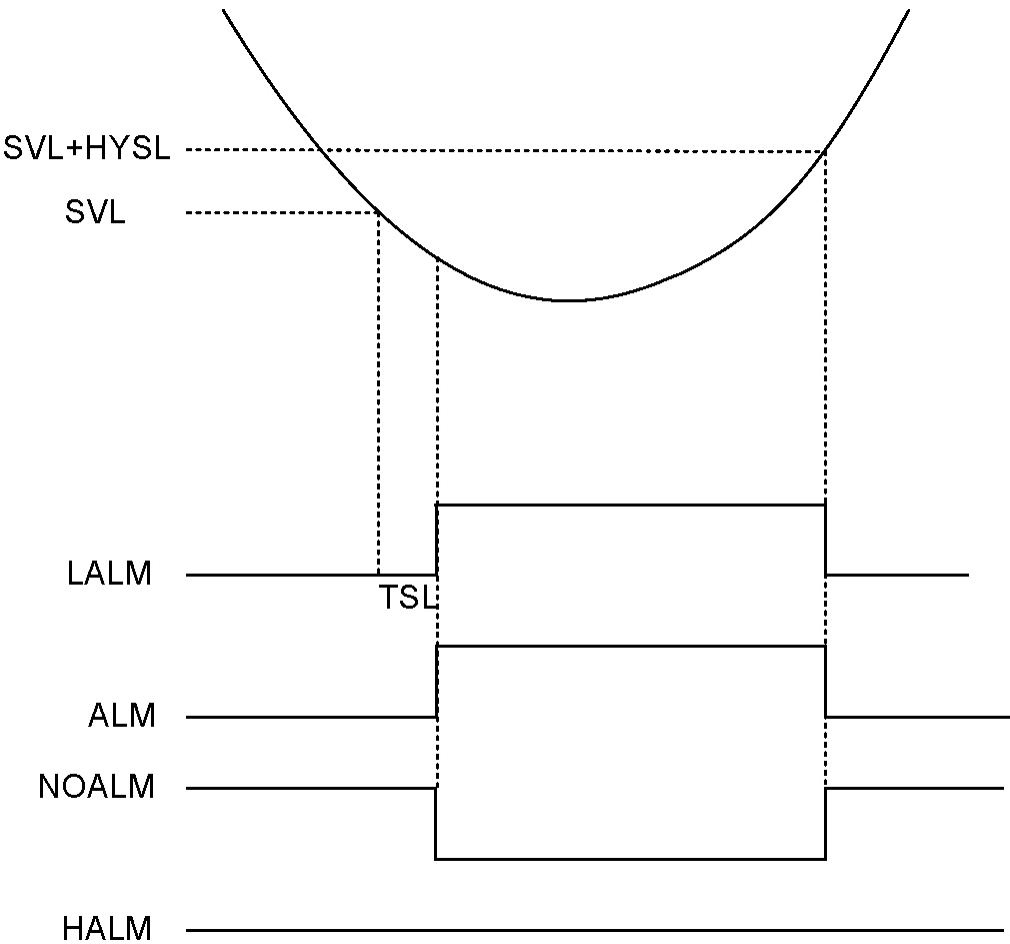


Figure 5.3 Relation between input and low limit alarm

5.9 Leading and Hysteresis Function Block (LDLAG)

This function block can perform first-order lag processing, first-order lead processing, and lead lag processing on the input signal, and it also has the function of output following the change of the set value. For the lead mode, you can choose to respond to the positive transition, or to the negative transition and to the two transitions. The lead mode is equivalent to impulse response to the input. When in the tracking mode, the output changes with changes in the input.

When using the lead-lag function block, you need to select lead, lag, or lead-lag compensation according to the low-frequency or high-frequency fluctuation characteristics of the input signal to effectively remove signal fluctuations and improve the transient and steady-status performance of the system.

This function block is a simple function block, the running time is 15μs. Parameter illustration of LDLAG function block is shown in Table 5.11.



Table 5.11 Leading and hysteresis function block parameter instruction

Name		Description	Upload	Properties	Application Reference
Input Pin	IN	Calculation Input Value	-	Input Pin	Connect AI and Function Block
	SWTR ^{Note3}	Tracking Switch(ON=Tracking)	-	Input Pin	OUT Track IN
Output Pin	OUT	Calculation Output Value	-	Output Pin	If there's a float abnormal happened to the OUT value, the OUT will be set as the value of previous period or 0. Please refer to "Application" for details.
Operation Parameter	TLAG	Lag Time (≥ 0.0), the unit is second	TRUE	Operation Parameter	-
	TLED	Leading Time (≥ 0.0), the unit is second	TRUE	Operation Parameter	-
	GAIN	Gain	TRUE	Operation Parameter	-
Configuration Parameter	MODE ^{Note1}	Select Mode: 0=First Order Lag, 1=First Order Leading, 2=Lead-Lag	-	Configuration Parameter	Configuration set in the Program Properties
	IMMODE- Note2	Pulse Mode: 0= Positive Transition-Sensing, 1= Negative Transition-Sensing, 2= Positive/Negative Transition-Sensing	-	Configuration Parameter	Configuration set in the Program Properties

Note 1. The detailed instruction of mode is shown as follows.

- lag mode

In lag mode:

$$OUT = \frac{GAIN}{1 + TLAGs} * IN$$

, s is Laplace factor.

In lag mode, its response graph is shown as follows:

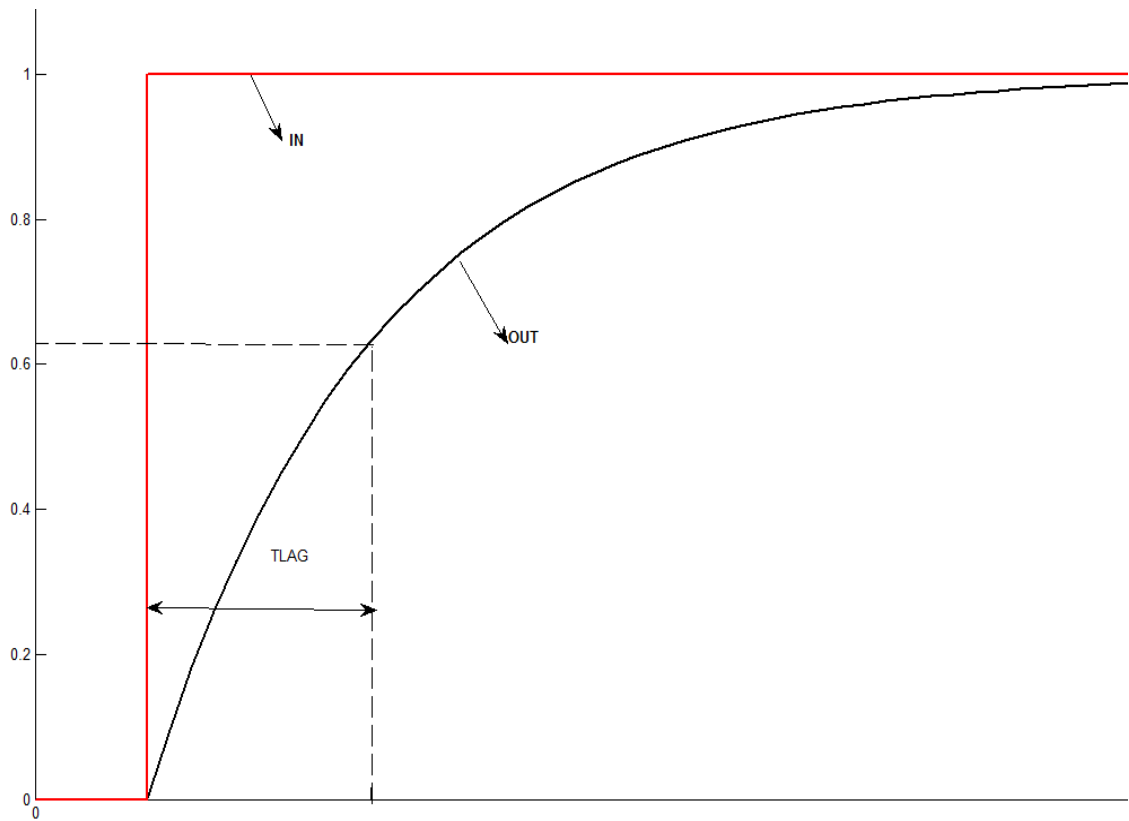


Figure 5.4 Lead-lag Function Block response curve in lag mode

- Lead mode

In lead mode:

$$\text{OUT} = \text{IN} * \text{TLEDs} / (1 + \text{TLEDs})$$

In lead mode, its response curve is shown as follows:

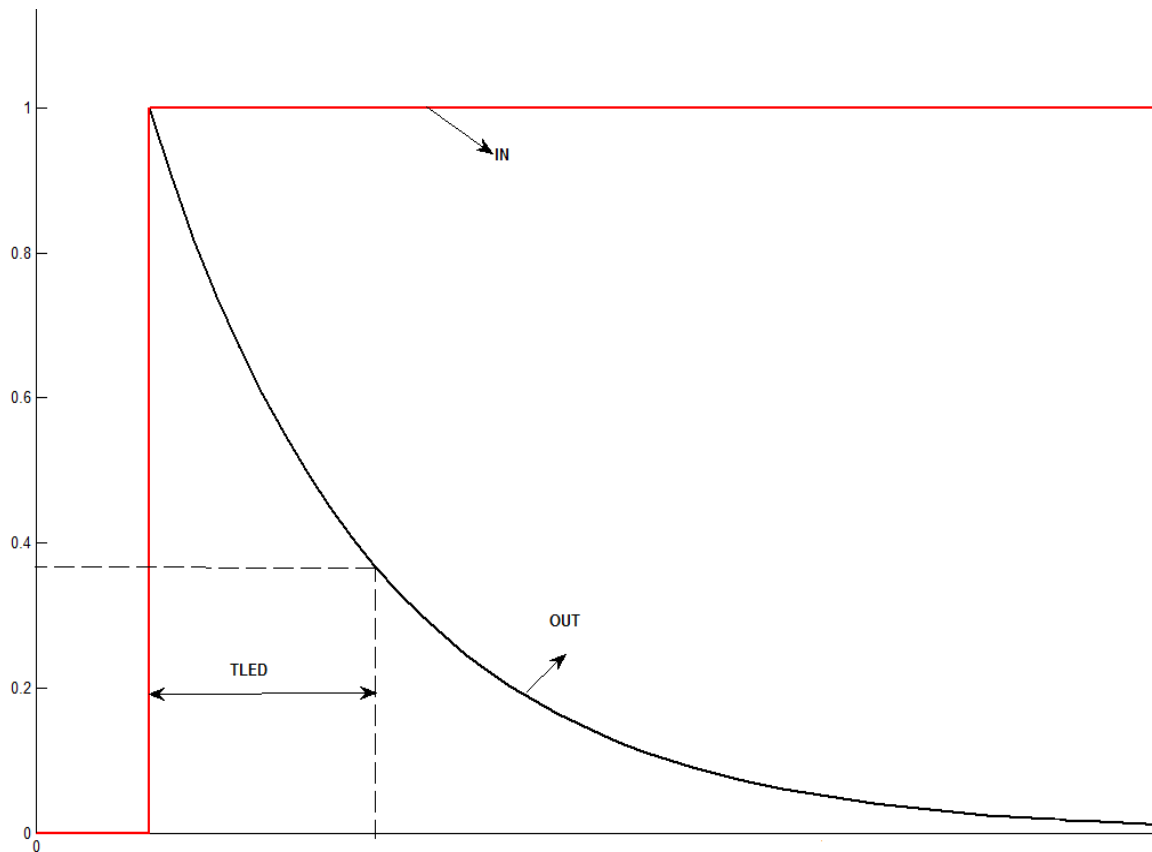


Figure 5.5 Lead-lag Function Block response curve in lead mode

- Lead-lag mode

In lead-lag mode:

$$OUT = \frac{GAIN (1 + TLEDs)}{1 + TLAGs} * IN$$

, s is Laplace factor.

In lead-lag mode, its respond graph is shown as follows:

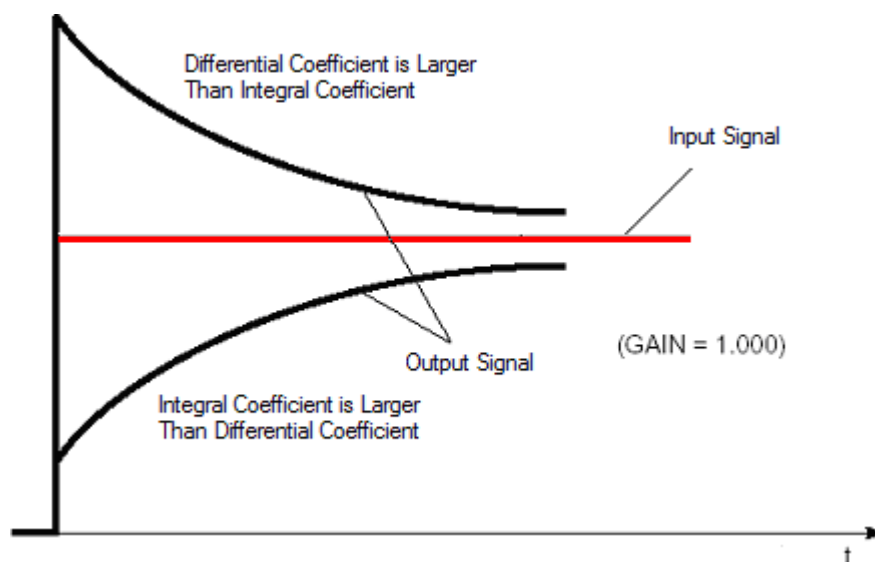


Figure 5.6 Lead-lag Function Block response curve

Note 2. In lead mode, there are three modes to choose: positive jump mode, negative jump mode and positive/negative jump mode. In positive jump mode, output only responds to positive jump signal. In negative jump mode, situation is the same. In positive/negative jump mode, output value changes with the input value.

Note 3. Track mode

Users can transfer the three modes above to tracking mode by SWTR. In tracking mode, output value changes with tracing value.



ATTENTION:

Modifying lead time or lag time will influence ascending (descending) curve. Thus, please modify the time parameters in balanced process.

Application

The float abnormal of output values means that the output values are not float format, or a meaningless output value is produced in a calculation that performs a divide-by-zero operation.

When float abnormal happened, the function block is processed according to the following rules:

- If there's the normal value of previous period, OUT outputs the value of previous period.
- If there's the abnormal value of previous period or no previous period value, OUT outputs 0.

5.10 Pure Hysteresis Function Block (DED)

Pure lag function block simulates dynamic features of pure lag which is used to transfer delay and distance rate lag. It has two modes: auto and trace. This function block is a simple function block, the running time is 29μs.

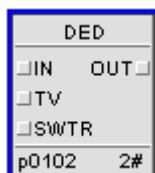


Table 5.12 Pure hysteresis function block parameter instruction

Name		Description	Upload	Properties	Application Reference
Input Pin	IN	Calculation Input Value	-	Input Pin	Connect AI and Function Block
	TV	Tracking Value	-	Input Pin	OUT Track TV, associate SWTR
	SWTR	Tracking Selection Switch (ON=Tracking)	-	Input Pin	Associate TV

Table 5.12 Pure hysteresis function block parameter instruction (continued)

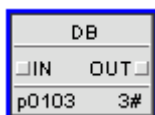
Name		Description	Upload	Properties	Application Reference
Output Pin	OUT	Calculation Output Value	-	Output Pin	-
Operation Parameter	TDED	Pure Lag Time (Unit: S, ≥ 0.0)	TRUE	Operation Parameter	-

Note1: When function block is in the track mode, pure lag fails and output value changes with tracing value. When function block switches from trace mode to pure lag mode, implement pure lag function. After going through pure lag time, current value of output hold will equal input value of switch.

The function block opens up an array of length 32 to store the sampling data. The sampling accuracy is related to the control cycle and pure lag time. When the pure lag time is less than or equal to 16s, the sampling accuracy is high. If the pure lag time is longer, the sampling point will be It will become sparse and the accuracy will be lower. For example, when the control cycle is 500ms and the pure lag time is 64s, because $64 \div (32 \times 0.5) = 4$, the function block records the value every 4 operation cycles, that is, the sampling accuracy of each point is $4 \times 0.5s = 2s$.

5.11 Deadband Function Block (DB)

The principle of the dead zone function block is that when the input changes within the set dead zone range, the output is 0, that is, the output is not triggered, which plays an effective protective role. For example, when the controller has a low-frequency input signal with a low amplitude, it may cause the system to operate frequently and cause frequent oscillations. For example, in some scenarios, the frequent triggering of the equipment causes wear and tear, these conditions will cause the wear of the components, and even lead to the instability of the control system. In order to avoid these situations, it is necessary to introduce dead zone function blocks. The parameter description of the dead zone function block is shown in Table 5.13.

**Table 5.13 Deadband function block parameter instruction**

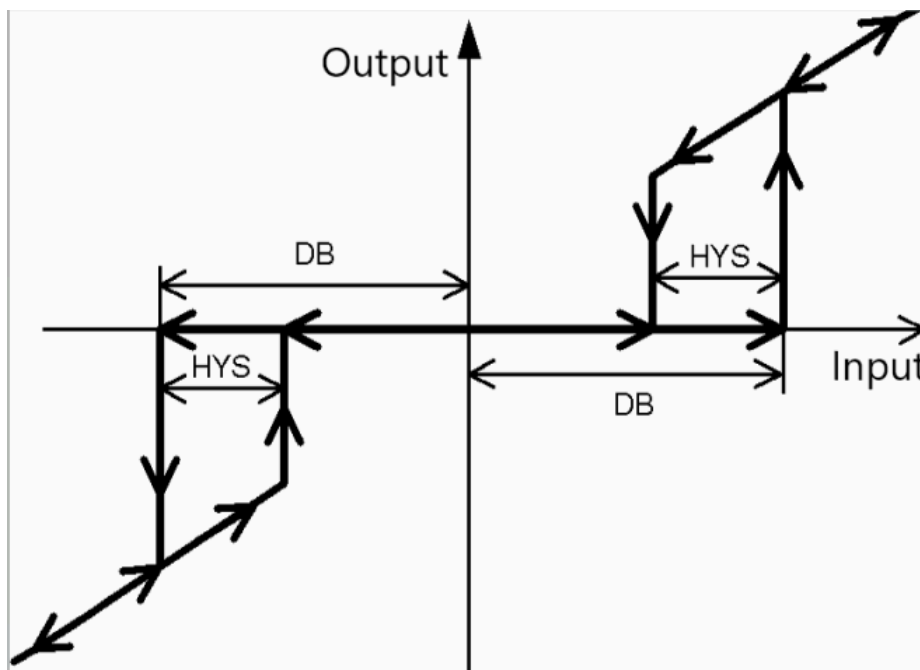
Name		Name	Upload	Properties	Application Reference
Input Pin	IN	Calculation Input Value	-	Input Pin	Connect AI and Function Block
Output Pin	OUTNote1	Calculation Input Value	-	Output Pin	-
Operation Parameter	DB	Deadband (≥ 0.0)	TRUE	Operation Parameter	-

Table 5.13 Deadband function block parameter instruction (continued)

Name		Name	Upload	Properties	Application Reference
	HYS	Hysteresis (≥ 0.0)	TRUE	Operation Parameter	-
	K1	Rise Scale Coefficient (≥ 0.0)	TRUE	Operation Parameter	-
	K2	Decline Scale Coefficient (≥ 0.0)	TRUE	Operation Parameter	-

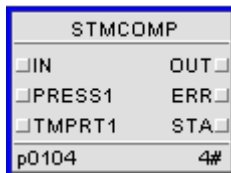
Note 1: The logic of Deadband Function Block is shown as follows.

- When inputting $IN \geq DB$, output $OUT = IN * K1$;
- When inputting $IN \leq -DB$, output $OUT = IN * K2$.
- When last period output $OUT = IN * K1$ and $DB > IN \geq DB - HYS$ in current period, $OUT = IN * K1$;
- When last period output $OUT = IN * K2$ and $DB < IN \leq -DB + HYS$ in current period, $OUT = IN * K2$.
- Otherwise, $OUT = 0$.

**Figure 5.7 Deadband function block operation process**

5.12 Steam Compensation Function Block (STMCOMP)

This function block can compensate the density to over heat steam and saturated steam. This function block is a simple function block, the running time is $31\mu s$.



5.12.1 Parameter Description

Table 5.14 Steam compensation function block parameter description

Name		Name	Upload	Properties	Application Reference
Input Pin	IN	Calculation Input Value	-	Input Pin	Connect AI and Function Block
	PRESS1	Working Press(Unit: Mpa)	-	Input Pin	-
	TMPRT1	Working Temperature(Unit: °C)	-	Input Pin	-
Output Pin	OUT	Calculation Output Value	-	Output Pin	-
	ERR ^{Note2}	Block Alarm	-	Output Pin	-
	STA	Block Alarm Status	-	Output Pin	-
Operation Parameter	PRESS0	Design Press(Unit: Mpa)	TRUE	Operation Parameter	-
	TMPRT0	Design Temperature(Unit: °C)	TRUE	Operation Parameter	-
	BYPASS	Compensation Bypass Enable Switch	TRUE	Operation Parameter	If temperature or pressure exceed compensation range, enable compensation bypass function and OUT=IN.
Configuration Parameter	MODE- ^{Note1}	Working Mode Selection [0, 2, 3, 5, 6, 8~12]	-	Configuration Parameter	Configuration set in the Program Properties When the controller is FCU712-S or above, the MODE can be 9, 10, 11, 12.



TIP:

The maximum range of processed over heat steam: temperature (100~800)°C, pressure(-0.001325~29.898675)MPa.

The maximum range of saturated steam: temperature (0~373.946)°C, pressure (-0.100325~21.962675)MPa.

5.12.2 Algorithm Illustration

By the real pressure and temperature, the enthalpy and μ can be get from table, and $\rho = \frac{1}{\mu}$.

- If flow is processed, the formula is $FLOW = \sqrt{\frac{\rho_1}{\rho_0}} \times IN$.
- If pressure difference signal is processed, the formula is $FLOW = \sqrt{\frac{\rho_1}{\rho_0}} \times IN$.
- If flow and density is linear transformation, the formula is $FLOW = \frac{\rho_1}{\rho_0} \times IN$.

In the above formula, ρ_0 is the designed density, ρ_1 the real density, IN is the input and the FLOW is OUT.

Note1: This function block has following modes.

- MODE=0
Adopt formula $OUT = \sqrt{\frac{\rho_1}{\rho_0}} \times IN$ to compensate over heat steam.
- MODE=2
Adopt formula $OUT = \frac{\rho_1}{\rho_0} \times IN$ to compensate over heat steam.
- MODE=3
Adopt formula $OUT = \sqrt{\frac{\rho_1}{\rho_0}} \times IN$ to compensate saturated steam by pressure.
- MODE=5
Adopt formula $OUT = \frac{\rho_1}{\rho_0} \times IN$ to compensate saturated steam by pressure.
- MODE=6
Adopt formula $OUT = \sqrt{\frac{\rho_1}{\rho_0}} \times IN$ to compensate saturated steam by temperature.
- MODE=8
Adopt formula $OUT = \frac{\rho_1}{\rho_0} \times IN$ to compensate saturated steam by pressure.
- MODE=9(Temperature is the main feature), and count by $OUT = \sqrt{\frac{\rho_1}{\rho_0}} \times IN$, to compensate the saturated and overheated vapor. When it is saturated vapor, it would be calculated by temperature.

$$OUT = \sqrt{\frac{\rho_1}{\rho_0}} * IN$$

- MODE=10(Pressure is the main feature), and count by $\sqrt{\frac{\rho_1}{\rho_0}}$, to compensate the saturated and overheated vapor. When it is saturated vapor, it would be calculated by pressure.

$$OUT = \frac{\rho_1}{\rho_0} * IN$$

- MODE=11(Temperature is the main feature), and count by $\frac{\rho_1}{\rho_0}$, to compensate the saturated and overheated vapor. When it is saturated vapor, it would be calculated by temperature.

$$OUT = \frac{\rho_1}{\rho_0} * IN$$

- MODE=12(Pressure is the main feature), and count by $\frac{\rho_1}{\rho_0}$, to compensate the saturated and overheated vapor. When it is saturated vapor, it would be calculated by pressure.

Mode=0, 3, 6 apply same process formula, while check 3 different tables. Mode=2, 5, 8 apply same process formula, while check 3 different tables.

Note 2: ERR Alarm

- When steam corresponding to designed/work pressure and temperature is not in over heat zone or surpass design range, and MODE=0/2, ERR=ON. When steam corresponding to designed pressure and temperature is not in over heat zone or surpass design range, STA=0x2. When steam corresponding to work pressure and temperature is not in over heat zone or surpass design range, STA=0x4. When both are not in over heat zone or out of designed range, STA=0x6.
- When the designed/work pressure is out of designed range, and MODE=3/5, ERR=ON. When the designed pressure is out of designed range, STA=0x2. When the work pressure is out of designed range, STA=0x4. When both are out of designed range, STA=0x6.
- When the designed/work temperature is out of designed range, and MODE= 6/8, ERR=ON. When the designed temperature is out of designed range, STA=0x2. When the work temperature is out of designed range, STA=0x4. When both are out of designed range, STA=0x6.

- When the designed/work temperature is out of designed range and MODE=9/10/11/12, the function block work by following figure.

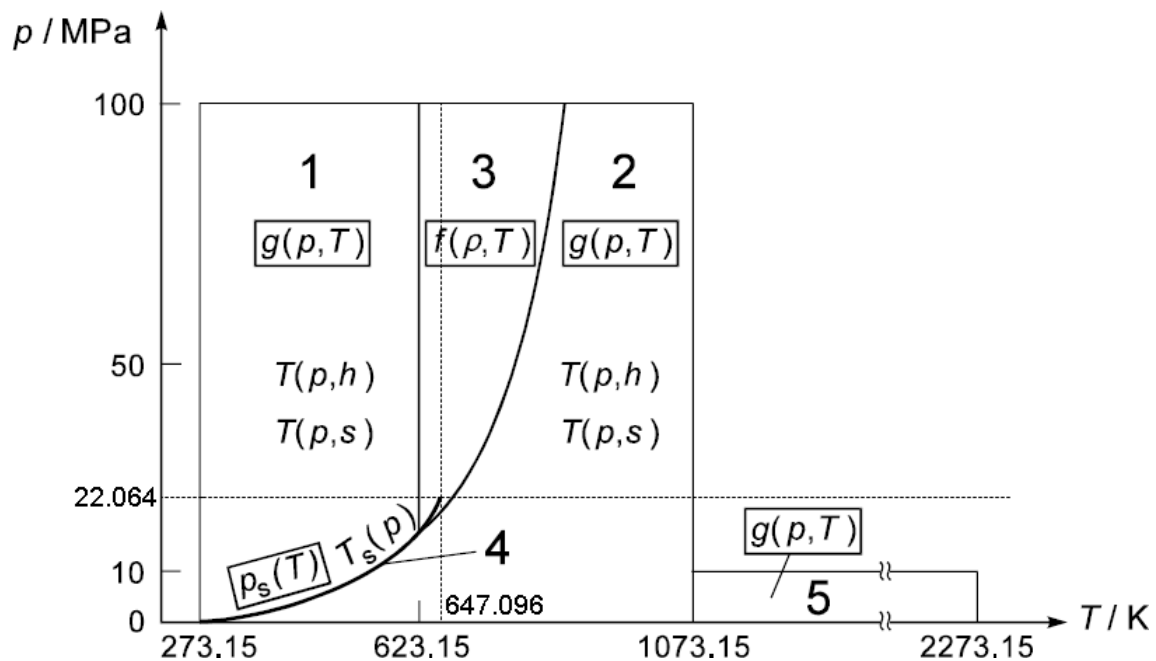


Figure 5.8 Graphics of Steam Feature

There are 5 region, 1 liquid region, 2 superheat region, 3 liquid-vapor region, 4 windup region (temperature is in the range of (273.15 ~ 647.096)K and pressure is in the range of (0 ~ 22.064)MPa), 5 high-temperature region. And:

- In the region 2, specific volume and density should be count by superheat feature.
- In the region 4, specific volume and density should be count by windup feature.
- In the region 1 and pressure is less than 16.5292Mpa, if the windup line is in the deadzone of 5°C, the specific volume and density should be count according to the current temperature and pressure, and ERR=ON, STA=1.
- In the region 1 and pressure is less than 16.5292Mpa, if the windup line is out of the deadzone, there will be no compensation, and ERR=ON, STA=32.
- In the region 1 and pressure is between 16.5292Mpa and 22.064Mpa, and ERR=ON, STA=4.
- In the region 1 and pressure is greater than 22.064Mpa, and ERR=ON, STA=8.
- In the region 3 an the pressure is between 16.5292Mpa and 22.064Mpa, and ERR=ON, STA=4.
- In the region 3 an the pressure is greater than 22.064Mpa, and ERR=ON, STA=8.
- When the temperature is greater than 1073.15K (800°C) or less than 273.15K (0°C), or the pressure is over 100Mpa or less than 0Mpa, and ERR=ON, STA=16.

5.12.3 Application Example

Refer to Application Example.

5.12.4 Application Illustration

A floating-point exception of output value refers to an output value that is not a floating-point value or meaningless output value is generated due to a divide-by-zero operation. When a floating-point exception occurs, the function block handles the output value according to the following rules:

- If the output value was normal in the previous cycle, the output value remains the same as the previous cycle, i.e., $OUT = \text{previous value}$.
- If the previous value is also an abnormal value or there is no previous value, $OUT = \text{value of the cycle before previous cycle}$.
- If the value of the cycle before previous cycle is also abnormal, $OUT = 0$.

5.13 Ideal Gas Compensation Function Block (PTCOMP)

This function block can compensate approximative ideal gas, and converse it to standard air pressure (pressure: 0.1013223Mpa, temperature: 20℃).

This function block is a simple function block, the running time is 13μs.

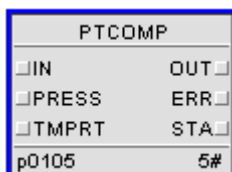


Table 5.15 Ideal gas compensation function block parameter instruction

Name		Name	Upload	Properties	Application Reference
Input Pin	IN	Calculation Input Value	-	Input Pin	Connect AI and Function Block
	PRESS	Working Pressure(Unit: Mpa)	-	Input Pin	-
	TMPRT	Working Temperature(Unit: ℃)	-	Input Pin	-
Output Pin	OUT	Calculation Output Value	-	Output Pin	-
	ERR	Block Alarm	-	Output Pin	-
	STA	Alarm Status	-	Output Pin	-

Table 5.15 Ideal gas compensation function block parameter instruction (continued)

Name		Name	Upload	Properties	Application Reference
Configuration Parameter	MODE-Note1	Select Work Mode[0~2]	-	Configuration Parameter	Configuration set in the Program Properties

Note 1: This function block follows ideal gas balance formula:

$$\frac{P_1 V_1}{T_1} = \frac{P_0 V_0}{T_0}$$

There are 2 modes of this function block, Mode 1 applies to (but not limited to) using a volumetric flow meter to measure the volume flow, the volume of gas flow is converted to standard conditions; Mode 2 applies to (but not limited to) using the differential pressure flowmeter to measure the volume flow, volume flow of the gas conversion to the standard conditions.

The 2 modes are shown below:

- Mode 1(MODE=0)

$$OUT = \frac{IN * (PRESS + 0.1013223) * 293.15}{(TMPRT + 273.15) * 0.1013223}$$

- Mode 2 (MODE=1)

$$OUT = IN * \sqrt{\frac{(PRESS + 0.1013223) * 293.15}{(TMPRT + 273.15) * 0.1013223}}$$

Note 2: When pressure or temperature is out of the range, STA = 1, ERR = ON. When pressure and temperature and MODE are in the range and when IN<0.0, OUT=0.0, ERR = ON, and STA = 4.

5.14 Limiting Function Block (LIM)

The function of the limiter function block is to limit the upper and lower limits of the input and the rate of change, that is, when the input amplitude/rate of change exceeds the specified upper limit or lower limit, the output will remain unchanged. Limiting function blocks are widely used. For example, the speed of the motor should not be arbitrarily large, and there should be an upper limit of the maximum speed; in some cases, the opening of the valve needs to be limited. The parameter description of the limiter function block is shown in Table 5.16.

Limit the threshold of input and change rate. This function block is a simple function block, the running time is 14μs.

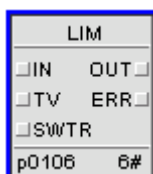


Table 5.16 Limiting function block parameter instruction

Name		Name	Upload	Properties	Application Reference
Input Pin	IN	Calculation Input Value	-	Input Pin	Connect AI and Function Block
	TV	Tracking Value	-	Input Pin	Related SWTR
	INH	High Limit Value	TRUE	Input Pin	-
	INL	Low Limit Value	TRUE	Input Pin	-
	PRIN	Positive Rate Alarm Value (>=0.0)	TRUE	Input Pin	-
	NRIN	Negative Rate Alarm Value (>=0.0)	TRUE	Input Pin	-
	SWTR	Track Selection Switch (ON=Tracking)	-	Input Pin	Related TV
	HOLD	Keep Switch (ON=Keep)	TRUE	Input Pin	-
Output Pin	OUT ^{Note1}	Calculation Output Value	-	Output Pin	-
	ERR ^{Note3}	Block Alarm	-	Output Pin	-
	INHIND- Note2	High Alarm Indication	-	Output Pin	Related INH
	INLIND- Note2	Low Alarm Indication	-	Output Pin	Related INL
	PRININD	Positive Rate Alarm Indication	-	Output Pin	Related PRIN
	NRININD	Negative Rate Alarm Indication	-	Output Pin	Related NRIN

Note 1: The working mode of the limiter function block is sorted by priority as follows:

Tracking>Holding>Auto.

- When SWTR=ON, the function block is in tracking mode, all limiters are invalid, all alarm information does not occur, and the output OUT follows the change of the tracking value TV. When switching from tracking to automatic mode, the rate alarm does not occur in the first cycle.
- When SWTR=OFF and HOLD=ON, when the function block is in the hold mode, the output value remains unchanged. Priority: Track>Keep>Auto.
- When none of the above modes occur, and the function block is in automatic mode, the function block limits the input upper and lower limits and the rate of change. When the output

change rate decreases from greater than the set change rate to less than the set change rate, the output continues to change at the set change rate until the output is equal to the input, and then the output changes with the change of the input..

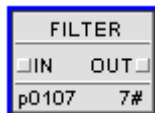
Note 2: Output value is in the range of high limit and low limit.

- When $OUT > INH$, $OUT = INH$, $INHIND = ON$;
- When $OUT < INL$, $OUT = INL$, $INLIND = ON$;
- When $IN > INH$, $INHIND = ON$;
- When $IN < INL$, $INLIND = ON$.

Note 3: In automatic mode, when high limit is less than low limit, output $ERR = ON$.

5.15 Filter function Block (FILTER)

Filter function block filter processes the input with five filter methods: first order lag filter, ButterWorth second order filter, moving average value filter, medium value filter and cumulation average value. Choose filter mode by parameter MODE. This function block is a simple function block, the running time is 35 μ s.



5.15.1 Parameter Description

Table 5.17 Filter function block parameter description

Name		Name	Upload	Properties	Application Reference
Input Pin	IN	Calculation Input Value	-	Input Pin	Connect AI and Function Block
Output Pin	OUT	Calculation Output Value	-	Output Pin	If there's a float abnormal happened to the OUT value, the OUT will be set as the value of period before previous, the value of previous period or 0. Please refer to "Application Illustration" for details.
Operation Parameter	TI	Filter Time (≥ 0.0), the unit is second	TRUE	Operation Parameter	-
Configuration Parameter	MODE-Note1	Filter Mode: 0=First Order, 1=Butterworth, 2=Moving Average,	-	Configuration Parameter	In average value filter and middle value filter modes, the input time is limited in 1~8.

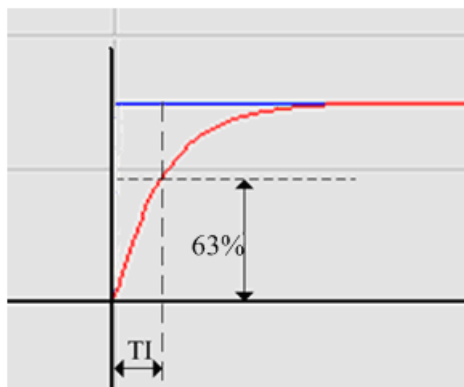
Table 5.17 Filter function block parameter description (continued)

Name	Name	Upload	Properties	Application Reference
	3=Mid-Value, 4=Cumulation Average			When it overruns, the filter does not work and output changes with input value.
	NUM Filter Input Number with AV Filter and Mid-Value Filter [1~8]	-	Configuration Parameter	-

Note 1: There are five modes:

- First order lag filter

When MODE=0, it is in first order lag filter mode and $OUT = \frac{1}{1 + TIs} * IN$. The respond curve is shown as follows.

**Figure 5.9 First order lag filter response curve**

- ButterWorth filter

When MODE=1, it is in ButterWorth filter mode and high frequency interfere is filtered.

$$OUT = \frac{1}{1 + TIs + (TIs)^2 / 2} * IN$$

, its frequency is $\sqrt{2} / TI$ rad/s.

- Moving average value filter

When MODE=2, it is in moving average value filter mode, $OUT = (IN(K) + IN(K-1) + \dots + IN(K-(N-1))) / N$. Users can set sampling period by setting TI. For example, when $TI=1$, $IN(K)$ renews the data every one second. When TI is less than control period, $IN(K)$ renews data with control period as unit.

- Middle value filter

When MODE=3, it is in middle value filter. Sort N input values and dismisses 1/3 big and small values, and average 1/3 middle values, the result is output value. When there are less than three input values, take the average value. Its sampling rule is same with moving

average value filter function block. When NUM is not three multiple, take the integer of NUM/3.

- Cumulation average value filter

When MODE=4, it is in cumulation average value filter mode to take average value of input data input once every scan period in certain time. When it is not set time, output the average value of data in last period of time. The maximum set time is 256*scan period.

Output= $\frac{SPV}{TI}$. SPV is cumulation value of input value in certain time.

5.15.2 Application Illustration

The float abnormal of output values means that the output values are not float format, or a meaningless output value is produced in a calculation that performs a divide-by-zero operation. When float abnormal happened, the function block is processed according to the following rules:

- If there's the normal value of previous period, OUT outputs the value of previous period.
- If there's the abnormal value of previous period or no previous period value, OUT outputs the value of period before previous.
- If there's the abnormal value of period before previous, MV outputs 0.

5.15.3 Application Example

A water level height measurement device is shown in the figure below. As the water level will waves with the water level, the filter should be performed for the field gathering signals to reduce the wave and get the PV. Thus the first order lag filter should be performed for the water level signal of 4-20mA.

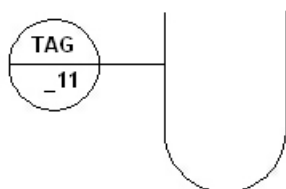


Figure 5.10 Diagram of analog filter

Its FBD programming is shown below and can be achieved by FILTER. Filter function block can perform filter for input signal and has 5 filter methods: first order lag filter, ButterWorth second low-pass filter, movement average filter, medium filter and accumulation average filter. The filter mode can be chosen via the parameter MODE. The filter function of tag table is first order lag filter.

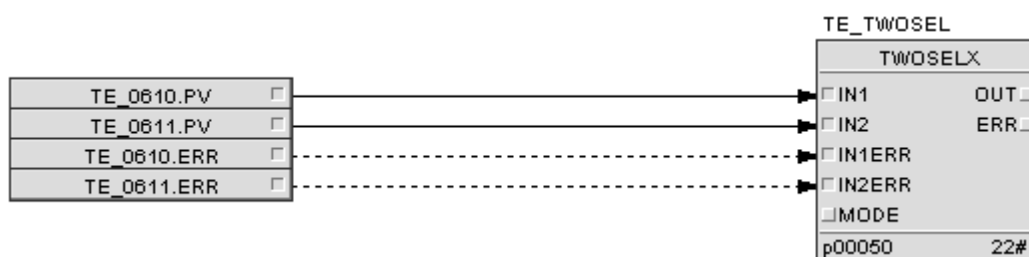


Figure 5.11 Programming of analog filter

The function block instruction and examples are shown below.

Table 5.18 Function block instruction and example

NO.	Example	Type	Instruction	Remark
001	LI_101	AI (Input)	Tag of AI	Field AI
002	LI_101A	Tag of Function Block	Output Tag	Tag Displayed

Parameter settings for FILTER:

- TI: 1s (take the control cycle as unit to update data when TI is less than the system control cycle)
- MODE: 0

Parameter settings of PVIEX:

- INSCH: the same as the input tag
- INSCL: the same as the input tag
- INEU: the same as the input tag
- The tag status alarm is transferred by the input tag.

Note:

- In application, the signal filter can be performed only when the user agree to.
- Take the control cycle as unit to update the data when applying the FILTER movement average filter and TI is less than the system control cycle.
- When applying FILTER medium filter, take the average value when NUM is less than 3, take the integer of NUM/3 when NUM is not the multiple of 3.
- When applying FILTER average filter and medium filter, if NUM is not in the range of 1~8, filter does not work, and the output is equal to input.

5.16 Statistic Function Block (STAT)

This function block works out cumulation value, average value, maximum and minimum values of input value in certain period of time.

In the user program window, if FCU731 is used, STAT function block is named as STAT_X, which shares the same functions as STAT.

This function block is a simple function block, the running time is 11μs.

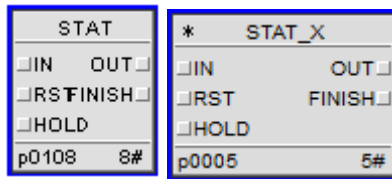


Table 5.19 Statistic function block parameter instruction

Name		Name	Upload	Properties	Application Reference
Input Pin	IN	Calculation Input Value	-	Input Pin	Connect AI and Function Block
	RST- Note1	Reset Statistics Value (ON=Reset)	-	Input Pin	Related MODE
	HOLD Note3	Keeping	-	Input Pin	-
Output Pin	OUT	Calculation Output Value	-	Output Pin	If there's a float abnormal happened to the OUT value, the OUT will be set as 0. Please refer to "Application" for details.
	FINISH	Indication Which Statistics Has Finished	-	Output Pin	-
Operation Parameter	TM	Statistics Time (>=0.0)	TRUE	Operation Parameter	Related SWTM
	IV	Statistics Original Value	TRUE	Operation Parameter	When RST=ON,OUT=IV
Configuration Parameter	MODE- Note1	Statistics Mode : 0=Accumulated Value, 1=AV, 2=Maximum, 3=Minimum	-	Configuration Parameter	Related RST
	SWTM Note2	Statistics Unit: 0=Second, 1=Minute, 2=Hour, 3=Day	-	Configuration Parameter	Related TM
	TM_PT	Statistics Parting Time (S)	-	Configuration Parameter	-

Note 1:

- When restore signal RST=ON, output value is original value IV.
- When restore signal RST=OFF, according to MODE, select following calculation:

- When MODE=0, choose cumulation mode, output $OUT(K) = OUT(K-1) + IN(K) \cdot TS$. TS is control period.
- When MODE=1, choose average mode to get average value in certain period of time started when RST=OFF.
- When MODE=2, choose maximum value mode, and output $OUT(K) = MAX(OUT(K-1), IN(K))$;
- When MODE=3, choose minimum value mode, and output $OUT(K) = MIN(OUT(K-1), IN(K))$;

Note 2: When SWTM=0, statistic time has second as unit; when SWTM=1, minute as unit; when SWTM=2, hour as unit; and when SWTM=3, day as unit.

Note 3: When RST=OFF and HOLD=ON, statistic pauses. When HOLD=OFF, continue the statistic until FINISH=ON.

Application

The float abnormal of output values means that the output values are not float format, or a meaningless output value is produced in a calculation that performs a divide-by-zero operation.

When float abnormal happened, the function block is processed according to the following rules:

- If there's the normal value of previous period, OUT outputs the value of previous period.
- If there's the abnormal value of previous period or no previous period value, OUT outputs 0.

5.17 Hysteresis Compare Function Block (CMP_LAG)

This function block works compare operation with lag features. It compares input signal and set value and decide output status of this period according to compare result and that of last period. Main parameters are: REAL type input signal IN, output status OUT, input high limit HL and low limit LL. This function block is a simple function block, the running time is 35μs.

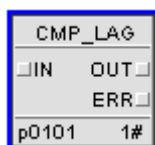


Table 5.20 Hysteresis compare function block parameter instruction

Name		Name	Upload	Properties	Application Reference
Input Pin	IN	Calculation Input Value	-	Input Pin	Connect AI and Function Block
Output Pin	OUTNote1	Calculation Output Value	-	Output Pin	Related HL, LL

Table 5.20 Hysteresis compare function block parameter instruction (continued)

Name		Name	Upload	Properties	Application Reference
	ERRNote2	Block Alarm	-	Output Pin	Related HL, LL
Operation Parameter	HL	Input High Limit	TRUE	Operation Parameter	-
	LL	Input Low Limit	TRUE	Operation Parameter	-

Note 1: When the output status of last period OUT (n-1)= OFF and IN \geq HL, OUT = ON; When IN <HL, OUT = OFF.

When the output status of last period OUT (n-1)= ON and IN \leq LL, OUT = OFF; When IN > LL, OUT = ON.

Note 2: When HL<LL, output remains with that of last period and ERR = ON.

5.18 Error alarm Function Block (DVALM)

Alarm process the difference of two input values. When input1 is bigger than input2, positive error alarm happens and when it is smaller than input2, negative error alarm happens. Either of alarms happens, error alarm=ON. This function block is a simple function block, the running time is 4 μ s.

**Table 5.21 Error alarm function block parameter instruction**

Name		Description	Upload	Properties	Application Reference
Input Pin	IN1	Calculation Input Value	-	Input Pin	-
	IN2	Calculation Input Value	-	Input Pin	-
Output Pin	ALM ^{Note1}	Deviation Alarm	-	Output Pin	-
	PALM- Note1	Positive Deviation Alarm	-	Output Pin	Related PDEV
	NALM- Note1	Negative Deviation Alarm	-	Output Pin	Related NDEV
Operation Parameter	PDEV	Positive Deviation Alarm Value (≥ 0.0)	TRUE	Operation Parameter	Related PALM

Table 5.21 Error alarm function block parameter instruction (continued)

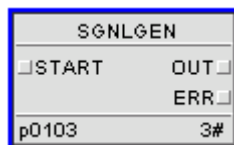
Name		Description	Upload	Properties	Application Reference
	NDEV	Negative Deviation Alarm Value (≥ 0.0)	TRUE	Operation Parameter	Related NALM

Note 1: When $IN1-IN2 \geq PDEV$, positive error alarm PALM=ON, ALM=ON;

When $IN1-IN2 \leq -NDEV$, negative error alarm NALM=ON, ALM=ON.

5.19 Signal Generation Function Block (SGNLGEN)

Generate sine wave, square wave, saw tooth wave, triangle wave, random wave and pulse signal according to user requirement. This function block is a simple function block, the running time is 45 μ s.

**Table 5.22 Signal generation function block parameter instruction**

Name		Description	Upload	Properties	Application Reference
Input Pin	START	Begin to Produce Signal	-	Input Pin	-
Output Pin	OUT	Calculation Output Value	-	Output Pin	-
	ERR	Block Alarm	-	Output Pin	-
Operation Parameter	HOUT- Note1	Output High Limit	TRUE	Operation Parameter	-
	LOUT- Note1	Output Low Limit	TRUE	Operation Parameter	-
	TC ^{Note2}	Cardiac-Vascular Cycle (≥ 0.0)	TRUE	Operation Parameter	-
	TPW	Pulse Width (0.0)	TRUE	Operation Parameter	-
Configuration Parameter	MODE- Note1	Mode Selection: 0=Sine Wave, 1=Square Wave, 2=Delta Wave, 3=Sawtooth Wave, 4=Random Wave, 5=Pulse Wave	-	Configuration Parameter	-

Note 1: When output high limit is smaller than low limit, HL=LL.

Note 2: When TC is less than 2*control period, TC=2*control period.

Note 3: When MODE set has errors, ERR=ON. When START=OFF and MODE=0, OUT= (HOUT +LOUT)/2.0; Otherwise, OUT=LOUT.

Note 4: Output value is in the limit of HOUT and LOUT. When it is out of range, OUT=HOUT or OUT=LOUT.

5.20 Water Enthalpy Compensation Function Block (ENTHALPY)

This function block calculates enthalpy of saturated water, steam and overheats Water enthalpy c. This function block is a simple function block, the running time is 7μs.

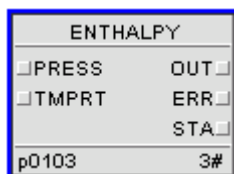


Table 5.23 Water enthalpy compensation function block parameter instruction

Name		Description	Upload	Properties	Application Reference
Input Pin	PRESS	Input Pressure (Unit: Mpa)	-	Input Pin	-
	TMPRT	Input Temperature (Unit: ℃)	-	Input Pin	-
Output Pin	OUT	Enthalpy value Output (Unit: Kj/Kg)	-	Output Pin	-
	ERR	Block Alarm	-	Output Pin	-
	STANote2	Alarm Status	-	Output Pin	Related ERR
Configuration Parameter	MODENote1	Mode Selection [0,4]	-	Configuration Parameter	-

Note1: this function block has five modes.

- Calculate saturated water enthalpy by temperature (MODE=0)
In this mode, input signal is temperature signal and output value is enthalpy of saturated water under this temperature. When temperature is out of range of (0.00~374.15)℃, ERR=ON.
- Calculate saturated water enthalpy by pressure(MODE=1)
In this mode, input signal is temperature signal and output value is enthalpy of saturated water under this pressure. When pressure is out of range of (0.0010~22.12) MPa, ERR=ON.
- Calculate saturated steam enthalpy by temperature(MODE=2)

In this mode, input signal is temperature signal and output value is enthalpy of saturated steam under this temperature. When temperature is out of range of (0.00~374.15)℃, ERR=ON.

- Calculate saturated steam enthalpy by pressure (MODE=3)
In this mode, input signal is temperature signal and output value is enthalpy of saturated steam under this pressure. When pressure is out of range of (0.0010~22.12) MPa, ERR=ON.
- Calculate enthalpy of overheat according to temperature and pressure(MODE=4)
In this mode, input signal is temperature and pressure signals and the output value is enthalpy of overheat steam under this temperature and pressure. When pressure and temperature are out of range of (0.10~10.5) MPa and (100~560)℃ respectively, ERR=ON.
When pressure and temperature are not in overheat steam status, ERR=ON.

When MODE=4 and pressure is in the range of (0.10~10.5) MPa and temperature in (100~560)℃, because scrambling of overheat steam density exists in non-overheat steam area, the five digit is 1, otherwise, it is 0; when the mode has any error, the forth digit is 1, otherwise, it is 0.

Note 2: When ERR=ON, STA indicates ERR.

- When temperature is low than low limit, then the lowest digit is 1, otherwise, it is 0.
- When temperature is higher than high limit, the first digit is 1, otherwise, it is 0.
- When pressure is lower than low limit, the second digit is 1, otherwise, it is 0.
- When pressure is higher than high limit, the third digit is 1, otherwise, it is 0.

5.21 Natural Gas Compensation Function Block (GASCOMP)

This function block compensates volume flow and quality flow and measures energy flow. This function block is a simple function block, the running time is 260μs.

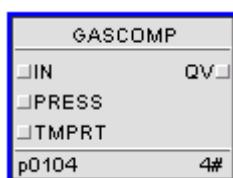


Table 5.24 Nature gas compensation function block parameter instruction

Name			Description	Upload	Properties	Application Reference
Basic Parameters	Input Signal Type Selection	MODE- Note1	Select Input Signal Type:0=Differential Pressure Signal, 1=Volume Flow Compensating, 2=Mass Flow Compensating	-	Configuration Parameter	-

Table 5.24 Nature gas compensation function block parameter instruction (continued)

Name		Description	Upload	Properties	Application Reference
Nature Gas Component Setting <small>Note2</small>	CH4	Methane	TRUE	Operation Parameter	-
	C2H6	Ethane	TRUE	Operation Parameter	-
	C3H8	Propane	TRUE	Operation Parameter	-
	C4H10 _i	2-Methyl-Propane	TRUE	Operation Parameter	-
	C4H10 _n	N-Butane	TRUE	Operation Parameter	-
	C5H12 _i	2-Methyl-Propane	TRUE	Operation Parameter	-
	C5H12 _n	N-Pentane	TRUE	Operation Parameter	-
	C6H14	N-Hexane	TRUE	Operation Parameter	-
	C7H16	N-Heptane	TRUE	Operation Parameter	-
	C8H18	N-Octane	TRUE	Operation Parameter	-
	N2	Azote	TRUE	Operation Parameter	-
	H2	Hydrogen	TRUE	Operation Parameter	-
	O2	Oxygen	TRUE	Operation Parameter	-
	He	Helium	TRUE	Operation Parameter	-

Table 5.24 Nature gas compensation function block parameter instruction (continued)

Name			Description	Upload	Properties	Application Reference
		Ar	Argon	TRUE	Operation Parameter	-
		CO	Carbon Monoxide	TRUE	Operation Parameter	-
		CO2	Carbon Dioxide	TRUE	Operation Parameter	-
		H2S	Hepatic Gas	TRUE	Operation Parameter	-
		H2O	Water	TRUE	Operation Parameter	-
Extended Parameter	Input Pin	IN	Input Signal	-	Input Pin	Connect AI
		PRESS	Natural Gas Pressure with Operative Mode (Unit: Mpa)	-	Input Pin	-
		TM-PRT	Natural Gas Temperature with Operative Mode (Unit: °C)	-	Input Pin	-
	Output Pin	QV ^{Note1}	Volume Flow (M3/S) With Normal Temperature-Pressure (20°C 0.1013223Mpa)	-	Output Pin	Related MODE
		QM- ^{Note1}	Mass Flow (Kg/S)	-	Output Pin	Related MODE
		QE ^{Note1}	Energy Flow (MJ/S)	-	Output Pin	Related MODE
		ER- ^{Note3}	Function Block Illegality Alarm	-	Output Pin	-
	Iterative Times	ITE_Z	Iterations Limit for Calculate Compressibility Z	-	Configuration Parameter	-
	Flow Properties	SWDISTEN	Iterations Limit for Calculate Compressibility Z	-	Configuration Parameter	-

Table 5.24 Nature gas compensation function block parameter instruction (continued)

Name		Description	Upload	Properties	Application Reference
	EXP	Fluid Isentropic Index	TRUE	Operation Parameter	-
	MM	Natural Gas Molar Mass (Kg/Kmol)	-	Configuration Parameter	-
	DENS	Natural Gas Density in Normal Temperature-Pressure (Kg/M ³)	-	Configuration Parameter	-
	DENSF	Natural Gas Density in Operative Mode (Kg/M ³)	-	Configuration Parameter	-
	ZN	Natural Gas Coefficient of Compressibility in Normal Temperature-Pressure	-	Configuration Parameter	-
	ZF	Natural Gas Coefficient of Compressibility in Operative Mode	-	Configuration Parameter	-
	GAS_SUM	Natural Gas Number of Components Sum General	-	Configuration Parameter	Value Range [SUM-L, SUMH]
	SUMH	Component Sum General Allow High Limit (%)	-	Configuration Parameter	-
	SUML	Component Sum General Allow Low Limit (%)	-	Configuration Parameter	-
	C	Runout Coefficient	TRUE	Operation Parameter	-
	DISTEN	Dilatancy Coefficient of Throttling Element Positive Terminal Fetch Pressure Stoma	TRUE	Operation Parameter	-
	ROW1	Fluid Density of Throttle Device Positive Terminal Fetch Pressure Stoma (Kg/M ³)	TRUE	Operation Parameter	-

Table 5.24 Nature gas compensation function block parameter instruction (continued)

Name	Description		Upload	Properties	Application Reference
	Flag	FLAG	Flag Code	-	Output Pin
	Pipe Set-tings	D_- PIPE	Tubing Internal Conjugate (M)	TRUE	Operation Parame-ter
		D_- ORIF	Orifice Plate Conjugate (M)	TRUE	Operation Parame-ter

Note 1: Output is shown as follows.

Differential pressure signal input measure (MODE=0)

Input required parameters in this mode: mol fraction, TF, PF, D_PIPE, D_ORIF, ROW1, C, DISTEN (EXP is input if function block processes interior compensation)

Quality flow

Throttling differential pressure measurement is:

$$q_m = \frac{C}{\sqrt{1-\beta^4}} \varepsilon_1 \frac{\pi}{4} d^2 \sqrt{2\Delta p \rho_1}$$

q_m ----quality flow, kg/s;

C ----flow efficient;

β ----diameter proportion, $\beta = d/D$;

ε_1 ----Dilatancy coefficient of throttling element positive terminal fetches pressure stoma;

d ----diameter of hole in throttling element, m;

Δp ----differential pressure signal, Pa;

ρ_1 ----Fluid density of throttling element positive terminal fetches pressure stoma, kg/m³;

D ----pipe diameter, m.

In the expression, 6 parameter are classified to actual measurement parameter [d , ρ_1 , Δp , $\beta(D)$] and statistics parameter [C , ε_1].

- real measurement
 d , D ---- d is square of flow. It is related with precision and overall precision, also temperature should be considered.
 ρ_1 ----it is in the same position with Δp . Enhance both precisions of Δp and ρ_1 .
 Δp ----it is got by equipments. Its precision is influenced by making craft and install specification.
- Statistics

C-Outflow coefficient is regarded as constant in certain range of flow. The actual flow coefficient is relevant with Reynolds number. When Reynolds number is low, the outflow coefficient is influenced dramatically. And Reynolds number is relevant with actual flow. Therefore, outflow coefficient can be regarded constant in certain range of flow. When flow changes dramatically, outflow coefficient can be corrected by offline calculation.

Offline correction of outflow coefficient: Select several typical measuring points q_i in the whole measurement range ($0 \sim q_{\max}$). Calculate $R_{ed}(i)$ of these points according to

$$R_{ed}(i) = \frac{4q_i}{\pi D \mu}$$
 (μ is measured fluid viscosity (Pa*s) in work status; D is piping bore (m) in work status). And then outflow coefficients of each point will be obtained according to the relation between outflow coefficient and Reynolds number.

$$\varepsilon_1 = 1 - (0.41 + 0.35 \times \beta^4) \frac{\Delta p}{k p_1};$$

ε_1 ----Dilatancy coefficient. In the ISO5167,

ε_1 --expansion coefficient, when differential pressure flowmeter measures gas and steam, liquid

κ --isentropic index

p_1 --absolute hydrostatic of throttling element upriver fetch pressure stoma plane.

p_2 --absolute hydrostatic of throttling element downstream fetch pressure stoma plane

$$\frac{p_2}{p_1} \geq 0.75$$

The formula is applicable when $\frac{p_2}{p_1}$. Compensation methods above of the coefficient are set available. Its relevant coefficient will be input only when compensation is selected.

Volume flow

Standard volume flow QV in the status of 293.15K, 101.325Kpa can be obtained by weight

$$v_n = \frac{q_m}{\rho_n}$$

flow dividing density in standard status, i.e., ρ_n , ρ_n -flow density in standard status.

The density can be calculated by absolute static pressure p_n , mole mass of gas M_m , thermodynamic temperature T_n , compression coefficient Z_n and general gas constant R_a ,

$$\rho_n = \frac{p_n M_m}{T_n Z_n R_a}.$$

Energy flow

$$E_n = q_m * H_{snm}.$$

q_m -Weighty flow of natural gas;

$$H_{snm} = \sum_{j=0}^{n-1} (x_j * \frac{M_j}{M}) H_j$$

x_j --mole component of component j ;

M_j --mole mass of component j ;

M --mole mass of mixture;

H_j -- Ideal mass thermal power of component j ;

Volume flow compensation (MODE=1)

Volume flow compensation transforms volume flow from work condition to standard status 293.15K, 101.325Kpa. TUF, EMF, VSF measures volume flow which will compensate to standard volume flow.

$$v_n = v_f \frac{p_f T_n Z_n}{p_n T_f Z_f}$$

Compensation formula

V_n , T_n , P_n , Z_n --volume flow, absolute temperature, absolute pressure and condensed coefficient in standard status respectively.

V_f , T_f , P_f , Z_f --volume flow, absolute temperature, absolute pressure and condensed coefficient in work status respectively.

Quality flow is transformed from volume flow and density in work status $q_m = v_f * \rho_f$.

Natural gas energy flow is standard volume flow multiplied with unit standard energy of real gas which is sum of ingredient and multiple of high position energy.

$$E_n = v_n * Hsnv$$

E_n --energy flow of natural gas, MJ/s;

v_n --standard volume flow of natural gas, m³/s;

$Hsnv$ ----high position energy of unit standard volume, MJ/m³;

$$Hsnv = \frac{\sum_{j=0}^{n-1} x_j * H_j[t_1, V(t_2, p_2)]}{Z_{mix}(t_2, p_2)}$$

x_j --mol fraction of J

$H_j[t_1, V(t_2, p_2)]$ --ideal gas volume energy of j , burning temperature t_1 , measuring temperature t_2 and pressure p_2 ;

$Z_{mix}(t_2, p_2)$ ----condensed factors in measuring and comparing condition

IN is volume flow signal. PF and TF are pressure and temperature in work status.

Quality flow compensation (MODE=2)

Input signal is quality flow and the compensation formula is

$$q_{mn} = q_{mf} \times \sqrt{\frac{p_f T_n Z_n}{p_n T_f Z_f}}$$

Q_{mn} ----quality flow after compensation

q_{mf} ----input quality flow signal

T_n , P_n , Z_n ----absolute temperature, absolute pressure and condensed coefficient in standard status respectively.

T_f , P_f , Z_f --absolute temperature, absolute pressure and condensed coefficient in work status respectively.

$$v_n = \frac{q_m}{\rho_n}$$

Standard volume flow v_n is got by formula:

Energy flow QE is got by following formula: $E_n = q_m * H_{snm}$

q_m --quality flow of natural gas

H_{snm} --high position energy of unit quality

$$H_{snm} = \sum_{j=0}^{n-1} (x_j * \frac{M_j}{M}) H_j$$

x_j --mol fraction of j;

M_j --mol quality of j;

M --mol quality of mixture;

H_j --ideal quality energy of j;

IN is quality flow signal and PF, TF are pressure and temperature in work status.

Note 2: The gas ingredients of natural gas should input first. The value indicates mol fraction, and the set is 0 when there is no ingredient.

Energy flow measurement adopts status standard GB/T11062-1998. It has restriction to gas ingredients.

- (CH₄)>=0.5;
- (C₂H₆)<=0.15;
- (N₂)<=0.3,
- (CO₂)<=0.15;
- And other ingredients should not surpass 0.05.

Note 3: Alarm function

- ALM_GAS, component sum alarm. When the summation of all component is in the range of [SUML,SUMH](99.995-100.005 by default), ALM_GAS=ON, ERR=ON and stop calculation until summation is in the range.
- ALM_MODE, mode fault alarm. When mode is not 0,1and 2, ALM_MODE=ON, ERR=ON;
- ALM_ITE, condensed coefficient calculation overrun alarm. When it surpasses set times, ALM_ITE=ON. ERR=ON;
- ALM_REVSCL, summation threshold overturn alarm. When set SUMH is smaller than SUMH, generate alarm and block alarm ERR=ON.

5.21.1 Natural Gas Compensation Function Block (GASCOMP)

This function block compensates volume flow and quality flow and measures energy flow. This function block is a simple function block, the running time is 260μs.

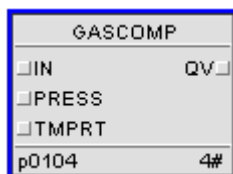


Table 5.25 Nature gas compensation function block parameter instruction

Name			Description	Upload	Properties	Application Reference
Basic Parameters	Input Signal Type Selection	MODE- Note1	Select Input Signal Type:0=Differential Pressure Signal, 1=Volume Flow Compensating, 2=Mass Flow Compensating	-	Configuration Parameter	-
	Nature Gas Component Setting Note2	CH4	Methane	TRUE	Operation Parameter	-
		C2H6	Ethane	TRUE	Operation Parameter	-
		C3H8	Propane	TRUE	Operation Parameter	-
		C4H10 _i	i-2-Methyl-Propane	TRUE	Operation Parameter	-
		C4H10 _n	n-N-Butane	TRUE	Operation Parameter	-
		C5H12 _i	i-2-Methyl-Propane	TRUE	Operation Parameter	-
		C5H12 _n	n-N-Pentane	TRUE	Operation Parameter	-
		C6H14	N-Hexane	TRUE	Operation Parameter	-
		C7H16	N-Heptane	TRUE	Operation Parameter	-
		C8H18	N-Octane	TRUE	Operation Parameter	-

Table 5.25 Nature gas compensation function block parameter instruction (continued)

Name			Description	Upload	Properties	Application Reference
		N2	Azote	TRUE	Operation Parameter	-
		H2	Hydrogen	TRUE	Operation Parameter	-
		O2	Oxygen	TRUE	Operation Parameter	-
		He	Helium	TRUE	Operation Parameter	-
		Ar	Argon	TRUE	Operation Parameter	-
		CO	Carbon Monoxide	TRUE	Operation Parameter	-
		CO2	Carbon Dioxide	TRUE	Operation Parameter	-
		H2S	Hepatic Gas	TRUE	Operation Parameter	-
		H2O	Water	TRUE	Operation Parameter	-
Extended Parameter	Input Pin	IN	Input Signal	-	Input Pin	Connect AI
		PRESS	Natural Gas Pressure with Operative Mode (Unit: Mpa)	-	Input Pin	-
		TM-PRT	Natural Gas Temperature with Operative Mode (Unit: °C)	-	Input Pin	-
	Output Pin	QV ^{Note1}	Volume Flow (M3/S) With Normal Temperature-Pressure (20°C 0.1013223Mpa)	-	Output Pin	Related MODE
		QM- ^{Note1}	Mass Flow (Kg/S)	-	Output Pin	Related MODE

Table 5.25 Nature gas compensation function block parameter instruction (continued)

Name			Description	Upload	Properties	Application Reference
		QE ^{Note1}	Energy Flow (MJ/S)	-	Output Pin	Related MODE
		ER- ^{Note3} R	Function Block Illegality Alarm	-	Output Pin	-
	Iterative Times	ITE_Z	Iterations Limit for Calculate Compressibility Z	-	Configuration Parameter	-
	Flow Properties	SWDIST	Iterations Limit for Calculate Compressibility Z	-	Configuration Parameter	-
		EXP	Fluid Isentropic Index	TRUE	Operation Parameter	-
		MM	Natural Gas Molar Mass (Kg/Kmol)	-	Configuration Parameter	-
		DENSN	Natural Gas Density in Normal Temperature-Pressure (Kg/M ³)	-	Configuration Parameter	-
		DENSF	Natural Gas Density in Operative Mode (Kg/M ³)	-	Configuration Parameter	-
		ZN	Natural Gas Coefficient of Compressibility in Normal Temperature-Pressure	-	Configuration Parameter	-
		ZF	Natural Gas Coefficient of Compressibility in Operative Mode	-	Configuration Parameter	-
		GAS_SUM	Natural Gas Number of Components Sum General	-	Configuration Parameter	Value Range [SUM-L, SUMH]
		SUMH	Component Sum General Allow High Limit (%)	-	Configuration Parameter	-
		SUML	Component Sum General Allow Low Limit (%)	-	Configuration Parameter	-

Table 5.25 Nature gas compensation function block parameter instruction (continued)

Name			Description	Upload	Properties	Application Reference
		C	Runout Coefficient	TRUE	Operation Parameter	-
		DISTEN	Dilatancy Coefficient of Throttling Element Positive Terminal Fetch Pressure Stoma	TRUE	Operation Parameter	-
		ROW1	Fluid Density of Throttle Device Positive Terminal Fetch Pressure Stoma (Kg/M ³)	TRUE	Operation Parameter	-
	Flag	FLAG	Flag Code	-	Output Pin	-
	Pipe Settings	D_ - PIPE	Tubing Internal Conjugate (M)	TRUE	Operation Parameter	-
		D_ - ORIF	Orifice Plate Conjugate (M)	TRUE	Operation Parameter	-

Note 1: Output is shown as follows.

Differential pressure signal input measure(MODE=0)

Input required parameters in this mode: mol fraction, TF, PF, D_PIPE, D_ORIF, ROW1, C, DISTEN (EXP is input if function block processes interior compensation)

Quality flow

Throttling differential pressure measurement is:

$$q_m = \frac{C}{\sqrt{1-\beta^4}} \varepsilon_1 \frac{\pi}{4} d^2 \sqrt{2\Delta p \rho_1}$$

q_m ----quality flow, kg/s;

C ----flow efficient;

β ----diameter proportion, $\beta = d/D$;

ε_1 ----Dilatancy coefficient of throttling element positive terminal fetches pressure stoma;

d ----diameter of hole in throttling element, m;

Δp ----differential pressure signal, Pa;

ρ_1 ----Fluid density of throttling element positive terminal fetches pressure stoma, kg/m³;

D ----pipe diameter, m.

In the expression, 6 parameter are classified to actual measurement parameter [$d, \rho_1, \Delta p, \beta(D)$] and statistics parameter [C, ε_1].

- real measurement

d, D ---- d is square of flow. It is related with precision and overall precision, also temperature should be considered.

ρ_1 ----it is in the same position with Δp . Enhance both precisions of Δp and ρ_1 .

Δp ----it is got by equipments. Its precision is influenced by making craft and install specification.

- Statistics

C -Outflow coefficient is regarded as constant in certain range of flow. The actual flow coefficient is relevant with Reynolds number. When Reynolds number is low, the outflow coefficient is influenced dramatically. And Reynolds number is relevant with actual flow. Therefore, outflow coefficient can be regarded constant in certain range of flow. When flow changes dramatically, outflow coefficient can be corrected by offline calculation.

Offline correction of outflow coefficient: Select several typical measuring points q_i in the whole measurement range ($0 \sim q_{\max}$). Calculate $R_{ed}(i)$ of these points according to

$$R_{ed}(i) = \frac{4q_i}{\pi D \mu}$$
 (μ is measured fluid viscosity (Pa*s) in work status; D is piping bore (m) in work status). And then outflow coefficients of each point will be obtained according to the relation between outflow coefficient and Reynolds number.

$$\varepsilon_1 = 1 - (0.41 + 0.35 \times \beta^4) \frac{\Delta p}{\kappa p_1};$$

ε_1 ----Dilatancy coefficient. In the ISO5167,

ε_1 --expansion coefficient, when differential pressure flowmeter measures gas and steam, liquid

κ --isentropic index

p_1 --absolute hydrostatic of throttling element upriver fetch pressure stoma plane.

p_2 --absolute hydrostatic of throttling element downstream fetch pressure stoma plane

$$\frac{p_2}{p_1} \geq 0.75$$

The formula is applicable when $\frac{p_2}{p_1}$. Compensation methods above of the coefficient are set available. Its relevant coefficient will be input only when compensation is selected.

Volume flow

Standard volume flow Q_V in the status of 293.15K, 101.325Kpa can be obtained by weight

$$v_n = \frac{q_m}{\rho_n}$$

flow dividing density in standard status, i.e., ρ_n , ρ_n -flow density in standard status.

The density can be calculated by absolute static pressure p_n , mole mass of gas M_m ,

thermodynamic temperature T_n , compression coefficient Z_n and general gas constant R_a ,

$$\rho_n = \frac{p_n M_m}{T_n Z_n R_a}$$

i.e.,

Energy flow

$$E_n = q_m * H_{snm}$$

q_m -Weighty flow of natural gas;

$$H_{snm} = \sum_{j=0}^{n-1} (x_j * \frac{M_j}{M}) H_j$$

x_j --mole component of component j;

M_j --mole mass of component j;

M --mole mass of mixture;

H_j -- Ideal mass thermal power of component j;

Volume flow compensation(MODE=1)

Volume flow compensation transforms volume flow from work condition to standard status 293.15K, 101.325Kpa. TUF, EMF, VSF measures volume flow which will compensate to standard volume flow.

$$v_n = v_f \frac{p_f T_n Z_n}{p_n T_f Z_f}$$

Compensation formula

V_n, T_n, P_n, Z_n --volume flow, absolute temperature, absolute pressure and condensed coefficient in standard status respectively.

V_f, T_f, P_f, Z_f --volume flow, absolute temperature, absolute pressure and condensed coefficient in work status respectively.

Quality flow is transformed from volume flow and density in work status $q_m = v_f * \rho_f$.

Natural gas energy flow is standard volume flow multiplied with unit standard energy of real gas which is sum of ingredient and multiple of high position energy.

$$E_n = v_n * H_{snv}$$

E_n --energy flow of natural gas, MJ/s;

v_n --standard volume flow of natural gas, m³/s;

H_{snv} ---high position energy of unit standard volume, MJ/m³;

$$H_{snv} = \frac{\sum_{j=0}^{n-1} x_j * H_j[t_1, V(t_2, p_2)]}{Z_{mix}(t_2, p_2)}$$

x_j --mol fraction of J

$H_j[t_1, V(t_2, p_2)]$ --ideal gas volume energy of j, burning temperature t_1 , measuring temperature t_2 and pressure p_2 ;

$Z_{mix}(t_2, p_2)$ ----condensed factors in measuring and comparing condition

IN is volume flow signal. PF and TF are pressure and temperature in work status.

Quality flow compensation(MODE=2)

Input signal is quality flow and the compensation formula is

$$q_{mn} = q_{mf} \times \sqrt{\frac{p_f T_n Z_n}{p_n T_f Z_f}}$$

Q_{mn} ----quality flow after compensation

q_{mf} ----input quality flow signal

T_n, P_n, Z_n ----absolute temperature, absolute pressure and condensed coefficient in standard status respectively.

T_f, P_f, Z_f --absolute temperature, absolute pressure and condensed coefficient in work status respectively.

$$v_n = \frac{q_m}{\rho_n}$$

Standard volume flow v_n is got by formula:

Energy flow QE is got by following formula: $E_n = q_m * H_{snm}$

q_m --quality flow of natural gas

H_{snm} --high position energy of unit quality

$$H_{snm} = \sum_{j=0}^{n-1} (x_j * \frac{M_j}{M}) H_j$$

x_j --mol fraction of j;

M_j --mol quality of j;

M --mol quality of mixture;

H_j --ideal quality energy of j;

IN is quality flow signal and PF, TF are pressure and temperature in work status.

Note 2: The gas ingredients of natural gas should input first. The value indicates mol fraction, and the set is 0 when there is no ingredient.

Energy flow measurement adopts status standard GB/T11062-1998. It has restriction to gas ingredients.

- (CH₄)>=0.5;
- (C₂H₆)<=0.15;
- (N₂)<=0.3,
- (CO₂)<=0.15;
- And other ingredients should not surpass 0.05.

Note 3: Alarm function

- ALM_GAS, component sum alarm. When the summation of all component is in the range of [SUML,SUMH](99.995-100.005 by default), ALM_GAS=ON, ERR=ON and stop calculation until summation is in the range.
- ALM_MODE, mode fault alarm. When mode is not 0,1and 2, ALM_MODE=ON, ERR=ON;
- ALM_ITE, condensed coefficient calculation overrun alarm. When it surpasses set times, ALM_ITE=ON. ERR=ON;
- ALM_REVSCL, summation threshold overturn alarm. When set SUMH is smaller than SUMH, generate alarm and block alarm ERR=ON.

5.21.2 Flag

Table 5.26 Flag

Flag	Alarm	Description
D4	ALM_GAS	Alarm of GAS_SUM exceeding limit.
D5	ALM_MODE	Mode fault alarm.
D6	ALM_ITE	Condensed coefficient calculation overrun alarm.
D7	ALM_REVSCL	Summation threshold overturn alarm.

5.22 Air Compensation Function Block (ATMCOMP)

The function block is mainly used to implement temperature and pressure compensation for gas volume measured by float flowmeter, temperature and pressure compensation for volume flow of wet gas measured by frequency type vortex flowmeter, analogy vortex flowmeter and differential pressure flowmeter and calculation for volume of dry part of wet gas.

This function block is a simple function block, the running time is 450μs.

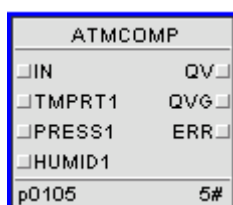


Table 5.27 Air compensation function block parameter instruction

Name	Description	Upload	Properties	Application Reference
Basic Parameters	Input Pin	IN	Input Signal	-

Table 5.27 Air compensation function block parameter instruction (continued)

Name			Description	Upload	Properties	Application Reference
		TMPRT1	Gas Temperature in the Operating Mode (Unit: °C)	-	Input Pin	-
		PRESS1	Gas Pressure in the Operating Mode (Unit: Mpa)	-	Input Pin	-
		HUMID1	Relative Humidity in the Operating Mode [0,1]	-	Input Pin	-
	Configura- tion Para- meter	MODE ^{Note1}	Input Signal Type:0=Frequen- cy Type Vortex Street, 1=Ana- log Type Vortex Street, 2=Differ- ence Pressure, 3=Bob	-	Configuration Parameter	-
		TMPRT0	Design Tempera- ture [-25,100] °C	-	Configuration Parameter	-
		PRESS0	Design Pressure (Unit: Mpa)	-	Configuration Parameter	-
		HUMID0	Relative Humidity in the Design Sta- tus [0,1]	-	Configuration Parameter	-
		K	Vortex Street Flowmeter Meter Coefficient (Unit: P/M ³)	-	Configuration Parameter	-
		N2	Azote Mole Frac- tion	TRUE	Operation Parameter	-
	Operation Parameter	O2	Oxygen Mole Fraction	TRUE	Operation Parameter	-
		Ar	Argon Mole Frac- tion	TRUE	Operation Parameter	-
		CO2	Carbon Dioxide Mole Fraction	TRUE	Operation Parameter	-
		H2O	Water Mole Frac- tion	TRUE	Operation Parameter	-
		QV ^{Note1}	Output Volume Fluid (Unit: M ³ /H)	-	Output Pin	Related MODE
	Extended Parameters	QVG ^{Note1}	Output Volume Flow which It is	-	Output Pin	Related MODE

Table 5.27 Air compensation function block parameter instruction (continued)

Name			Description	Upload	Properties	Application Reference
			Dry Part of Wet Gas (Unit: M ³ /H)			
		ERR ^{Note2}	Function Block Illegality Alarm	-	Output Pin	Related ITE_LIM, SUMH, SUM
		FLAG	Flag Code	-	Output Pin	-
	configuration parameter	ITE_LIM	Restrict Frequency for Default Compressibility Iterative Computation	-	Configuration Parameter	-
		SUMH	Allow High Limit of Each Composition Component Sum General (%)	-	Configuration Parameter	-
		SUML	Allow Low Limit of Each Composition Component Sum General (%)	-	Configuration Parameter	-

Note 1: Output is shown as follows.

- Frequency output vortex street flowmeter (MODE=0)
 - Calculation of wet gas flow

In this work mode, when input signal type is frequency vortex street flowmeter, calculate the volume flow and convert it from the current status to the standard status (101.325kpa, 20℃).

$$q_m = \frac{f \cdot p_f \cdot T_n \cdot Z_n}{K \cdot p_n \cdot T_f \cdot Z_f}$$

The compensation formula is:

q_{vn} - Volume flow in standard status, m³/h;

f - Frequency of vortex, pulse amount/time, P/h;

K -Instrument coefficient of flowmeter, P/m³;

p_n, p_f - Absolute pressure in standard status and work status, MPa;

T_n, T_f - Thermodynamics temperature in standard status and work status, K;

Z_n, Z_f - Gas compression coefficient in standard status and work status;

- Wet gas flow instruction

In this mode, IN is frequency signal input of vortex street flowmeter (pulse amount/h);

Input TMPRT1 is pressure in work status; Input PRESS1 is temperature in work status;

Input K is instrument coefficient; QV is output value of volume flow after compensation;

K is relevant with size of eddy happen tubing and Strouhal number S_r . S_r is relevant with shape of vortex and reynolds number. However, S_r can be regarded as constant in normal work range of instrument.

- Flow calculation of dry part of wet gas

The flow of dry part of the wet air is obtained by converting the volume flow from work status to standard status and then deducting steam pressure. The compensation is:

$$q_{vg} = q_{vf} \frac{P_f - \phi_f P_{sf \max}}{P_n} \times \frac{T_n}{T_f} \times \frac{Z_n}{Z_f} = \frac{f}{K} \times \frac{P_f - \phi_f P_{sf \max}}{P_n} \times \frac{T_n}{T_f} \times \frac{Z_n}{Z_f}$$

q_{vg} - Volume flow of dry part of wet air, Nm³/h;

q_{vf} - Volume flow of wet air in work status, m³/h;

f- Output frequency of vortex flowmeter, P/h;

K-Instrument coefficient of frequency type vortex flowmeter, P/m³;

ϕ_f -- Relative humidity of wet gas in work status, 0~100%;

$P_{sf \max}$ -- Pressure of windup steam in work status;

ρ_{sf} -- Steam density in work status, kg/m³;

$\rho_{sf \max}$ -- Windup steam density in work status, kg/m³;

T_n, P_n -- Absolute temperature and absolute pressure of gas in standard status;

T_f, P_f -- Absolute temperature and absolute pressure of gas in work status;

Z_n, Z_f -- Compression coefficient of gas in standard status and work status;

- Instruction of dry part flow of wet gas

When calculate this part flow, it require relative humidity (HUMID 1) in operating mode. Carry-out bit of flow calculation of dry part in wet gas is QVG.

- Analog output vortex street flowmeter(MODE=1)

- Flow algorithm of wet gas

$$q_{vd} = q_{vf} \frac{P_f T_d Z_d}{P_d T_f Z_f}$$

q_{vd} --volume flow in the design mode, m³/h;

q_{vf} --volume flow in the operative mode, m³/h;

P_d, P_f --absolute pressure of design mode or operative mode, MPa;

T_d, T_f --thermodynamic temperature of design mode or operative mode, K;

Z_d, Z_f --gas compression coefficient of design mode or operating mode.

- Wet gas flow explain Require IN is indication value of volume flow of flowmeter; input temperature of operating mode to TMPRT1; input pressure of operating mode to PRESS1; QV is volume flow output value after compensating.

- Flow algorithm for dry part of wet gas When operative mode and design mode (temperature, pressure, relative humidity, coefficient of compressibility) differ, must carry out compensating. Compensating algorithm:

$$q_{vd} = q_{vf} \frac{p_f - \phi_f p_{sf \max}}{p_d - \phi_d p_{sd \max}} \times \frac{T_d}{T_f} \times \frac{Z_d}{Z_f}$$

Among:

q_{vf} --volume flow of gas (meter indication value) in the operative mode.m³/h;

p_f --absolute pressure of gas in the operative mode, MPa;

T_f --absolute temperature of gas in the operative mode, K;

ϕ_f -- relative humidity of wet gas in operative mode, 0~100%;

$p_{sf \max}$ --moist team pressure in operative mode, MPa;

p_d --absolute pressure of wet air in the design mode, MPa;

ϕ_d --relative humidity of wet air in design mode, 0~100%;

$p_{sd \max}$ --moist team pressure of wet air in design mode. Unit same p_d ;

T_d --temperature of wet air in design mode, K;

Z_d --coefficient of compressibility of wet air in design mode.

- Slow explain for dry part of wet gas IN is volume flow indication value of flowmeter; input TMPRT1; input PRESS1; input HUMID1; Set TMPRT0; set PRESS0; set HUMID0; QVG is volume flow output value of dry part of wet gas which is calculating gain.

- Throttling flow meter (MODE =2)

- Wet gas flow When input signal type is throttling flow meter, carry out density compensating for departure of reality usage and designed operating mode.

$$q_d = \sqrt{\frac{\rho_f}{\rho_d}} \times q_f$$

q_f --volume flow of measured gas in operative mode, m³/h;

P_f --density of measured gas in operative mode, kg/m³;

p_d --density of measured gas in design mode, kg/m³;

q_d --set scale of meter with designed operative mode, it is meter value, m³/h;

- Explain for flow of wet gas IN is volume flow signal of throttling flow meter; input TMPRT1, PRESS1, HUMID1; Set HUMID0, TMPRT0, PRESS0.

- Flow algorithm for dry part of wet gas

$$q_{vg} = q_v \times \frac{p_f - \phi_f p_{sf \max}}{p_n} \times \frac{Z_n}{T_f} \times \frac{T_n}{Z_f} \times \sqrt{\frac{\rho_d}{\rho_f}};$$

q_{vg} --flow actual value of dry part in wet gas NTP, Nm³/h;

q_v --meter value of volume flow in the wet gas operative mode, m³/h;

Φ_f -- relative humidity in wet gas operative mode, 0~100%;

P_d --density in wet gas design mode, kg/m³;

p_f --density in wet gas operative mode, kg/m³;

P_f --absolute pressure of gas in operative mode, MPa;

T_f --absolute temperature of gas in operative mode, K;

$P_{sf\ max}$ --moist team pressure in operative mode, MPa;

Z_n --coefficient of compressibility of wet air in NTP mode;

Z_f --coefficient of compressibility of wet air in operative mode.

- Explain for flow of dry part of wet gas IN is volume flow signal of throttling flow meter; input TMPRT1, PRESS1, HUMID1; Set HUMID0, TMPRT0, PRESS0.

- Float flowmeter (MODE=3)

- Wet gas flow

$$q_v = q_{vf} \times \sqrt{\frac{p_f T_n}{p_n T_f}}$$

q_v --actual volume flow, Nm³/h;

q_{vf} --meter showed value, m³/h;

T_n, P_n -- absolute temperature/pressure of gas in NTP;

T_f, P_f -- absolute temperature/pressure of gas in operative mode.

- - Explainf for wet gas flow
IN is volume flow signal of float flowmeter; input TMPRT1, PRESS1.



TIP:

This mode doesn't have the function of calculating the dry part flow of the wet gas.

Note 2: Alarm function

- Input signal type illegality alarm
When input signal are not 0, 1, 2, 3, set D5 of flag code to alarm, and set Block alarm ERR=ON.,
Alarm with iterative computation of coefficient of compressibility overrun When calculate coefficient of compressibility, if iterative computation excess ITE_LIM, then set D6 of flag code to alarm, and set Block alarm ERR=ON.
- Alarm for air component general overrun
When all component general of wet gas are not [SUML, SUMH], set D4 bit of flag code to alarm, and set Block alarm ERR=ON.
- Alarm for measured temperature overrun

When measure temperature is not in the -25 °C~100 °C, set D7 bit of flag code to alarm, and set Block alarm ERR=ON.

- Alarm for relative humidity overrun in operative mode
If input relative humidity are not [0, a] in operative mode, then set D8 bit of flag code to alarm, and set Block alarm ERR=ON.
- Alarm for high and low limit of component general reversal
If high and low limit of component general of compressed air reversal (SUMH<SUML), then set D9 bit of flag code, and set Block alarm ERR=ON.

Note 3:

Water component content of wet gas ask user supply. Default of each gas component is gas in the standard dry air. When happen function block ERR alarm (except coefficient of compressibility iterative computation overrun), inner flow computation is shielded, and output is held.

5.23 Linearization Function Block (FXY)

The function block can implement processing of two-dimensional broken-line diagram.

This function block is a complicated function block, the running time is 25μs.



5.23.1 Parameter Description

Table 5.28 Linearization function block parameter description

Name			Name	Upload	Properties	Application Reference
Basic Parameters	X Axis Coordinate Setting	X1 ^{Note1}	X Axes Input 1 st Coordinate	TRUE	Operation Parameter	-
		X2	X Axes Input 2 nd Coordinate	TRUE	Operation Parameter	-
		X3	X Axes Input 3 rd Coordinate	TRUE	Operation Parameter	-
		X4	X Axes Input 4th Coordinate	TRUE	Operation Parameter	-
		X5	X Axes Input 5th Coordinate	TRUE	Operation Parameter	-
		X6	X Axes Input 6th Coordinate	TRUE	Operation Parameter	-

Table 5.28 Linearization function block parameter description (continued)

Name			Name	Upload	Properties	Application Reference
		X7	X Axes Input 7th Coordinate	TRUE	Operation Parameter	-
		X8	X Axes Input 8th Coordinate	TRUE	Operation Parameter	-
		X9	X Axes Input 9th Coordinate	TRUE	Operation Parameter	-
		X10	X Axes Input 10th Coordinate	TRUE	Operation Parameter	-
		X11	X Axes Input 11th Coordinate	TRUE	Operation Parameter	-
		X12	X Axes Input 12th Coordinate	TRUE	Operation Parameter	-
		X13	X Axes Input 13th Coordinate	TRUE	Operation Parameter	-
		X14	X Axes Input 14th Coordinate	TRUE	Operation Parameter	-
		X15	X Axes Input 15th Coordinate	TRUE	Operation Parameter	-
		X16	X Axes Input 16th Coordinate	TRUE	Operation Parameter	-
		X17	X Axes Input 17th Coordinate	TRUE	Operation Parameter	-
		X18	X Axes Input 18th Coordinate	TRUE	Operation Parameter	-
		X19	X Axes Input 19th Coordinate	TRUE	Operation Parameter	-
		X20	X Axes Input 20th Coordinate	TRUE	Operation Parameter	-
		X21	X Axes Input 21 st Coordinate	TRUE	Operation Parameter	-

Table 5.28 Linearization function block parameter description (continued)

Name			Name	Upload	Properties	Application Reference
	Y Axis Coordinate Setting	Y1	Y Axes Input 1 st Coordinate	TRUE	Operation Parameter	-
		Y2	Y Axes Input 2 nd Coordinate	TRUE	Operation Parameter	-
		Y3	Y Axes Input 3 rd Coordinate	TRUE	Operation Parameter	-
		Y4	Y Axes Input 4th Coordinate	TRUE	Operation Parameter	-
		Y5	Y Axes Input 5th Coordinate	TRUE	Operation Parameter	-
		Y6	Y Axes Input 6th Coordinate	TRUE	Operation Parameter	-
		Y7	Y Axes Input 7th Coordinate	TRUE	Operation Parameter	-
		Y8	Y Axes Input 8th Coordinate	TRUE	Operation Parameter	-
		Y9	Y Axes Input 9th Coordinate	TRUE	Operation Parameter	-
		Y10	Y Axes Input 10th Coordinate	TRUE	Operation Parameter	-
		Y11	Y Axes Input 11th Coordinate	TRUE	Operation Parameter	-
		Y12	Y Axes Input 12th Coordinate	TRUE	Operation Parameter	-
		Y13	Y Axes Input 13th Coordinate	TRUE	Operation Parameter	-
		Y14	Y Axes Input 14th Coordinate	TRUE	Operation Parameter	-
		Y15	Y Axes Input 15th Coordinate	TRUE	Operation Parameter	-
		Y16	Y Axes Input 16th Coordinate	TRUE	Operation Parameter	-

Table 5.28 Linearization function block parameter description (continued)

Name			Name	Upload	Properties	Application Reference
		Y17	Y Axes Input 17th Coordinate	TRUE	Operation Parameter	-
		Y18	Y Axes Input 18th Coordinate	TRUE	Operation Parameter	-
		Y19	Y Axes Input 19th Coordinate	TRUE	Operation Parameter	-
		Y20	Y Axes Input 20th Coordinate	TRUE	Operation Parameter	-
		Y21	Y Axes Input 21 st Coordinate	TRUE	Operation Parameter	-
	Segment Settings	SEGUSE ^{Note3}	Used Segment[1,20]	TRUE	Operation Parameter	-
	Range Settings	INSCH	Input Range High Value	-	Configuration Parameter	-
		INSCL	Input Range Low Value	-	Configuration Parameter	-
		OUTSCH	Output Range High Value	-	Configuration Parameter	-
		OUTSCL	Output Range Low Value	-	Configuration Parameter	-
		INDLEN	Input Decimal Digits[0,5]	-	Configuration Parameter	Used for Data Displayed on Function Block Panel (Equal to 3 as Default)
		INEU	Input Engineering Unit	-	Configuration Parameter	-
		OUTEU	Output Engineering Unit	-	Configuration Parameter	-
		OUTDLEN	Output Engineering Unit[0,5]	-	Configuration Parameter	Used for Data Displayed on Function Block

Table 5.28 Linearization function block parameter description (continued)

Name			Name	Upload	Properties	Application Reference
						Panel (Equal to 3 as Default)
Extended Parameters	Input Pin	IN	Input Variable	-	Input Pin	-
	Output Pin	OUT ^{Note2}	Output Variable	-	Output Pin	Related MODE
		ERR ^{Note1}	Block Alarm	-	Output Pin	-
		STA	Function Block Status	-	Output Pin	-
	Mode settings	MODE	OFF=Incline ModeON=Jump Mode	TRUE	Operation Parameter	-
	OOS settings	SWOOS	Status Is OOS (ON= Forbid)	TRUE	Operation Parameter	-
	Alarm Enabled and Suppress	AOF	Suppress Module Alarm AOF=ON, Real-Time Alarm Do not Show; AOF=OFF, Real-Time Alarm Show	TRUE	Operation Parameter	-
		FLAG	Flag Code	-	Output Parameter	Refer to "Flag"

Note 1: Input X coordinate value X1 and X2 must put in order from small to large. Otherwise bring ERR (ERR=ON) alarm. STA indicate low-bit of arrange error.

Note 2: The program first judge segment number of IN which in X axes 20th coordinate, then carry out interpolating calculation.

If IN is value between X[i] and X [i+1]:

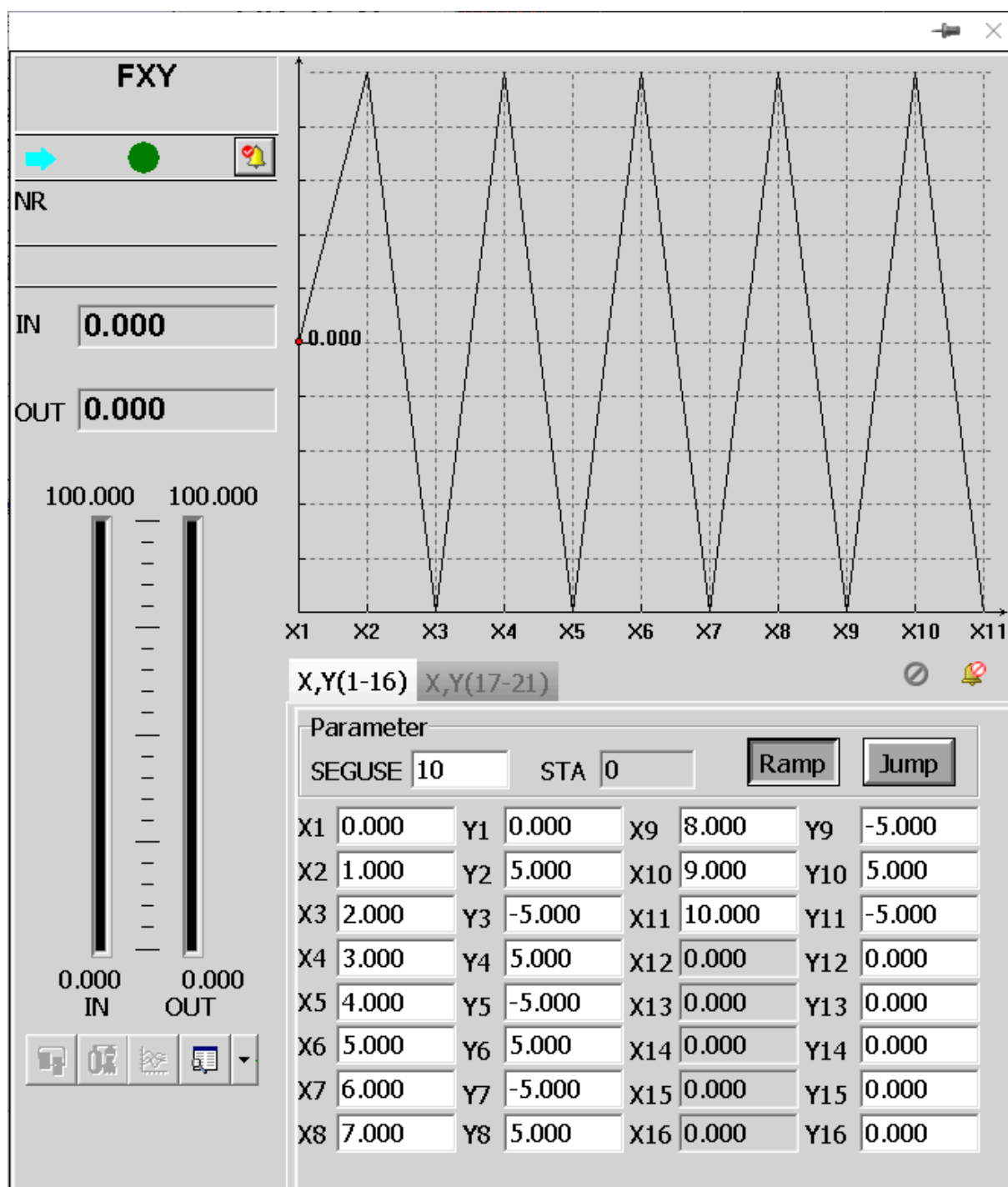
$$OUT = Y[i] + (IN - X[i]) * \frac{Y[i+1] - Y[i]}{X[i+1] - X[i]}$$

If IN < X1, then output Y1; if IN > X21, then output Y21.

If IN = X[i], then OUT = Y[i].

Note 3: The amount of interval segment can be configured, allowed range is 1~20. Parameter illegality detecting is only used in the segment.

5.23.2 Panel Parameter



X,Y(1-16)
X,Y(17-21)

X17

X18

X19

X20

X21

Y17

Y18

Y19

Y20

Y21

Table 5.29 Function Block Panel Parameter

Panel Parameter Name			Function Block Parameter Name	Initial Value	Value Range	Application Instruction
X,Y(1-16)	Parameter	SEGUSE	SEGUSE	1	[1,20]	Seguse of Broken Line
		STA	STA	0	-	Read-only, can be set in the Function Block Properties window or in the program settings
		Ramp	MODE	Selected	-	Set MODE = OFF in the Function Block Properties window, select the "Ramp" slope or function block panel button settings
		Jump	MODE	Not selected	-	MODE = ON is set in the Function Block Properties window set for the transition or "Jump" button is selected in the function panel
	X1		X1	0.0000	-	Not be set when the set box set gray. Can be set to the X-axis coordinate number and the number of segments, if the number of segments is set to N, you can set the X-axis coordinate for N +1
	X2		X2	1.0000	-	With X1

Table 5.29 Function Block Panel Parameter (continued)

Panel Parameter Name		Function Block Parameter Name	Initial Value	Value Range	Application Instruction
	X3	X3	0.0000	-	With X1
	X4	X4	0.0000	-	With X1
	X5	X5	0.0000	-	With X1
	X6	X6	0.0000	-	With X1
	X7	X7	0.0000	-	With X1
	X8	X8	0.0000	-	With X1
	Y1	Y1	0.0000	-	Y-axis coordinates can be set, but the entry into force of the Y-axis coordinate number and the number of segments, if the number of segments is set to N, the entry into force of the Y-axis coordinate for N + 1
	Y2	Y2	0.0000	-	With Y1
	Y3	Y3	0.0000	-	With Y1
	Y4	Y4	0.0000	-	With Y1
	Y5	Y5	0.0000	-	With Y1
	Y6	Y6	0.0000	-	With Y1
	Y7	Y7	0.0000	-	With Y1
	Y8	Y8	0.0000	-	With Y1
	X9	X9	0.0000	-	With X1
	X10	X10	0.0000	-	With X1
	X11	X11	0.0000	-	With X1
	X12	X12	0.0000	-	With X1
	X13	X13	0.0000	-	With X1
	X14	X14	0.0000	-	With X1
	X15	X15	0.0000	-	With X1
	X16	X16	0.0000	-	With X1
	Y9	Y9	0.0000	-	With Y1

Table 5.29 Function Block Panel Parameter (continued)

Panel Parameter Name		Function Block Parameter Name	Initial Value	Value Range	Application Instruction
	Y10	Y10	0.0000	-	With Y1
	Y11	Y11	0.0000	-	With Y1
	Y12	Y12	0.0000	-	With Y1
	Y13	Y13	0.0000	-	With Y1
	Y14	Y14	0.0000	-	With Y1
	Y15	Y15	0.0000	-	With Y1
	Y16	Y16	0.0000	-	With Y1
X,Y(17-21)	X17	X17	0.0000	-	With X1
	X18	X18	0.0000	-	With X1
	X19	X19	0.0000	-	With X1
	X20	X20	0.0000	-	With X1
	X21	X21	0.0000	-	With X1
	Y17	Y17	0.0000	-	With Y1
	Y18	Y18	0.0000	-	With Y1
	Y19	Y19	0.0000	-	With Y1
	Y20	Y20	0.0000	-	With Y1
	Y21	Y21	0.0000	-	With Y1

5.23.3 Flag

Table 5.30 Flag List

Flag	Alarm	Description
D0	OOS	Disable
D1	CFGERR	Configuration Error
D2	AOF	Suppress Alarm

5.23.4 Application Example

Example1. The densities of saturated steam and saturated water will change a lot with the modification of drum pressure, thus the pressure compensation should be performed to the drum water level. Water measuring methods include single-room balance vessel measurement and double-room balance vessel measurement, the former is used more often, and this part takes it as an example.

The FBD program is shown below.

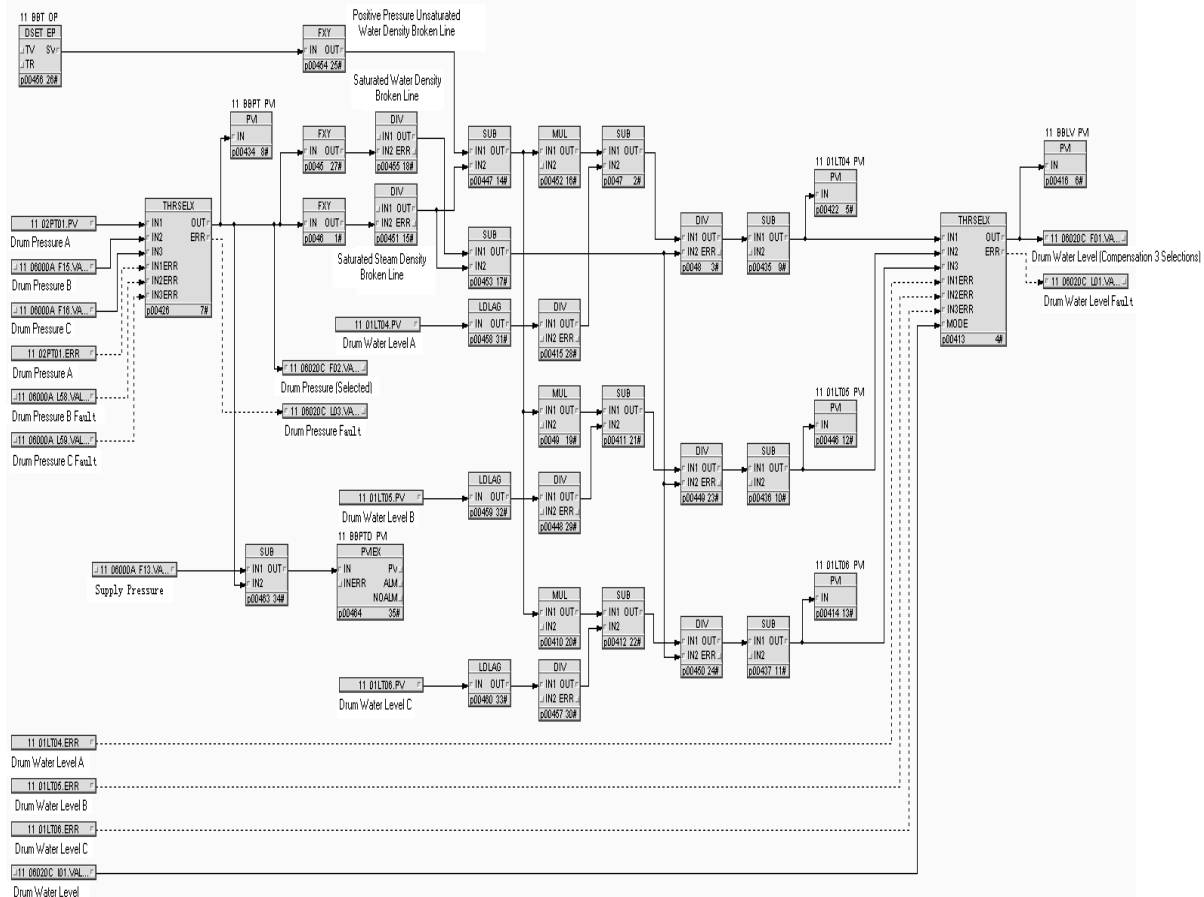


Figure 5.12 Steam Flow Compensation Program

FIX function block parameter settings (set in the function block properties interface).

- X : drum pressure of saturated water.
- Y: drum pressure of saturated steam, density broken line table.

THRSELX function block parameter settings (set in the function block properties interface).

- MODE: 3, use the medium value.

Example2. To convert irregular container's level signal measured by the liquid level transducer to the actual volume of medium in the container. In some occasions, the two types of dimensions' correlation cannot be expressed by a linear or one single expression but rather by an expression with different domains, with differing linear correlation in differing domains. If you want to figure out the volume according to the liquid level, as for an irregular container, you cannot get this directly by calculation through expressions. You can chart a correlation table between the liquid

level and its corresponding volums by carrying out experiments. Between the adjacent liquid levels, their correlation can be roughly considered linear. In this condition, we need to use broken line.

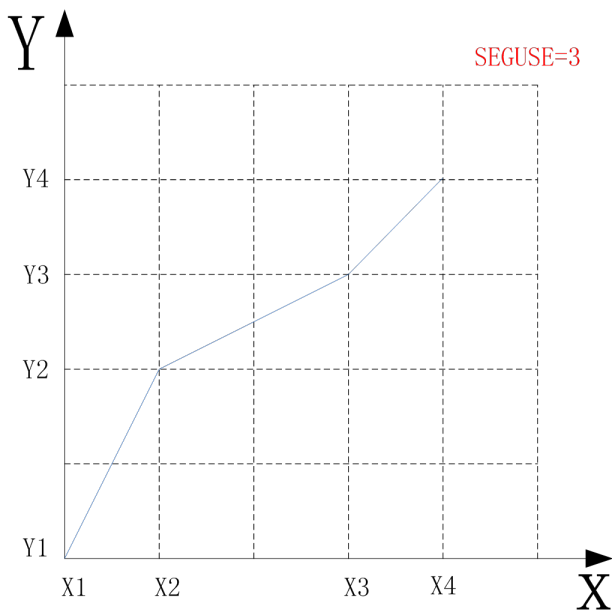


Figure 5.13 Non-linear

The program building in shown in the figure below.

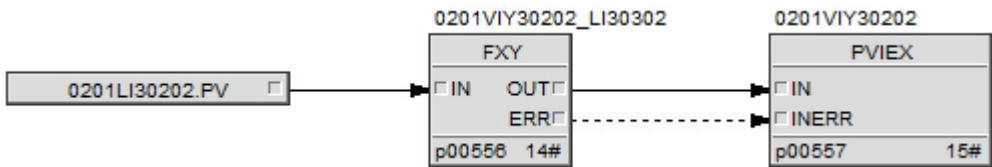


Figure 5.14 Non-linear program

Function block illustration and corresponding instantiations' illustrations are shown in the table below.

No.	Instantiation	Type	Illustration
001	0201LI30202	AI Input	Analog input
002	0201VIY30202_LI30202	FXY	Broken line function block
003	0201VIY30202	PVIEX	Analog indication function block

Parameter settings

- MODE: broken line mode, ON is step mode(leap) and OFF is ramp mode.
- SEGUES: broken line, supports up to 20 domains; when the domain number is set n, X and Y coordinates are set n+1. X coordinate values input have to be from small to big, otherwise

parameter setting error would appear. FXY module maintains lasting output; coordinates' values outside domains are allowed to not to conform to this requirement.

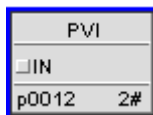
- Input and output tag and the measuring range unit of X and Y pins

Within the domains, X coordinate's values are not progressively increasing along one direction and configuration error alarm appears, ERR=ON, by the mean time, FXY outputs the value before the error configuration is saved.

5.24 Indication Function Block (PVI)

This function block can display signals from I/O and other function blocks and has functions of rate alarm and error alarm.

This function block is a Complicated function block, the running time is 30μs.



5.24.1 Parameter Description

Table 5.31 Indication function block parameter description

Name			Description	Upload	Properties	Application Reference
Basic Parameters	Range Settings	INSCH	Input Range High Limit	-	Configuration Parameter	When range high limit is less than high limit, generate range threshold overturn alarm.
		INSCL	Input Range Low Limit	-	Configuration Parameter	Ditto
		INEU	Input Unit	-	Configuration Parameter	-
		DLEN	Decimal Digits [0,5]	-	Configuration Parameter	Used for Data Displayed on Function Block Panel (Equal to 3 as Default)
Extended Parameters	Input Pin	IN	Input	-	Input Pin	Connect to AI and function block
	OOS Settings	SWOOS	Whether Disable Function Block (ON=Disable)	TRUE	Operation Parameter	-

Table 5.31 Indication function block parameter description (continued)

Name			Description	Upload	Properties	Application Reference
	Error Indication	EI	Deviation	-	Monitoring Parameter	-
	Alarm- Note1	PRININD- Note2	Positive Rate Alarm Indication	-	Monitoring Parameter	The functional block name displayed in the flowchart.
		NRININD- Note2	Negative Rate Alarm Indication	-	Monitoring Parameter	The functional block name displayed in the flowchart.
		PDEVIND- Note3	Positive Deviation Alarm Indication	-	Monitoring Parameter	-
		NDEVIND- Note3	Negative Deviation Alarm Indication	-	Monitoring Parameter	-
		HH-HIND	Input Alarm Indication of 3 rd High Limit	-	Monitoring Parameter	Can be set in the function panel
		HHIND	Input HH Alarm Indication	-	Monitoring Parameter	
		HIND	Input High Limit Alarm Indication	-	Monitoring Parameter	
		LIND	Input Low Limit Alarm Indication	-	Monitoring Parameter	
		LLIND	Input LL Alarm Indication	-	Monitoring Parameter	
		LLLIND	Input Alarm Indication of 3 rd Low Limit.	-	Monitoring Parameter	
	Alarm Enabled and	AOF	Suppress Module Alarm-	TRUE	Operation Parameter	-

Table 5.31 Indication function block parameter description (continued)

Name			Description	Upload	Properties	Application Reference
	Sup- press		AOF=ON Real-Time Alarm No Shown- AOF=OFF Real-Time Alarm Shown			
		ENALM	Enable Alarm	TRUE	Operation Pa- rameter	-
		FLAG	Flag Code	-	Output Pin	Refer to "Flag"
	SV	SV	Setting Value	TRUE	Operation Pa- rameter	-
	Alarm Limits	INH HH	Input 3 rd High Limit Alarm Val- ue	TRUE	Operation Pa- rameter	-
		INH H	Input HH Alarm Val- ue	TRUE	Operation Pa- rameter	-
		INH	Input High Limit Alarm Val- ue	TRUE	Operation Pa- rameter	-
		INL	Input Low Limit Alarm Val- ue	TRUE	Operation Pa- rameter	-
		INLL	Input LL Limit Alarm Val- ue	TRUE	Operation Pa- rameter	-
		INLLL	Input 3 rd Low Limit Alarm Val- ue	TRUE	Operation Pa- rameter	-
		INHYS	Alarm HYS (≥ 0.0)	TRUE	Operation Pa- rameter	-
		PRIN	Posi- tive Rate Alarm Val- ue (≥ 0.0)	TRUE	Operation Pa- rameter	-
		NRIN	Nega- tive Rate	TRUE	Operation Pa- rameter	-

Table 5.31 Indication function block parameter description (continued)

Name			Description	Upload	Properties	Application Reference
			Alarm Value (≥ 0.0)			
		PDEV	Positive Deviation Alarm Value (≥ 0.0)	TRUE	Operation Parameter	-
		NDEV	Negative Deviation Alarm Value (≥ 0.0)	TRUE	Operation Parameter	-

Note 1: The relationship between input and alarm is shown as follows:

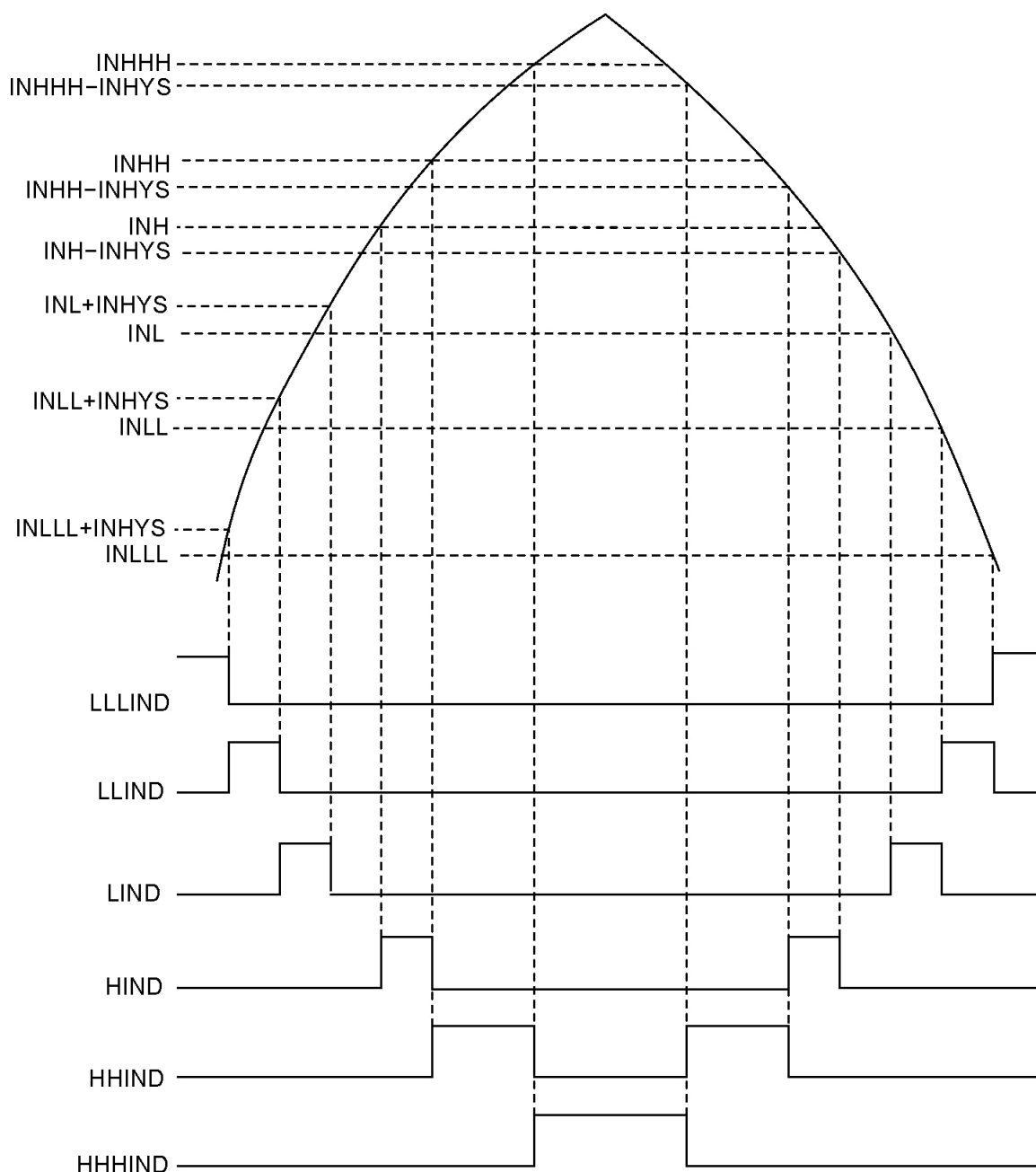


Figure 5.15 indicate function block input alarm process sign

Note 2: Rate alarm

This function block has indication function of rate alarm; when positive change rate \geq PRIN, generate positive rate alarm; when negative change rate \geq NRIN, generate negative rate alarm.

Note 3: Error alarm

This function block has error alarm function; when input value is bigger than SV and error absolute value \geq positive error alarm, generate positive error alarm; when input value is smaller than SV and error absolute value \geq negative error alarm, generate negative error alarm.

5.24.2 Panel Parameter

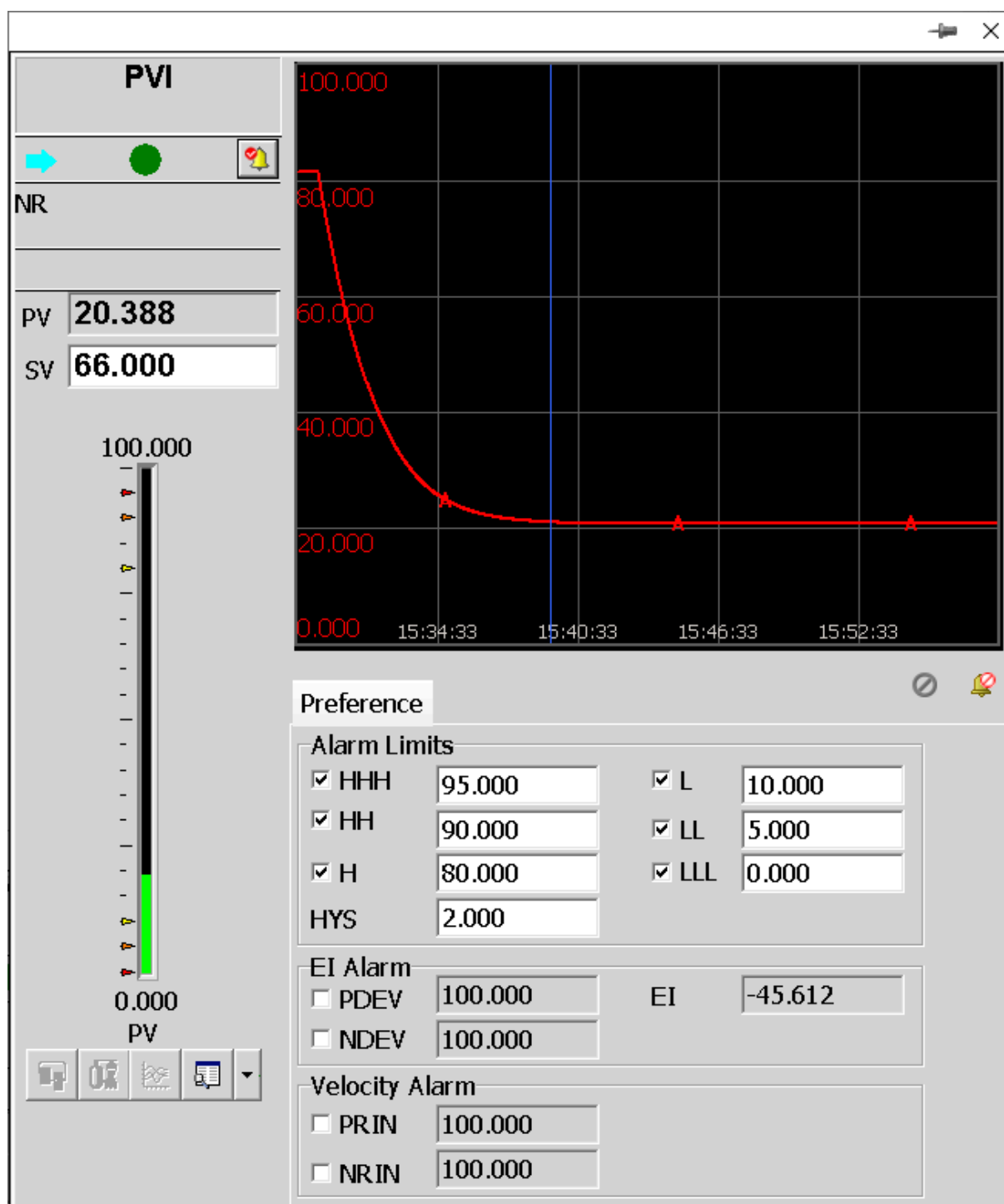


Table 5.32 Function Block Panel Parameter

Panel Parameter Name			Function Block Parameter Name	Initial Value	Value Range	Application Instruction
Preference	Alarm Limits(%)	HHH	INH HH	100.0000	[INSCH,INSCL]	Input HHH Alarm Value (the option selected alarm, otherwise invalid)

Table 5.32 Function Block Panel Parameter (continued)

Panel Parameter Name			Function Block Parameter Name	Initial Value	Value Range	Application Instruction
		HH	INHH	95.0000	[INSCH,INSCL]	Input HH Alarm Value (the option selected alarm, otherwise invalid)
		H	INH	90.0000	[INSCH,INSCL]	Input H Alarm Value (the option selected alarm, otherwise invalid)
		HYS	INHYS	0.0000	Not less than 0	Read-only, can be set in the Function Block Properties window or in the program settings
		L	INL	10.0000	[INSCH,INSCL]	Input L Alarm Value (the option selected alarm, otherwise invalid)
		LL	INLL	5.0000	[INSCH,INSCL]	Input LL Alarm Value (the option selected alarm, otherwise invalid)
		LLL	INLL	0.0000	[INSCH,INSCL]	Input LLL Alarm Value (the option selected alarm, otherwise invalid)
	EI Alarm(%)	PDEV	PDEV	100.0000	Not less than 0	Positive Deviation Alarm Value (the option selected alarm, otherwise invalid)
		NDEV	NDEV	100.0000	Not less than 0	Negative Rate Alarm Value (the option selected alarm, otherwise invalid)
		EI	EI	0.0000	-	-
	Velocity Alarm (%)	PRIN	PRIN	100.0000	Not less than 0	Positive Rate Alarm Value (the option selected alarm, otherwise invalid)
		NRIN	NRIN	100.0000	Not less than 0	Negative Rate Alarm Value (the option selected alarm, otherwise invalid)

5.24.3 Flag

Table 5.33 Flag list

Flag	Alarm	Description
D0	OOS	Disable
D1	HHH	HHH Limit Alarm

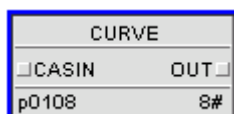
Table 5.33 Flag list (continued)

Flag	Alarm	Description
D2	HH	HH Limit Alarm
D3	H	H Limit Alarm
D4	L	L Limit Alarm
D5	LL	LL Limit Alarm
D6	LLL	LLL Limit Alarm
D7	PRIN	Positive Rate Alarm
D8	NRIN	Negative Rate Alarm
D9	PDEV	Positive Deviation Alarm
D10	NDEV	Negative Deviation Alarm
D12	REVSCL	Span H/L Limit Reverse
D13	AOF	Suppress Alarm

5.25 Segment Signal Generate Function Block (CURVE)

This function block curve outputs values by time and changes with set value of time sequence program.

This function block is a simple function block, the running time is 20μs.

**Table 5.34 Segment signal generate function block parameter instruction**

Name			Name	Upload	Properties	Application Reference
Basic Parameters	Time Point Settings	T0	Time Dot 0	TRUE	Operation Parameter	-
		T1	Time Dot 1	TRUE	Operation Parameter	-
		T2	Time Dot 2	TRUE	Operation Parameter	-
		T3	Time Dot 3	TRUE	Operation Parameter	-
		T4	Time Dot 4	TRUE	Operation Parameter	-

Table 5.34 Segment signal generate function block parameter instruction (continued)

Name			Name	Upload	Properties	Application Reference
		T5	Time Dot 5	TRUE	Operation Parameter	-
		T6	Time Dot 6	TRUE	Operation Parameter	-
		T7	Time Dot 7	TRUE	Operation Parameter	-
		T8	Time Dot 8	TRUE	Operation Parameter	-
		T9	Time Dot 9	TRUE	Operation Parameter	-
		T10	Time Dot 10	TRUE	Operation Parameter	-
		T11	Time Dot 11	TRUE	Operation Parameter	-
		T12	Time Dot 12	TRUE	Operation Parameter	-
		T13	Time Dot 13	TRUE	Operation Parameter	-
	Output Value Settings	Y0	Output Value 0	TRUE	Operation Parameter	-
		Y1	Output Value 1	TRUE	Operation Parameter	-
		Y2	Output Value 2	TRUE	Operation Parameter	-
		Y3	Output Value 3	TRUE	Operation Parameter	-
		Y4	Output Value 4	TRUE	Operation Parameter	-
		Y5	Output Value 5	TRUE	Operation Parameter	-
		Y6	Output Value 6	TRUE	Operation Parameter	-
		Y7	Output Value 7	TRUE	Operation Parameter	-
		Y8	Output Value 8	TRUE	Operation Parameter	-

Table 5.34 Segment signal generate function block parameter instruction (continued)

Name			Name	Upload	Properties	Application Reference
		Y9	Output Value 9	TRUE	Operation Parameter	-
		Y10	Output Value 10	TRUE	Operation Parameter	-
		Y11	Output Value 11	TRUE	Operation Parameter	-
		Y12	Output Value 12	TRUE	Operation Parameter	-
		Y13	Output Value 13	TRUE	Operation Parameter	-
	Segment Settings	SEGUSE	Used Segment Number [1,13]	-	Operation Parameter	-
Extended Parameters	Input Pin	CASIN- Note3	Cascade Input	-	Input Pin	Related SEGUSE
		CASNUM	Cascade Input Segment Number	-	Input Pin	-
		CASTR	Cascade Tracking (OFF=Tracking)	-	Input Pin	-
		HOLD- Note2	Maintain	-	Input Pin	-
		RST	Reset	-	Input Pin	-
	Output Pin	OUT- Note1	Output Value	-	Output Pin	Related RST
		PNUM	Present Segment Number	-	Output Pin	-
		FINISH	End Symbol	-	Output Pin	-
		PEND	Indicate Present Segment Reach	-	Output Pin	-
		ER- Note4	Block Alarm	-	Output Pin	Related T0-T13
	End Mode Settings	MODE- Note5	End Mode: OFF=Retention; ON=Reset	-	Configuration Parameter	-

Note 1: RST relationship with OUT as follows.

- When RST=ON, output value OUT restore to original valueY0, PNUM=CASNUM, PEND=OFF, FINISH=OFF;
- When RST = OFF, output value OUT starts from Y0 and changes to Y1 in T1-T0 in slope; PEND outputs a pulse signal, PNUM=CASNUM + 1; then changes to Y2 in T2-T1 in slope, PNUM = CASNUM +2; at last changes to Y13, PNUM = CASNUM + 13, FINISH = ON.

Note 2: The hold functions as follows.

In outputting but not restoring period, HOLD=ON, and output is maintained and interior timing pauses; HOLD=OFF, output changes with former rule.

Note 3: The Trip functions as follows.

When more than thirteen interval segment are required, adopt two function blocks trip mode.

- Upriver function block PNUM inputs to lower function block CASNUM;
- Upriver function block FINISH inputs to lower function block CASTR;
- Upriver function block OUT inputs to lower function block CASIN; same set is required in upriver function block [T13,Y13] and lower function block [T0,Y0].

Through SEGUSE parameters configuration setting the used segues. For example SEGUSE=5, use the front five interzone segues.

Note 4: In the amount of SEGUSE set interval segment, if time axes is not sorted from small to big, generate alarm.

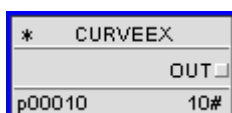
Note 5: The end mode as follows

- When MODE=OFF, output value maintains after the end of interval is output.
- When MODE=ON, output value restores to Y[0] after the end of interval is output.

When the amount of interval segment is changed, restore and restart.

5.26 Expanded Segment Signal Generate Function Block (CURVEEX)

This function block can realize the output is in curve as time passes and it can change as per the chronically set program. This function is a complex function block and the operating time is 50μs.



5.26.1 Parameter Description

Parameter Name			Description	Upload	Illustration	Application
Basic Parameter	Time set	T1~T21	time point 1~time point 21	True	operating parameter	-

Parameter Name			Description	Upload	Illustration	Application
me- ters		UNIT	time unit	True	operating parameter	0=s, 1=minute
	Output value setting	Y1~Y21	output 1~output 21	True	operating parameter	-
	Section number settings	SEGUSE	used segments [1,21]	True	operating parameter	The default is 1 section
	End mode settings	RUN_OPT	running mode	True	operating parameter	0=normal, 1=circulate
		INIT_OPT	cold startup option	True	operating parameter	OFF=initialized1=hold
	switch with-out disturbance settings	BUMP_OPT	bumpless process option	-	operating parameter	OFF=none, ON=bumpless
		BL_S_NUM	bumpless process start segment[1,21]	True	operating parameter	-
		BL_E_NUM	umpless process end segment [1,21]	True	operating parameter	-
	range settings	OUTSCH	OUT high scale	-	configuration parameter	-
		OUTSCL	OUT low scale	-	configuration parameter	-
		OUTEU	OUT engineer unit	-	configuration parameter	-
		OUTDLEN	OUT decimal digits [0,5]	-	configuration parameter	function block panel display the output with 3 decimal places
Ex- tend- ed pa- ra- me- ters	input pin	BKIN	back calculation input	-	input pin	-
		BKINERR	back calculation input state	-	input pin	-
		RUN	run command	-	input pin	-
		STOP	stop command	-	input pin	-
		PAUSE	pause command	-	input pin	-
		RESUME	resume command	-	input pin	-

Parameter Name		Description	Upload	Illustration	Application	
	output pin	OUT	output value	-	output pin	-
		ERR	module alarm	-	output pin	-
		PNUM	current section number	-	output pin	-
		END	end symbol	-	output pin	-
	operating parameters	CMD	command: 0= no action 1=switch to RUN; 2 =switch to STOP; 3=switch to Pause ; 4=switch to RESUME	-	operating parameters	It is reset to 0 by the function block as the period expires.
		ET	elapsed time	True	operating parameters	-
		SWOOS	switch of out of service	-	operating parameters	-
	alarm enable and shield	AOF	suppress alarm	-	operating parameters	-
		ENALM	alarm enable settings	True	operating parameters	-
	monitor parameter	FLAG	flag	-	operating parameters	-
		MODE	mode	-	operating parameters	1=OOS;2=I-MAN;5=AUTO
		STATUS	status	-	operating parameters	0=STOP;1=RUN;2=PAUSE;3=END

5.26.2 Algorithm Illustration

Input Pin processing

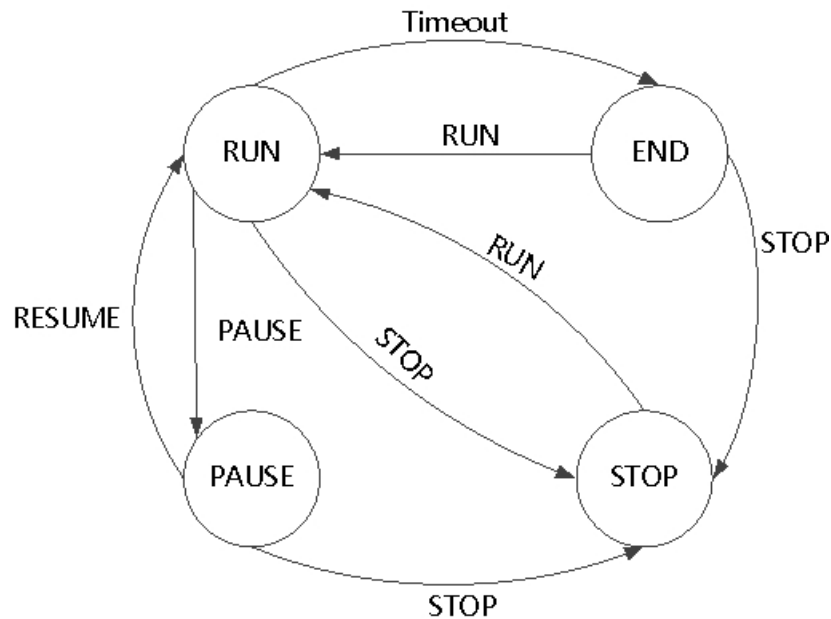
The input pin RUN/STOP/PAUSE/RESUME adopts level type signal.

- If one of the four pins is ON, the mode switch corresponding to that pin will be executed. If RUN=ON, it will enter RUN mode.
- If all the four pins are OFF, the current mode is maintained.
- If two or more of the four pins are ON, it will remain in the current mode and report a command blocking alarm.

CMD command processing

The value of CMD is 0~4, 0=no action; 1=switch to RUN; 2=switch to STOP; 3=switch to PAUSE; 4=switch to RESUME. After the end of each cycle, CMD will be reset to 0.

When the CMD command is (1, 2, 3, 4), if the input pin command is valid, the mode switch of the input pin will be executed, as shown in the figure below.

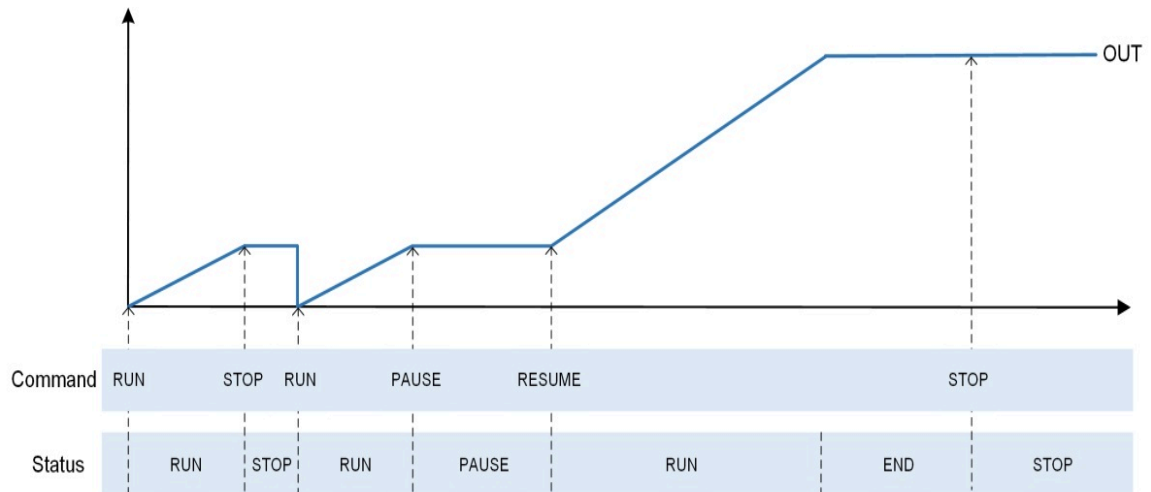


As shown in the figure above, in the STOP status, the function block only responds to the RUN command; in the RUN status, the function block can respond to the STOP and PAUSE commands; in the PAUSE status, it can respond to the STOP and RESUME commands, but cannot respond to the RUN command; in the END status It can respond to RUN and STOP commands, but cannot respond to PAUSE commands.

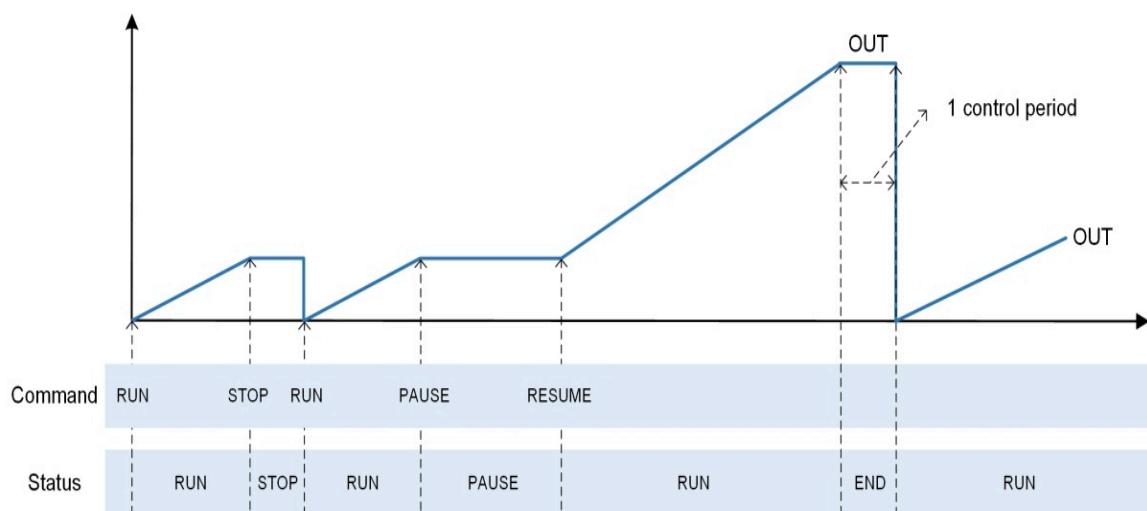
Operation mode description

The CURVEEX function block processes commands differently in different working modes.

- In normal mode (RUN_OPT=0), proceed as shown in the figure below.

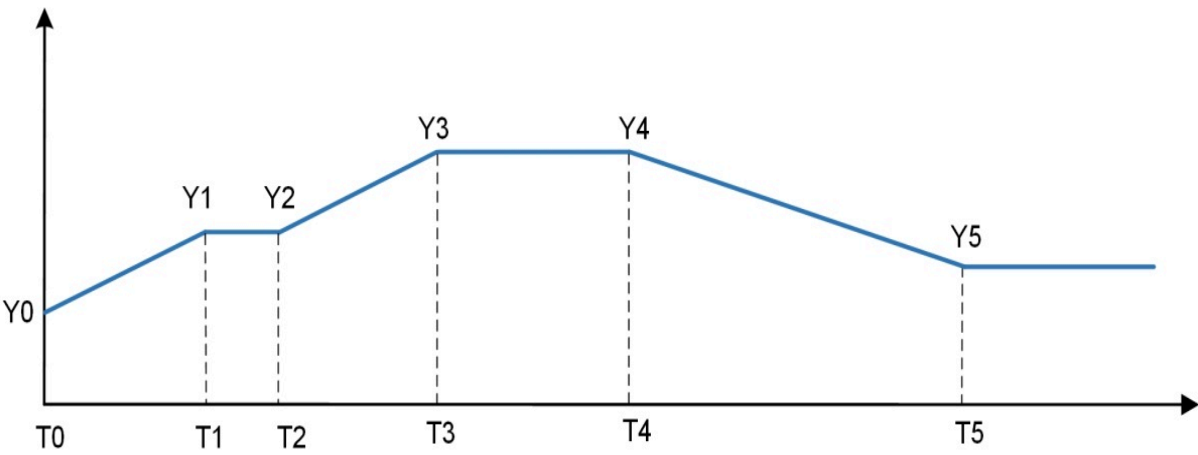


- In cycle mode (RUN_OPT=1), proceed as shown in the figure below.

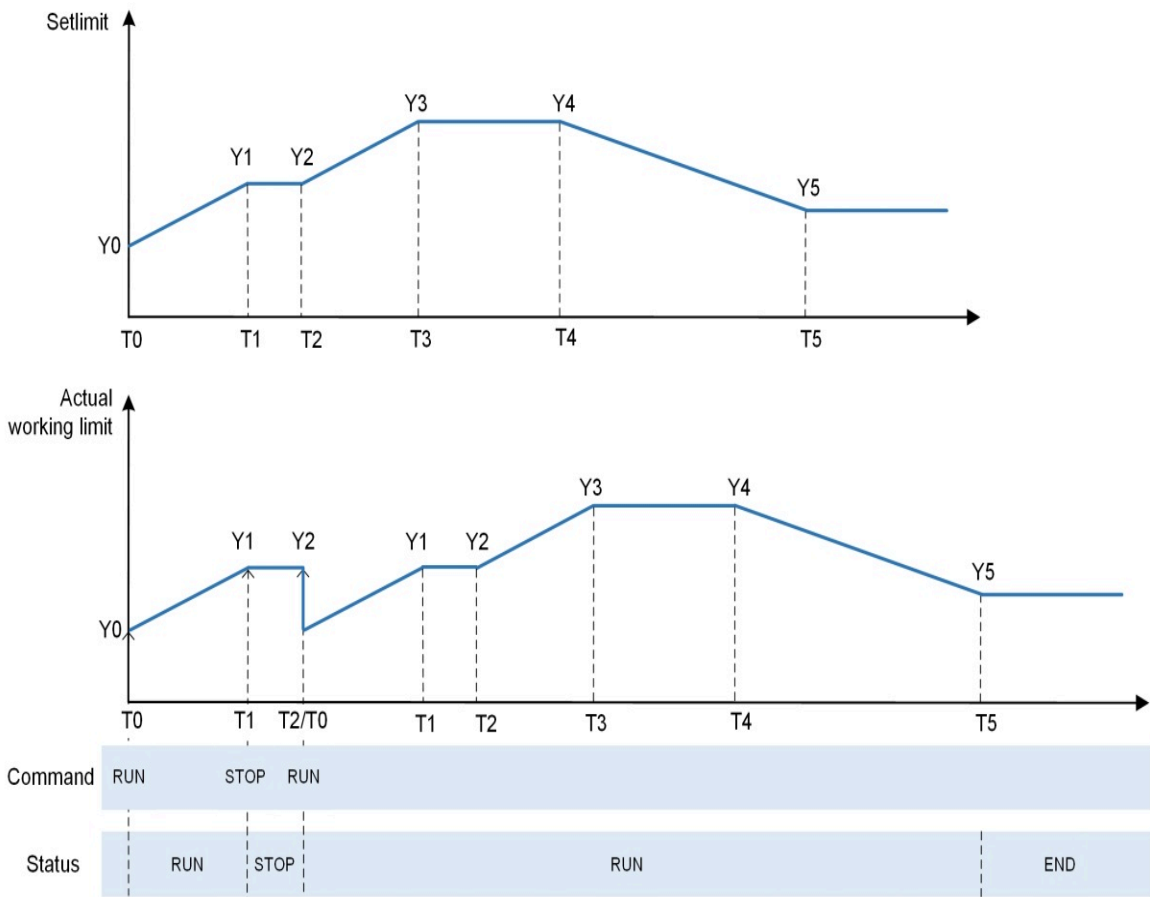


5.26.3 Output Illustration

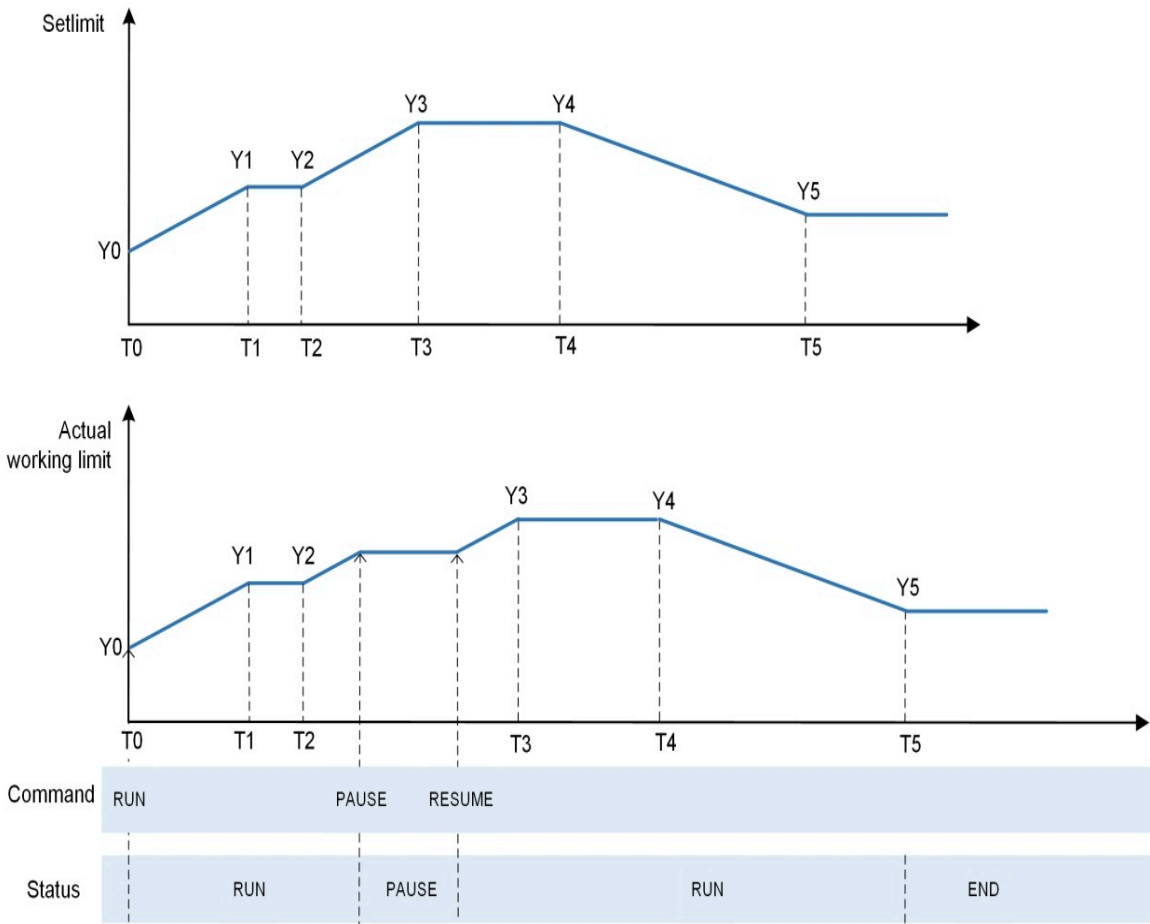
The output value Y_n is output in a curve as time goes by, as shown in the figure below. T_0 is 0 by default.



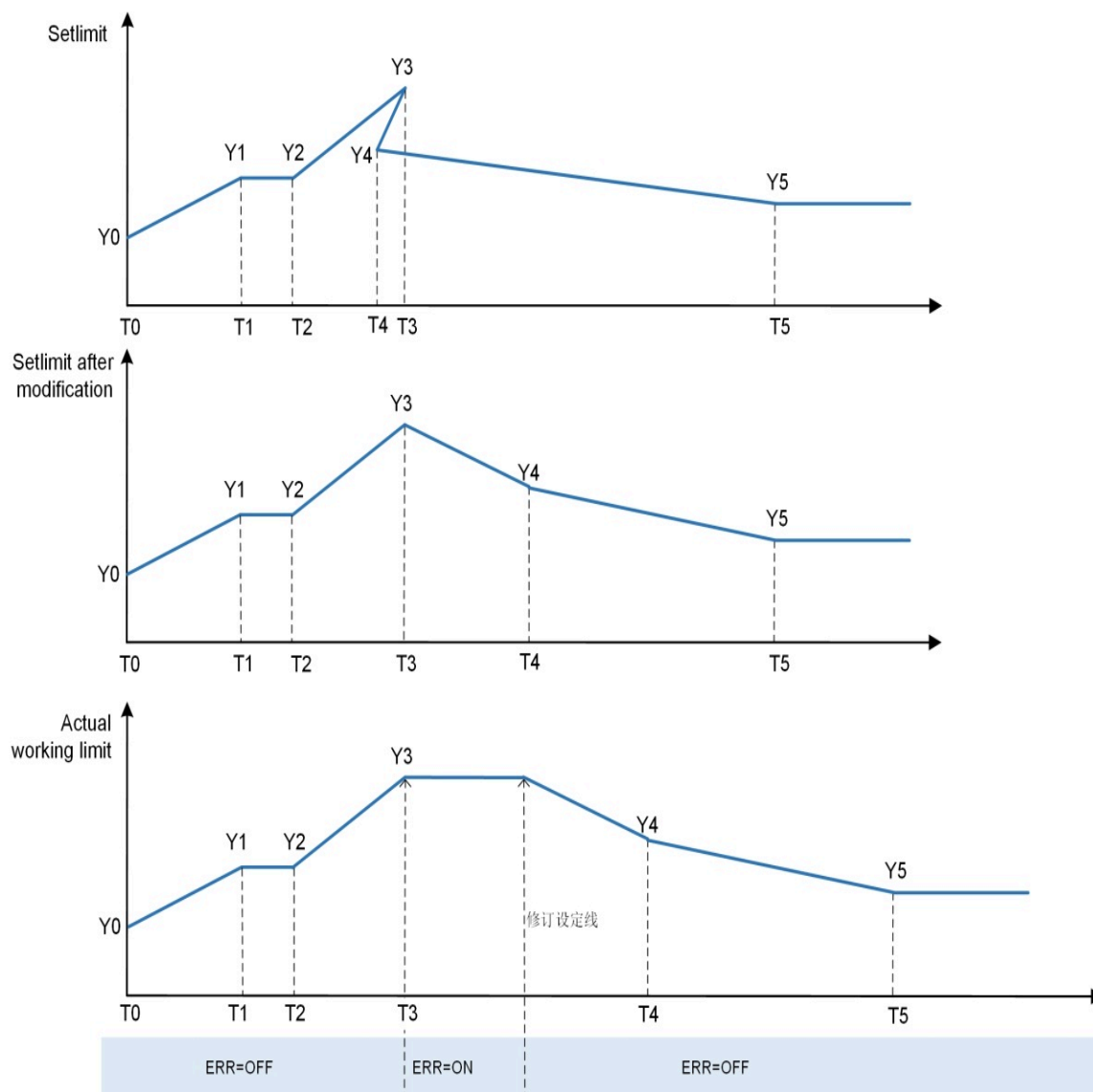
- The effect of STOP on output
When the function block receives the STOP command, the output value will change, as shown in the figure below.



- PAUSE impact on output



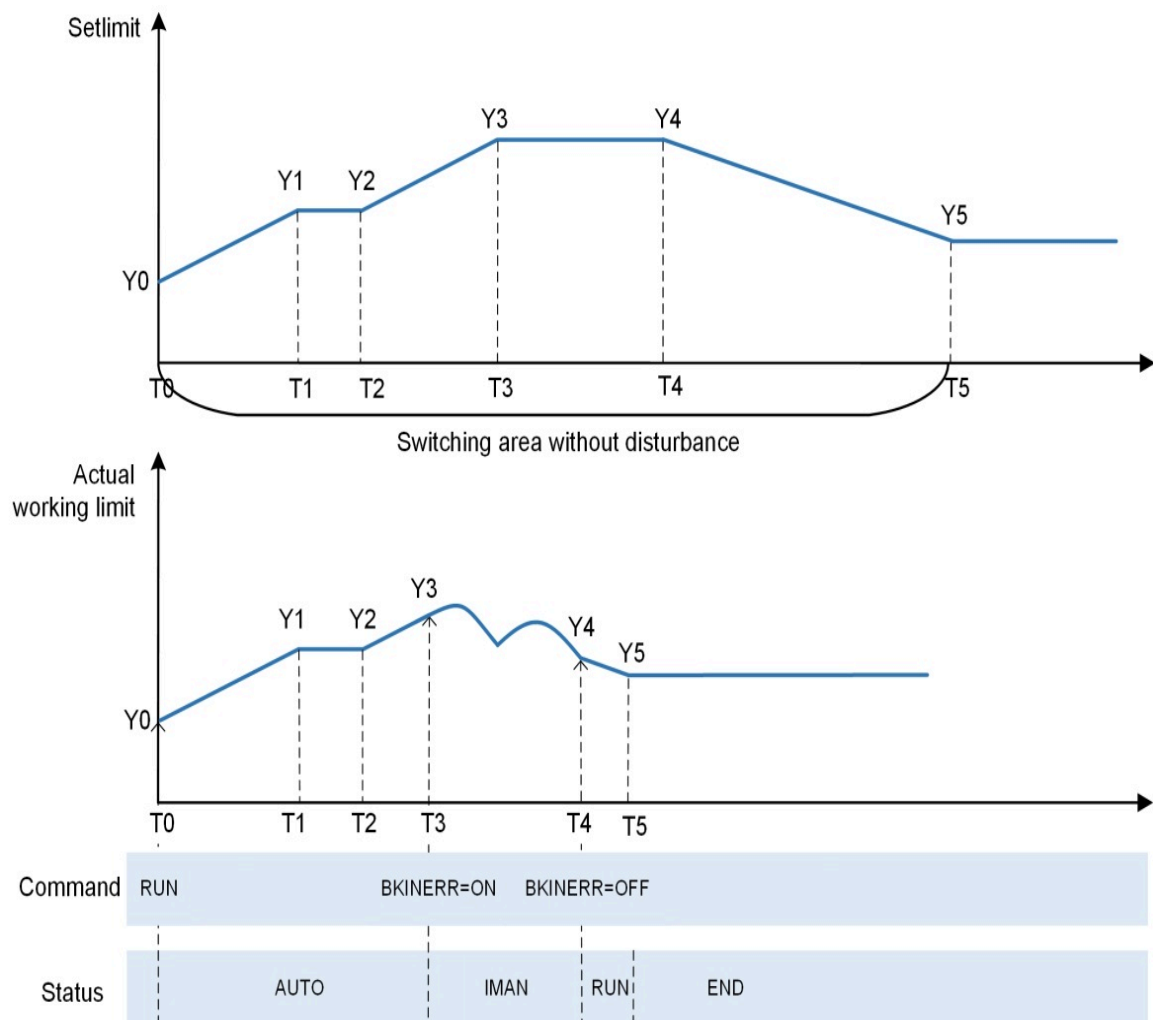
- time coordinates setting error impact on output



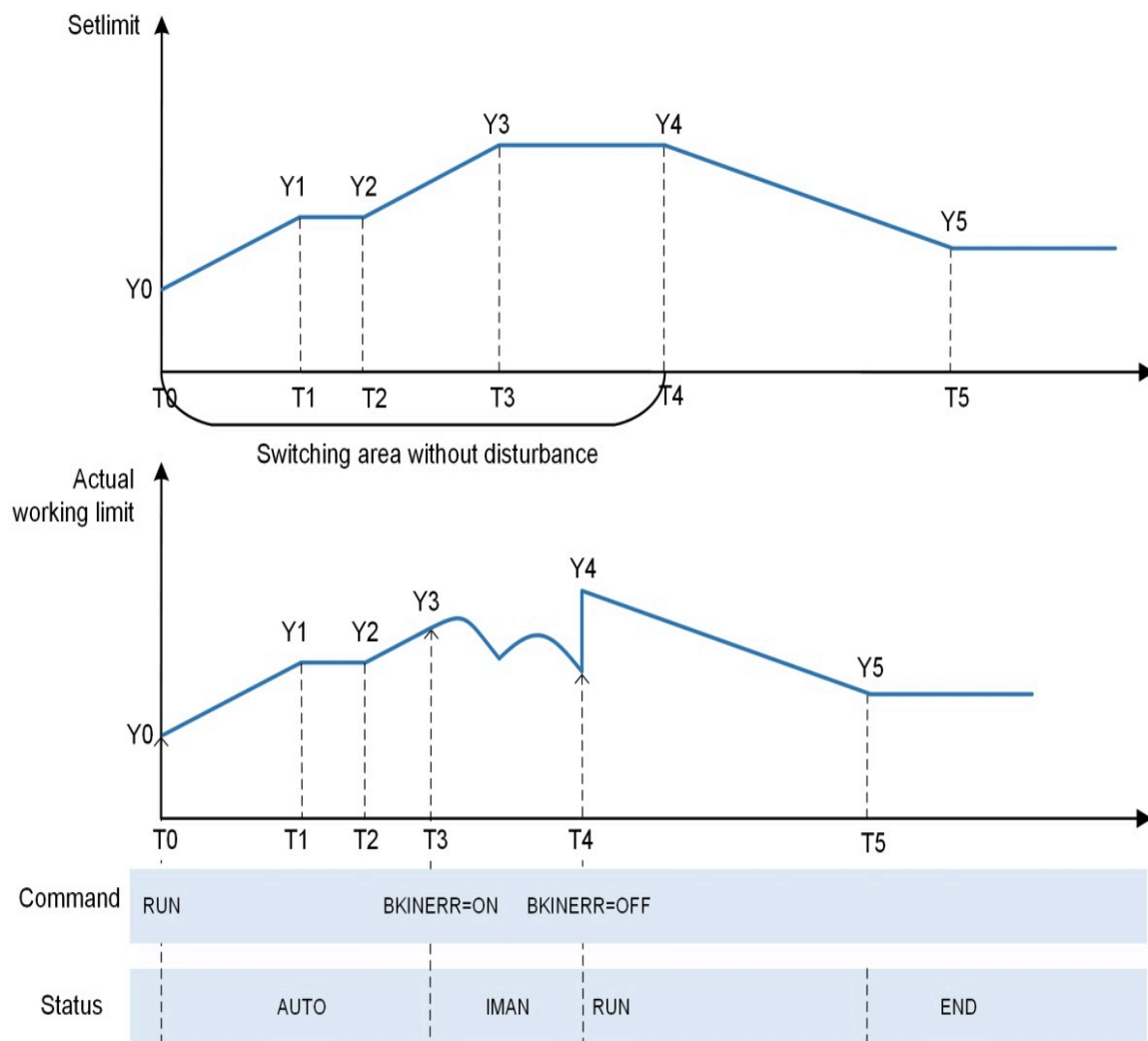
- Impact on the output in IMAN mode

When BKINERR=ON, it enters IMAN status, OUT in the fault period will track the change of BKIN.

When BKINERR=OFF, it exits IMAN status, if no disturbance switch function is enabled (BUMP_OPT=ON), it starts searching forward with the time axis when entering IMAN, find the same area as the current output value, and output according to the set line from the time found as show in the figure below.

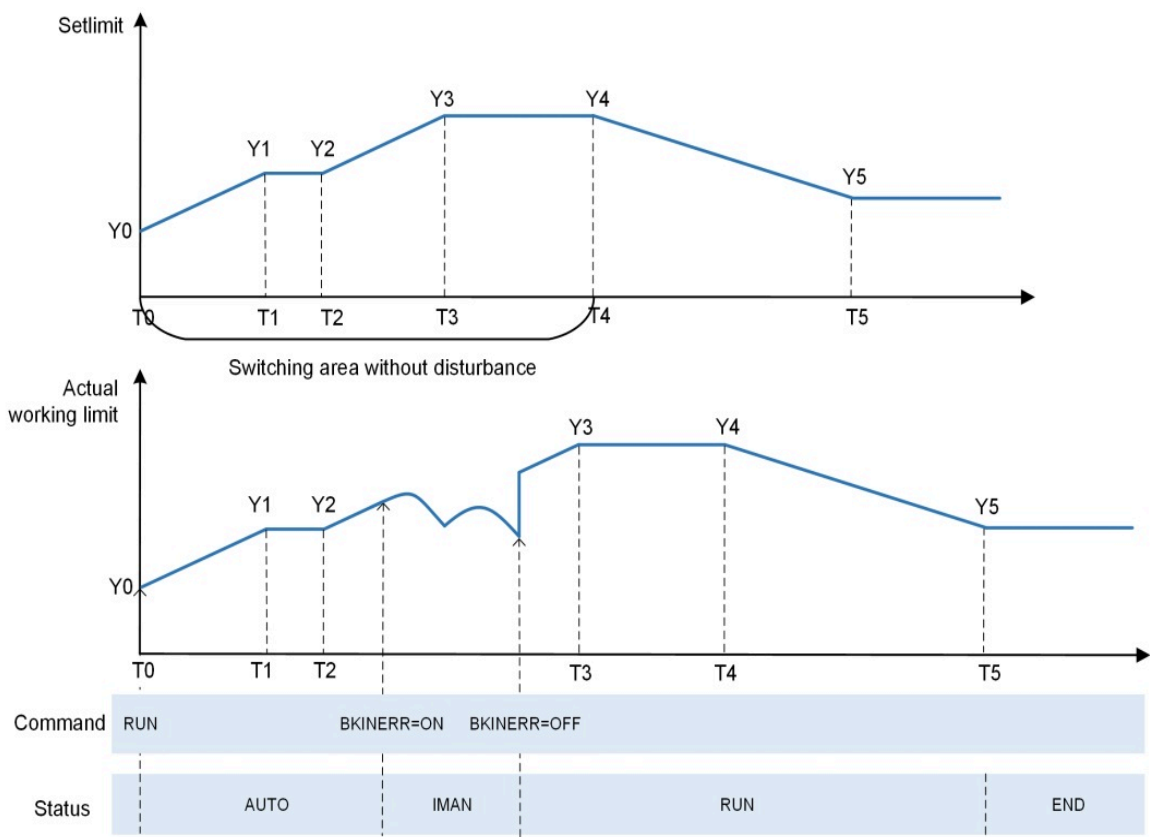


If the load regulation area is not found, output from the last point of the disturbance-free area.
As shown below:

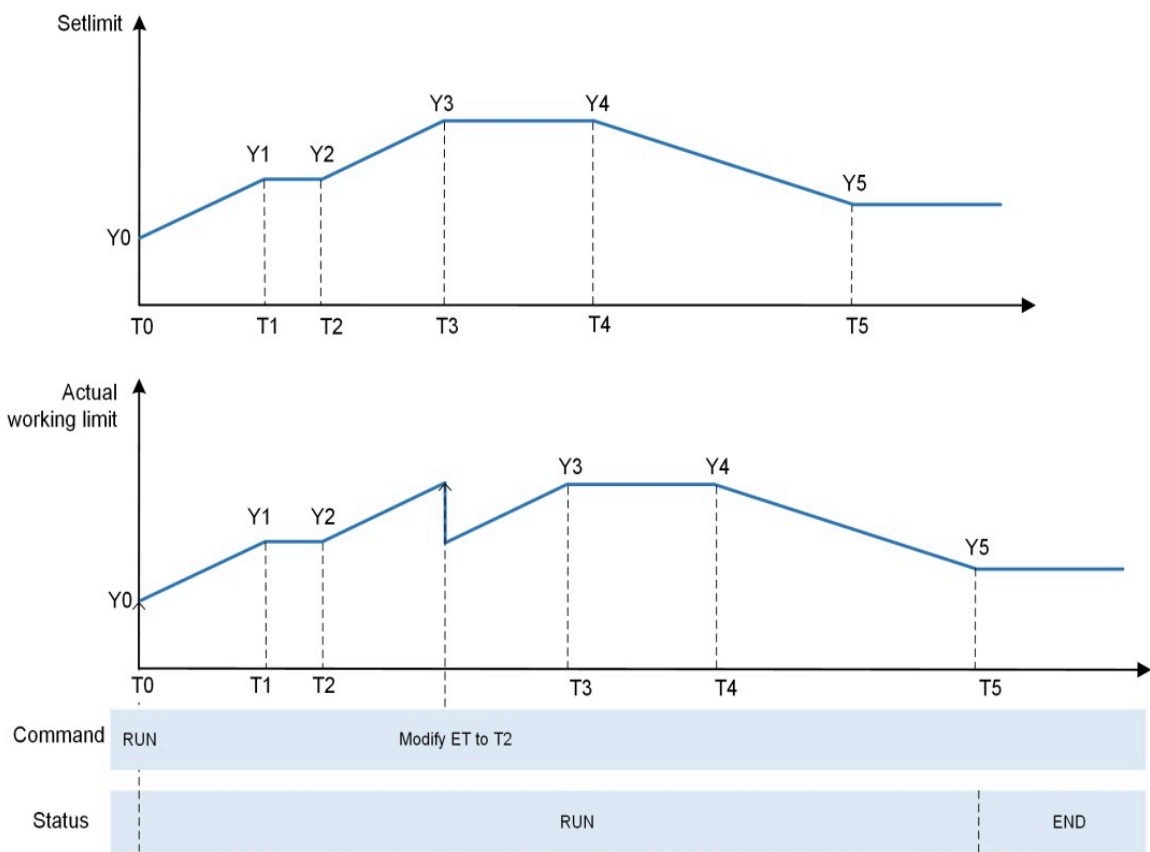


When BKINERR=ON, it enters the IMAN status, and the output OUT will track the change of BKIN during the fault.

When BKINERR=OFF, exit the IMAN status. If the don't disturb switch function is not enabled (BUMP_OPT=OFF), the output will continue on the time axis when entering IMAN.



- Modify ET time's impact on output



The screenshot displays the CURVEEX software interface. On the left, there are control buttons: "Start", "Stop", "Pause", and "Continue". Below these is a vertical scale from 0.000 to 100.000, with a green bar indicating the current temperature. The top left shows "NR" and "END AUTO". The "ET" (Exposure Time) is set to 12.000 s, and the "OUT" (Output) is set to 25.000 %.

The main graph shows a temperature profile over time. The x-axis is labeled T0 to T6, and the y-axis is labeled T, Y(0-21). The profile starts at T0 (0.000 s, 0.000 %), rises to T1 (2.000 s, 20.000 %), stays constant until T2 (3.000 s, 20.000 %), rises to T3 (5.000 s, 40.000 %), stays constant until T4 (8.000 s, 40.000 %), falls to T5 (10.000 s, 30.000 %), and finally to T6 (12.000 s, 25.000 %).

Below the graph is a table of parameters:

Parameter		SEGUSE	PNUM	UNIT
SEGUSE	6	PNUM	6	s min

The table also lists the temperature profile data points:

T	Y	T	Y
T0	0.000	T11	0.000
T1	2.000	T12	0.000
T2	3.000	T13	0.000
T3	5.000	T14	0.000
T4	8.000	T15	0.000
T5	10.000	T16	0.000
T6	12.000	T17	0.000
T7	0.000	T18	0.000
T8	0.000	T19	0.000
T9	0.000	T20	0.000
T10	0.000	T21	0.000

The alarm bar displays all the currently active alarms of the tag number (configuration is enabled, not enabled by default), including:

Illustration	Symbol	Whether to enable	Trigger Condition
Module fault alarm	ERR	enable	Parameter setting error
Operation timeout alarm	END_ALM	enable	running timeout
Command block alarm	CMD_ALM	enable	command input pins have two or more than two ON

Status bar

Status bar displays the current status of the tag, including:

Symbol	Illustration
OOS	tag prohibit
IMAN	IMAN mode
AUTO	Auto mode
RUN	Run mode
STOP	Stop status
PAUSE	Pause status
END	End status
AOF	Alarm shield

Panel Parameter Illustration

Panel parameter name	Function block parameter name	Initial Value	Value Range	Application
ET	ET	0.0	-	Past time
OUT	OUT	0.0	-	Output value
start	CMD	1	[0,4]	operation after authorization
stop		2	[0,4]	operation after authorization
pause		3	[0,4]	operation after authorization
resume		4	[0,4]	operation after authorization
Section number	SEGUSE	1	-	Section number
Serial number of section	PNUM	0	-	Current number of section
Time	UNIT	0	0/1	0=second, 1=minute

Panel parameter name	Function block parameter name	Initial Value	Value Range	Application
T0	-	0	0	Default is 0, cannot be modified
T1~T21	T1~T21	0.0	-	Time point 1~ time point 21
Y0~Y21	Y0~Y21	0.0	-	Output value 1~ output value 21

5.26.5 Flag

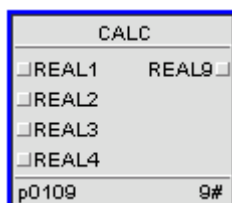
Flag	Alarm code	Illustration
D0	OOS	Tag prohibit
D1	IMAN	IMAN mode
D4	AUTO	Auto mode
D8	RUN	running
D9	STOP	stop
D10	PAUSE	pause status
D11	END	complete
D12	CMD_ALM	command block alarm
D13	AOF	alarm shield
D14	ERR	fault
D15	END_ALM	running time is up and alarm

5.27 Text Calculation Function Block (CALC)

This function processes simple operation. In "content" of text calculation function block, take mathematical and logic operation to function block. It supports ST language and function.

The width of line should be restricted to 50 and the amount of lines should be restricted to 1000.

This function block is a simple function block, the running time is 5μs.

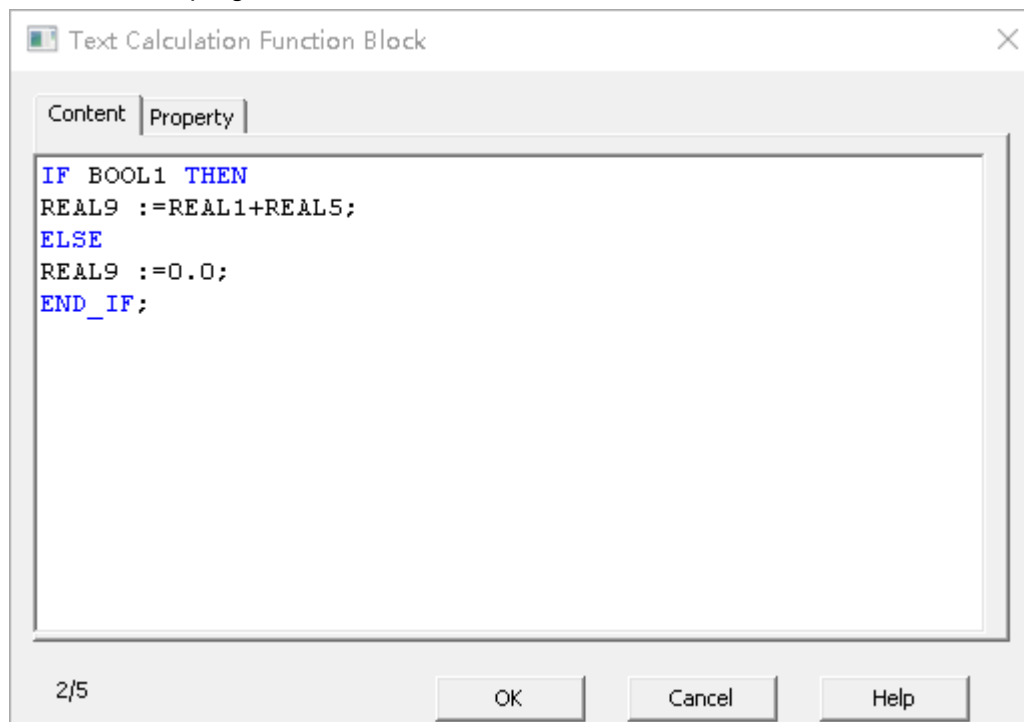


5.27.1 Parameter Description

Table 5.35 Text calculation function block parameter description

Name		Name	Upload	Properties	Application Reference
Input Pin	REAL1	User-defined Floating-point Date	-	Input Pin	-
	REAL2	User-defined Floating-point Date	-	Input Pin	-
	REAL3	User-defined Floating-point Date	-	Input Pin	-
	REAL4	User-defined Floating-point Date	-	Input Pin	-
Operation Parameter	BOOL1	User-defined Boolean Date	TRUE	Operation Parameter	-
	BOOL2	User-defined Boolean Date	TRUE	Operation Parameter	-
	BOOL3	User-defined Boolean Date	TRUE	Operation Parameter	-
	BOOL4	User-defined Boolean Date	TRUE	Operation Parameter	-
	INT1	User-defined Integral Date	TRUE	Operation Parameter	-
	INT2	User-defined Integral Date	TRUE	Operation Parameter	-
	INT3	User-defined Integral Date	TRUE	Operation Parameter	-
	INT4	User-defined Integral Date	TRUE	Operation Parameter	-
	REAL5	User-defined Floating-point Date	TRUE	Operation Parameter	-
	REAL6	User-defined Floating-point Date	TRUE	Operation Parameter	-
	REAL7	User-defined Floating-point Date	TRUE	Operation Parameter	-
	REAL8	User-defined Floating-point Date	TRUE	Operation Parameter	-
Output Parameter-Note1	REAL9	User-defined Floating-point Date	-	Output Pin	-

Note 1: The Input Pins, operation parameters and output parameters should be used to variables on program. For example, when BOOL1 = ON, REAL9=REAL1+REAL5; when BOOL1=OFF, REAL9=0, the program is show as follow.



TIP:
Adjust the window size by dragging.

Figure 5.16 Example of CALC function block

5.27.2 Application Example

Example1

To achieve the pressure drop of ATR burner nozzle, to figure out a normalized pressure drop and a low alarm PDAL-67019 (0.15 MPa) to show that the ART burner nozzle is not operated basing on the design parameter and to monitor mechanical integrity of mixture between ART burner nozzle and the oxygen and air.

The formula is:

$$\text{Normalised } dP = \text{Measured } dP \times \left(\frac{6298}{\text{Measured } O_2 \text{ flowrate}} \right)^2 \times \left(\frac{O_2 \text{ inlet } P + 0.0969}{2.79} \right) \times \left(\frac{273 + 230}{273 + O_2 \text{ inlet } T} \right)$$

Do the configuration as the expression shows:

Tag PY_67018A is *Normalised dP*, which means standardized Dp and the unit is MPa.

Tag PY-67018B.PV is *Measured dP*, which means measured Dp and the unit is MPa.

Tag FIC-67021.PV is *Measured O2 flowrate*, which means measured O2 flow and the unit is kNm³/h.

Tag PI-67018.PV is *O2 inlet Pressure*, which means the pressure at the inlet side and the unit is MPa (g).

Tag TIC-67015.PV is *O2 inlet T*, which means the temperature at the inlet side and the unit is °C.

Measured dP = MPa (PY-67018B.PV)

Measured O2 flowrate = kNm³/h (FIC-67021.PV)

O2 inlet Pressure = MPa (g) (PI-67018.PV)

O2 inlet T = °C (TIC-67015.PV)

As the example shows that when the modules of DCS system cannot meet the requirements for signal process directly, or the measuring device factory has provided the compensation calculation formula, such as the wind rate and natural gas flowrate of boiler device, the provided calculation sheet should be applied and module CALC can be used for formula calculation. Its programming can be achieved via CALC, as shown below. CALC is used for the experience formula calculation, and its inner algorithm can be customized based on the compensation formula. PVIEX can achieve the functions such as output result display and alarm process.

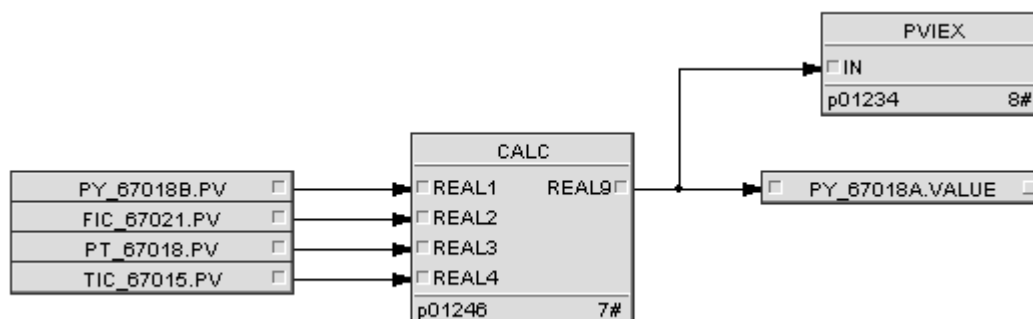


Figure 5.17 Programming of CALC

The instruction of function block and examples are shown below.

Table 5.36 Function block instruction and example

NO.	Example	Type	Instruction	Remark
001	PY_67018B	AI (Input)	Input Signal 1	
002	FIC_67021	AI (Input)	Input Signal 2	
003	PT_67018	AI (Input)	Input Signal 3	
004	TIC_67015	AI (Input)	Input Signal 4	
005	PY_67018A	Custom REAL	Output Signal	

Parameter settings of PVIEX:

- INSCH: set when needed
- INSCL: set when needed
- INEU: set when needed
- Alarm Enabled: set when needed
- Alarm Limit: set when needed

Parameter settings of CALC:

The inner parameter programming is shown below.

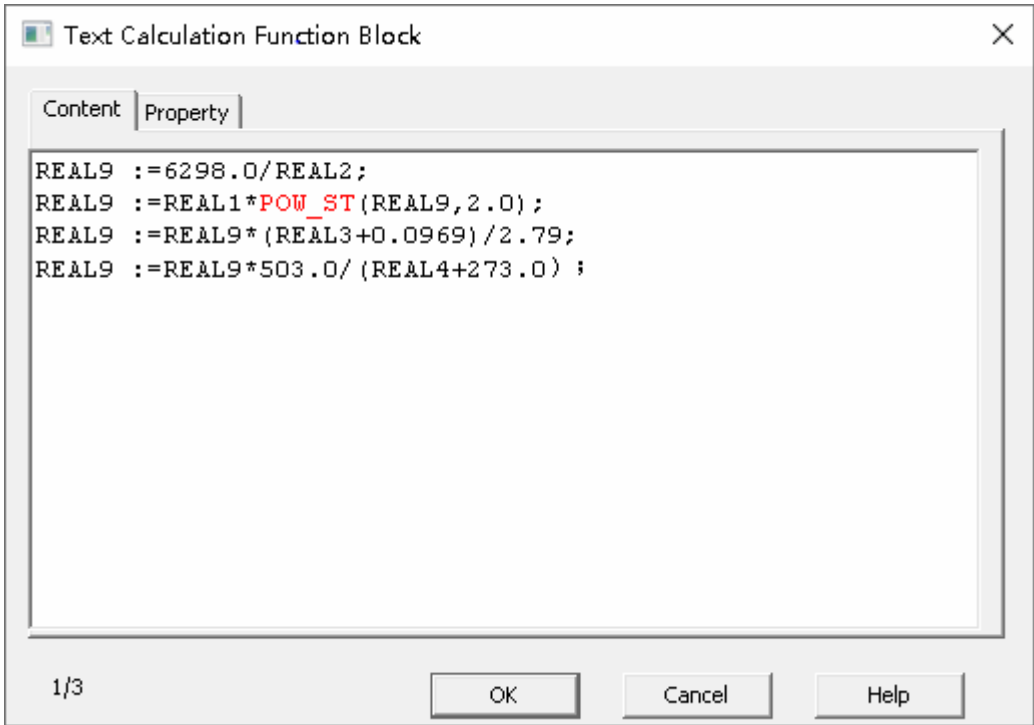


Figure 5.18 Programming of CALC

5.28 Text Logic Calculation Function Block (ACTION)

This function block through alias manner access or modify dates, the dates is other functions”.

This function block is a simple function block, the running time is 5μs.

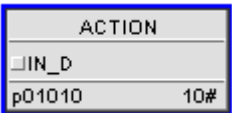


Table 5.37 Text logic calculation function block parameter instruction

Name		Name	Upload	Properties	Application Refer- ence
Input Pin	IN_D(IN_D = ON, effec- tive)	Input Pin	-	Input Pin	-

The setting method is shown as follows.

1. In "Alias List" of ACTION function block, announce the tag of programming, and modify the function name in the "name" page. For example, reference the FXY and FXYEX function blocks, the FXY is named fxy1, the FXYEX is named fxyex1, which are shown as follows.

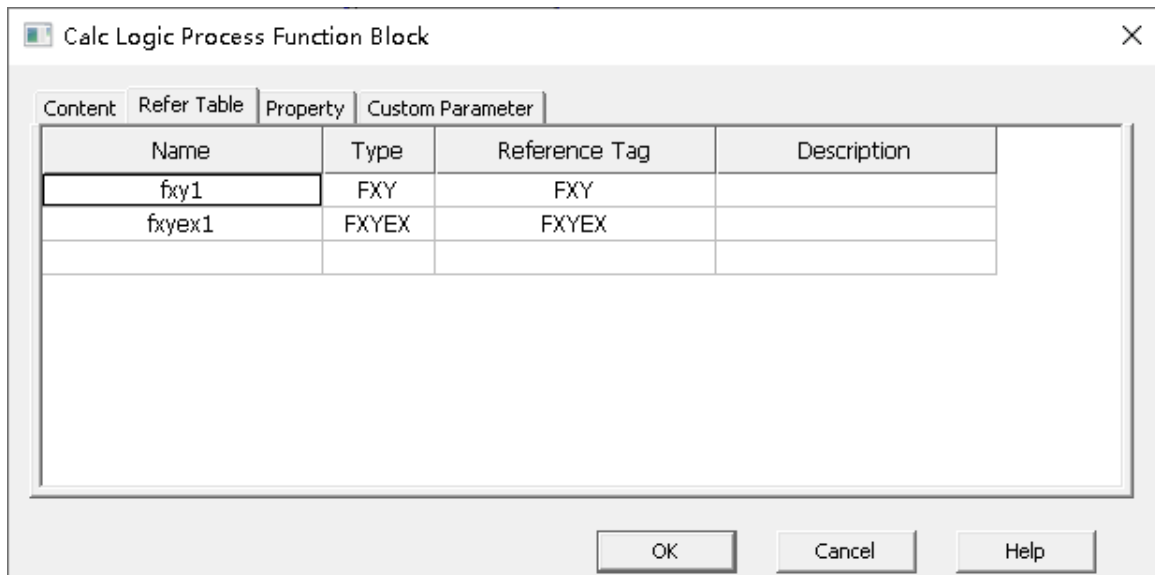


Figure 5.19 Excerpt the tag by alias manner



TIP:

The tag can be excerpted after aliasing, and it can be excerpted 200 at most, and supports global function block.

2. Parameters conforming to the parameter naming rules can be set in "Custom Parameter" tab. The name should be started by letter, and contain letters, numbers and underline. Other characters are illegal. If the names of new parameter and alias in custom parameter list or "Alias List" are repeated, a prompt of repeated name will pop up and create new parameter failed. Custom parameter cannot be input/ output pins.

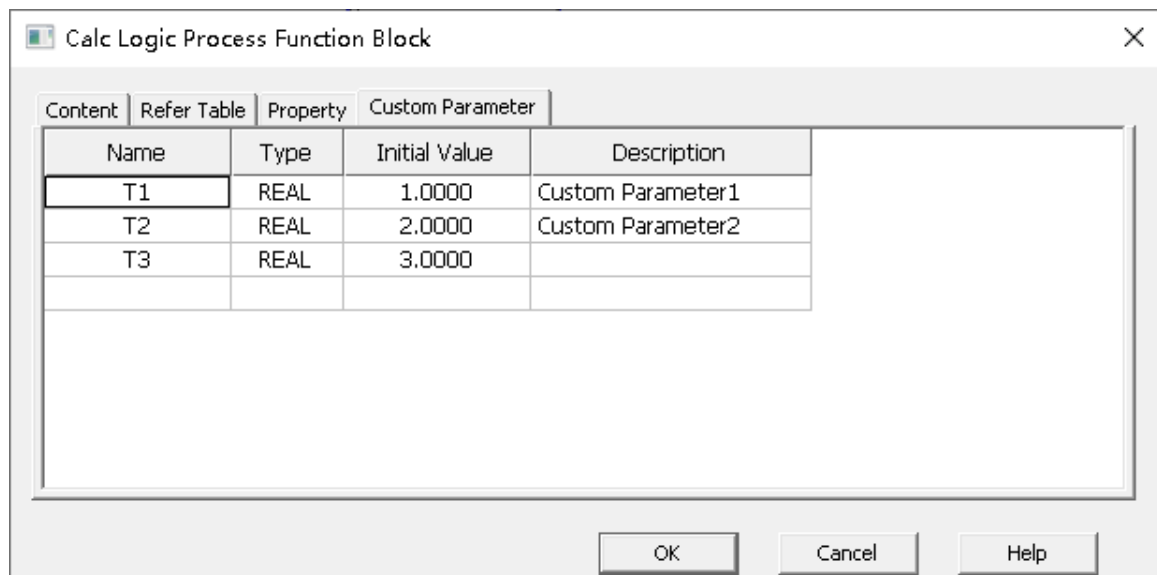


Figure 5.20 Custom parameter

3. In "Content" of ACTION function block, compile ST code and write the tag (comprise the function block) parameters. Excerpt the tag through the "alias.parameter" manner. For example, achieve `fxyx1.OUT= fxy1.OUT+2`, it is shown as follows.

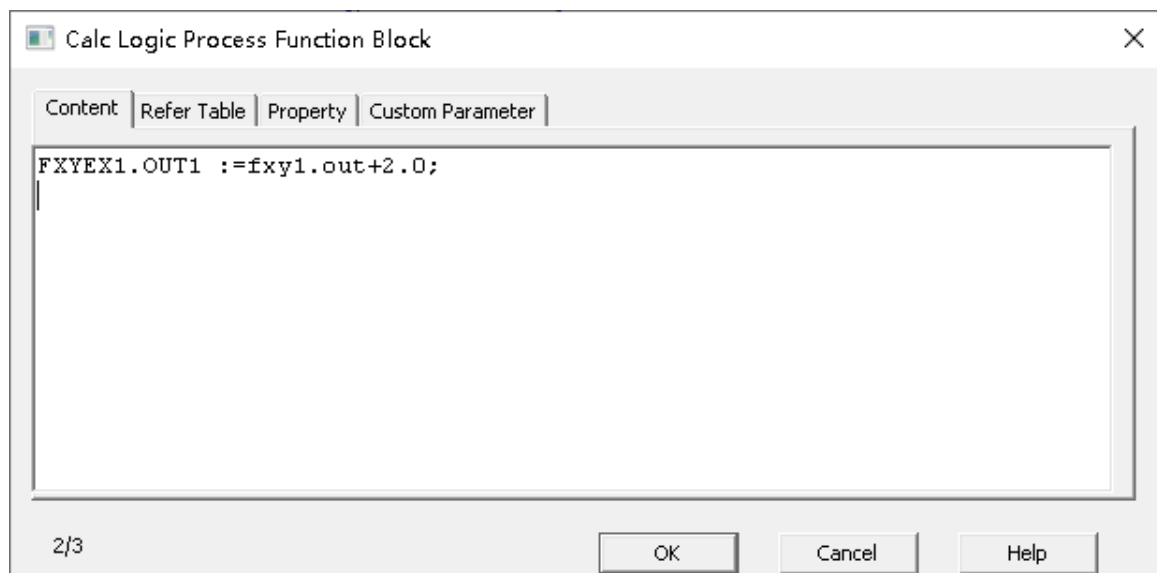


Figure 5.21 Example of ACTION function block



TIP:

- In "content" of ACTION function block, it supports program helper and displays the key words, alias, member.
- The width of line should be restricted to 50 and the amount of lines should be restricted to 1000.
- Adjust the window size by dragging.

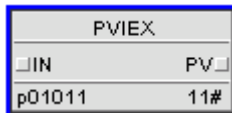
The function block supports creating custom parameters of float, integer (6 types) and BOOL, and perform ST coding via parameter, and achieve control logic.

The function block supports array set by controller, such as float, integer, BOOL, and supports timer set by controller, such as minute, second and 100 milliseconds.

5.29 Extended Indicator Function Block (PVIEX)

This block can execute linear conversion for the input data, low cutting, filter calculation, rate alarm, error alarm, high and low limit alarm, output holding, etc.

This function block is a Complicated function block, the running time is 50μs.



5.29.1 Parameter Description

Table 5.38 Extended indicator functional block description

Name			Name	Up-load	Properties	Application Reference
Basic Parameters	Range Settings	INSCH	Input maximum	-	Configuration Parameter	When range high limit is less than high limit, generate range threshold overturn alarm.
		INSCL	Input span minimum	-	Configuration Parameter	Ditto
		INEU	Input unit	-	Configuration Parameter	-
		DLEN	Decimal digits[0,5]	-	Configuration Parameter	Used for Data Displayed on Function Block Panel (Equal to 3 as Default)
Extended Parameters	Input Pin	IN	Original input value	-	Input Pin	Connect to AI and function block
		INERR	Raw input signal quality	-	Input Pin	-
	Output Pin	PV	Compensation output value	-	Output Pin	If there's a float abnormal happened to the PV value, the PV will be set as 0 Please refer to "Application Illustration" for details.

Table 5.38 Extended indicator functional block description (continued)

Name			Name	Up-load	Properties	Application Reference
		ALM	General alarm output	-	Output Pin	-
		NOALM	General normal output	-	Output Pin	-
	Alarm	FLEX	Turning Point Alarm indication	-	Monitoring Parameter	-
		PRININD	Positive rate alarm indication	-	Monitoring Parameter	-
		NRININD	Negative rate alarm indication	-	Monitoring Parameter	-
		PDEVIND	Positive deviation alarm indication	-	Monitoring Parameter	-
		NDEVIND	Negative deviation alarm indication	-	Monitoring Parameter	-
		HHHIND	Input HHH alarm indication	-	Monitoring Parameter	-
		HHIND	Input HH limit alarm indication	-	Monitoring Parameter	-
		HIND	Input H limit alarm indication	-	Monitoring Parameter	-
		LIND	Input L limit alarm indication	-	Monitoring Parameter	-
		LLIND	Input LL limit alarm indication	-	Monitoring Parameter	-
		LLLIND	Input LLL alarm indication	-	Monitoring Parameter	-

Table 5.38 Extended indicator functional block description (continued)

Name			Name	Up-load	Properties	Application Reference
		RININD	Indicator for General velocity alarm	-	Monitoring Parameter	Related PVP
		DEVIND	Indicator for General error alarm	-	Monitoring Parameter	-
	OOS Settings	SWOOS	Function block Enable/Disable (ON = Disable)	TRUE	Operation Parameter	-
	Other Param Indication	PVP	Rate alarm initial value	-	Monitoring Parameter	Related RININD
		TS	Rate sampling cycle display (s)	-	Monitoring Parameter	-
		TC	Velocity check period value (s)	-	Monitoring Parameter	-
		DEI	The difference of border upon sampling cycle (indication)	-	Monitoring Parameter	-
		DDEI	Change rate in last sampling cycle (indication)	-	Monitoring Parameter	-
		DDEI_LT	Velocity of input value at the sampling period before last(just for indicator)	-	Monitoring Parameter	-
	Error Indication	EI	Error	-	Monitoring Parameter	EI=PV-SV
	Alarm Enable and Suppress	AOF	Suppress Module Alarm AOF=ON,	TRUE	Operation Parameter	-

Table 5.38 Extended indicator functional block description (continued)

Name			Name	Up-load	Properties	Application Reference
			not display real-time alarm-AOF=OFF, display real-time alarm			
		ENALM	Alarm enable	TRUE	Operation Parameter	-
		FLAG	Flag	-	Output Pin	Refer to "Flag"
	SV	SV	Bias alarm SV	TRUE	Operation Parameter	-
	Low Cut	SWLCUT	Low cut switch	TRUE	Operation Parameter	-
		LCUT	Low cut value (%)	TRUE	Operation Parameter	-
	Modified Co-efficient Settings	GAIN	Gain	TRUE	Operation Parameter	-
		BIAS	Bias value	TRUE	Operation Parameter	-
	Time Settings	TFLT	Filter time (s)	TRUE	Operation Parameter	-
		TLAG	H/L alarm delay time (s)	TRUE	Operation Parameter	For example, set as 1s, it will not alarm immediately when exceeding limits, but alarm after 1s.
		M ^{Note11}	Sampling cycle multiple(sampling period TS=M*run cycle)	TRUE	Operation Parameter	Range: [1,65535] When the values of M and N are unreasonable, alarm will occur.
		N ^{Note11}	Rate observation period multiple(observation period TC=N*TS)	TRUE	Operation Parameter	Range: [1,31] When the values of M and N are unreasonable, alarm will occur.
	SV Limits ^{Note7}	SVH	SV maximum	TRUE	Operation Parameter	Value Range[INSCH,INSC-L]

Table 5.38 Extended indicator functional block description (continued)

Name			Name	Up-load	Properties	Application Reference
		SVL	SV minimum	TRUE	Operation Parameter	Value Range[INSCH,INSC-L]
	Alarm Limits-Note4	INHHH	Input the HHH limit alarm value	TRUE	Operation Parameter	-
		INH	Input the HH limit alarm value	TRUE	Operation Parameter	-
		INH	Input the H limit alarm value	TRUE	Operation Parameter	-
		INL	Input the L limit alarm value	TRUE	Operation Parameter	-
		INLL	Input the LL limit alarm value	TRUE	Operation Parameter	-
		INLLL	Input the LLL alarm value	TRUE	Operation Parameter	-
		INHYS	H/L limit alarm Hysteresis (≥ 0.0)	TRUE	Operation Parameter	-
		RHYS	Rate alarm Hysteresis (≥ 0.0)	TRUE	Operation Parameter	-
		PRIN	Positive rate alarm value(no less than 0.0)	TRUE	Operation Parameter	-
		NRIN	Negative rate alarm value(no less than 0.0)	TRUE	Operation Parameter	-
		PDEV	Positive error alarm value(no less than 0.0)	TRUE	Operation Parameter	-

Table 5.38 Extended indicator functional block description (continued)

Name			Name	Up-load	Properties	Application Reference
		NDEV	Negative error alarm value(no less than 0.0)	TRUE	Operation Parameter	-
	Inflexion Alarm Reset Settings	RSTFLEX	Turning Point Alarm Reset	TRUE	Operation Parameter	-

Note1:Low Cut

Execute the low cutting for the input IN in the range from INSCL to INSCH. When the mode is started (SWLCUT= ON) and the percentage of input IN in the range from INSCL to INSCH is less than LCUT, change signal to the low limitl.

Note2: Filter

The signal after the low cutting can be filter calculated to the OUT. The filter mode is a first-order filter.

Note3: linear conversion

The functional block can execute linear conversion calculation to the OUT, $PV = GAIN \cdot OUT + BIAS$; the GAIN means the gain value, and the BIAS means the bias value.

Note4: High and low limit alarm

- Judge the high and low alarm for the PV value which is linear converted.
- Only when PV exceeds alarm limit and maintains for TLAG, the alarm will be generated.
- The alarm has the function of alarm hysteresis. The alarm will be eliminated after the PV value out the alarm hysteresis range.

Note5: Output holding

When the input signal quality INERR= ON, the output PV will hold the value in last period. The signal quality information is comprised in the multicast flag.

Note6: Rate alarm

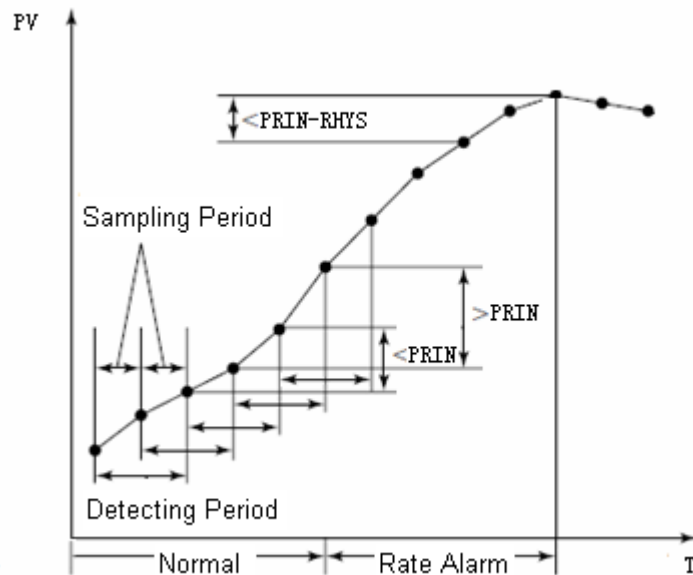


Figure 5.22 Rate alarm

- Data sampling period $TS = \text{sampling period} \times M \times \text{program running period}$;
- Rate detecting period $TC = \text{detecting period} \times N \times \text{data sampling period } TS$;
- When the differential value which the current value minors the original value of the rate detecting period is greater than and equal to $PRIN$, then the positive rate alarm will be generated, and the positive rate alarm will be eliminated when the differential value is less than $PRIN - RHYS$.
- When the differential value which the original value minors the current value of the rate detecting period is greater than and equal to $NRIN$, then the negative rate alarm will be generated, and the negative rate alarm will be eliminated when the differential value is less than $NRIN - RHYS$.

Note7: Setting value alarm

- When the input SV is over SVH , then SV will be limited within the SVH , and the high limit alarm of the setting value will be generated.
- When the input SV is under SVH , then SV will be limited within the SVL , and the low limit alarm of the setting value will be generated.

Note8: EI alarm

- When PV is greater than SV , and the error absolute value is greater than and equal to positive error alarm value $PDEV$, the positive deviation alarm indication will be generated.
- When PV is less than SV , and the error absolute value is greater than and equal to negative error alarm value $NDEV$, the negative deviation alarm indication will be generated.

Note9: Turning point alarm

In mathematics, an inflection point refers to the point where a curve changes from sloping up or down to sloping down or up. If the function describing the curve has a second derivative at the inflection point, then that second derivative must be zero or undefined.

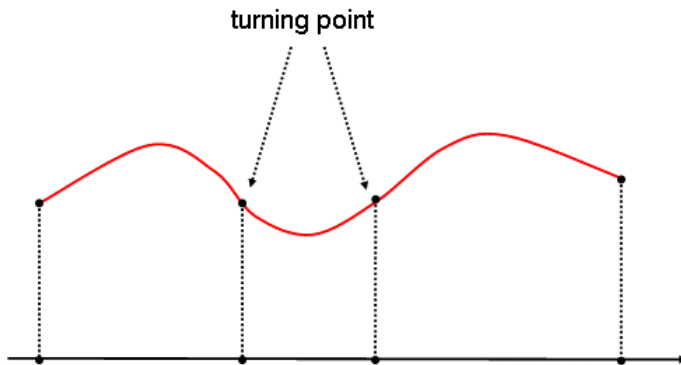


Figure 5.23 turning point

When turning point is appeared in the variation curve of PV, then the alarm will be generated.

When judging the turning point alarm, 3 sampling data values are needed, current rate value DPV, last period rate value DDEI, and before last period rate value DDEI_LT.

When $(DPV - DDEI) * (DDEI - DDEI_LT) < 0.0$, the turning point alarm will be generated.

The turning point alarm detecting is related to the signal quality. When the noise bar is large, filtering will be needed. When the signal period changes slowly, the sampling period multiple TP can be adjusted.

Note10: General alarm

- Alarm output indication: general alarm output ALM, the normal output NOALM.
- When there is no alarm, ALM =OFF, NOALM=ON.
- When there is any alarm, ALM=ON, NOALM=OFF.

Note11: Positive/negative rate alarm processing

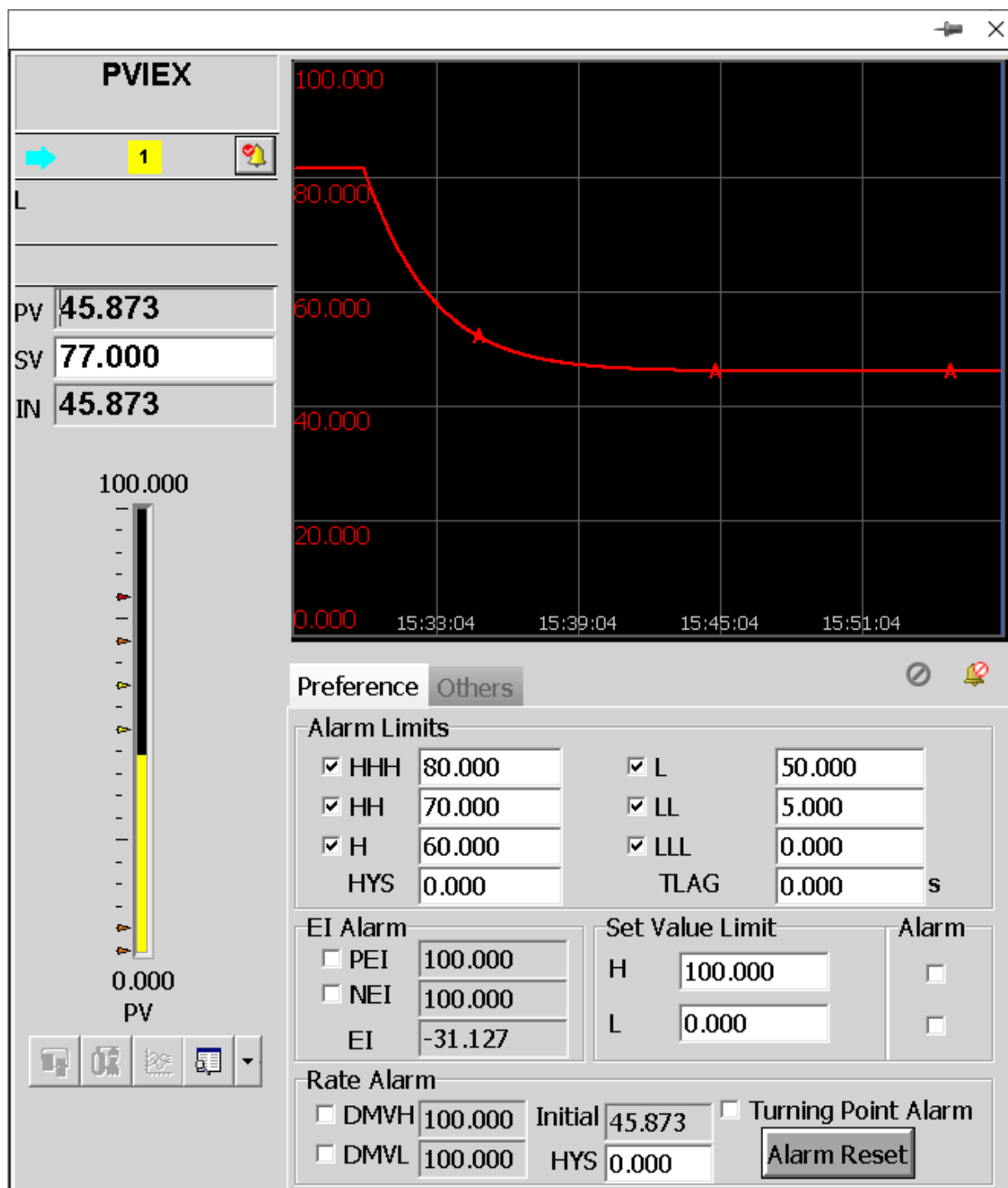
After achieving the PV values of each AI samples, PVIEX function block will calculate the variation by comparing it with the PV values got from the next period. Then compare the variation with the set positive/negative rate alarm value to get the situation of the positive/negative rate alarms.

5.29.2 Application Illustration

The float abnormal of output values means that the output values are not float format, or a meaningless output value is produced in a calculation that performs a divide-by-zero operation. When float abnormal happened, the function block is processed according to the following rules:

- The output value PV is 0.
- The 13th bit of flag is 1.

5.29.3 Panel Parameter



Preference Others

Rate Alarm

Sampling Cycle

Multiple of Rate

Detecting Cycle

Rate Sampling Cycle s

Rate Detecting Cycle s

Linear Conversion

GAIN

BIAS

Filter Process

Filter s

Low Cut

☐ SWLCUT %

Table 5.39 Function Block Panel Parameter

Panel Parameter Name			Function Block Parameter Name	Initial Value	Value Range	Application Instruction
Preference	Alarm Limit Settings(%)	HHH	INH HH	100.0000	[INSCH,INS-CL]	Input the HHH limit alarm value (the option selected alarm, otherwise invalid)
		HH	INH H	95.0000	[INSCH,INS-CL]	Input the HH limit alarm value (the option selected alarm, otherwise invalid)
		H	INH	90.0000	[INSCH,INS-CL]	Input the H limit alarm value (the option selected alarm, otherwise invalid)
		HYS	INHYS	0.0000	≥0	H/L limit alarm Hysteresis
		L	INL	10.0000	[INSCH,INS-CL]	Input the L limit alarm value (the option selected alarm, otherwise invalid)
		LL	INLL	5.0000	[INSCH,INS-CL]	Input the LL limit alarm value (the option selected alarm, otherwise invalid)
		LLL	INLLL	0.0000	[INSCH,INS-CL]	Input the LLL limit alarm value (the option select-

Table 5.39 Function Block Panel Parameter (continued)

Panel Parameter Name			Function Block Parameter Name	Initial Value	Value Range	Application Instruction
						ed alarm, otherwise invalid)
		TLAG	TLAG	0.0000	-	H/L alarm delay time
	EI Limit Settings(%)	PEI	PDEV	100.0000	-	Positive error alarm value (the option selected PDEV valid, otherwise invalid)
		NEI	NDEV	100.000	-	Negative error alarm value (the option selected NDEV valid, otherwise invalid)
		EI	EI	0.0000	-	Read-only. EI=PV-SV
	Set Limit Value	H	SVH	100.0000	[INSCH,INS-CL]	SV maximum (the option selected SVH valid, otherwise invalid)
		L	SVL	0.0000	[INSCH,INS-CL]	SV minimum (the option selected SVL valid, otherwise invalid)
	Rate Alarm Set	DMVH	PRIN	100.0000	≥0	Positive rate alarm value (the option selected PRIN valid, otherwise invalid)
		DMVL	NRIN	100.0000	≥0	Negative rate alarm value (the option selected NRIN valid, otherwise invalid)
		Initial	PVP	0.0000	-	Rate alarm initial value, Read-only, can be set in the Function Block Properties window or in the program settings
		HYS	RHYS	0.0000	≥0	Rate alarm Hysteresis
		Turning Point Alarm	FLEX	OFF	-	Turning Point Alarm Indication, Check the "Turning Point Alarm" effective, and then click the "alarm reset" button to complete the setup.
		Alarm Reset	RSTFLEX	OFF	-	Turning Point Alarm Reset, Check the "Alarm Reset" effective, and then click the "alarm re-

Table 5.39 Function Block Panel Parameter (continued)

Panel Parameter Name			Function Block Parameter Name	Initial Value	Value Range	Application Instruction
						set" button to complete the setup.
Others	Rate Alarm Set	Sampling Cycle	M	20	[1,65535]	Sampling cycle multiple
		Multiple of rate detection cycle(N)	N	1	[1,31]	Rate observation period multiple
		Rate Sampling Cycle (TS)	TS	0.0000	-	Read-only, can be set in the Function Block Properties window or in the program settings
		Rate Detecting Cycle(TC)	TC	0.0000	-	Read-only, can be set in the Function Block Properties window or in the program settings
	Linear Conversion	GAIN	GAOM	1.0000	-	The gain value of linearity conversion
		BIAS	BIAS	0.0000	-	The bias value of linearity conversion
	Filter Process	Filter Time (TFLT)	TFLT	0.0000	-	-
	Low Cut	SWLCUT	SWLCUT	0.0000	-	Low cut switch (the option selected SWLCUT valid, otherwise invalid)

5.29.4 Flag

Table 5.40 Flag list

Flag	Alarm	Description
D0	OOS	Disable
D1	HHH	HHH Limit Alarm
D2	HH	HH Limit Alarm
D3	H	H Limit Alarm
D4	L	L Limit Alarm
D5	LL	LL Limit Alarm

Table 5.40 Flag list (continued)

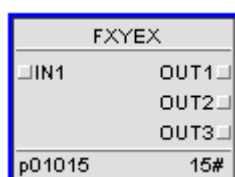
Flag	Alarm	Description
D6	LLL	LLL Limit Alarm
D7	PRIN	Positive Deviation Alarm
D8	NRIN	Negative Rate Alarm
D9	PDEV	Positive Deviation Alarm
D10	NDEV	Negative Deviation Alarm
D11	CFGERR	Configuration Error
D12	REVSCL	Span H/L Limit Reverse or output value float abnormal
D13	AOF	Suppress Alarm
D14	ERR	Fault
D15	SVH	SV H Limit Alarm
D16	SVL	SV L Limit Alarm
D17	-	General Alarm
D18	-	No General Alarm
D19	FLEX	Inflexion Alarm

5.29.5 Application Example

Refer to "Application Example", "Application Example", "Application Example" and "Application Example".

5.30 Extended Linearization Chart Functional Block (FXYEX)

This extended linearization chart function block can realize the calculation function of the linearization chart with 3-channel output. This function block is a Complicated function block, the running time is 25μs.



5.30.1 Parameter Description

Table 5.41 Extended linearization chart function block parameter description

Name			Description	Upload	Properties	Application Reference
Basic Parameters	X Axis Settings- Note 1	X1	X axis input coordinate 1	TRUE	Operation Parameter	-
		X2	X axis input coordinate 2	TRUE	Operation Parameter	-
		X3	X axis input coordinate 3	TRUE	Operation Parameter	-
		X4	X axis input coordinate 4	TRUE	Operation Parameter	-
		X5	X axis input coordinate 5	TRUE	Operation Parameter	-
		X6	X axis input coordinate 6	TRUE	Operation Parameter	-
		X7	X axis input coordinate 7	TRUE	Operation Parameter	-
		X8	X axis input coordinate 8	TRUE	Operation Parameter	-
		X9	X axis input coordinate 9	TRUE	Operation Parameter	-
		X10	X axis input coordinate 10	TRUE	Operation Parameter	-
		X11	X axis input coordinate 11	TRUE	Operation Parameter	-
		X12	X axis input coordinate 12	TRUE	Operation Parameter	-
		X13	X axis input coordinate 13	TRUE	Operation Parameter	-
		X14	X axis input coordinate 14	TRUE	Operation Parameter	-
		X15	X axis input coordinate 15	TRUE	Operation Parameter	-
		X16	X axis input coordinate 16	TRUE	Operation Parameter	-
		X17	X axis input coordinate 17	TRUE	Operation Parameter	-
		X18	X axis input coordinate 18	TRUE	Operation Parameter	-
		X19	X axis input coordinate 19	TRUE	Operation Parameter	-

Table 5.41 Extended linearization chart function block parameter description (continued)

Name			Description	Upload	Properties	Application Reference
		X20	X axis input coordinate 20	TRUE	Operation Parameter	-
		X21	X axis input coordinate 21	TRUE	Operation Parameter	-
	Y Axis A Settings	YA1	Y axis A input coordinate 1	TRUE	Operation Parameter	-
		YA2	Y axis A input coordinate 2	TRUE	Operation Parameter	-
		YA3	Y axis A input coordinate 3	TRUE	Operation Parameter	-
		YA4	Y axis A input coordinate 4	TRUE	Operation Parameter	-
		YA5	Y axis A input coordinate 5	TRUE	Operation Parameter	-
		YA6	Y axis A input coordinate 6	TRUE	Operation Parameter	-
		YA7	Y axis A input coordinate 7	TRUE	Operation Parameter	-
		YA8	Y axis A input coordinate 8	TRUE	Operation Parameter	-
		YA9	Y axis A input coordinate 9	TRUE	Operation Parameter	-
		YA10	Y axis A input coordinate 10	TRUE	Operation Parameter	-
		YA11	Y axis A input coordinate 11	TRUE	Operation Parameter	-
		YA12	Y axis A input coordinate 12	TRUE	Operation Parameter	-
		YA13	Y axis A input coordinate 13	TRUE	Operation Parameter	-
		YA14	Y axis A input coordinate 14	TRUE	Operation Parameter	-
		YA15	Y axis A input coordinate 15	TRUE	Operation Parameter	-
		YA16	Y axis A input coordinate 16	TRUE	Operation Parameter	-
		YA17	Y axis A input coordinate 17	TRUE	Operation Parameter	-

Table 5.41 Extended linearization chart function block parameter description (continued)

Name			Description	Upload	Properties	Application Reference
		YA18	Y axis A input co-ordinate 18	TRUE	Operation Parameter	-
		YA19	Y axis A input co-ordinate 19	TRUE	Operation Parameter	-
		YA20	Y axis A input co-ordinate 20	TRUE	Operation Parameter	-
		YA21	Y axis A input co-ordinate 21	TRUE	Operation Parameter	-
	Y Axis B Settings	YB1	Y axis B input co-ordinate 1	TRUE	Operation Parameter	-
		YB2	Y axis B input co-ordinate 2	TRUE	Operation Parameter	-
		YB3	Y axis B input co-ordinate 3	TRUE	Operation Parameter	-
		YB4	Y axis B input co-ordinate 4	TRUE	Operation Parameter	-
		YB5	Y axis B input co-ordinate 5	TRUE	Operation Parameter	-
		YB6	Y axis B input co-ordinate 6	TRUE	Operation Parameter	-
		YB7	Y axis B input co-ordinate 7	TRUE	Operation Parameter	-
		YB8	Y axis B input co-ordinate 8	TRUE	Operation Parameter	-
		YB9	Y axis B input co-ordinate 9	TRUE	Operation Parameter	-
		YB10	Y axis B input co-ordinate 10	TRUE	Operation Parameter	-
		YB11	Y axis B input co-ordinate 11	TRUE	Operation Parameter	-
		YB12	Y axis B input co-ordinate 12	TRUE	Operation Parameter	-
		YB13	Y axis B input co-ordinate 13.	TRUE	Operation Parameter	-
		YB14	Y axis B input co-ordinate 14	TRUE	Operation Parameter	-
		YB15	Y axis B input co-ordinate 15	TRUE	Operation Parameter	-

Table 5.41 Extended linearization chart function block parameter description (continued)

Name			Description	Upload	Properties	Application Reference
		YB16	Y axis B input co-ordinate 16	TRUE	Operation Parameter	-
		YB17	Y axis B input co-ordinate 17	TRUE	Operation Parameter	-
		YB18	Y axis B input co-ordinate 18	TRUE	Operation Parameter	-
		YB19	Y axis B input co-ordinate 19	TRUE	Operation Parameter	-
		YB20	Y axis B input co-ordinate 20	TRUE	Operation Parameter	-
		YB21	Y axis B input co-ordinate 21	TRUE	Operation Parameter	-
	Y Axis C Settings	YC1	Y axis C input co-ordinate 1	TRUE	Operation Parameter	-
		YC2	Y axis C input co-ordinate 2	TRUE	Operation Parameter	-
		YC3	Y axis C input co-ordinate 3	TRUE	Operation Parameter	-
		YC4	Y axis C input co-ordinate 4	TRUE	Operation Parameter	-
		YC5	Y axis C input co-ordinate 5	TRUE	Operation Parameter	-
		YC6	Y axis C input co-ordinate 6	TRUE	Operation Parameter	-
		YC7	Y axis C input co-ordinate 7	TRUE	Operation Parameter	-
		YC8	Y axis C input co-ordinate 8	TRUE	Operation Parameter	-
		YC9	Y axis C input co-ordinate 9	TRUE	Operation Parameter	-
		YC10	Y axis C input co-ordinate 10	TRUE	Operation Parameter	-
		YC11	Y axis C input co-ordinate 11	TRUE	Operation Parameter	-
		YC12	Y axis C input co-ordinate 12	TRUE	Operation Parameter	-
		YC13	Y axis C input co-ordinate 13	TRUE	Operation Parameter	-

Table 5.41 Extended linearization chart function block parameter description (continued)

Name		Description	Upload	Properties	Application Reference	
		YC14	Y axis C input co-ordinate 14	TRUE	Operation Parameter	-
		YC15	Y axis C input co-ordinate 15	TRUE	Operation Parameter	-
		YC16	Y axis C input co-ordinate 16	TRUE	Operation Parameter	-
		YC17	Y axis C input co-ordinate 17	TRUE	Operation Parameter	-
		YC18	Y axis C input co-ordinate 18	TRUE	Operation Parameter	-
		YC19	Y axis C input co-ordinate 19	TRUE	Operation Parameter	-
		YC20	Y axis C input co-ordinate 20	TRUE	Operation Parameter	-
		YC21	Y axis C input co-ordinate 21	TRUE	Operation Parameter	-
	Seguse settings	SEGUSE	Used Segment [1,20]	TRUE	Operation Parameter	-
	Range Settings	INSCH1	Input 1 maximum	-	Configuration Parameter	-
		INS-CL1	Input 1 minimum	-	Configuration Parameter	-
		OUT-SCH1	Output 1 maximum	-	Configuration Parameter	-
		OUT-S-CL1	Output 1 minimum	-	Configuration Parameter	-
		OUT-SCH2	Output 2 maximum	-	Configuration Parameter	-
		OUT-S-CL2	Output 2 minimum	-	Configuration Parameter	-
		OUT-SCH3	Output 3 maximum	-	Configuration Parameter	-

Table 5.41 Extended linearization chart function block parameter description (continued)

Name		Description	Upload	Properties	Application Reference
	OUT-S-CL3	Output 3 minimum	-	Configuration Parameter	-
	SVSCH1	Input PV and SV maximum	-	Configuration Parameter	-
	SVS-CL	Input PV and SV minimum	-	Configuration Parameter	-
	MVSCH1	Output MV maximum	-	Configuration Parameter	-
	MVS-CL	Output MV minimum	-	Configuration Parameter	-
	INEU1	Input 1 engineering unit	-	Configuration Parameter	-
	OUTEU1	output 1 engineering unit	-	Configuration Parameter	-
	OUTEU2	output 2 engineering unit	-	Configuration Parameter	-
	OUTEU3	output 3 engineering unit	-	Configuration Parameter	-
	SVEU	SV and PV engineering unit	-	Configuration Parameter	-
	MVEU	MV engineering unit	-	Configuration Parameter	-
	INDLEN1	Input 1 engineering unit	-	Configuration Parameter	Used for Data Displayed on Function Block Panel (Equal to 3 as Default)
	OUTDLEN1	Output 1 decimal digits [0,5]	-	Configuration Parameter	Used for Data Displayed on Function Block Panel (Equal to 3 as Default)
	OUTDLEN2	Output 2 decimal digits [0,5]	-	Configuration Parameter	Used for Data Displayed on Function Block Panel (Equal to 3 as Default)

Table 5.41 Extended linearization chart function block parameter description (continued)

Name		Description	Upload	Properties	Application Reference
		OUT- Output 3 decimal DLEN3 digits [0,5]	-	Configura- tion Para- meter	Used for Data Displayed on Function Block Panel (Equal to 3 as Default)
		SVDLEN SV and PV deci- mal digits [0,5]	-	Configura- tion Para- meter	Used for Data Displayed on Function Block Panel (Equal to 3 as Default)
		MVDLEN MV decimal digits [0,5]	-	Configura- tion Para- meter	Used for Data Displayed on Function Block Panel (Equal to 3 as Default)
Extended Parame- ters	Output Sup- press Settings	PB- MV Shield MV	-	Configura- tion Para- meter	-
		PBOU Output 1 Shield	-	Configura- tion Para- meter	-
		PBOU Output 2 Shield	-	Configura- tion Para- meter	-
		PBOU Output 3 Shield	-	Configura- tion Para- meter	-
	Input Pin	IN1 Input variable 1	-	Input Pin	-
		MV Input variable MV	-	Input Pin	-
		PV Input variable PV	-	Input Pin	-
		SV Input variable SV	-	Input Pin	-
	Output Pin	OUT1 Output variable 1	-	Output Pin	Related MODE
		OUT2 Output variable 2	-	Output Pin	Related MODE
		OUT3 Output variable 3	-	Output Pin	Related MODE
		ERR Block alarm	-	Output Pin	-
		STA Block status	-	Output Pin	-
		FLAG Flag	-	Output Pin	Refer to "Flag"
	OOS Settings	SWOOS In OOS status (ON=forbidden)	TRUE	Operation Parameter	-
	Sup- press Alarm	AOF Suppress Module Alarm; AOF=ON not display the real-time alarm; AOF=OFF dis-	TRUE	Operation Parameter	-

Table 5.41 Extended linearization chart function block parameter description (continued)

Name			Description	Upload	Properties	Application Reference
			play the real-time alarm			
	Mode Settings	MODE	OFF=ramp mode ON=jump mode	TRUE	Operation Parameter	When the output is transited among different segments of the X axis, if MODE=ON, then the output is in the jump mode. If MODE=OFF, then the output is in the ramp mode.

Note:

- Input X coordinate value X1 to X21 must put in order from small to large, otherwise ERR alarm will be generated and STA indicate low-bit of arrange error.
- The program first judge segment number of IN which in X axes 20th coordinate, then carry out interpolating calculation. The algorithm is shown below:
- If IN is value between X[i] and X [i+1]: (The same to the OUT1, OUT2, OUT3, the Y axis coordinate value is respectively YA[i], YB[i], YC[i])

$$OUT = Y[i] + (IN - X[i]) * \frac{Y[i+1] - Y[i]}{X[i+1] - X[i]}$$

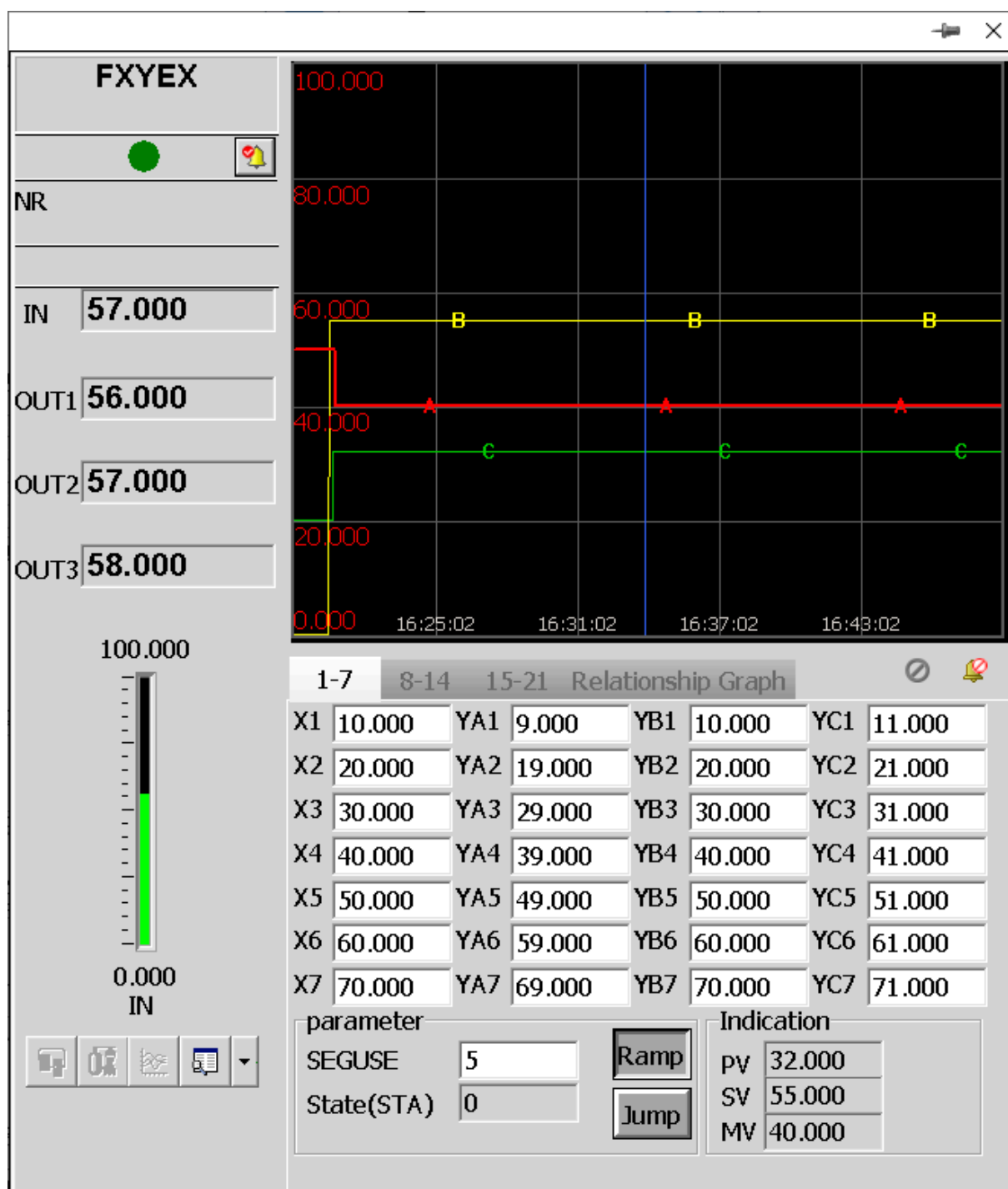
If the input $IN1 < X1$, then output $OUT1=YA1$, $OUT2=YB1$, $OUT3=YC1$;



If the input $IN1 > X21$, then output $OUT1=YA21$, $OUT2=YB21$, $OUT3=YC21$;



If $IN1=X[i]$, then $OUT1=YA[i]$, $OUT2=YB[i]$, $OUT3=YC[i]$.

- The amount of interval segment can be configured, allowed range is 1~20. Parameter illegality detecting is only used in the segment.

5.30.2 Panel Parameter



1-7	8-14	15-21	Relationship Graph						
X8	0.000	YA8	0.000	YB8	0.000	YC8	0.000		
X9	0.000	YA9	0.000	YB9	0.000	YC9	0.000		
X10	0.000	YA10	0.000	YB10	0.000	YC10	0.000		
X11	0.000	YA11	0.000	YB11	0.000	YC11	0.000		
X12	0.000	YA12	0.000	YB12	0.000	YC12	0.000		
X13	0.000	YA13	0.000	YB13	0.000	YC13	0.000		
X14	0.000	YA14	0.000	YB14	0.000	YC14	0.000		

1-7	8-14	15-21	Relationship Graph						
X15	0.000	YA15	0.000	YB15	0.000	YC15	0.000		
X16	0.000	YA16	0.000	YB16	0.000	YC16	0.000		
X17	0.000	YA17	0.000	YB17	0.000	YC17	0.000		
X18	0.000	YA18	0.000	YB18	0.000	YC18	0.000		
X19	0.000	YA19	0.000	YB19	0.000	YC19	0.000		
X20	0.000	YA20	0.000	YB20	0.000	YC20	0.000		
X21	0.000	YA21	0.000	YB21	0.000	YC21	0.000		

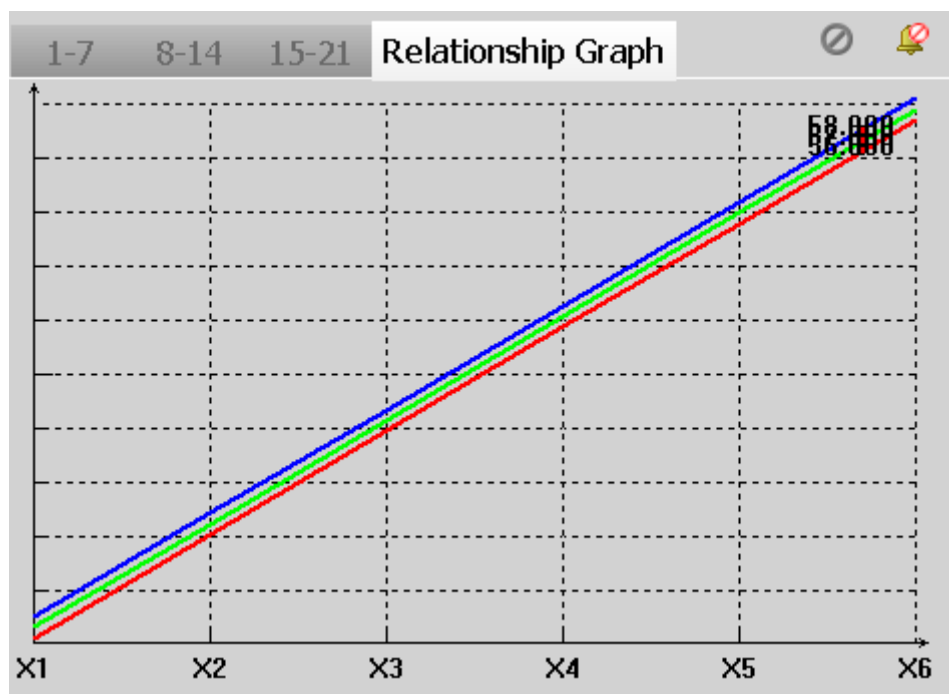


Table 5.42 Panel parameter operation instruction

Panel Parameter Name		Function Block Parameter Name	Initial Value	Value Range	Application
Coordinate 1-7	X1	X1	0.0000	-	The number of X can be set, while the valid number is determined by segment data. If the segment data is set as N, the valid X number is N+1.
	X2	X2	1.0000	-	The same as X1
	X3	X3	0.0000	-	The same as X1
	X4	X4	0.0000	-	The same as X1
	X5	X5	0.0000	-	The same as X1
	X6	X6	0.0000	-	The same as X1
	X7	X7	0.0000	-	The same as X1
	YA1	YA1	0.0000	-	The number of Y can be set, while the valid number is determined by segment data. If the segment data is set as N, the valid Y number is N+1.
	YA2	YA2	0.0000	-	The same as YA1

Table 5.42 Panel parameter operation instruction (continued)

Panel Parameter Name		Function Block Parameter Name		Initial Value	Value Range	Application	
	YA3	YA3		0.0000	-	The same as YA1	
	YA4	YA4		0.0000	-	The same as YA1	
	YA5	YA5		0.0000	-	The same as YA1	
	YA6	YA6		0.0000	-	The same as YA1	
	YA7	YA7		0.0000	-	The same as YA1	
	YB1	YB1		0.0000	-	The same as YA1	
	YB2	YB2		0.0000	-	The same as YA1	
	YB3	YB3		0.0000	-	The same as YA1	
	YB4	YB4		0.0000	-	The same as YA1	
	YB5	YB5		0.0000	-	The same as YA1	
	YB6	YB6		0.0000	-	The same as YA1	
	YB7	YB7		0.0000	-	The same as YA1	
	YC1	YC1		0.0000	-	The same as YA1	
	YC2	YC2		0.0000	-	The same as YA1	
	YC3	YC3		0.0000	-	The same as YA1	
	YC4	YC4		0.0000	-	The same as YA1	
	YC5	YC5		0.0000	-	The same as YA1	
	YC6	YC6		0.0000	-	The same as YA1	
	YC7	YC7		0.0000	-	The same as YA1	
	Parameter		Segment Data	SEGUSE	1	[1,20]	Segment data of broken line
			Status	STA	0	-	Read-only. It can be set in the function properties interface or in the program.
			Ramp	MODE	Selected	-	When it is set as MODE=OFF in the function properties interface, it is in ramp mode. And it also can be set by select “Ramp” on

Table 5.42 Panel parameter operation instruction (continued)

Panel Parameter Name	Function Block Parameter Name		Initial Value	Value Range	Application
					the function block panel.
		Jump	MODE	Not Selected	- When it is set as MODE=OFF in the function properties interface, it is in jump mode. And it also can be set by select "Jump" on the function block panel.
	Indication	PV	PV	0.0000	- Read-only. It can be set in the function properties interface or in the program.
		SV	SV	0.0000	- Read-only. It can be set in the function properties interface or in the program.
		MV	MV	0.0000	- Read-only. It can be set in the function properties interface or in the program.
Coordinate 8-14	X8	X8		0.0000	- The same as X1
	X9	X9		0.0000	- The same as X1
	X10	X10		0.0000	- The same as X1
	X11	X11		0.0000	- The same as X1
	X12	X12		0.0000	- The same as X1
	X13	X13		0.0000	- The same as X1
	X14	X14		0.0000	- The same as X1
	YA8	YA8		0.0000	- The same as YA1
	YA9	YA9		0.0000	- The same as YA1
	YA10	YA10		0.0000	- The same as YA1
	YA11	YA11		0.0000	- The same as YA1
	YA12	YA12		0.0000	- The same as YA1
	YA13	YA13		0.0000	- The same as YA1

Table 5.42 Panel parameter operation instruction (continued)

Panel Parameter Name		Function Block Parameter Name	Initial Value	Value Range	Application
	YA14	YA14	0.0000	-	The same as YA1
	YB8	YB8	0.0000	-	The same as YA1
	YB9	YB9	0.0000	-	The same as YA1
	YB10	YB10	0.0000	-	The same as YA1
	YB11	YB11	0.0000	-	The same as YA1
	YB12	YB12	0.0000	-	The same as YA1
	YB13	YB13	0.0000	-	The same as YA1
	YB14	YB14	0.0000	-	The same as YA1
	YC8	YC8	0.0000	-	The same as YA1
	YC9	YC9	0.0000	-	The same as YA1
	YC10	YC10	0.0000	-	The same as YA1
	YC11	YC11	0.0000	-	The same as YA1
	YC12	YC12	0.0000	-	The same as YA1
	YC13	YC13	0.0000	-	The same as YA1
	YC14	YC14	0.0000	-	The same as YA1
Coordinate 15-21	X15	X15	0.0000	-	The same as X1
	X16	X16	0.0000	-	The same as X1
	X17	X17	0.0000	-	The same as X1
	X18	X18	0.0000	-	The same as X1
	X19	X19	0.0000	-	The same as X1
	X20	X20	0.0000	-	The same as X1
	X21	X21	0.0000	-	The same as X1
	YA15	YA15	0.0000	-	The same as YA1
	YA16	YA16	0.0000	-	The same as YA1
	YA17	YA17	0.0000	-	The same as YA1
	YA18	YA18	0.0000	-	The same as YA1
	YA19	YA19	0.0000	-	The same as YA1

Table 5.42 Panel parameter operation instruction (continued)

Panel Parameter Name	Function Block Parameter Name	Initial Value	Value Range	Application
YA20	YA20	0.0000	-	The same as YA1
YA21	YA21	0.0000	-	The same as YA1
YB15	YB15	0.0000	-	The same as YA1
YB16	YB16	0.0000	-	The same as YA1
YB17	YB17	0.0000	-	The same as YA1
YB18	YB18	0.0000	-	The same as YA1
YB19	YB19	0.0000	-	The same as YA1
YB20	YB20	0.0000	-	The same as YA1
YB21	YB21	0.0000	-	The same as YA1
YC15	YC15	0.0000	-	The same as YA1
YC16	YC16	0.0000	-	The same as YA1
YC17	YC17	0.0000	-	The same as YA1
YC18	YC18	0.0000	-	The same as YA1
YC19	YC19	0.0000	-	The same as YA1
YC20	YC20	0.0000	-	The same as YA1
YC21	YC21	0.0000	-	The same as YA1

5.30.3 Flag

Table 5.43 Flag

Flag	Alarm	Instruction
D0	OOS	Disable
D1	CFGERR	Configuration Error
D2	AOF	Suppress Alarm

5.31 Alarm Auto Track Function Block (ALMTR)

This block is used to amend the alarm limit of AI automatically.

This function block is a simple function block, the running time is 30μs.

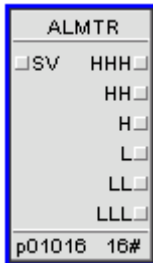


Table 5.44 alarm auto track function block parameter instruction

Name		Name	Upload	Properties	Application Reference
Input Pin	SV	Set value	-	Input Pin	-
Output Pin- Note1	HHH	HHH output value	-	Output Pin	Value Range[SCL,SCH],Related MODE, BIAS
	HH	HH output value	-	Output Pin	Value Range[SCL,SCH],Related MODE, BIAS
	H	H output value	-	Output Pin	Value Range[SCL,SCH],Related MODE, BIAS
	L	L output value	-	Output Pin	Value Range[SCL,SCH],Related MODE, BIAS
	LL	LL output value	-	Output Pin	Value Range[SCL,SCH],Related MODE, BIAS
	LLL	LLL output value	-	Output Pin	Value Range[SCL,SCH],Related MODE, BIAS
Operation Parameter	BIAS	Alarm offset settings	TRUE	Operation Parameter	-
	MODE	Alarm offset value type(OFF=actual value, ON=percentage)	TRUE	Operation Parameter	-
Configuration Parameter	SCH	Input span maximum	-	Configuration Parameter	-
	SCL	Input span minimum	-	Configuration Parameter	-

Note: Output is shown as follows.

- MODE=OFF
 $HHH = SV + 3 * BIAS$
 $HH = SV + 2 * BIAS$
 $H = SV + BIAS$
 $L = SV - BIAS$

$$LL = SV - 2 * BIAS$$

$$LLL = SV - 3 * BIAS$$

- MODE=ON

$$HHH = SV + 3 * BIAS / 100.0 * (SCH - SCL)$$

$$HH = SV + 2 * BIAS / 100.0 * (SCH - SCL)$$

$$H = SV + BIAS / 100.0 * (SCH - SCL)$$

$$L = SV - BIAS / 100.0 * (SCH - SCL)$$

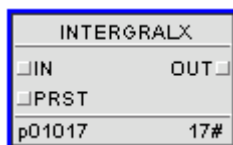
$$LL = SV - 2 * BIAS / 100.0 * (SCH - SCL)$$

$$LLL = SV - 3 * BIAS / 100.0 * (SCH - SCL)$$

5.32 Extended Integral Function Block (INTERGRALX)

The extended integral function block can make integral action to the input, and used in accumulation calculation.

This function block is a Complicated function block, the running time is 30μs.



5.32.1 Parameter Description

Table 5.45 Extended integral function block parameter description

Name			Description	Upload	Properties	Application Reference
Basic Parameters	Equivalent Coefficient Settings-Notes	KFCT	Equivalent coefficient	TRUE	Operation Parameter	-
		TFCT	Time coefficient	TRUE	Operation Parameter	-
	Calculation Finish Value Settings	FOUT	Calculation finish value	TRUE	Operation Parameter	Output limit value
	Range Settings	INSCH	Input maximum	-	Configuration Parameter	-
		INSCL	Input span minimum	-	Configuration Parameter	-
		INEU	Input unit	-	Configuration Parameter	-
		OUT-SCH	Output maximum	-	Configuration Parameter	-

Table 5.45 Extended integral function block parameter description (continued)

Name			Description	Upload	Properties	Application Reference
		OUTSCL	Output minimum	-	Configuration Parameter	-
		OUTEU	Output unit	-	Configuration Parameter	-
		INDLEN	IN decimal digits[0,5]	-	Configuration Parameter	Used for Data Displayed on Function Block Panel (Equal to 3 as Default)
		OUT-DLEN	OUT decimal digits[0,5]	-	Configuration Parameter	Used for Data Displayed on Function Block Panel (Equal to 3 as Default)
Extended Parameters	Input Pin	IN	Input value	-	Input Pin	Value Range[IN-CL,INSCH], Connect to AI and function block
		INERR	Input signal qualityON: ERR alarm	-	Input Pin	When accumulation is enabled <ul style="list-style-type: none"> INERR=ON, accumulate based on 0; INERR=OFF, normal accumulation
		PRST	Program reset input	-	Input Pin	-
		PHOLD	Keep input of program	-	Input Pin	-
		PSTART	Startup input of program	-	Input Pin	-
	Output Pin	OUT-Note1	Output value	-	Output Pin	Value Range[OUTSCL,OUTSCH]If there's a float abnormal happened to the OUT value, the OUT will be set as the value of previous period.Please refer to "Application Illustration" for details.
		ERR	Block alarm	-	Output Pin	-
	OOS Settings	SWOOS	Function block forbidden (ON=forbidden)	TRUE	Operation Parameter	-

Table 5.45 Extended integral function block parameter description (continued)

Name			Description	Upload	Properties	Application Reference
	Run Control ^{Note4}	SWAM	Manual and auto of function block(ON=auto)	-	Operation Parameter	-
		HOLD	Hold enable/disable (ON=hold)	-	Operation Parameter	-
		START	Startup On/Off (ON=startup)	-	Operation Parameter	-
		RST	Reset Enable/Disable (ON=reset)	-	Operation Parameter	-
	Run Status Monitor	RUN	Module Run Status: ON=Run ,OFF=Keep, Read-only	-	Monitoring Parameter	-
		MODE	Function block mode	-	Monitoring Parameter	Connect to digital, Related MODE_OPT
		FINISH- ^{Note3}	Calculation finish	-	Monitoring Parameter	-
		FINISH1	Calculation finish of pre-set alarm 1	-	Monitoring Parameter	-
		FINISH2	Calculation finish of pre-set alarm 2	-	Monitoring Parameter	-
		FINISH3	Calculation finish of pre-set alarm 3	-	Monitoring Parameter	-
		TFINISH	Calculation finish count	TRUE	Monitoring Parameter	-
		POUT	Previous reset accumulation value	TRUE	Monitoring Parameter	-
		ROUT	Calculation value after reset	TRUE	Monitoring Parameter	-
	Alarm Enabled and Suppress	AOF	Suppress Module Alarm	TRUE	Operation Parameter	-

Table 5.45 Extended integral function block parameter description (continued)

Name			Description	Upload	Properties	Application Reference
		FLAG	Flag	-	Output Pin	Refer to "Flag"
		ENALM	Alarm enabled	TRUE	Operation Parameter	-
	Calculation pre-Error Setting	OUT-DEV1	Calculation finish of pre-set alarm error 1	TRUE	Operation Parameter	-
		OUT-DEV2	Calculation finish of pre-set alarm error 2	TRUE	Operation Parameter	-
		OUT-DEV3	Calculation finish of pre-set alarm error 3	TRUE	Operation Parameter	-
	Input Alarm Settings	INHH	Input HH limit alarm value	TRUE	Operation Parameter	-
		INH	Input H limit alarm value	TRUE	Operation Parameter	-
		INL	Input L limit alarm value	TRUE	Operation Parameter	-
		INLL	Input LL limit alarm value	TRUE	Operation Parameter	-
		INHYS	Alarm hysteresis value(No less than 0.0)	TRUE	Operation Parameter	-
	Mode Settings	MODE_-OPT	Mode selection: 0=limit value,1=auto reset ,2=accumulation incessdantly, [0, 2]	TRUE	Operation Parameter	-
	Calculation Increase/Decrease Setting	SWID	Calculation increase/decrease switch(ON=decrease)	TRUE	Operation Parameter	-
	Low Cut Settings	SWL-CUT	Low cut switch(ON=cut)	TRUE	Operation Parameter	When SWLCUT=ON, if IN< LCUT, the current IN is not cumulated
		LCUT	Low cut value	TRUE	Operation Parameter	-

Table 5.45 Extended integral function block parameter description (continued)

Name			Description	Upload	Properties	Application Reference
	Cold Start Reset Settings	RST_CLD	Reset calculation value while cool startup switch(ON=reset)	-	Configuration Parameter	When cool startup, if RST_CLD =ON, then OUT=ROUT; if RST_CLD=OFF, then the accumulation value will hold still

Note 1. Basic algorithm

The algorithm of extended integral function block is shown below:

$$OUTPUT = \int_{t_0}^{t_x} \pm INPUT * \frac{1}{TIME\ COEFFICIENT} * \frac{1}{EQUIVALENT\ COEFFICIENT} dt + CUMULATION\ INITIAL(t_0)$$

- When SWID=OFF, the positive integral is applied:

$$OUTPUT = \int_{t_0}^{t_x} INPUT * \frac{1}{TIME\ COEFFICIENT} * \frac{1}{EQUIVALENT\ COEFFICIENT} dt + CUMULATION\ INITIAL(t_0)$$

- When SWID= ON, negative integral is applied:

$$OUTPUT = \int_{t_0}^{t_x} -INPUT * \frac{1}{TIME\ COEFFICIENT} * \frac{1}{EQUIVALENT\ COEFFICIENT} dt + CUMULATION\ INITIAL(t_0)$$

Note 2. Integral mode

- User can choose whether to execute integral limit function or not. When MODE =0 (Select MODE_OPT=0), it is in the integral limit status. The output value will be restricted in the cumulation finish value (FOUT) when it reaches .FOUT
- When MODE=1 (Select MODE_OPT=1), it is in automatically reset status. The output value will reset automatically and cumulate from the calculation value after reset (ROUT) when it reaches FOUT, TFINISH automatically plus 1 for every cumulation.
- When MODE=2 (Select MODE_OPT=2), it is in the cumulation incessdantly status, cumulation output will continue until it is reset to cumulation value manually when output value reaches FOUT.

Note 3. Calculation finish mode

- For the positive integral mode (SWID=OFF)
 - When $OUT \geq FOUT$, then FINISH=ON.
 - When $OUT \geq FOUT-OUTDEV1$, then FINISH1=ON.
 - When $OUT \geq FOUT-OUTDEV2$, then FINISH2=ON.
 - When $OUT \geq FOUT-OUTDEV3$, then FINISH3=ON.

- For the negative integral mode (SWID=ON)
 - When $OUT \leq FOUT$, then FINISH =ON.
 - When $OUT \leq FOUT + OUTDEV1$, then FINISH 1=ON.
 - When $OUT \leq FOUT + OUTDEV2$, then FINISH 2=ON.
 - When $OUT \leq FOUT + OUTDEV3$, then FINISH 3 =ON.

Note 4. Hold and reset

- When HOLD =ON or PHOLD makes a positive transmission, then RUN =OFF, and the current integral function block is in the holding mode and set HOLD =OFF after holding for a period, at same time preparing for next command.
- When START =ON or PSTART makes a positive transmission, then RUN =ON, and the current integral function block is in the running mode and set START =OFF after holding for a period, at same time preparing for next command..
- When the function block is in the holding status (RUN=OFF), the output value maintain current value still.
- When RST=ON or PRST makes a positive transmission, then POUT=OUT, OUT=ROUT, that means to reset accumulation value and store the one before resetting to POUT, and set RST=OFF after holding for a period at same time preparing for next command.

Note 5. Equivalent coefficient (KFCT) and Time coefficient (TFCT)

It is used in span converting. For example, input IN is the flow, measure how many tons of the accumulated diesel oil. The density of the diesel oil is 0.86kg/L and the input unit is L/h. After accumulation, the unit of the accumulation value is t. The parameter needs to be set to $KFCT = 1/0.86 \times 1000 = 1162.79$, $TFCT = 3600$.

Note 6: Output of FINISH has no relationship to alarm enable

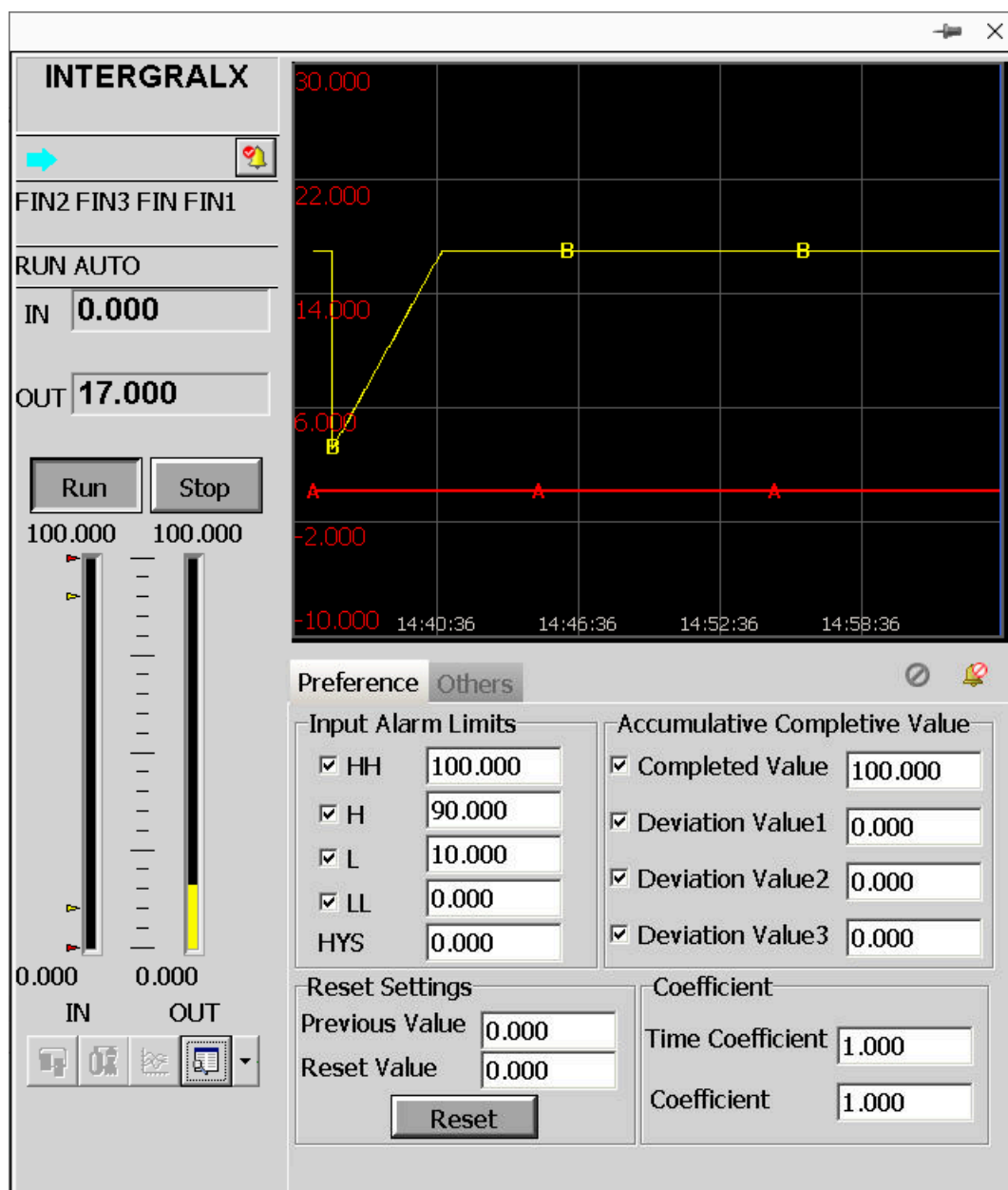
The monitoring parameter FINISH, FINISH1, FINISH2 and FINISH3 has no relationship to alarm enable configuration. If the alarm is disable and the output met the condition, the fore parameter will be ON.

5.32.2 Application Illustration

The float abnormal of output values means that the output values are not float format, or a meaningless output value is produced in a calculation that performs a divide-by-zero operation. When float abnormal happened, the function block is processed according to the following rules:

- Output values The output value OUT is equal to previous period value.
- ERR: the alarm value turns ON.

5.32.3 Panel Parameter



The screenshot shows a software window titled 'Preference' with a sub-tab 'Others'. It is divided into two main panels. The left panel has two sub-sections: 'Low Signal Excise Settings' which includes a checkbox for 'Cut Value' and a text input field set to '0.000'; and 'Mode Set' which contains two buttons labeled 'Manual' and 'Auto'. The right panel also has two sub-sections: 'Mode' which includes checkboxes for 'Limit' (checked), 'Auto Reset', and 'Always Cumulate'; and 'Accumulative Direction' which includes checkboxes for 'Inc' (checked) and 'Dec'.

Table 5.46 Function Block Panel Parameter

Panel Parameter Name			Function Block Parameter Name	Initial Value	Value Range	Application Instruction
Preference	Alarm Limit Settings(%)	HH	INHH	100.0000	[INS-CL,INSCH]	Input HH limit alarm value (the option selected alarm, otherwise invalid)
		H	INH	90.0000	[INS-CL,INSCH]	Input H limit alarm value(the option selected alarm, otherwise invalid)
		L	INL	10.0000	[INS-CL,INSCH]	Input L limit alarm value (the option selected alarm, otherwise invalid)
		LL	INLL	0.0000	[INS-CL,INSCH]	Input LL limit alarm value (the option selected alarm, otherwise invalid)
		HYS	INHYS	0.0000	-	Alarm hysteresis value
	Accumulative Compleitive Value	Com-ple-tive	FOUT	100.0000	-	-
		Error Value 1	OUTDEV1	0.0000	-	Read-only, can be set in the Function Block Properties window or in the program settings
		Error Value 2	OUTDEV2	0.0000	-	Read-only, can be set in the Function Block Properties window or in the program settings
		Error Value 3	OUTDEV3	0.0000	-	Read-only, can be set in the Function Block Properties window or in the program settings

Table 5.46 Function Block Panel Parameter (continued)

Panel Parameter Name			Function Block Parameter Name	Initial Value	Value Range	Application Instruction
	Reset Setting(%)	Previous	POUT	0.0000	-	-
		Rest	ROUT	0.0000	-	-
	Coefficient	Time	TFCT	1.0000	-	-
		Coef-ficient	KFCT	1.0000	-	-
Others	Low Signal Ex-cise Set-tings(%)	Cut Value	LCUT	0.0000	-	-
	Mode Set	Man-u-al,Au-to	SWAM	Auto	-	Manual and auto of function block, Optional manual or auto-matic control, click the appropriate button to set
	Mode	Limit	MODE_OPT	OFF	-	Integral mode selection, the check is to select the integration mode for limiting
		Auto	MODE_OPT	OFF	-	Integral mode selection, the check is to select the integration mode for auto reset
		Al-ways Cum-late	MODE_OPT	ON	-	Integral mode selection, the check is to select the integration mode for accumulation incessantly
	Accumu-lative Di-rection	Inc	SWID	ON	-	Calculation increase/decrease, the check is to select the in-crease integration
		Dec	SWID	OFF	-	Calculation increase/decrease, the check is to select the de-crease integration

5.32.4 Flag

Table 5.47 Flag list

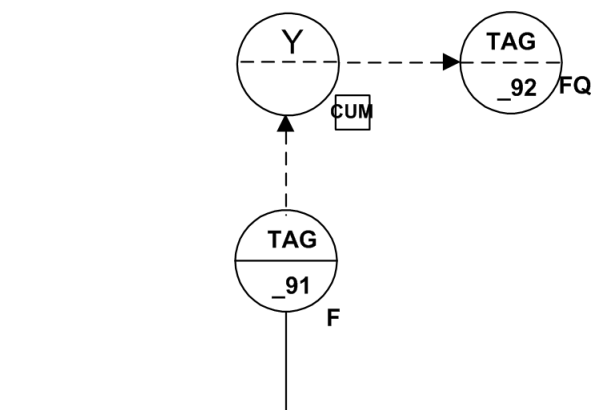
Flag	Alarm	Description
D0	OOS	Disable
D2	RESET	Reset
D3	FIN	Finish

Table 5.47 Flag list (continued)

Flag	Alarm	Description
D4	ERR	Fault
D5	INHH	Input HH Limit Alarm
D6	INH	Input H Limit Alarm
D7	INL	Input L Limit Alarm
D8	INLL	Input LL Limit Alarm
D12	REVSCL	Span H/L Limit Reverse or output value float abnormal
D13	CFGERR	Configuration Error
D14	AOF	Suppress Alarm
D15	MAN	Manual
D16	AUTO	Auto
D17	RUN	Running
D18	HOLD	Hold
D19	FIN1	Finish Pre-alarm 1
D20	FIN2	Finish Pre-alarm 2
D21	FIN3	Finish Pre-alarm 3

5.32.5 Application Example

The flow accumulation is used to check the instant flow of some fluid and gas in pipe and to count the sum of a period of time. The flow signal FT_2103 (range: 0~7000, unit: kg/h) need to be accumulated, and the unit of accumulated value is t.

**Figure 5.24 Diagram of flow accumulation**

Its programming is shown below and can be achieved via INTERGRALX, which can perform integral and accumulation calculation for input and functions such as hold, reset, small signal cutting, input alarm function and cold-boot reset for accumulated value.

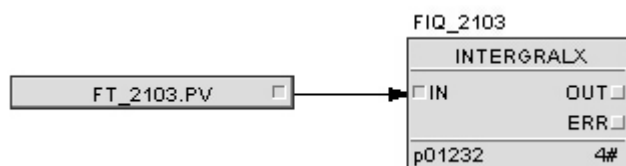


Figure 5.25 Programming of INTERGRALX

The function block instruction and examples are shown below.

NO.	Example	Type	Instruction
001	FT_2103	AI (Input)	Tag of AI
002	FIQ_2103	Tag of Function Block	Name of Flow Accumulation Tag

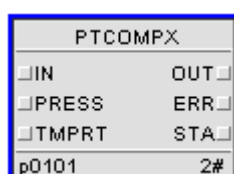
Parameter settings of INTERGRALX:

- INSCH: keep the same with input tag.
- INSCL: keep the same with input tag.
- INEU: the range conforms to the technical requirements and cannot be set as infinity.
- OUTEU: the range conforms to the technical requirements and cannot be set as infinity.
- MODE_OPT: 2
- KFCT: 1000
- TFCT: 3600
- The two levels H/L limit alarms of IN can be set for INTERGRALX
- Other alarm functions are set as disabled.

5.33 Extended Ideal Gas Compensation Function Block (PTCOMPX)

This function block is an ideal gas compensation function block, which can compensate approximate ideal gas in the setting mode.

This function block is a simple function block, the running time is 13μs.



5.33.1 Parameter Description

Table 5.48 Extended ideal gas compensation function block parameter description

Name		Description	Upload	Properties	Application Reference
Input Pin	IN	Calculate input value	-	Input Pin	Connect AI
	PRESS	Air pressure in working (unit: MPa)	-	Input Pin	-
	TMPRT	Temperature in working (unit: degree. C.)	-	Input Pin	-
Output Pin	OUT	Calculate output value	-	Output Pin	Related MODE
	ERR	Module alarm	-	Output Pin	Related MODE, ERR
	STA	Alarm status	-	Output Pin	-
Configuration Parameter	MODE	Work mode selection [0,2]	-	Configuration Parameter	-
Operation Parameter	PRESS0	Compensation Pressure(unit: MPa)	TRUE	Operation Parameter	-
	TMPRT0	Compensation temperature	TRUE	Operation Parameter	-

Note .

This function block follows the below ideal gas balance equation:

$$\frac{P_1 V_1}{T_1} = \frac{P_0 V_0}{T_0}$$

There are three modes.

- mode 1(MODE=0)

Mode 1 is applied in (Not limited to) the measuring of volume flow using the volume flowmeter.

$$OUT = \frac{IN * (PRESS + 0.101325) * (TMPRT0 + 273.15)}{(TMPRT + 273.15) * (PRESS0 + 0.101325)}$$

- mode 2 (MODE =1)

Mode 2 is applied in (Not limited to) the measuring of volume flow using the differential pressure flowmeter. Volume flow is transferred to the value in the setting condition. Mode 2 is applied when the signal is the flow signal.

$$OUT = IN * \sqrt{\frac{(PRESS + 0.101325) * (TMPRT0 + 273.15)}{(TMPRT + 273.15) * (PRESS0 + 0.101325)}}$$

- mode 3(MODE =2)

Mode 3 is applied in (Not limited to) the measuring of volume flow using the differential pressure flowmeter. Volume flow is transferred to the value in the setting condition. Mode 2 is applied when the signal is the flow signal.

Mode 3 is applied when the sent-up signal is the differential pressure signal.

$$OUT = \sqrt{\frac{IN * (PRESS + 0.101325) * (TMPRT0 + 273.15)}{(TMPRT + 273.15) * (PRESS0 + 0.101325)}}$$

If the temperature or pressure is not in the required range or MODE>2, then ERR=ON. If temperature or pressure is not in the required range, then STA=1; if MODE>2 then STA=2; if temperature or pressure is not in the required range and MODE>2, then STA =3.

If temperature and pressure is in the required range, then MODE is in the reasonable range.

If IN is less than 0.0, then OUT =0.0, ERR = ON, and STA = 4.

5.33.2 Application Example

Use a flowmeter to measure the flow of a technical gas (steam), its designed temperature is 250°C, designed pressure is 1.05MPa (gauge pressure); its measured pressure is PT_0101: range is 0~4MPa, measured temperature is TE_0102: range is 0~500°C, flow is FT_0101: range is 0~7000Nm3/h (has been extracted the root in the transducer), the compensated flow us the customized analog value FIB0101: range is 0~7000Nm3/h. It is needed to be performed the ideal gas compensation and superheated steam flow compensation.

The density of gas changes wit the pressure and temperature. If the field devices have not provided compensation for speed or volume types of flowmeters, the temperature and pressure compensation is needed to be performed. The compensation varies with different gas mediums. Generally, there are ideal gas gas flow compensation, superheated steam and saturated steam flow compensation, special gas flow compensation. The definitions of various gas types:

- Ideal gas: refers to the gas, in any pressure and temperature, its status conforms to $P*V/T=\text{constant value}$. Generally, gas difficult to be liquefied, such as H_2 , N_2 , O_2 , are ideal gas, which requires temperature and pressure compensation. If the medium temperature is always near designed temperature (like normal temperature) and not often changed, it only requires pressure compensation.
- Superheanted steam: when the temperature of steam with current pressure is higher than the boiling temperature of liquid phase with the pressure, the steam is in superheated status and requires temperature and pressure compensation.
- Saturated steam: when the molecule number entering into space in a unit time is equal to the molecule number returning to the liquid, the evaporation and condensation are in status of dynamic balance. The evaporation and condensation is performing, while density of steam molecule in space stops increase. At that time, it is the saturated status.

- Special gas, such as air (it can be processed as ideal gas if the precision is not highly required), natural gas and ammonia, etc. Normally the measurement device factory should provide clear compensation calculation formula, such as the air volume (air) of boiler devices and natural gas flow, etc., should conform to the calculation sheet provided by the factory.

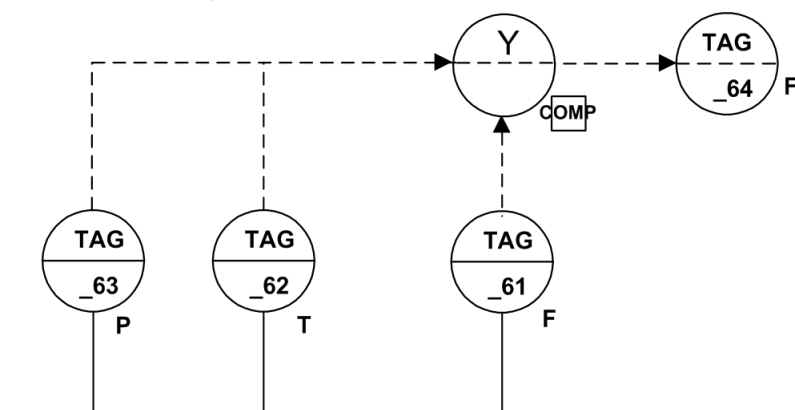


Figure 5.26 Diagram of gas compensation

If the flow compensation gas is ideal gas, apply PTCOMPX to perform flow compensation, its programming is shown below.

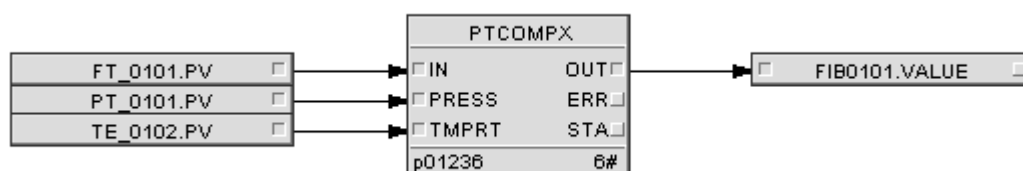


Figure 5.27 Programming of PTCOMPX

The function block instruction and examples are shown below.

Table 5.49 Function block instruction and examples

NO.	Example	Type	Instruction	Remark
001	FT_0101	AI (Input)	Flow Tag	
002	TE_0102	AI (Input)	Temperature Tag	Real-time Temperature of Compensation
003	PT_0101	AI (Input)	Pressure Tag	Real-time Pressure of Compensation
004	FIB0101	Custom REAL	Compensated Flow Tag	

Parameter settings of PTCOMPX:

- MODE: 1
- PRESS0: 1.05
- TMPRT0: 250

- The two levels H/L limit alarms can be set for the compensated flow according to the requirements. It can be achieved via PVIEX.
 - Other alarms, like change rate alarm, are set as disabled in default.
- If the flow compensation gas is superheated steam or saturated steam, apply STMCOMP to perform flow compensation, its programming is shown below.

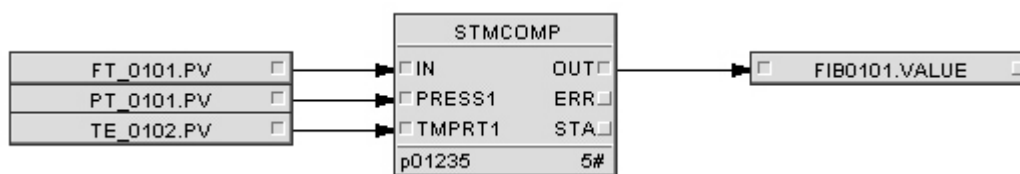


Figure 5.28 Programming of STMCOMP

The function block instruction and examples are shown below.

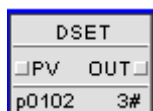
Parameter settings of STMCOMP:

- MODE: 0
- PRESS0: 1.05
- TMPRT0: 250
- The two levels H/L limit alarms can be set for the compensated flow according to the requirements. It can be achieved via PVIEX.
- Other alarms, like change rate alarm, are set as disabled in default.

5.34 Setting Function Block (DSET)

Taking into account the characteristics of the equipment in the system or some special reasons, the process may have specific requirements for the input signal. At the same time, in order to play a protective role, the input value or set value needs to be limited, and then the setting function is needed. The setting function block limits and sets the input measurement value PV, the range of the PV and the set value SV, and the function block generates an alarm when the upper and lower limits are exceeded. The parameter description is shown in Table 548.

Analog alarm limit, range and other parameters set. This function block is a complicated function block, the running time is 30μs.



5.34.1 Parameter Description

Table 5.50 Setting function block parameter description

Name			Description	Upload	Properties	Application Reference
Basic Parameters	Input Alarm Settings	PVHHH	Input HHH limit alarm value	TRUE	Operation Parameter	-
		PVHH	Input HH limit alarm value	TRUE	Operation Parameter	-
		PVH	Input H limit alarm value	TRUE	Operation Parameter	-
		PVL	Input L limit alarm value	TRUE	Operation Parameter	-
		PVLL	Input LL limit alarm value	TRUE	Operation Parameter	-
		PVLLL	Input L limit alarm value	TRUE	Operation Parameter	-
		PVHYS	PV alarm hysteresis value(No less than 0.0)	TRUE	Operation Parameter	not less than 0.0
	Set Value Limits	SVH	Set value maximum	TRUE	Operation Parameter	-
		SVL	Set value minimum	TRUE	Operation Parameter	-
		SVVL	Rate limit value (No less than 0.0,every control period)	TRUE	Operation Parameter	-
		GSV	SV safety protection input increase or decrease value	TRUE	Operation Parameter	-
	Range Settings	SCH	Input maximum	-	Configuration Parameter	-
		SCL	Input span minimum	-	Configuration Parameter	-
		EU	Input unit	-	Configuration Parameter	-
		DLEN	Decimal digits [0,5]	-	Configuration Parameter	Used for Data Displayed on Function Block Panel (Equal to 3 as Default)
Extended Parameters	Input Pin	PV ^{Note1}	Input	-	Input Pin	-

Table 5.50 Setting function block parameter description (continued)

Name			Description	Upload	Properties	Application Reference
	Output Pin	OUT	Output	-	Output Pin	-
	OOS Settings	SWOOS	Function block enable/disable (ON=disable)	TRUE	Operation Parameter	-
	SV	SV	Set value	TRUE	Operation Parameter	Value Range[SVL, SVH]If there's a float abnormal happened to the OUT value, the OUT will be equal to SV.Please refer to "Application Illustration" for details.
	Alarm	PRININD	Positive rate alarm indication	-	Monitoring Parameter	Related ENALM
		NRININD	Negative rate alarm indication	-	Monitoring Parameter	Related ENALM
		HH-HIND	Input HHH limit alarm indication	-	Monitoring Parameter	Related ENALM
		HHIND	Input HH limit alarm indication	-	Monitoring Parameter	Related ENALM
		HIND	Input H limit alarm indication	-	Monitoring Parameter	Related ENALM
		LIND	Input L limit alarm indication	-	Monitoring Parameter	Related ENALM
		LLIND	Input LL limit alarm indication	-	Monitoring Parameter	Related ENALM
		LLLIND	Input limit alarm indication	-	Monitoring Parameter	Related ENALM
		SVHIND	SV H limit alarm indication	-	Monitoring Parameter	Related ENALM
		SVLIND	SV L limit alarm indication	-	Monitoring Parameter	Related ENALM

Table 5.50 Setting function block parameter description (continued)

Name			Description	Upload	Properties	Application Reference
	Alarm Enable and Suppress	ENALM	Alarm enabled	TRUE	Operation Parameter	-
		FLAG	Flag	-	Output Pin	-
		AOF	Suppress module alarm	TRUE	Operation Parameter	-

Note 1. Alarm settings to measure values and the logical relations are shown below:

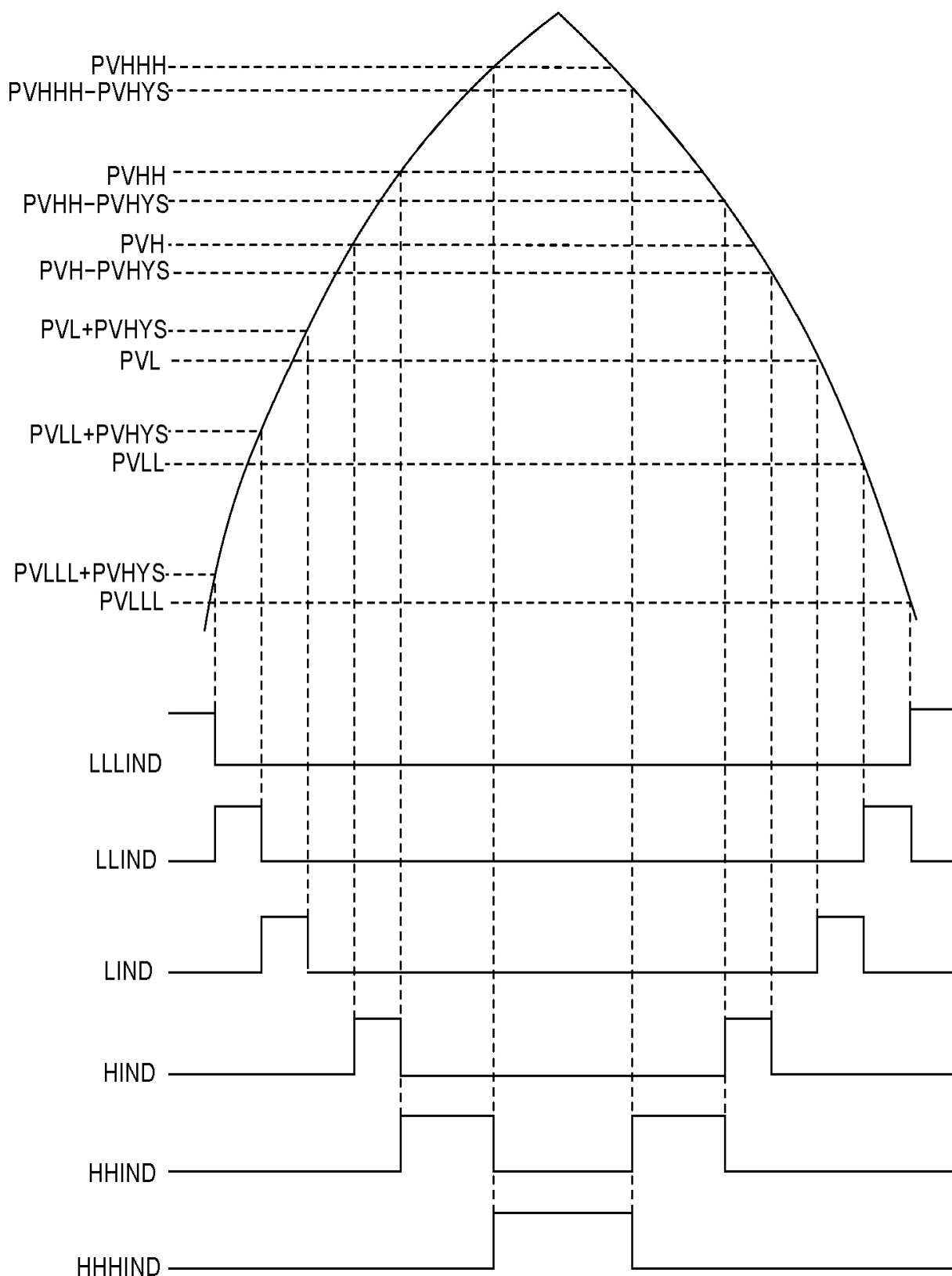


Figure 5.29 measurement value-alarm relation

Note 2. amplitude limiting and settings

The setting value is limited in [SVL, SVH]. Execute the ramp action to the limited SV. The output curve is shown below.

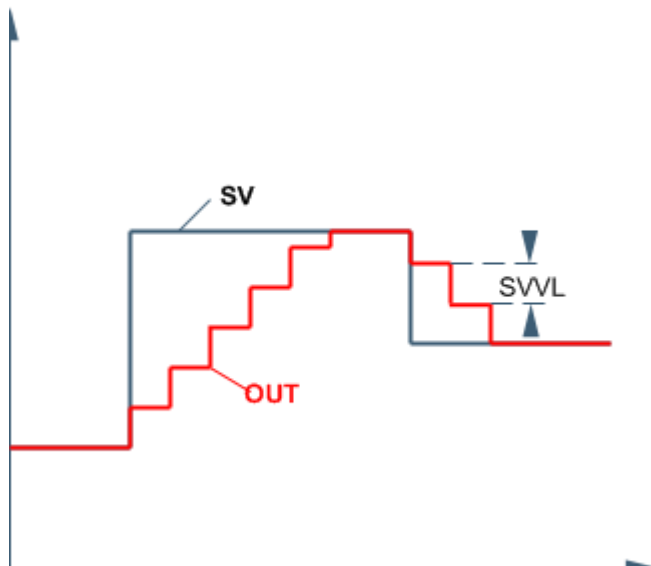


Figure 5.30 indication

5.34.2 Application Illustration

The float abnormal of output values means that the output values are not float format, or a meaningless output value is produced in a calculation that performs a divide-by-zero operation. When float abnormal happened, the output value is the set value, that is OUT=SV.

5.34.3 Panel Parameter



Figure 5.31 DEST Function Block Panel Parameter

Table 5.51 DEST function block panel parameter description

Panel Parameter Name	Function Block Parameter Name	Initial Value	Value Range	Application Instruction
PV Alarm Limit Settings	HHH	PVHHH	100.0000	[SCL,SCH]
				PV HHH limit alarm value (the option selected alarm, otherwise invalid)

Table 5.51 DEST function block panel parameter description (continued)

Panel Parameter Name		Function Block Parameter Name	Initial Value	Value Range	Application Instruction
	HH	PVHH	95.0000	[SCL,SCH]	PV HH limit alarm value (the option selected alarm, otherwise invalid)
	H	PVH	90.0000	[SCL,SCH]	PV H limit alarm value (the option selected alarm, otherwise invalid)
	L	PVL	10.0000	[SCL,SCH]	PV L limit alarm value (the option selected alarm, otherwise invalid)
	LL	PVLL	5.0000	[SCL,SCH]	PV LL limit alarm value (the option selected alarm, otherwise invalid)
	LLL	PVLLL	0.0000	[SCL,SCH]	PV LLL limit alarm value (the option selected alarm, otherwise invalid)
	HYS	PVHYS	0.0000	≥0.0	Alarm hysteresis value
SV Limit Settings	H	SVH	100.0000	-	SV H limit alarm indication (the option selected alarm, otherwise invalid)
	L	SVL	0.0000	-	SV L limit alarm indication (the option selected alarm, otherwise invalid)
SV Velocity Limit Settings	Velocity Limit	SVVL	100.0000	-	Rate limit value
	DSVH	PRININD	OFF	-	Positive rate alarm indication (the option selected alarm, otherwise invalid)
	DSVL	NRININD	OFF	-	Negative rate alarm indication (the option selected alarm, otherwise invalid)
OUT		OUT	0.0000	-	Read-only, can be set in the Function Block Properties window.
Change Limit of SV		GSV	0.000	-	SV safety protection input increase or decrease value

5.34.4 Flag

Table 5.52 Flag list

Flag	Alarm	Description
D0	OOS	Disable
D1	HHH	HHH Limit Alarm

Table 5.52 Flag list (continued)

Flag	Alarm	Description
D2	HH	HH Limit Alarm
D3	H	H Limit Alarm
D4	L	L Limit Alarm
D5	LL	LL Limit Alarm
D6	LLL	LLL Limit Alarm
D7	PRIN	Positive Rate Alarm
D8	NRIN	Negative Rate Alarm
D11	CFGERR	Configuration Error
D12	REVSCL	Span H/L Limit Reverse or output value float abnormal
D13	AOF	Suppress Alarm
D15	SVH	SV H Limit Alarm
D16	SVL	SV L Limit Alarm

5.35 Setting Function Block (DSET_EP)

The function block is mainly used in the settings of the operator indicator, parameter, etc. This function block is a complicated function block, the running time is 30μs.



5.35.1 Parameter Description

Table 5.53 Setting function block parameter description

Name		Description	Upload	Properties	Application Instruction
Input Pin	TV	Track value	-	Input Pin	Related TR
	TR	Track switch	-	Input Pin	-
Output Pin	SV ^{Note1}	Set value	TRUE	Output Pin	Value Range[SVL, SVH], Related TR, SWOOS. If there's a float abnormal happened to the SV value, the SV will be set as the value of previous period or the lower limit. Please

Table 5.53 Setting function block parameter description (continued)

Name		Description	Upload	Properties	Application Instruction
					refer to "Application Illustration" for details.
Operation Parameter	SWOOS	Function block enable / disable (ON=disable)	TRUE	Operation Parameter	-
	AOF	Suppress module alarm	TRUE	Operation Parameter	-
	SVH	Set value maximum	TRUE	Operation Parameter	Value Range[SCL, SCH]
	SVL	Set value minimum	TRUE	Operation Parameter	Value Range[SCL, SCH]
	SSV	Set value slow increase/decrease value	-	Operation Parameter	-
	GSV	SV safety protection input increase or decrease value	TRUE	Operation Parameter	-
	FSV	Set value fast increase/decrease value	-	Operation Parameter	-
Monitoring Parameter	SVI	Setting value operation indication	-	Monitoring Parameter	-
	SVHIND	SV H limit alarm indication	-	Monitoring Parameter	-
	SVLIND	SV L limit alarm indication	-	Monitoring Parameter	-
Alarm Enable and Suppress	FLAG	Flag	-	Output Pin	-
	ENALM	Alarm enabled	TRUE	Operation Parameter	-
Configuration Parameter	SCH	Input Pin	-	Configuration Parameter	-
	SCL	Input span minimum	-	Configuration Parameter	-
	EU	Input unit	-	Configuration Parameter	-
	DLEN	Input decimal digits [0, 5]	-	Configuration Parameter	Used for Data Displayed on Function Block Panel (Equal to 3 as Default)

Note 1. This function block provides an analogy output for the downstream program. The function block can be operated by operators in the supervision and send the analog indication.

- When SWOOS=ON, the function block is in the OOS status. In this mode, the algorithm does not work and the output can be assigned in the debugging window.
- When SWOOS=OFF:
 - When TR =ON, the output SV tracks TV;
 - When TR =OFF, the function block is in the manual status and SV can be set by operator; and operator can write specific value directly or press the plus/minor button to modify SV. For every operation, SVI send out a pulse.

5.35.2 Application Illustration

The float abnormal of output values means that the output values are not float format, or a meaningless output value is produced in a calculation that performs a divide-by-zero operation.

When float abnormal happened, the function block's SV value shall conform to the following rules:

- If the SV value of previous period is normal, the SV value maintains the normal value of previous period and the SV is equal to previous period value.
- If the upper period is also an abnormal value or has no upper period value, the SV is equal to the lower range limit.

5.35.3 Panel Parameter

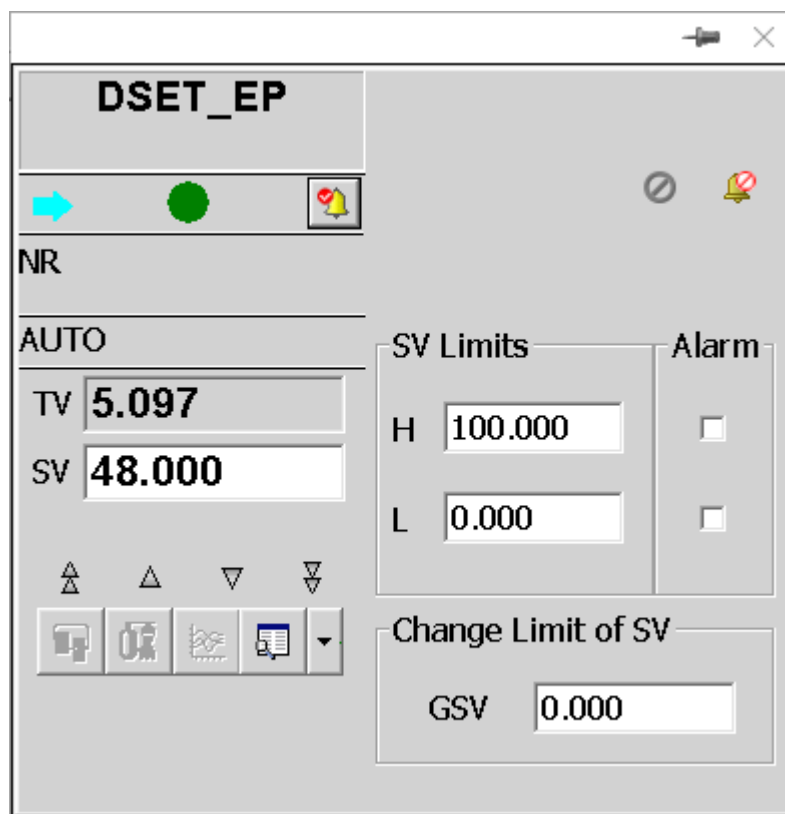


Table 5.54 Function Block Panel Parameter

Panel Parameter Name		Function Block Parameter Name	Initial Value	Value Range	Application Instruction
SV Limit Settings	H	SVH	100.0000	-	Set value maximum (the option selected alarm, otherwise invalid)
	L	SVL	0.0000	-	Set value minimum (the option selected alarm, otherwise invalid)
Change Limit of SV	GSV	GSV	0.000	-	SV safety protection input increase or decrease value

5.35.4 Flag

The corresponding relationship between the quality code and the alarm code of the DSET_EP function block is shown in the following table. For the use of the quality code, please refer to "Flag".

Table 5.55 Flag list

Flag	Alarm	Description
D0	OOS	Disable
D1	TR	Track

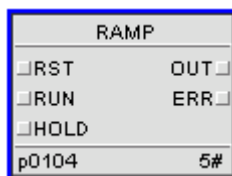
Table 5.55 Flag list (continued)

Flag	Alarm	Description
D2	AUTO	Auto
D3	SVL	SV L Limit Alarm
D4	SVH	SV H Limit Alarm
D5	CFGERR	Configuration Error
D6	REVSCL	Span H/L Limit Reverse or output value float abnormal
D7	SVI	Iput Change Indicator
D8	AOF	Suppress Alarm

5.36 Ramp Function Block (RAMP)

Generate ramp ascending or descending signal and limit the output.

This function block is a simple function block, the running time is 5μs.

**Table 5.56 Ramp function block parameter instruction**

Name		Name	Upload	Properties	Application Reference
Input Pin	RST	Reset switch	-	Input Pin	When RST jumps from OFF to ON, the function block is in track status, MODE=0
	RUN	Run switch	-	Input Pin	When RUN jumps from OFF to ON, the function block is in running status, MODE=1
	HOLD	Keep switch	-	Input Pin	When HOLD jumps from OFF to ON, the function block is in holding status, MODE=2
	IV	Initial value	-	Input Pin	-
	SW	Direction select switch	-	Input Pin	Related PR, NR
	PR	Rising rate (unit:/s)	TRUE	Input Pin	Related SW
	NR	Descend rate (unit:/s)	TRUE	Input Pin	Related SW

Table 5.56 Ramp function block parameter instruction (continued)

Name		Name	Upload	Properties	Application Reference
	OUTL	Output minimum	TRUE	Input Pin	-
	OUTH	Output maximum	TRUE	Input Pin	-
Output Pin	OUT ^{Note1}	Ramp output value	-	Output Pin	Value Range[OUTL, OUTH], Related MODE. If there's a float abnormal happened to the OUT value, the OUT will be set as lower limit.
	MODE	Output status	-	Output Pin	Related RST, RUN, HOLD All the three modes are applied with rising edge jump detecting, the priority is: 0>1>2.
	ERR	Parameter settings error	-	Output Pin	Related OUTL, OUTH

Note 1. output process

- When MODE=0: OUT=TV;
- When MODE=1:
 - SW=ON, OUT rises with rate PR;
 - SW=OFF, OUT descends with rate NR;
- When MODE =2: OUT keeps the current output;

Note 2. No matter in what mode, the output will be limited between OUTL and OUTH. If OUTL>OUTH, then output limit will not work and the ERR alarm will be set to ON.

Application

- The OUT outputs the lower range limit.
- ERR: the alarm value turns ON.

The float abnormal of output values means that the output values are not float format, or a meaningless output value is produced in a calculation that performs a divide-by-zero operation. When float abnormal happened, the function block is processed according to the following rules:

5.37 Date Timer Function Block (DATETIMER)

Read controller time and output the system time of the controller, and send out an ON signal that lasts for a preset time period.

This function block is a simple function block, the running time is 5μs.

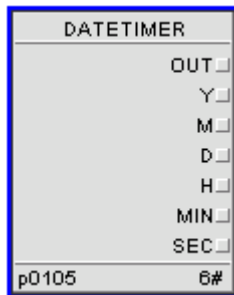


Table 5.57 Data timer function block parameter instruction

Name		Description	Upload	Properties	Application Reference
Output Pin	OUT ^{Note1}	Output value	-	Output Pin	-
	Y	Current year	-	Output Pin	-
	M	Current month	-	Output Pin	-
	D	Current date	-	Output Pin	-
	H	Current hour	-	Output Pin	-
	MIN	Current minute	-	Output Pin	-
	SEC	Current second	-	Output Pin	-
Operation Parameter	M_SET	Month set(>12 means anyone)	TRUE	Operation Parameter	If M_SET is larger than 12, the system will not set the month and automatically jump to the next time parameter.
	D_SET	Day set(>31 means anyone)	TRUE	Operation Parameter	If D_SET is larger than 31, the system will not set the day and automatically jump to the next time parameter.
	H_SET	Hour set (>23 means anyone)	TRUE	Operation Parameter	If H_SET is larger than 23, the system will not set the hour and automatically jump to the next time parameter.
	MIN_SET	Minute set (>59 means anyone)	TRUE	Operation Parameter	If MIN_SET is larger than 59, the system will not set the minute and automatically jump to the next time parameter.
	SEC_SET	Second set (>59 means anyone)	TRUE	Operation Parameter	If SEC_SET is larger than 59, the system will not set the second and automatically jump to the next time parameter.

Table 5.57 Data timer function block parameter instruction (continued)

Name		Description	Upload	Properties	Application Reference
	TZ ^{Note1}	Region (unit: h)	-	Operation Parameter	-

Note 1:

The unit of the time zone value is hour. For example, TZ=1.5 means that add 1.5 hours in the controller ($1.5 \times 60 = 90$ minutes). The time zone value ranges in $[-12.0, 13.0]$, and decimal like as 0.0, 0.25, 0.5 and 0.75 are also supported. There might be precision loss for other time zone value end with decimal, but it does not matter in the practical application. When the time zone value is used, the decimal will be one of the 4 decimals 0.0, 0.25, 0.5 and 0.75.

This function block will not adjust automatically the clock following the daylight saving time.

When used in those countries adopted the daylight saving time, users should adjust the TZ by themselves.

Note 2:

Output process is described below:

- It is based on the standard Greenwich Mean Time, then plus the current time zone value, get the current year, month, data, hour, minute, second. For example, China is located in the East 8 zone, so TZ=8. If the Greenwich Mean Time is 2010.05.07 13:00:00, then the Beijing Time will be 2010.05.07 21:00:00.
- If the current time is compared with the setting time, a pulse will be outputted when the current time reaches or exceeds the setting time the first time. The pulse width is the calculation period.
- If the controller time transits, the function block will update the time.
 - If the controller time transits to a future time after update, and the target time exceeds the predefined time, the function block does not output ON signal.
 - If the current time has satisfied the defined time of the function block, the controller time transits to a past time after update, the function block outputs ON signal again after it re-satisfies the defined time.

Example

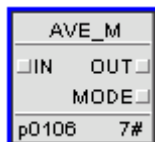
To output a pulse lasts for 1 second and a pulse lasts for 60 seconds at 8AM on 1st every month:

Table 5.58 DATETIMER application example

Target	Set Time					Result
	Month	Day	Hour	Minute	Second	
Output a pulse lasts for 1 second at 8AM on 1 st every month	13 (any integer that is larger than 12)	1	8	0	0	At 8AM on 1 st every month, the set time is satisfied, OUT=ON. At 08:00:01, the set time is not satisfied, OUT=OFF.
Output a pulse lasts for 60 seconds at 8AM on 1 st every month	13 (any integer that is larger than 12)	1	8	0	61	At 8AM on 1 st every month, the set time is satisfied, OUT=ON. At 08:01:00, the set time is not satisfied, OUT=OFF.

5.38 Moving-average Block (AVE_M)

The block is used to get the average value of the input sampling data in the past period of time. It records the input value according to the setting sampling time and can record 60 sampling values at most. This function block is a simple function block, the running time is 11μs.

**Table 5.59 Function block parameter instruction**

Name		Name	Upload	Properties	Application Reference
Input Pin	IN	Input value of moving-average block	-	Input Pin	-
Output Pin	OUT ^{Note1}	Output value of moving-average block	-	Output Pin	Related MODE
	MODE	Current (run, stop, reset)	-	Output Pin	Related RST, STOP
Operation Parameter	TS	Sampling time, the actual value is the integer multiple of scan period of function block 0.1~10000.0(Unit: s)	TRUE	Operation Parameter	In the running mode, the inner sampling data will be reset when TS is modified
	NUM	Number of sampling point (No more than 60)	-	Operation Parameter	Value Range[0,60]In the running mode, the current available sampling data will be calculated for output after NUM is modified

Table 5.59 Function block parameter instruction (continued)

Name	Name	Upload	Properties	Application Reference
	GAIN	Gain	TRUE	Operation Parameter
	RST	Reset switch	-	Operation Parameter
	STOP	Stop switch	-	Operation Parameter
	PREV	Earliest calculation input value	TRUE	Operation Parameter
	OUTH	High limit of output value	TRUE	Operation Parameter
	OUTL	Low limit of output value	TRUE	Operation Parameter

Note 1. function mode

- reset mode
When RST=ON, the function block is in the reset mode. MODE =0, OUT=IN, the inner sampling data is reset.
- stop mode
When RST=OFF, STOP=ON, the block is in the stop mode. MODE=1, OUT holding, the inner sampling data is reset.
- Running mode
When RST=OFF, STOP=OFF, the function block is in the running mode, MODE=2, OUT is the value of the average value of the current available sampling data multiplied by GAIN. The available sampling data must be used for the average value calculation. That means that the divisor is the amount of the recorded available sampling data, when it reaches NUM and the divisor is NUM.
The sampling data and the output are refreshed once in a sampling period.
Create a piece of storage space in the function block to record the sampling data.
Create 60 input data buffers in function block which are used to store the sampling value. Therefore, the sampling number NUM shall be in the range of [0, 60]. When NUM > 60, NUM=60 will be forced by the program. When NUM=0, the function block will output the current IN value.

Note 2. The calculation of TS is based on the integer multiple of the running period.

- When TS is less than the running period of the function block, then TS is the running period.
- If TS is greater than the running period, then the practical calculation time equals the maximum integer multiple of the function block running period which is less than TS.

5.39 Sampling Function Block (SAMPLE)

In the running mode, the sampling function block can output the current sampling value according to the sampling time. The user can sample the signal at a certain time interval according to the actual needs to understand the signal characteristics and the law of change. The parameter description of the sampling function block is shown in Table 557

Judge the mode according to the parameter. In the running mode, output the current sampling value according to the sampling time.

This function block is a simple function block, the running time is 11μs.

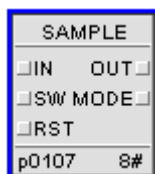


Table 5.60 Sampling function block parameter instruction

Name		Description	Upload	Properties	Application Reference
Input Pin	IN	Input value of sampling data	-	Input Pin	-
	SW	Enable switch to sampling	-	Input Pin	-
	RST	Reset switch	-	Input Pin	-
Output Pin	OUT- Note1	Output value of sampling calculation	-	Output Pin	Related MODE
	MODE	Mode output value (reset =0, stop=1, run =2)	-	Output Pin	Related RST, SW
Operation Parameter	TS	Sampling time(s)	TRUE	Operation Parameter	-
	PSET	Preset value	TRUE	Operation Parameter	-
	RST_- OPT	Reset output mode switch (HOLD =ON, Output Preset Value=,OFF)	TRUE	Operation Parameter	-

Note 1. Output is processed as the mode.

- Reset mode
 - When RST=ON, the function block is in the reset mode, MODE=0, the inner timer will be reset.
 - When RST_OPT=ON, OUT will hold the current output value. When RST_OPT=OFF, OUT=PSET.
- Stop mode
 - When RST=OFF and SW=OFF, the function block will be in the stop mode, MODE=1. The inner timer will be reset and the output will be held.
 - Running mode
 - When RST=OFF and SW=ON, the function block will be in the running mode, MODE=2, and output the current sampling value according to the sampling time.

Note 2. TS sampling time

The calculation of TS is based on the integer multiple of the running period. When TS is less than the running period of the function block, then TS is the running period. If TS is greater than the running period, then the practical calculation time equals the maximum integer multiple of the function block running period which is less than TS.

That means $N \cdot T \leq TS$, and the N is the maximum integral which can be chosen, then the practical sampling time is $N \cdot T$.

5.40 Extended Natural Gas Compensation (GASCOMP_EX)

Function blocks are used to calculate the volumetric, mass and energy flow rates of natural gas.



TIP:

The function block is available to the user program when the control station FCU713-S and above.

Before using this function block, please make sure you have obtained the software dog license for this function block, license model: VFGASCOMPEX.

Function block based on "GB/T 21446-2008 measurement of natural gas flow with standard orifice flowmeter" and "GB/T 17747.2-2011 calculation of natural gas compression factor Part 2: calculation by molar composition", designed to meet the standard orifice flowmeter measurement of natural gas flow application requirements.

The functional block is suitable for throttling devices with flange pressure extraction and angle connection pressure extraction, and the flow of methane as the main component of the gas mixture extracted from gas or oil fields is measured by standard orifice plate.

The absolute pressure of the orifice plate under the reference condition is $P_n=101.325\text{kPa}$, the thermodynamic temperature is $T_n=293.15\text{K}$ (20°C) and the temperature range is $-15^\circ\text{C} \leq T \leq 50^\circ\text{C}$. When the Willy coefficient correction switch $\text{SWCALC_B}=\text{OFF}$, the Willy coefficient is calculated in real time and the average load on the controller is about 40% (40ms for a single function block running time at a control cycle of 100ms), and when $\text{SWCALC_B}=\text{ON}$, the Willy coefficient is manually corrected and a correction needs to be triggered after a change in the natural gas component, and the average load on the controller is about 9% (for the same configuration). comparison).

The controller requires one automatic calibration or triggers one manual calibration when it is downloaded offline.

Table 5.61 Parameter Description

Parameter Name		Type	Initial value	Description
Input Parameters	TMPRT	REAL	0.00	Gas working temperature ($^\circ\text{C}$)
	PRESS	REAL	0.00	Working pressure, gauge pressure (MPa)
	DP	REAL	0.00	Differential pressure (KPa)
	PN	REAL	0.10	Local atmospheric pressure (MPa)
Output Parameters	QV	REAL	0.00	Volumetric flow rate (m^3/s)
	QM	REAL	0.00	Mass flow rate (Kg/s)
	QE	REAL	0.00	Energy flow (MJ/s)
	ERR	BOOL	OFF	Error marker output (OFF: no error; ON: with error)
Monitoring parameters	FLAG	UDINT	0	Quality Code
	GAS_SUM	REAL	0.00	Natural gas components and, sum of natural gas components
	Fz	REAL	0.00	Super compression factor
	C	REAL	0.00	Outflow coefficient
	Gr	REAL	0.00	Relative Density
	Exp	REAL	0.00	Isentropic index
	Vi	REAL	0.00	Viscosity coefficient
	Ep	REAL	0.00	Expandable coefficient
	ReD	REAL	0.00	Reynolds number
	E	REAL	0.00	Progressive speed factor

Table 5.61 Parameter Description (continued)

Parameter Name		Type	Initial value	Description
	Hv	REAL	0.00	Volumetric heat generation
	COUNT1	INT	0	Number of compression factor iterations calculated
	COUNT2	INT	0	Number of Reynolds number iterations calculated
Configuration Parameters	MODE	INT	0	Pressure taking method (0: flange pressure taking; 1: angle connection pressure taking)
	ITE_LIM	INT	30	Maximum number of iterative calculations
	SUMH	REAL	100.00	Allowable upper limit of group sum (percentage)
	SUML	REAL	100.00	Allowable lower limit of group sum (percentage)
	LIFE	REAL	0.00	Service life of the pipeline (years)
	Kr	REAL	0.00	Pipe wall roughness (mm)
	Z_PIPE	REAL	11.16	Pipe wall material coefficient (10^-6mm/(mm*°C))
	Z_ORIF	REAL	16.60	Orifice plate material factor (10^-6mm/(mm*°C))
	D_PIPE	REAL	50.00	Pipe inner diameter (mm), 20°C±2°C condition
	D_ORIF	REAL	12.50	Orifice plate inner diameter (mm), 20°C±2°C condition
	MODE_CAL	USINT	0	Outflow coefficient calibration method (0: no consideration of age and pipe diameter limits; 2: consideration of age and pipe diameter limits)
	SWCALC_B	BOOL	ON	Willy coefficient calculation switch OFF: Single cycle calculation ON: Multi-cycle calculation
	EU	EUNIT		Engineering Unit
	DLEN	USINT	5	Fractional digit length [0,5]
Grouping parameters	CH4	REAL	1.000000	Methane
	N2	REAL	0.000000	Nitrogen
	CO2	REAL	0.000000	Carbon Dioxide

Table 5.61 Parameter Description (continued)

Parameter Name	Type	Initial value	Description
C2H6	REAL	0.000000	Ethane
C3H8	REAL	0.000000	Propane
H2O	REAL	0.000000	Water
H2S	REAL	0.000000	Hydrogen sulfide
H2	REAL	0.000000	Hydrogen
CO	REAL	0.000000	Carbon monoxide
O2	REAL	0.000000	Oxygen
C4H10_i	REAL	0.000000	Isobutane
C4H10_n	REAL	0.000000	n-Butane
C5H12_i	REAL	0.000000	Isopentane
C5H12_n	REAL	0.000000	n-Pentane
C6H14_n	REAL	0.000000	n-Hexane
C7H16_n	REAL	0.000000	n-Heptane
C8H18_n	REAL	0.000000	n-octane
C9H20_n	REAL	0.000000	n-nonane
C10H22_n	REAL	0.000000	Anemone
He	REAL	0.000000	Helium
Ar	REAL	0.000000	Argon gas

5.40.1 Calculation process

Function block calculation process is shown in the following figure, the arrow indicates the calculation order, all the calculation formula and calculation process are in line with GB/T 21446-2008 and GB/T 17747.2-2011 part II, this paper will not be introduced in detail one by one. If the corresponding value is found to be out of range in the process of determining the validity of the signal, the validity of the component, and the way of taking pressure, the corresponding alarm will be given, and the function block will stop the operation and keep the value of the previous cycle output; if it is determined to be normal, the function block will continue the operation.

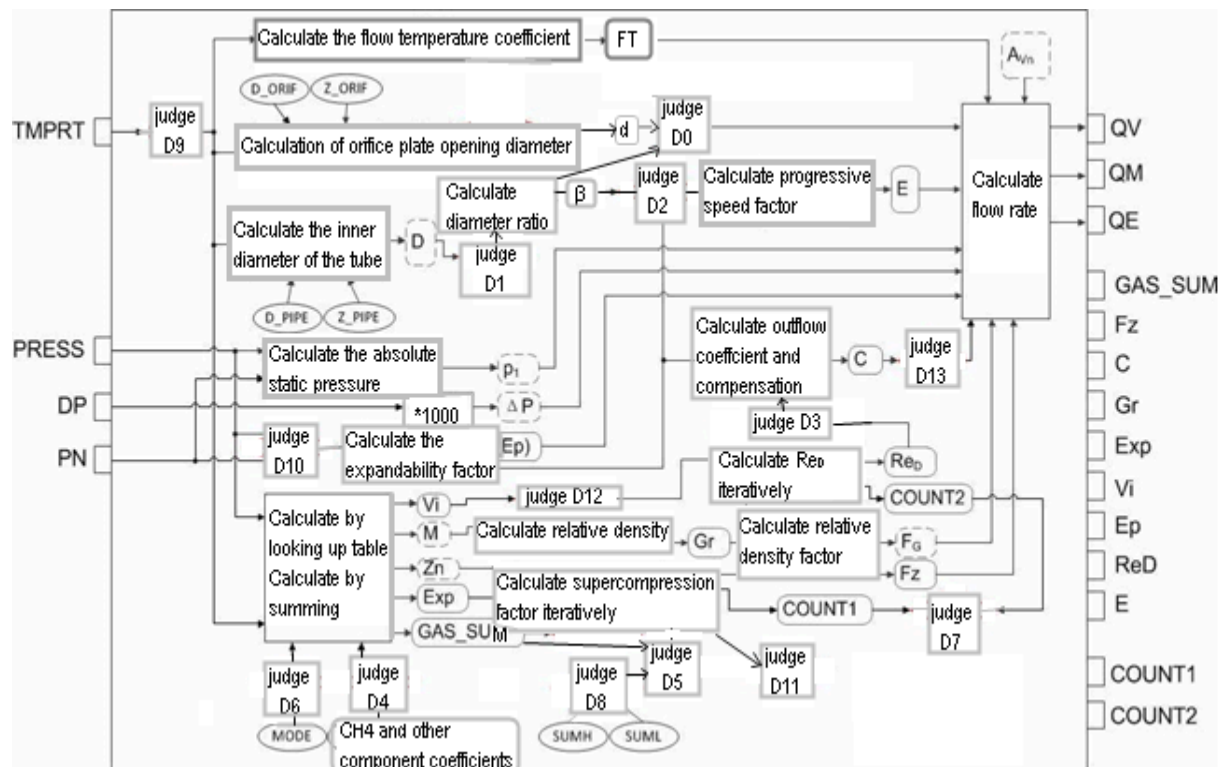


Figure 5.32 Module calculation process

5.40.2 Auxiliary calculations

Calculation of orifice plate opening diameter

$$d = d_{20} [1 + \Delta d (t_1 - t_{20})]$$

Eq.

- d —hole plate opening diameter, in millimeters (mm).
- d_{20} —detection diameter of the hole plate opening at $20 \pm 2^\circ\text{C}$, in millimeters (mm) for parameter D_ORIF in this function block.
- Δd —coefficient of linear expansion of the orifice plate material, parameter Z_ORIF in this function block, to be derived from the table, in millimeters \cdot per millimeter Celsius ($\text{mm}/(\text{mm} \cdot ^\circ\text{C})$).
- t_1 —the measured gas stream temperature as the natural gas flows through the throttling device, in degrees Celsius ($^\circ\text{C}$) for the parameter TMPRT in this function block.
- t_{20} —constant 20 in degrees Celsius ($^\circ\text{C}$).

Calculate the inner diameter of the measuring tube upstream of the orifice plate

$$D = D_{20} [1 + \Delta D (t_1 - t_{20})]$$

Eq.

- D——measuring tube inner diameter, unit (mm).
- D20——the inner diameter of the measuring tube detected at $20\pm 2^{\circ}\text{C}$, in millimeters (mm) for parameter D_PIPE in this function block.
- ΔD ——coefficient of linear expansion of the measuring tube material, parameter Z_PIPE in this function block, to be derived from the table, in millimeters ° per millimeter Celsius (mm/(mm*°C)).
- t1——the measured gas stream temperature as the natural gas flows through the throttling device, in degrees Celsius (°C) for the parameter TMPRT in this function block.
- t20——constant 20 in degrees Celsius (°C).

Calculate the diameter ratio

$$\beta = d/D$$

Eq.

- β ——the diameter ratio of the orifice plate.
- d——hole plate opening diameter, in millimeters (mm).
- D——the inner diameter of the measuring tube in millimeters (mm).

Signal validity judgment

The function block will determine whether the bore diameter d, tube inner diameter D, diameter ratio β and Reynolds number value Re_D are within the range of the table below. If they are not within the range, the bore diameter overrun, tube inner diameter overrun, tube diameter ratio overrun and Reynolds coefficient overrun alarms will be made respectively; if they are within the range of the table below, the calculation will continue. Table 223 Bore diameter, tube inner diameter, diameter ratio and Reynolds number limit table

Table 5.62 Table of bore size, tube ID, diameter ratio and Reynolds number limits

Parameter Name	Type
$d \geq 12.5\text{mm}$	
$50\text{mm} \leq D \leq 1000\text{mm}$	
$0.10 \leq \beta \leq 0.75$	
$Re_D \geq 5000$ and $Re_D \geq 170\beta^2 D$	$Re_D \geq 5000$ for $0.1 \leq \beta \leq 0.56$
	$Re_D \geq 16000\beta^2$ for $\beta > 0.56$

Group validity judgment

When the sum of the components of natural gas is between the upper and lower limits allowed for the sum of components, the calculation continues.

Judgment of pressure extraction method

Set the pressure taking mode MODE, 0: flange pressure taking, 1: angle connection pressure taking. If the setting is correct, the calculation continues.

Calculation of absolute pressure

$$P1 = p1 + Pn$$

Where:

P1—absolute pressure of airflow in megapascals (Mpa).

p1 —the measured gauge pressure of the upstream side of the orifice plate, in megapascals (Mpa). Pn - local atmospheric pressure value, PN in MPa (megapascals) for the function block parameters.

Calculate the compression factor

- Calculate the compression factor Z_n

$$Z_n = 1 - \left(\sum_{j=1}^n X_j \sqrt{b_j} \right)^2$$

Z_n —compression factor of dry air at standard reference conditions.

X_j —molar fraction of component j of natural gas.

$$\sqrt{b_j}$$

—summing factor for natural gas j component, obtained by looking up the table.

n —the total number of gas components, for the parameter GAS_SUM of the function block.

- Calculate the compression factor Z

The value of compression factor Z is calculated according to the national standard (GB/T 17747) or AGA8-92DC method.

Calculate molar mass

$$M = \sum_{j=1}^n X_j M_j$$

M --molar mass of natural gas in kilograms per kilomole (kg/kmol).

X_j --molar fraction of component j of natural gas.

M_j --the molar mass of component j of natural gas in kilograms per kilomole (kg/kmol).

n --the total number of natural gas j components, for the function block parameter GAS_SUM.

Calculation of molar heat generation

$$\bar{H}_s = \sum_{j=1}^n X_j \bar{H}_{sj}^0$$

Where:

$$\tilde{H}_s$$

--The true volumetric heat of natural gas at standard reference conditions in megajoules

per kilomole (MJ/kmol), $\tilde{H}_s = \tilde{H}_s^0 / Z_n$

$$\tilde{H}_s^0$$

--the ideal volumetric heat of natural gas under standard reference conditions, in

megajoules per kilomole (MJ/kmol), $\bar{H}_s = \tilde{H}_s \times P_n / RT_n$

Z_n --compression , see "Calculate the compression factor".

$$\bar{H}_s$$

--Molar heat of natural gas in megajoules per kilomole (MJ/kmol).

$$\bar{H}_{sj}^0$$

--Molar heat of natural gas j component (ideal) in megajoules per kilomole (MJ/kmol), obtained by checking the table.

R --universal gas constant with the value of 0.00831451 in megapascals cubic meters per kilomokay (Mpa·m³ / (kmol·k)).

P_n, T_n --temperature and pressure at standard reference conditions.

Calculate relative density

$$G_r = \frac{Z_a}{Z_n} \times G_1 = \frac{Z_a}{Z_n} \times \frac{M}{M_a} = \frac{0.99963}{28.9626} \times \frac{M}{Z_n}$$

$G_1 = M/M_a$

G_r --true relative density of natural gas, for the parameter Gr in the function block.

Z_a --the compression factor of dry air at standard reference conditions with the value of 0.99963.

Z_n --Compression factor of natural gas at standard reference conditions, see "Calculate the compression factor".

G_1 --the ideal relative density of natural gas.

M --molar mass of natural gas in kilograms per kilomole (kg/kmol).

M_a --the molar mass of dry air with a value of 28.9626 in kilograms per kilomole (kg/kmol).

Calculating natural gas density

$$\rho_n = \frac{MP_n}{RZ_nT_n} = \frac{0.101325}{0.00831451 * 293.15} * \frac{M}{Z_n}$$

ρ_n --natural gas density

M --molar mass of natural gas, see "Calculate molar mass".

Z_n --Compression factor of natural gas at standard reference conditions, see "Calculate the compression factor".

Calculate the supercompression factor

$$F_z = \sqrt{\frac{Z_n}{Z_1}}$$

Where:

F_z --super compression coefficient, for the parameter F_z in the function block, its value can be calculated according to the national standard (GB/T17747) or AGANX-19 calculation method.

Z_n --the compression factor of natural gas at standard reference conditions.

Z_1 --compression factor of natural gas at operating conditions.

Calculating the natural gas isentropic index

$$\kappa = C_p / C_v$$

Where:

κ --isentropic index, the parameter Exp in this function block.

C_p --the constant pressure specific heat capacity of methane in kilojoules per kilogram Celsius (KJ/(Kg-°C)).

C_v --the constant specific heat capacity of methane in kilojoules per kilogram Celsius (KJ/(Kg-°C)).

Calculate viscosity factor

The viscosity factor μ_1 , obtained by looking up the table, is the parameter V_i in this function block.

5.40.3 Calculation of basic flow parameters

Define the initial Reynolds coefficient as follows: $\text{Re}_D = 10^6$.

Calculate the initial outflow coefficient

$$C = 0.5961 + 0.0261\beta^2 - 0.216\beta^8 + 0.000521\left(\frac{10^6\beta}{Re_D}\right)^{0.7} +$$

$$(0.0188 + 0.0063A)\beta^{3.5}\left(\frac{10^6\beta}{Re_D}\right)^{0.3} + 0.043 + 0.080e^{-10L_1}$$

$$- 0.123e^{-7L_1}(1 - 0.11A)\frac{\beta^4}{1 - \beta^4} - 0.031(M_2 - 0.8M_2^{1.1})\beta^{1.3}$$

When $D < 72.12\text{mm}$, the value of C in the above equation should also be increased by the value of the term $0.011(0.75 - \beta)(2.8 - D/25.4)$.

Where: $M_2 = 2L_2/(1 - \beta)$, $A = (19000\beta^2/Re_D)^{0.8}$.

C --outflow coefficient.

β --see "Auxiliary calculations".

L_1 --the quotient obtained by dividing the distance from the upstream end of the orifice plate to the axis of the upstream pressure extraction hole by the inner diameter of the measuring tube.

L_2 --the quotient obtained by dividing the distance from the downstream end of the orifice plate to the axis of the downstream pressure extraction hole by the inner diameter of the measuring tube.

Calculation of progressive speed coefficient

$$E = \frac{1}{\sqrt{1 - \beta^4}}$$

E --Progressive speed coefficient.

β --see "Auxiliary calculations".

Calculate the relative density coefficient

$$F_G = \sqrt{\frac{1}{G_r}}$$

F_G --relative density coefficient.

G_r --the true relative density of natural gas.

Calculate the expandability factor

$$\varepsilon = 1 - (0.351 + 0.256\beta^4 + 0.93\beta^4)[1 - (P_2/P_1)^{1/\kappa}]$$

ε --expandable coefficient, parameter E_p in this function block.

β --see "Auxiliary calculations".

The following principles should be satisfied when calculating values according to the above equation.

- The ratio of the absolute static pressure of the downstream airflow of the orifice plate to the absolute static pressure of the upstream airflow of the orifice plate should be greater than or equal to 0.75.
- The isentropic index is calculated as "Auxiliary calculations" determined.
- The absolute static pressure of the airflow on the upstream side of the orifice plate is calculated as "Auxiliary calculations" determine

Calculate the flow temperature coefficient

$$F_T = \sqrt{\frac{293.15}{T_1}} = \sqrt{\frac{293.15}{t_1 + 273.15}}$$

F_T --flow temperature coefficient.

t_1 --natural gas flow through the throttling device measured gas stream temperature in degrees Celsius (°C) (see "GB/T 21446-2008 measuring natural gas flow with standard orifice flowmeter" for the installation position of the thermometer).

Calculate volume flow approximation

The cold start assumes a pipe diameter Reynolds number $Re_D = 10^6$, which is used for iterations, and subsequent iterations with the previously calculated Reynolds number. so that we have

$$q'_{vns} = 3.1795 \times 10^{-5} C' E d^2 F_G \varepsilon F_Z F_T \sqrt{P_1 \Delta p}$$

Where:

q'_{vns} --volume flow approximation in m³/s.

C' --corrected outflow coefficient, see "Calculating the outflow coefficient compensation factor".

For other parameters, please see "Calculation of basic flow parameters" .

Iterative calculation of outflow coefficients

$$Re'_D = 1.53 \times 10^6 \frac{q'_{vns} G_r}{\mu_I D} = C' \times A$$

The initial flow rate q'_{vns} can be used to find an approximation of the Reynolds number of the pipe diameter Re'_D for the actual operating conditions of natural gas. Where:

Re'_D --the pipe diameter Reynolds under actual operating conditions of natural gas.

C' --corrected outflow coefficient, see "Calculating the outflow coefficient compensation factor".

q'_{vns} --approximate volume flow rate in m³/s, see "Calculate the flow temperature coefficient".

G_r --true relative density of natural gas, for the parameter G_r in the function block, see ""Auxiliary calculations"".

μ_1 --viscosity coefficient, for the parameter V_i in this function block, see ""Auxiliary calculations"".

D --measuring tube inner diameter in millimeters (mm), see ""Auxiliary calculations"".

Then use the calculated Reynolds number Re'_D to find the actual outflow coefficient based on "Calculate the initial outflow coefficient" according to 22.5.1 until $|1-C/C'| < 5 \times 10^{-10}$. The maximum number of iterations is 30, more than 30, an alarm is generated.

Calculation of roughness coefficient

$$\gamma_{Re} = (\gamma_0 - 1) \left(\frac{\lg Re_D}{6} \right) + 1$$

Where:

γ_{Re} --roughness coefficient.

γ_0 --is related to the relative roughness of the inner wall of the tube (for the parameter K_r in the function block), the value of which is obtained by looking up the table.

When Re_D , $\gamma_{Re} = \gamma_0$.

Calculating the outflow coefficient compensation factor

To avoid errors caused by scouring and corrosion during the use of the throttling device, the original outflow coefficient C needs to be multiplied by the orifice plate sharpness b_k or roughness coefficient γ_{Re} , or by both coefficients if both deviations occur.

C' --the corrected outflow coefficient.

C --outflow coefficient, see "Calculate the initial outflow coefficient".

γ_{Re} --pipe roughness coefficient, see "Calculation of roughness coefficient".

b_k --correction coefficient of sharpness of the entrance edge of the orifice tube opening of the orifice plate, check the table to obtain.

Flow coefficient calibration method

There are three ways to calibrate the outflow coefficient $MODE_CAL$ as follows.

- 0: no consideration of age and pipe diameter limits, b_k and Re_D coefficients are corrected according to age and pipe diameter size.
- 1: Considering the pipe diameter limitation, the pipe diameter size within 150mm, the Re_D coefficient is corrected, and the b_k coefficient is not corrected.
- 2: Considering the age and pipe diameter limitation, when the age is 0, b_k coefficient is not corrected, and the pipe diameter size is corrected by Re_D coefficient within 150mm; when the age is not 0, b_k coefficient is corrected according to the usage age, and the pipe diameter size is corrected by Re_D coefficient within 150mm.

Note: The default calibration method is 0.

5.40.4 Calculate the final flow output

Calculate volume flow rate

The volumetric flow rate of natural gas under reference conditions is calculated as

$$q_{vn} = A_{vn} C E d^2 F_G \varepsilon F_Z F_T \sqrt{P_1 \Delta p}$$

q_{vn} -- volumetric flow of natural gas under standard reference conditions, parameter QV in m³/s in this function block.

A_{vn} -- volumetric flow measurement coefficient, the value of which varies depending on the unit of measurement used.

- When its unit is m³/s, $A_{vn}=A_{vns}=3.1795 \times 10^{-6}$ m³/s
- When its unit is m³/h, $A_{vn}=A_{vnh}=A_{vns} \times 36000 = 0.011446$ m³/h
- When its unit is m³/d, $A_{vn}=A_{vnd}=A_{vnh} \times 24 = 0.27471$ m³/d

C -- outflow coefficient, please see "Calculation of basic flow parameters".

E -- progressive velocity coefficient, see "Calculation of basic flow parameters".

d -- orifice plate opening diameter, please see "Auxiliary calculations".

F_G -- relative density coefficient, see "Calculation of basic flow parameters".

ε -- expandability coefficient, parameter Ep in this function block, see "Calculation of basic flow parameters".

F_Z -- supercompression factor, see "Auxiliary calculations".

F_T -- flow temperature coefficient, see "Calculation of basic flow parameters".

P_1 -- the upstream side of the orifice plate to take the pressure hole airflow absolute static pressure, $P_1 = \text{PRESS} + \text{PN}$, the unit is MPa (MPa).

Δp -- the differential pressure generated when the air flow through the orifice plate, $\Delta p = \text{DP} \times 1000$, unit Pa (Pa).

Calculate mass flow rate

$$q_m = A_m C E d^2 \frac{1}{F_G} \varepsilon F_Z F_T \sqrt{P_1 \Delta p}$$

Natural gas mass flow rate calculation using the formula.

q_m -- natural gas mass flow rate, in kg/s for parameter QM in this function block.

A_m -- mass flow calculation factor, the value of which varies depending on the unit of measurement used.

- When its unit is m³/s, Ams=3.8295×10⁻⁶ kg/s
- When its unit is m³/h, Amh=0.013786 kg/h
- When its unit is m³/d, Amh=0.33087 kg/d

Other parameters are the same "Calculate volume flow rate".

Calculate energy flow

$$q_{Evn} = q_{vn} \tilde{H}_s$$

q_{Evn} -- natural gas energy flow, parameter QE in this function block, in MJ/s.

q_{vn} -- volumetric flow of natural gas under standard reference conditions, parameter QV in m³/s in this function block.

\tilde{H}_s -- Volumetric heat of natural gas under standard reference conditions, see "Auxiliary calculations".

6 String Process Function Block Library

Character string function block is mainly in charge of character string row parameters.

6.1 String Function Block (STRING64)

You can read and write the character string's parameters by STRING64 function block. This function block is a simple one and the running duration is 30μs.

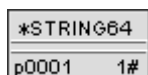


Table 6.1 STRING function block parameter

Parameter Name	Description	Parameter Upload
VALUE	Real-time value of character strings	FALSE

6.2 String Communication Output Function Block (SETSTR64)

Through the SETSTR64 function block, the value of the alias variable can be obtained and converted into string data and written to the designated data area.

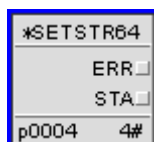


Table 6.2 SETSTR64 function block parameter

Parameter Name		Description	Parameter Upload
Operation parameter	VALUE	Character string real-time value	FALSE
Output parameter	ERR	Function block abnormal indication: ON=fault, OFF=normal. When STA is not 0, it displays ON; otherwise, it displays OFF.	FALSE
	STA	Function block status: 0=normal, 1=character length exceeds 64, 2=the address of the data block error, 4=the address is not a communication module, 8=the address range exceeds the limit, 16=alias address error	FALSE
Configuration Parameter	NODE	Node number	FALSE
	RACK	Rack number	FALSE
	IOM	Slave station address	FALSE

Table 6.2 SETSTR64 function block parameter (continued)

Parameter Name		Description	Parameter Upload
	DBNUM	Data block number	FALSE
	OFFSET	The offset address of tags in data block	FALSE
	LENGTH	The effective length of character strings	FALSE
	STRTYPE	Character string type, 0=normal, 1=add length	FALSE
Alias	STR_ADDR	Character string address	FALSE

Data Acquisition

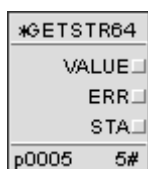
Copy the 64-byte data from the address pointed to by STR_ADDR to VALUE. STR_ADDR must be the address of the user program data area and it must be divisible by 4.

Character String Type Processing

1. When STRTYPE=0, the function block will write the designated data area to a value of the LENGTH length, and write 0 to the remaining 64-LENGTH length.
2. when STRTYPE=1, write a value of LENGTH+2 length to the designated data area, where the first byte of the designated data area is LENGTH+2, the second byte is LENGTH, and the third byte starts to The LENGTH+2 byte is the value of VALUE, and 0 is written for the remaining 62-LENGTH length.

6.3 String Communication Input Function Block (GETSTR64)

Through the GETSTR64 function block, you can read the character string in the specified data area and write it into the memory area corresponding to the alias variable

**Table 6.3 GETSTR64 function block parameter table**

Parameter Name		Description	Parameter Uploading
Operation Parameter	VALUE	Character string real-time value	FALSE

Table 6.3 GETSTR64 function block parameter table (continued)

Parameter Name		Description	Parameter Uploading
Output parameter	ERR	Function block abnormal indication: ON=fault, OFF=normal. When STA is not 0, it displays ON; otherwise, it displays OFF.	FALSE
	STA	Function block status: 0=normal, 1=character length exceeds 64, 2=the address of the data block error, 4=the address is not a communication module, 8=the address range exceeds the limit, 16=alias address error	FALSE
Configuration parameter	NODE	Node number	FALSE
	RACK	Rack number	FALSE
	IOM	Slave station address	FALSE
	DBNUM	Data block number	FALSE
	OFFSET	The offset address of tags in data block	FALSE
	LENGTH	The effective length of character string	FALSE
	STR-TYPE	Character string type, 0=normal, 1=add length	FALSE
Alias	STR_ADDR	Character string address	FALSE

Write to alias data area

Write the VALUE to the address pointed to by STR_ADDR. STR_ADDR must be the address of the user program data area, which must be divisible by 4.

Character string type processing

- When STRTYPE=0, the function block will read the data of the length of LENGTH from the designated data area and send it to VALUE, and write 0 for the remaining length of 64-LENGTH.
- When STRTYPE=1, the function block reads the data of LENGTH length from the data area of which address is the start address of the designated data area plus 2 and write it to VALUE, and writes 0 for the remaining 64-LENGTH length.
- If OFFSET=0 and the VALUE is data package with address information, STRTYPE must be set as 1 to make sure that the data can be transferred and written correctly.

6.4 String Function Block (EQ_STR64)

When FCU712 or FCU713 is used, EQ_STR64 allows you to compare the two-channel ASCII code inputs. Strings for comparison must not exceed 63 bits.

This is a simple function block.

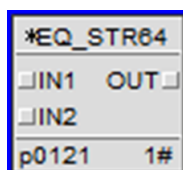


Table 6.4 EQ_STR64 function block parameter table

Parameter Name	Description	Parameter Uploading
IN1	Input 1	FALSE
IN2	Input 2	FALSE
OUT	Output value ON: Equal OFF: Not equal	FALSE

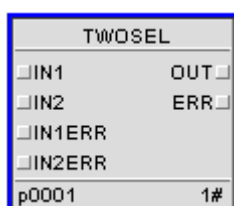
7 Selection Operation Function Block Library

Selection function block library contains 18 function blocks, including 6 complex function blocks and 12 simple function blocks. For complex function blocks, each of them has its own function block panel, and the parameter on the panel can be set in supervision widow.

7.1 2-to-1 Selector Function Block (TWOSEL)

Function block TWOSEL can select to output the average, maximum, minimum, input signal1 and input signal2 of the two input signals according to the value of parameter MODE.

It is a complex function block, whose running time is 12μs.



7.1.1 Parameter Description

Table 7.1 Parameter description of TWOSEL

Name			Description	Upload	Properties	Application Reference
Basic Parameters	Input Pin	IN1	Input 1	-	Input Pin	Testing point AI
		IN2	Input 2	-	Input Pin	Testing point AI
		IN1ERR	Input the Status of 1, ON=Error	-	Input Pin	Testing point AI.ERR
		IN2ERR	Input the Status of 2, ON=Error	-	Input Pin	Testing point AI.ERR
	Output Pin	OUT	Output When MOD-E=0,OUT=(IN1+IN2)/2; When MOD-E=1,OUT= Minimum Value; When MOD-E=2,OUT=Maximum Value; When MOD-E=3,OUT=IN1; When MOD-E=4,OUT=IN2	-	Output parameter	Relevant parameter: MODE ^{Note2}

Table 7.1 Parameter description of TWSEL (continued)

Name			Description	Upload	Properties	Application Reference
		ERR	Set Error Alarm	-	Output parameter	Related IN1ERR/IN2ERR/DL
		FLAG	Flag	-	Output parameter	Refer to "Flag"
	Operation Parameter	DL	When MODE=0.1.2, DL is the Preset Deviation Limit (Non-Negative). If Difference between IN1 and IN2 is larger than DL, ERR = ON, output remain the same with last cycle.	TRUE	Operation parameter	Relevant parameter: SCH, SCL. Normally set to (SCH - SCL)
		SWOOS	Function Block Forbidden	TRUE	Operation parameter	Set as ON when function block is downloaded first time
		AOF	Suppress Module Alarm When AOF=ON, It is Not Displaying the Real-Time Alarm. When AOF=OFF, It is Displaying the Real-Time Alarm.	TRUE	Operation parameters	Refer to "Alarm"
	Configuration Parameter	SCH	Range High Limit (Note: All Input and Output Share The Same Range, Unit and Decimal Digits)	-	Configuration parameter	-
		SCL	Range Low Limit	-	Configuration parameter	-
		MODE	Selection Type: 0=Average Value; 1=Minimum Value; 2=Maximum Value; 3=IN1; 4=IN2	-	Configuration parameter	Refer to parameter OUT
		EU	Unit	-	Configuration parameter	-
		DLEN	Decimal Digits	-	Configuration parameter	-

Note 1. Signal checking principle

Signal redundancy control system usually uses two identical instruments to check one signal. If one of the input signals is invalid, the detection system would output the value of the valid one. If both of the signals are checked invalid, the detection system would be considered in fault. If both of the signals are checked valid, the checking system would further check the deviation between the two input signals. If the deviation is larger than the setting value, the checking system would be considered in problem.

Note 2. Description of MODE selection

1. When MODE=0, 1 or 2:
 - If both of two inputs are invalid, set error alarm ERR=ON, and hold the output value of last period.
 - If one of two inputs is invalid, output the value of the other valid input.
 - If both of two inputs are valid, then check whether the deviation between the inputs exceeds the setting deviation limit DL. If the deviation exceeds the deviation limit (DL), meaning that the output is incredible, set error alarm ERR=ON, and hold the output value of last period. If the deviation does not exceed DL, then select to output the average, minimum, or maximum of the two input signals, according to the value of MODE.
2. When MODE=3 or 4, output the input value of the specified transmitter, value of IN1 or IN2. If the corresponding input is invalid, meaning that the output is incredible, set error alarm ERR=ON, and hold the output value of last period.
3. When MODE is set other value, set error alarm ERR=ON, and hold the output value of last period.

7.1.2 Panel Parameter

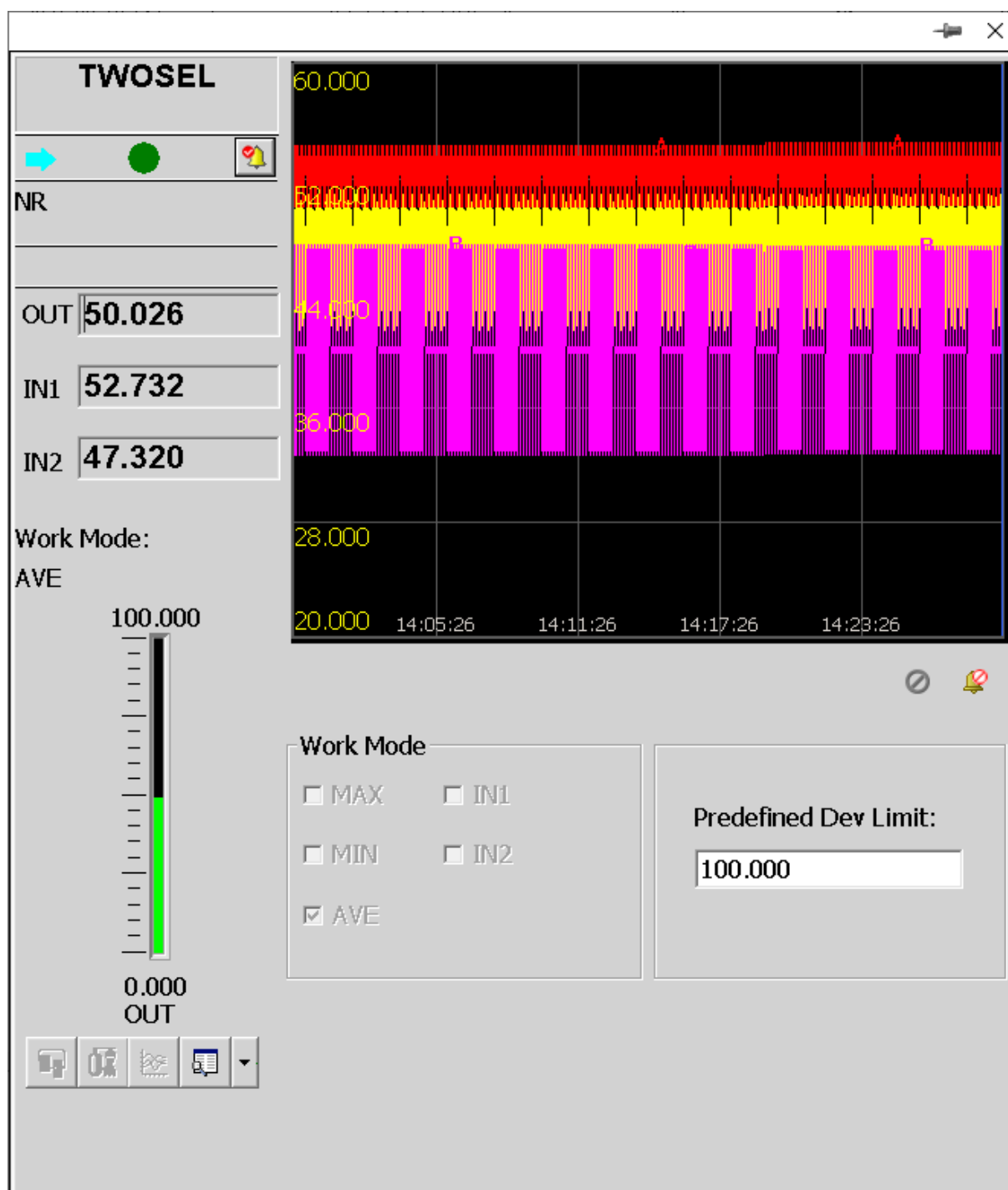


Table 7.2 Panel Parameter Instruction

Panel Parameter		Name	Initial Value	Range	Application Reference
Work Mode	MAX	MODE	-	-	Read-only, if selected, sets MODE=2
	MIN	MODE	-	-	Read-only, if selected, sets MODE=1

Table 7.2 Panel Parameter Instruction (continued)

Panel Parameter		Name	Initial Value	Range	Application Reference
	AVE	MODE	√	-	Read-only,if selected,Sets MODE=0
	IN1	MODE	-	-	Read-only,if selected, sets MODE=3
	IN2	MODE	-	-	Read-only,if selected, sets MODE=4
Predefined Error		DL	100.000	0~(SCH - SCL)	Refer to parameter reference

7.1.3 Flag

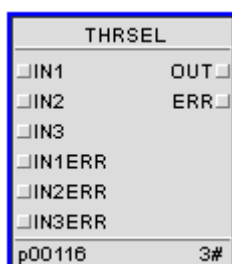
Table 7.3 Flag list

Flag	Alarm	Description
D0	OOS	Disable
D1	ERR	Fault
D2	IN1ERR	Quality of input 1 is bad
D3	IN2ERR	Quality of input 2 is bad
D4	AOF	Suppress Alarm
D5	REVSCL	Span H/L Limit Reverse
D6	DEV12	Input 12 Deviation Over Limit

7.2 3-to-1 Selector Function Block (THRSEL)

Function block THRSEL can select to output the average, maximum, minimum, median value, input signal1, input signal2 and input signal3 of the three input signals, or to output one of these three signals, according to the value of parameter MODE.

It is a complex function block, running time is 12μs.



7.2.1 Parameter Description

Table 7.4 THRSEL parameter instruction

Name			Description	Upload	Properties	Application Reference
Basic Parameters	Input Pin	IN1	Input 1	-	Input Pin	Connect to AI
		IN2	Input 2	-	Input Pin	Connect to AI
		IN3	Input 3	-	Input Pin	Connect to AI
		IN1ERR	Input the Status of 1, ON=Error	-	Input Pin	Connect to AI.ERR
		IN2ERR	Input the Status of 2, ON=Error	-	Input Pin	Connect to AI.ERR
		IN3ERR	Input the Status of 2, ON=Error	-	Input Pin	Connect to AI.ERR
	Output-Pin	OUT	When MODE=0, $OUT=(IN1+IN2+IN3)/3$ When MODE=1, OUT=minimum When MOD- E=2,OUT=maximum When MOD- E=3,OUT=median When MOD- E=4,OUT=IN1 When MOD- E=5,OUT=IN2 When MOD- E=6,OUT=IN3	-	Output Pin	Related parameter:MODE ^{Note2}
		ERR	Set Error Alarm	-	Output Pin	Related IN1ERR/ IN2ERR/IN3ERR/DL
		FLAG	Flag	-	Output Pin	
	Operation-Parameter	DL	Deviation Limit (Non-Negative)	TRUE	Operation Parameter	Related parameter: SCH, SCLnormally set to be(SCH - SCL)
		SWOOS	Function Block Forbidden (ON stands for mode OOS)	TRUE	Operation Parameter	Set to be "ON" when function block is downloaded first time

Table 7.4 THRSEL parameter instruction (continued)

Name			Description	Upload	Properties	Application Reference
		AOF	Suppress Module Alarm AOF=ON, It is Not Displaying	TRUE	Operation Parameter	
	Con- fig- ura- tion- Para- meter	SCH	Range High Limit	-	Configuration Parameter	-
		SCL	Range Low Limit	-	Configuration Parameter	-
		MODE	Working Mode	-	Configuration Parameter	Related parameter: OUT
		EU	Output Unit	-	Configuration Parameter	-
		DLEN	Decimal Digits [0,5]	-	Configuration Parameter	-

Note 1. Signal checking principle

Some important interlock control systems have higher requirement for checking the input signals, usually using the 2 of 3 detection mode which is, among 3 input signals, only two or above are valid then consider the detection system is normal. Based on this thought, THRSEL is designed. It is similar to TWSEL but increases the number of input signals to 3. According to the value of selective parameter MODE, THRSEL would select to output the average, maximum, minimum or median value of the three input signals, or to output one of these three signals.

Note 2. Description of MODE selection

- When MODE=0,1,2 or 3:
 1. If all of the three input signals are invalid, meaning the output is incredible, set ERR=ON, and hold the output value of last period.
 2. If two of the three input signals are invalid, output the value of the valid one.
 3. If one of the three input signals is invalid:

- If the deviation between the two valid input signals does not exceed the deviation limit (DL), output the corresponding value according to the value of MODE: when MODE=0 or 3, output their average; MODE=1, output their minimum; when MODE=2, output their maximum.
 - If the deviation between the two valid input signals exceeds the deviation limit (DL), meaning the output is incredible, set ERR=ON, and hold the output value of last period.
4. If all of the three input signals are valid:
- If all of the deviations between every two input signals exceed the deviation limit (DL), set ERR=ON, and hold the output value of last period.
 - If one deviation between two input signals does not exceed the deviation limit (DL), while the other two deviations between the third input signal and these two signals exceed the deviation limit (DL), output the average of these two input signals.
 - If one deviation between two input signals exceeds the deviation limit (DL), while the other two deviations between the third input signal and these two signals do not exceed the deviation limit (DL), output the value of the third input signal, median value of the three input signals.
 - If all of the deviations between every two input signals do not exceed the deviation limit, output the average, minimum maximum or median value of the three input signals according to the value of MODE.
- When MODE=4, output the input value of the specified transmitter, value of IN1. If IN1ERR=ON, meaning input 1 is invalid, set error alarm ERR=ON, and hold the output value of last period.
 - When MODE=5, output the input value of the specified transmitter, value of IN2. If IN2ERR=ON, meaning input 2 is invalid, set ERR=ON, and hold the output value of last period.
 - When MODE=6, output the input value of the specified transmitter, value of IN3. If IN3ERR=ON, meaning input 3 is invalid, set ERR=ON, and hold the output value of last period.
 - When MODE>6, set ERR=ON, and hold the output value of last period.

7.2.2 Panel Parameter

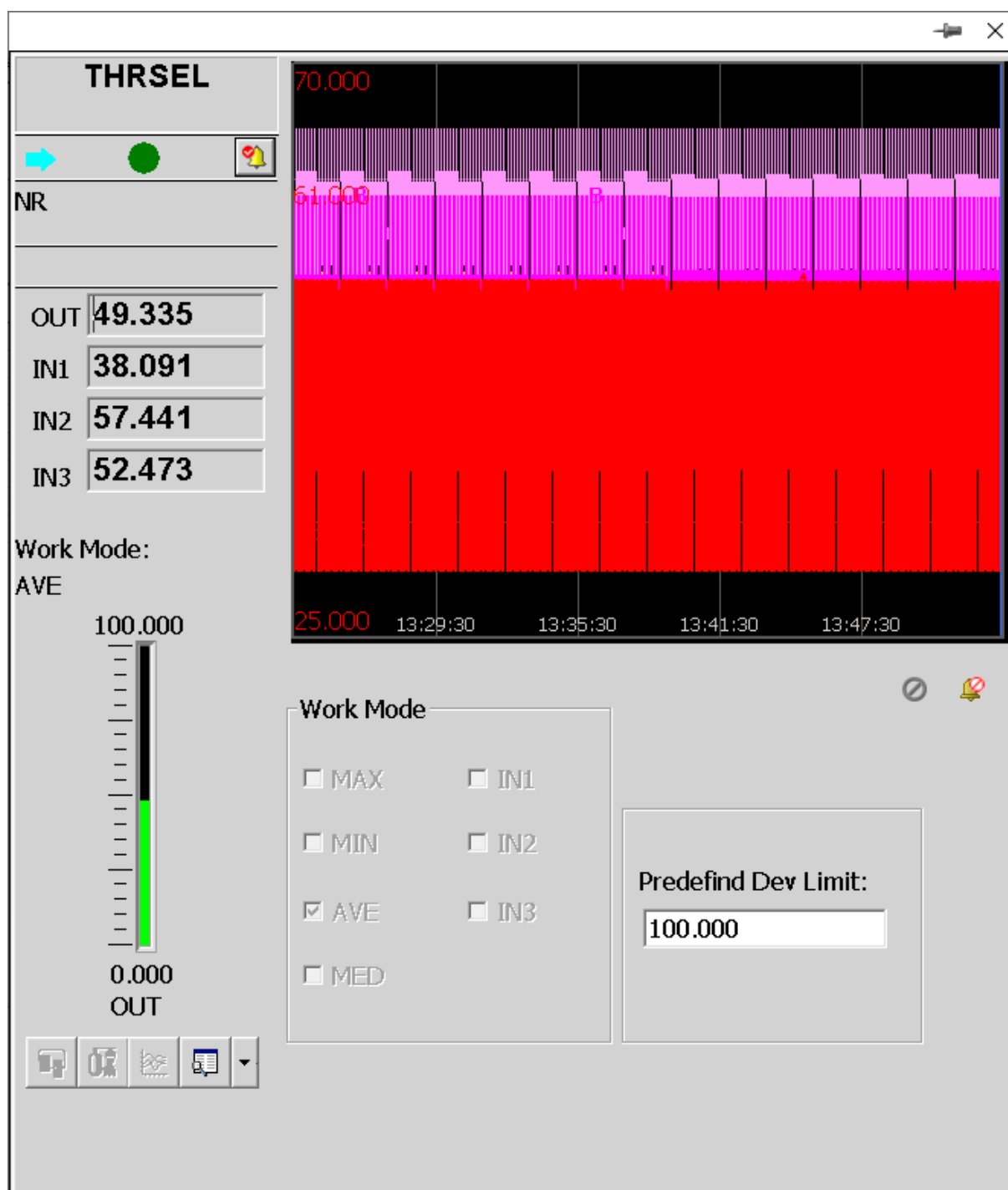


Table 7.5 Panel Parameter Instruction

Panel Parameter Name		Function Block Parameter Name	Initial Value	Value Range	Application Instruction
Work Mode	MAX	MODE	-	-	Read only, chosen, stands for setting MODE=2 in function block Properties

Table 7.5 Panel Parameter Instruction (continued)

Panel Parameter Name		Function Block Parameter Name	Initial Value	Value Range	Application Instruction
	MIN	MODE	-	-	Read only, chosen, stands for setting MODE=1 in function block Properties
	AVE	MODE	√	-	Read only, chosen, stands for setting MODE=0 in function block Properties
	MID	MODE	-	-	Read only, chosen, stands for setting MODE=3 in function block Properties
	IN1	MODE	-	-	Read only, chosen, stands for setting MODE=4 in function block Properties
	IN2	MODE	-	-	Read only, chosen, stands for setting MODE=5 in function block Properties
	IN3	MODE	-	-	Read only, chosen, stands for setting MODE=6 in function block Properties
Predefined Error Limit		DL	100.000	0~(SCH - SCL)	Refer to parameter reference

7.2.3 Flag

Table 7.6 Flag list

Flag	Alarm	Description
D0	OOS	Disable
D1	ERR	Fault
D2	IN1ERR	Quality of input 1 is bad
D3	IN2ERR	Quality of input 2 is bad
D4	IN3ERR	Quality of input 3 is bad
D5	REVSCL	Span H/L Limit Reverse
D6	DEV12	Input 12 Deviation Over Limit
D7	DEV13	Input 13 Deviation Over Limit
D8	DEV23	Input 23 Deviation Over Limit
D9	DEV123	Input 123 Deviation Over Limit

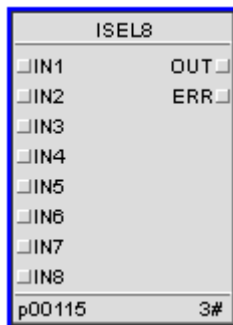
Table 7.6 Flag list (continued)

Flag	Alarm	Description
D10	AOF	Suppress Alarm

7.3 Eight Input Signal Select Function Block (ISEL8)

Function block ISEL8 can select to output the maximum, minimum, average, low-median value, high-median or any specified input, according to the value of parameters OPSEL and MODE.

It is a complex function block, running time is 27μs.



7.3.1 Parameter Description

Table 7.7 ISEL8 parameter instruction

Name			Description	Upload	Properties	Application Reference
Basic Parameters	Range-Settings	SCH	Range Maximum Limit	-	Configuration Parameter	-
		SCL	Range Minimum Limit	-	Configuration Parameter	-
		EU	Output Engineering Unit	-	Configuration Parameter	-
		DLEN	Decimal Digits[0,5]	-	Configuration Parameter	-
	Mode Settings	OPSEL	Operation Selection 0=Output Depends On MODE, and Others Select Corresponding Inputs. ^{Note1}	TRUE	Operation Parameter	-

Table 7.7 ISEL8 parameter instruction (continued)

Name			Description	Upload	Properties	Application Reference
		MODE	SelectionWhen OPSEL Is 0,0=Maximum Selection, 1=Minimum Selection2= Average Value, 3= Low-Median Value4=High-Median Value, 5=sum of effective values ^{Note1} , ^{Note2}	TRUE	Operation Parameter	When OPSEL=0, MODE setting is effective
	Enable Input	ENIN1	Input 1 Disable Switch: OFF=Disable.	-	Input Pin	-
		ENIN2	Input 2 Disable Switch: OFF=Disable.	-	Input Pin	-
		ENIN3	Input 3 Disable Switch: OFF=Disable.	-	Input Pin	-
		ENIN4	Input 4 Disable Switch: OFF=Disable.	-	Input Pin	-
		ENIN5	Input 5 Disable Switch: OFF=Disable.	-	Input Pin	-
		ENIN6	Input 6 Disable Switch: OFF=Disable.	-	Input Pin	-
		ENIN7	Input 7 Disable Switch: OFF=Disable.	-	Input Pin	-
		ENIN8	Input 8 Disable Switch: OFF=Disable.	-	Input Pin	-
Extended Parameters	Input Pin	IN1	Input 1	-	Input Pin	Connect to AI
		IN2	Input 2	-	Input Pin	Connect to AI
		IN3	Input 3	-	Input Pin	Connect to AI
		IN4	Input 4	-	Input Pin	Connect to AI
		IN5	Input 5	-	Input Pin	Connect to AI
		IN6	Input 6	-	Input Pin	Connect to AI
		IN7	Input 7	-	Input Pin	Connect to AI
		IN8	Input 8	-	Input Pin	Connect to AI
	OutputPin	OUT	Output	-	Output Pin	-
		ERR	Set Error Alarm ^{Note1}	-	Output Pin	-

Table 7.7 ISEL8 parameter instruction (continued)

Name			Description	Upload	Properties	Application Reference
	Others	SWOOS	WHETHER FUNCTION BLOCK IS IN OOS STATUS(ON stands for OOS Status)	TRUE	Operation Parameter	Set to be "ON" when function block is downloaded first time
		AOF	Suppress Module Alarm WHEN AOF=ON, IT IS NOT DISPLAYING THE REAL-TIME ALARM.	TRUE	Operation Parameter	Refer to "Integral Cutting"
		FLAG	Flag	-	Output Pin	Refer to Flag

Note 1. Selection instruction

ISEL8 has 8 REAL type inputs and gives an output according to the value of OPSEL and MODE. ENIN1~ENIN8 are the enable keys of input IN1~IN8. When they are OFF, the corresponding inputs are forbidden and excluded from operation. When they are ON, the corresponding input are enabled and included in operation.

When OPSEL is non-zero, output the corresponding input signal (for example: if OPSEL=2, OUT=IN2; if OPSEL=4, OUT=IN4), whether it is enabled or not.

When OPSEL=0, output the result operated under specified algorithm according to MODE. Only those enabled input signals are included in operation. When OPSEL=0, but there is no enabled input, set ERR=ON and alarm.

If MODE=0, output the maximum.

If MODE=1, output the minimum.

If MODE=2, output the average.

If MODE=3, output the low-median value.

If MODE=4, output the high-median value.

If MODE=5, output the sum of effective values. That is, count the INn whose related parameter ENINn=ON, For example, ENIN1=ON, ENIN2=OFF, ENIN3=OFF, ENIN4=ON, ENIN5=OFF, ENIN6=ON, ENIN7=ON, ENIN8=ON, then OUT=IN1+IN4+IN6+IN7+IN8.

If MODE>5, ERR=ON, and hold the output value of last period.

Note 2. Definition of median value

Whenever the number of flag entered is even, rank them from the large to the small ones, the two numbers in the middle are called median. The larger one of them is called high median while the smaller one of them is called low median.

For example, if there are four numbers, 100, 53, 27 and 18, in that way, 27 is the low median and 53 is the high median of the four of them.

7.3.2 Panel Paramter

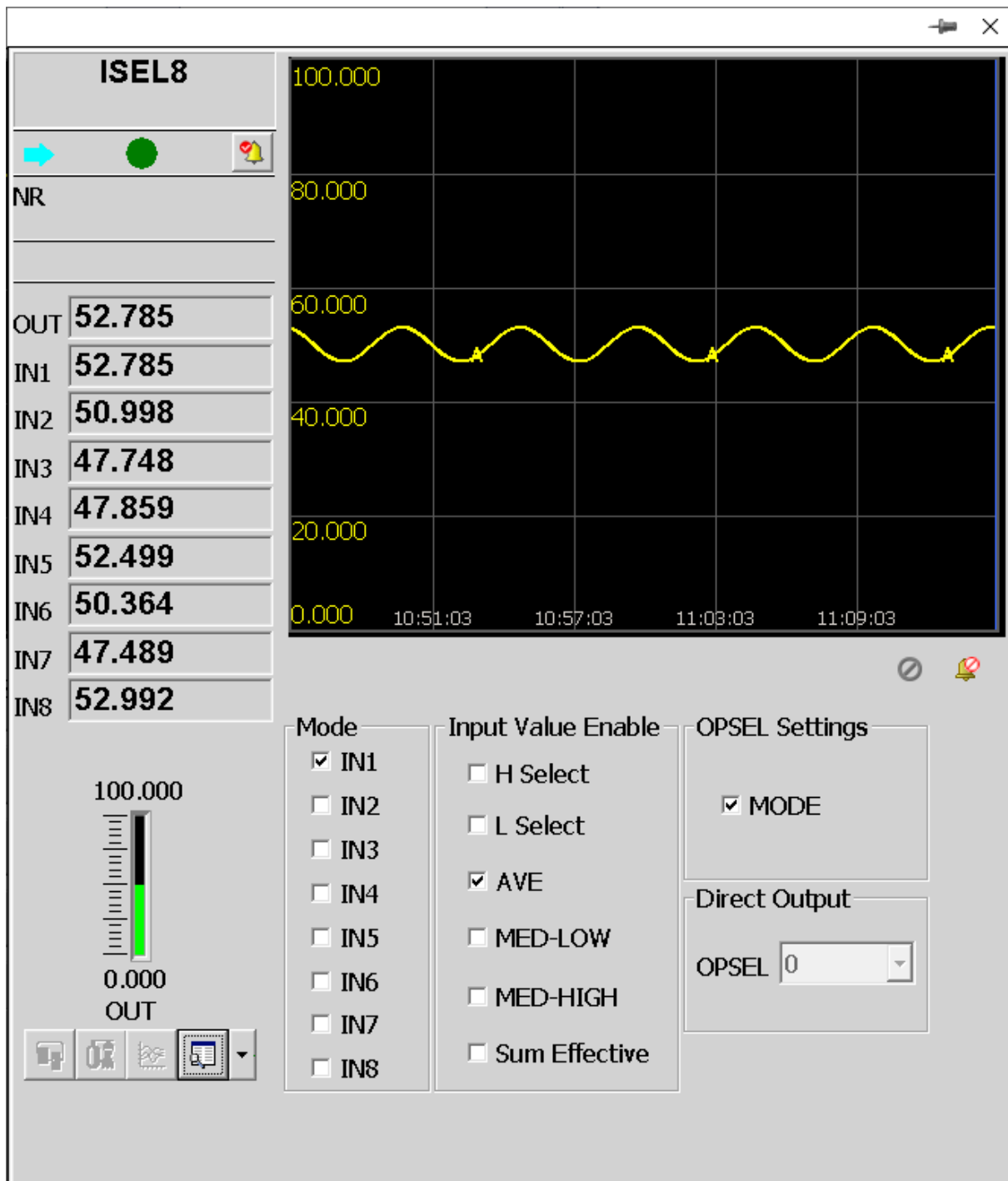


Table 7.8 Panel parameter instruction

Panel Parameter Name		Function Block Parameter Name	Initial Value	Value Range	Application Instruction
Mode	IN1	ENIN1	-	-	Input 1 suppress switch(unselected=suppress)
	IN2	ENIN2	-	-	Input 2 suppress switch(unselected=suppress)
	IN3	ENIN3	-	-	Input 3 suppress switch(unselected=suppress)
	IN4	ENIN4	-	-	Input 4 suppress switch(unselected=suppress)
	IN5	ENIN5	-	-	Input 5 suppress switch(unselected=suppress)
	IN6	ENIN6	-	-	Input 6 suppress switch(unselected=suppress)
	IN7	ENIN7	-	-	Input 7 suppress switch(unselected=suppress)
	IN8	ENIN8	-	-	Input 8 suppress switch(unselected=suppress)
Input Value Enable	MAX	MODE	-	-	If chosen, stands for setting MODE=0 in function block Properties
	MIN	MODE	-	-	If chosen, stands for setting MODE=1 in function block Properties
	AVE	MODE	√	-	If chosen, stands for setting MODE=2 in function block Properties
	MID-LOW	MODE	-	-	If chosen, stands for setting MODE=3 in function block Properties
	MID-HIGH	MODE	-	-	If chosen, stands for setting MODE=4 in function block Properties
OPSEL Settings	MODE	OPSEL	√	-	If chosen, OPSEL=0, conditional output. If not chosen, OPSEL does not equal to 0(reference 1),directly output.
DirectOutput	OPSEL	OPSEL	-	[0,8]	If Do not chose conditional output, output number is can be set. Setting input number to be 0 equals choosing conditional output.

7.3.3 Flag

Table 7.9 Flag list

Flag	Alarm	Description
D0	OOS	Disable
D1	ERR	Fault
D5	REVSCL	Span H/L Limit Reverse
D7	AOF	Suppress Alarm

7.3.4 Application Example

To output maximum of signals PT_1003A, PT_1003B, PT_1003C, PT_1003D, PT_1003E, PT_1003F, PT_1003G and PT_1003H, and the operator can choose output method in the flow chart.

Its programming is shown below and can be achieved via ISEL8. The select output for various analog signals can be performed by the host computer interface via function block tag, and the output value can be made sure based on the parameters OPSEL and MODE. The analog select-one-from-many can output the average, minimum, maximum, H medium value, L medium value and all input signals of various input signals when required.

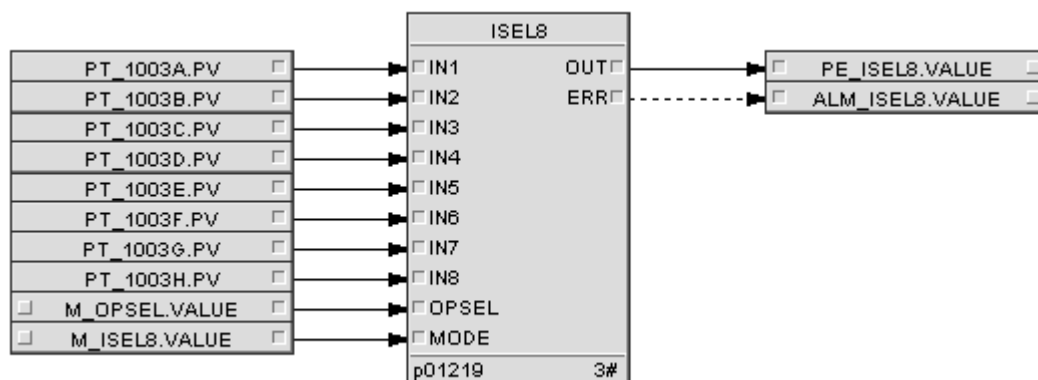


Figure 7.1 Programming of ISEL8

The function block instruction and examples are shown below.

NO.	Example	Type	Instruction
001	PT_1003A	AI (Input)	Analog Input Tag 1
002	PT_1003B	AI (Input)	Analog Input Tag 2
003	PT_1003C	AI (Input)	Analog Input Tag 3
004	PT_1003D	AI (Input)	Analog Input Tag 4

NO.	Example	Type	Instruction
005	PT_1003E	AI (Input)	Analog Input Tag 5
006	PT_1003F	AI (Input)	Analog Input Tag 6
007	PT_1003G	AI (Input)	Analog Input Tag 7
008	PT_1003H	AI (Input)	Analog Input Tag 8
009	M_OPSEL	Custom USINT	OPSEL Select Operation Tag
010	M_ISEL8	Custom USINT	MODE Select Tag
011	PE_ISEL8	Custom REAL	Select-One-from-Many Output Tag
012	ALM_ ISEL8	Custom BOOL	Invalid Alarm Output

ISEL8 can make sure the output value according to parameters OPSEL and MODE.

ENIN1~ENIN8 are enabled switches for input IN1~IN8.

Note: the data can be invoked via ISEL8 without custom tag.

Parameter settings of ISEL8:

- SCH: keep the same with the designed I/O tag
- SLH: keep the same with the designed I/O tag
- EU: keep the same with the designed I/O tag
- MODE: 0
- EN1IN-EN8IN: ON
- No related alarm settings.

7.4 Digital Switch Function Block (DS)

Function block DS can output one of the two BOOL inputs, according to the value of parameter SW.

It is a simple function block, running time is 1μs.

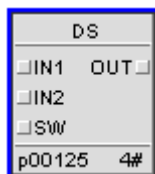


Table 7.10 DS parameter instruction

Name			Description	Upload	Properties	Application Reference
Basic Parameters	Input Pin	IN1	Input 1	-	Input Pin	-
		IN2	Input 2	-	Input Pin	-

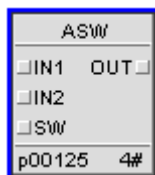
Table 7.10 DS parameter instruction (continued)

Name			Description	Upload	Properties	Application Reference
		SW	Switch	-	Input Pin	-
	Output Pin	OUT	When SW=ON,OUT=IN2 When SW=OFF,OUT=IN1	-	Output Pin	Related parameter: SW

7.5 Analog Switch Function Block (ASW)

Function block ASW can output one of the two REAL inputs, according to the value of parameter SW.

It is a simple function block, whose running time is 2μs.

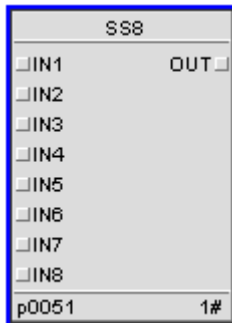
**Table 7.11 ASW parameter instruction**

Name			Description	Upload	Properties	Application Reference
Basic Parameters	Input Pin	IN1	Input 1	-	Input Pin	-
		IN2	Input 2	-	Input Pin	-
		SW	Switch	-	Input Pin	-
	Output Pin	OUT	When SW=ON,OUT=IN2 When SW=OFF,OUT=IN1	-	Output Pin	Related parameter:SW
	Operation Parameter	TFLT	Filtering Co-efficient	TRUE	Operation Parameter	During output switch, can smooth deviation between IN1 and IN2 to make it possible for output to switch to desired value smoothly. Suggesting engineering value is 1, meaning the value one second after switch is effective value. Default value is 0.0000, meaning output switch is not through smoothing.

7.6 Multi-choice of Eight Digital Signal Select Function Block (SS8)

Function block SS8 can count the input ON of 8 BOOL input signals, and compare the result with NUM, a preset parameter of number of input ON. If the input ON is larger than NUM, SS8 outputs ON, and specifically the forbidden inputs are not counted.

It is a complex function block, whose running time is 6μs.



7.6.1 Parameter Description

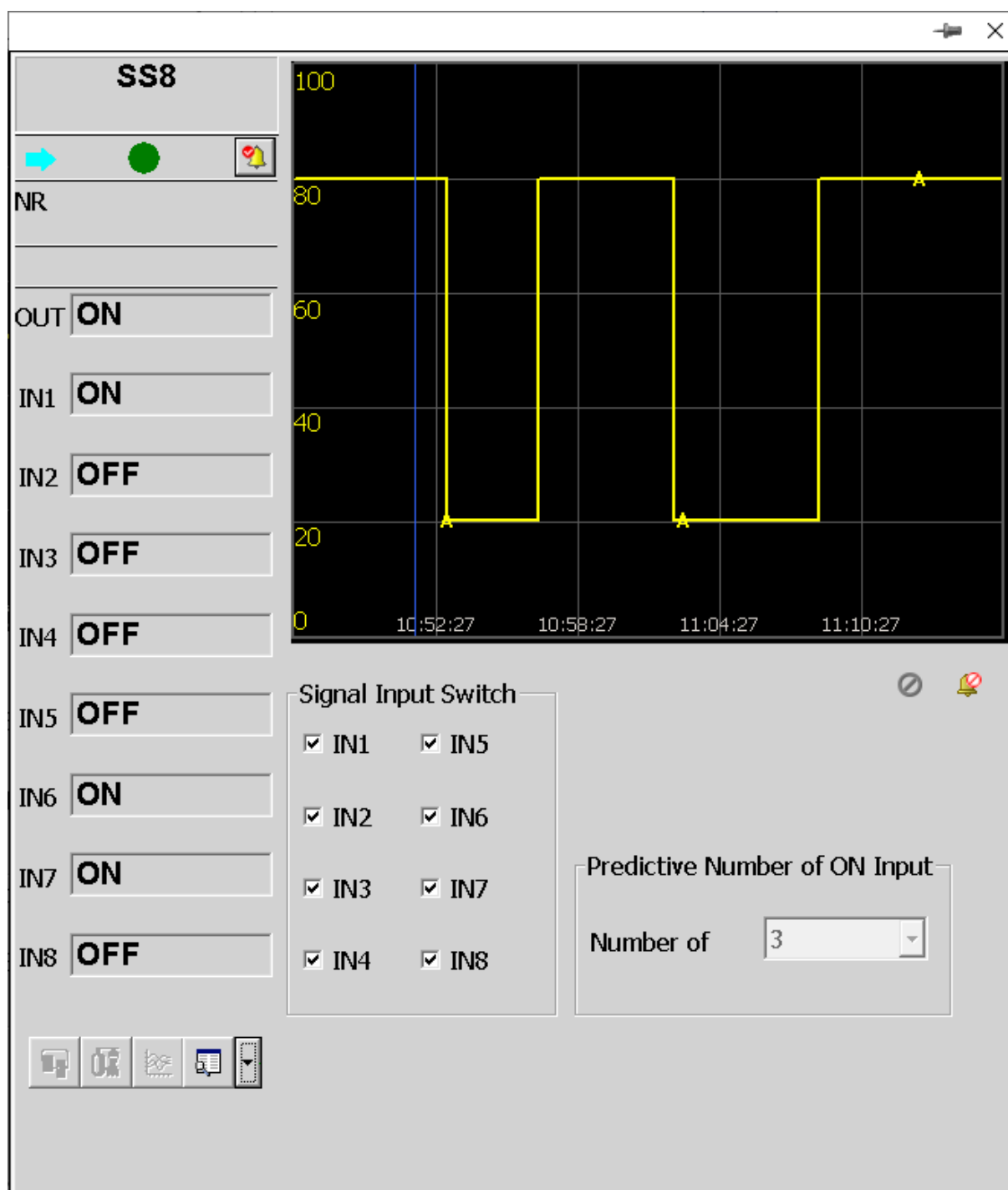
Table 7.12 SS8 parameter instruction

Name			Description	Upload	Properties	Application Reference
Basic Parameters	Input Pin	IN1	Input 1	-	Input Pin	Connect to DI
		IN2	Input 2	-	Input Pin	Connect to DI
		IN3	Input 3	-	Input Pin	Connect to DI
		IN4	Input 4	-	Input Pin	Connect to DI
		IN5	Input 5	-	Input Pin	Connect to DI
		IN6	Input 6	-	Input Pin	Connect to DI
		IN7	Input 7	-	Input Pin	Connect to DI
		IN8	Input 8	-	Input Pin	Connect to DI
	Output Pin	OUT	If number of ON input is larger or equal to NUM, OUT=ON. Otherwise, OUT=OFF	-	Output Pin	-
	Enable Input	ENIN1	Input 1 Disable Switch: OFF=Disable.	-	Input Pin	ON=correspondent input enable switch
		ENIN2	Input 2 Disable Switch: OFF=Disable.	-	Input Pin	ON=correspondent input enable switch

Table 7.12 SS8 parameter instruction (continued)

Name			Description	Upload	Properties	Application Reference
		ENIN3	Input 3 Disable Switch: OFF=Disable.	-	Input Pin	ON=correspondent input enable switch
		ENIN4	Input 4 Disable Switch: OFF=Disable.	-	Input Pin	ON=correspondent input enable switch
		ENIN5	Input 5 Disable Switch: OFF=Disable.	-	Input Pin	ON=correspondent input enable switch
		ENIN6	Input 6 Disable Switch: OFF=Disable.	-	Input Pin	ON=correspondent input enable switch
		ENIN7	Input 7 Disable Switch: OFF=Disable.	-	Input Pin	ON=correspondent input enable switch
		ENIN8	Input 8 Disable Switch: OFF=Disable.	-	Input Pin	ON=correspondent input enable switch
	Others	NUM	The Number of Pre-Setting ON is 0~8.	-	Configuration Parameter	Related parameter:OUT
		SWOOS	WHETHER FUNCTION BLOCK IS IN OOS STATUS(ON stands for OOS Status)	TRUE	Operation Parameter	Set to be "ON" when function block is downloaded first time
		AOF	Suppress Module AlarmWHEN AOF=ON, IT IS NOT DISPLAYING THE REAL-TIME ALARM.	TRUE	Operation Parameter	Refer to "Alarm"
		FLAG	Flag	-	Output Pin	Refer to "Flag"

7.6.2 Panel Parameter



Panel Parameter Name	Function Block Parameter Name	Initial Value	Value Range	Application Instruction
Signal suppress Switch	IN1	ENIN1	-	Input 1 suppress switch(unselected=suppress)
	IN2	ENIN2	-	Input 2 suppress switch(unselected=suppress)
	IN3	ENIN3	-	Input 3 suppress switch(unselected=suppress)

Panel Parameter Name		Function Block Parameter Name	Initial Value	Value Range	Application Instruction
	IN4	ENIN4	-	-	Input 4 suppress switch(unselected=suppress)
	IN5	ENIN5	-	-	Input 5 suppress switch(unselected=suppress)
	IN6	ENIN6	-	-	Input 6 suppress switch(unselected=suppress)
	IN7	ENIN7	-	-	Input 7 suppress switch(unselected=suppress)
	IN8	ENIN8	-	-	Input 8 suppress switch(unselected=suppress)
Predictive Number of ON Input	Number of ON	NUM	0	[0,8]	Read only, set in function Properties settings

7.6.3 Flag

Flag	Alarm	Description
D0	OOS	Disable
D7	AOF	Suppress Alarm

7.7 USINT Select Function Block (USINTSW)

Function block USINTSW can output one of the USINT input signals, according to the value of parameter SW.

It is a simple function block, whose running time is 2 μ s.

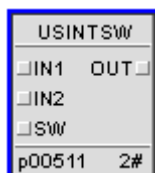


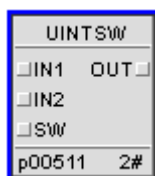
Table 7.13 USINTSW parameter instruction

Name			Description	Upload	Properties	Application Reference
Basic Parameters	Input Pin	IN1	Input 1	-	Input Pin	-
		IN2	Input 2	-	Input Pin	-
		SW	Switch	-	Input Pin	-
	Output Pin	OUT	When SW=ON,OUT=IN2When SW=OFF,OUT=IN1	-	Output Pin	Related parameter: SW

7.8 UINT Select Function Block (UINTSW)

Function block UNITSW can output one of the two UINT input signals according to the value of parameter SW.

It is a simple function block, whose running time is 2μs.

**Table 7.14 UNITSW parameter instruction**

Name			Description	Upload	Properties	Application Reference
Basic Parameters	Input Pin	IN1	Input 1	-	Input Pin	-
		IN2	Input 2	-	Input Pin	-
		SW	Switch	-	Input Pin	-
	Output Pin	OUT	When SW=ON,OUT=IN2When SW=OFF,OUT=IN1	-	Output Pin	Related parameter:SW

7.9 UDINT Select Function Block (UDINTSW)

Function block UDINTSW can output one of the UDINT input signals according to the value of parameter SW.

It is a simple function block, whose running time is 2μs.

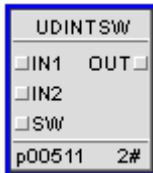


Table 7.15 UDINTSW parameter instruction

Name			Description	Upload	Properties	Application Reference
Basic Parameters	Input Pin	IN1	Input 1	-	Input Pin	-
		IN2	Input 2	-	Input Pin	-
		SW	Switch	-	Input Pin	-
	Output Pin	OUT	When SW=ON,OUT=IN2When SW=OFF,OUT=IN1	-	Output Pin	Related parameter: SW

7.10 SINT Select Function Block (SINTSW)

Function block SINTSW can output one of the two SINT input signals according to the value of parameter SW.

It is a simple function block, whose running time is 2μs.

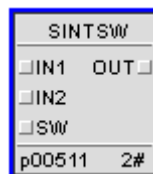


Table 7.16 SINTSW parameter instruction

Name			Description	Upload	Properties	Application Reference
Basic Parameters	Input Pin	IN1	Input 1	-	Input Pin	-
		IN2	Input 2	-	Input Pin	-
		SW	Switch	-	Input Pin	-
	Output Pin	OUT	When SW=ON,OUT=IN2 When SW=OFF,OUT=IN1	-	Output Pin	Related parameter: SW

7.11 INT Select Function Block (INTSW)

Function block INTSW can output one of the two INT input signals according to the value of parameter SW.

It is a simple function block, whose running time is 2μs.



Table 7.17 INTSW parameter instruction

Name			Description	Upload	Properties	Application Reference
Basic Parameters	Input Pin	IN1	Input 1	-	Input Pin	-
		IN2	Input 2	-	Input Pin	-
		SW	Switch	-	Input Pin	-
	Output Pin	OUT	When SW=ON,OUT=IN2 When SW=OFF,OUT=IN1	-	Output Pin	Related parameter: SW

7.12 DINT Select Function Block (DINTSW)

Function block DINTSW can output one of the two DINT input signals according to the value of parameter SW.

It is a simple function block, whose running time is 2μs.



Table 7.18 DINTSW parameter instruction

Name			Description	Upload	Properties	Application Reference
Basic Parameters	Input Pin	IN1	Input 1	-	Input Pin	-
		IN2	Input 2	-	Input Pin	-
		SW	Switch	-	Input Pin	-
	Output-Pin	OUT	When SW=ON,OUT=IN2	-	Output Pin	Related parameter: SW

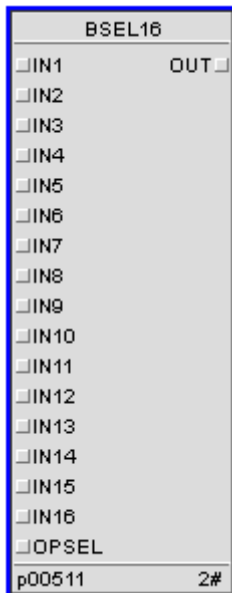
Table 7.18 DINTSW parameter instruction (continued)

Name			Description	Upload	Properties	Application Reference
			When SW=OFF, OUT=IN1			

7.13 16-channel Digital Selection Function Block (BSEL16)

Function block BSEL16 can select one channel input of 16 channels input to output via the serial number selection parameter.

It is a simple function block, whose running time is 27μs.

**Table 7.19 BSEL16 parameter instruction**

Name			Description	Upload	Properties	Application Reference
Basic Parameters	Input Pin	IN1	Input 1	-	Input Pin	-
		IN2	Input 2	-	Input Pin	-
		IN3	Input 3	-	Input Pin	-
		IN4	Input 4	-	Input Pin	-
		IN5	Input 5	-	Input Pin	-
		IN6	Input 6	-	Input Pin	-
		IN7	Input 7	-	Input Pin	-
		IN8	Input 8	-	Input Pin	-

Table 7.19 BSEL16 parameter instruction (continued)

Name			Description	Upload	Properties	Application Reference
		IN9	Input 9	-	Input Pin	-
		IN10	Input 10	-	Input Pin	-
		IN11	Input 11	-	Input Pin	-
		IN12	Input 12	-	Input Pin	-
		IN13	Input 13	-	Input Pin	-
		IN14	Input 14	-	Input Pin	-
		IN15	Input 15	-	Input Pin	-
		IN16	Input 16	-	Input Pin	-
		OPSEL	Select NO.(0= Hold)	-	Input Pin	Range is [0,16]
	Out-putPin	OUT	When OPSEL=0,output remains the same with the value of last round. When OPSEL is not equal to 0,chose an output according to the value of OPSEL. For instance, when OPSEL=8,OUT=IN8	-	Output Pin	-

7.14 Extended Two Input Signal Selector Function Block (TWOSELX)

Function Block TWOSELX can select to output one of two input signals according to the setting MODE.

It is a complex function block, whose running time is 8μs.



7.14.1 Prameter Description

Table 7.20 TWOSLX parameter instruction

Name			Description	Upload	Properties	Application Reference
Basic Parameters	OperationParameter	DL	Preset Deviation Limit	TRUE	Operation Parameter	-
		MODE	Selection Mode ^{Note2}	TRUE	Operation Parameter	-
	ConfigurationParameter	SCH	Range Maximum Limit	-	Configuration Parameter	-
		SCL	Range Minimum Limit	-	Configuration Parameter	-
		EU	Output Engineering Unit	-	Configuration Parameter	-
		DLEN	Decimal Digits[0,5]	-	Configuration Parameter	-
Extended Parameters	Input Pin	IN1	Input 1	-	Input Pin	Connect to AI
		IN2	Input 2	-	Input Pin	Connect to AI
		IN1ERR	Input 1 Quality Direction(OFF=input is good)	-	Input Pin	Connect to AI.ERR
		IN2ERR	Input 2 Quality Direction(OFF=input is good)	-	Input Pin	Connect to AI.ERR
	OutputPin	OUT	When MODE=0, OUT=(IN1+IN2)/ 2	-	Output Pin	Related parameter: MODERefer to ^{Note2}
			When MODE=1, OUT=minimum When MODE=2, OUT=maximum When MODE=3, OUT=IN1			

Table 7.20 TWOSELX parameter instruction (continued)

Name			Description	Upload	Properties	Application Reference
			When MODE=4, OUT=IN2 When MODE>4, set manually;			
		ERR	Module Illegal Alarm ^{Note1,} Note2	-	Output Pin	-
		FLAG	Flag	-	Output Pin	Refer to "Flag"
	OperationPa- rameter	SWOOS	WHETHER FUNCTION BLOCK IS IN OOS STATUS(ON stands for OOS Status)	TRUE	Operation Parameter	Set to be "ON" when function block is downloaded first time
		AOF	Suppress Module AlarmWHEN AOF=ON, IT IS NOT DIS- PLAYING THE RE- AL-TIME ALARM.	TRUE	Operation Parameter	Refer to "Alarm"
	Supervision Parameter	ADPTIN1	ADP- TIN1=ON, then IN1 is valid	-	Monitoring Parameter	-
		ADPTIN2	ADP- TIN2=ON , then IN2 is valid	-	Monitoring Parameter	-
		DEV12	Difference Between IN1 And IN2 Overlimit	-	Monitoring Parameter	-

Note 1. Signal detecting principleRefer to "Note 1. Signal checking principle"^{Note1}**Note 2. Selection instruction**

- When MODE=0, 1 or 2:
 1. If both of two inputs are invalid, the output is incredible. Set error alarm ERR=ON, and hold the output value of last period.
 2. If one of two inputs is invalid, output the value of the other valid input.
 3. If both of two inputs are valid:
 - If the deviation between the two inputs exceeds the setting deviation limit DL, set error alarm ERR=ON, and hold the output value of last period.
 - If the deviation between the two inputs does not exceed DL, then select to output the average, minimum, or maximum of the two input signals, according to the value of MODE.
- When MODE=3, output the input value of the specified transmitter, that is the value of IN1. If IN1ERR=ON means that input 1 is invalid, set error alarm ERR=ON, and hold the output value of last period.
- When MODE=4, output the input value of the specified transmitter, that is the value of IN2. If IN2ERR=ON means that input 2 is invalid, set error alarm ERR=ON, and hold the output value of last period.
- When MODE>4, set error alarm ERR=ON, and the output could be set manually.

7.14.2 Panel Parameter

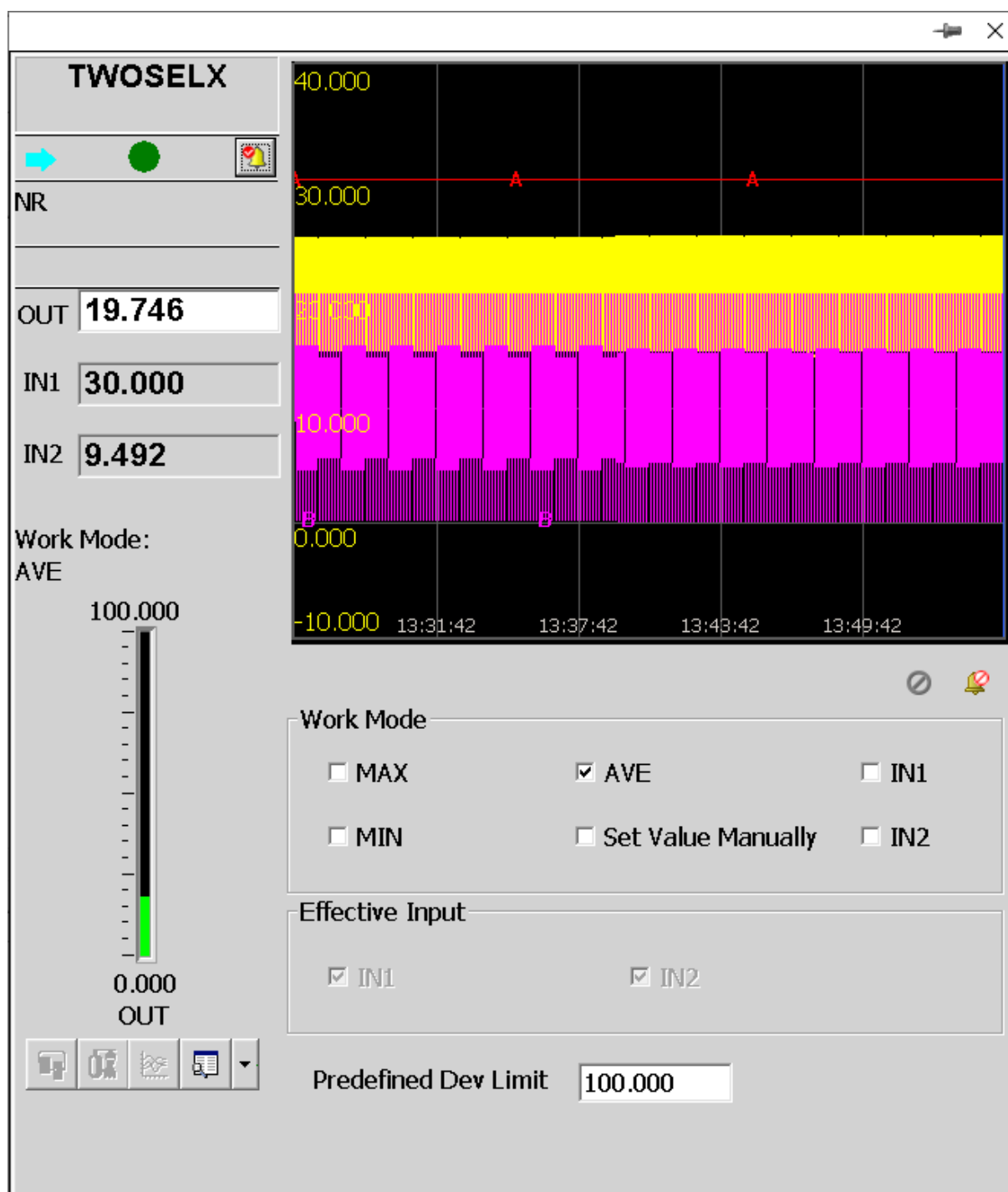


Table 7.21 HMI Parameters list

Panel Parameter Name		Function Block Parameter Name	Initial Value	Value Range	Application Instruction
Work Mode	Maximum	MODE	-	-	If chosen, stands for setting MODE= in function block Properties MODE=2
	Minimum	MODE	-	-	If chosen, stands for setting MODE= in function block Properties MODE=1

Table 7.21 HMI Parameters list (continued)

Panel Parameter Name		Function Block Parameter Name	Initial Value	Value Range	Application Instruction
	Average	MODE	√	-	If chosen, stands for setting MODE= in function block Properties MODE=0
	Input 1	MODE	-	-	If chosen, stands for setting MODE= in function block Properties MODE=3
	Input 2	MODE	-	-	If chosen, stands for setting MODE= in function block Properties MODE=4
	Set Value Manually	MODE	-	-	If chosen, stands for setting MODE= in function block Properties MODE>4
Effective Input	Input1	ADPTIN1	√	ON/OFF	If chosen, input 1 is valid, Read only, modify in function block Properties
	Input2	ADPTIN2	√	ON/OFF	If chosen, input 2 is valid, read only, modify in function block Properties
Predefined Error Limit		DL	100.000	0~(SCH - SCL)	Refer to "Parameter Description"
Work Mode		MODE	-	-	When MODE=0, display the average. When MODE=1, display the minimum. When MODE=2, display the maximum. When MODE=3, display the value of IN1. When MODE=4, display the value of IN2. When MODE>4, display "Set value Manually".

7.14.3 Flag

Table 7.22 FLAG list

Flag	Alarm	Description
D0	OOS	Disable
D1	ERR	Fault
D2	IN1ERR	Quality of input 1 is bad
D3	IN2ERR	Quality of input 2 is bad
D4	AOF	Suppress Alarm
D5	REVSCL	Span H/L Limit Reverse
D6	DEV12	Input 12 Deviation Over Limit

7.14.4 Application Example

It can output the average of TE_0610 and TE_0611 for the technical field when required, and the operator can choose the output method in the flow chart.

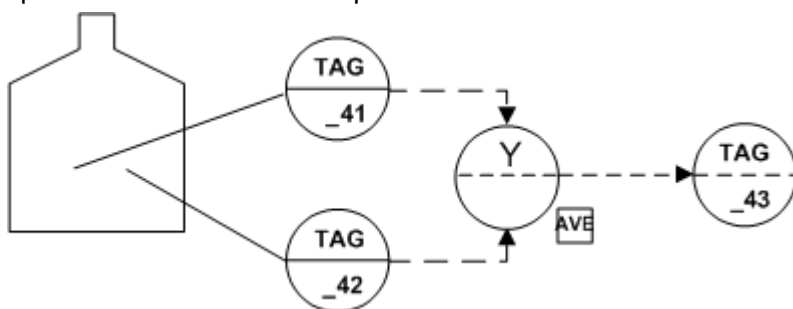


Figure 7.2 Diagram of analog select-one-from-two

Its programming is shown below and can be achieved via TWOSELX. The host computer interface can select and output 2 analog signals via function block tag. According to the 2 REAL type input signals and by selecting the value of type parameter MODE, it can select and output the average, maximum, minimum, input signal 1 and input signal 2 of 2 input signals. Many functions can be performed by assigning values for MODE in TWOSELX.

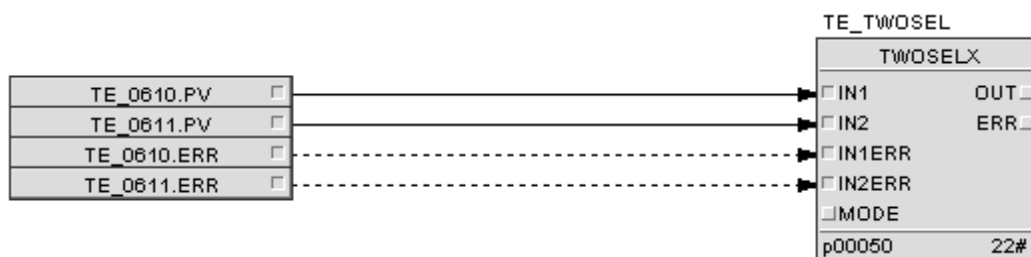


Figure 7.3 Programming of TWOSELX

The function block instruction and examples are shown below.

Table 7.23 Function block instruction and examples

NO.	Example	Type	Instruction	Remark
001	TE_0610	AI (Input)	Analog Input Tag 1	
002	TE_0611	AI (Input)	Analog Input Tag 2	
004	TE_TWSELX	Custom REAL	Select-one-from-two Output Tag	MODE=0

Parameter settings of TWOSELX:

- SCH: keep the same with designed I/O tag
- SLH: keep the same with designed I/O tag
- EU: keep the same with designed I/O tag
- MODE: 0

- If one input error occurs to TWOSSELX, TWOSSELX will ignore the error input and take another normal input to calculate the average. The loop error alarm (ERR) generates.
- If two errors occur to TWOSSELX, it will take the last normal value. The loop error alarm (ERR) generates.
- If the deviation of two input values is larger than the preset DL (set as DL=100 in default), TWOSSELX will take the last deviated value in normal range. The loop error alarm (ERR) generates.

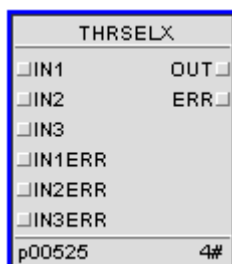
Notice:

- The parameter MODE of TWOSSEL can only be set in the program. The MODE pin of TWOSSELX can be selected and used. The related tag can be invoked via pin. Operator can select at the monitoring interface.
- When MODE=0, MODE=1, MODE=2
 - If both inputs are invalid, set ERR=ON, output holds the value of last period.
 - If one input is invalid, the output is equal to the valid input value.
 - If both inputs are valid, when the deviation of two input signals exceeds the preset DL, the output is incredible, set ERR=ON, output the value of last period; when the deviation of two input signals does not exceed the preset DL, output the average, maximum and minimum of the two input signals.
 - When MODE=3 or MODE=4, the output is equal to the input value of transducer, output the value of IN1 or IN2. If the input is invalid, the output is incredible, set ERR=ON, output holds the value of last period.
 - When MODE is equal to other values, set ERR=ON, output holds the value of last period.

7.15 Extended three Input Signal Selector Function Block (THRSSELX)

Function Block THRSSELX can select to output one of three input signals according to the setting MODE.

It is a complex function block, whose running time is 12μs.



7.15.1 Parameter Description

Table 7.24 *THRSELX parameter instruction*

Name			Description	Upload	Properties	Application Reference
Basic Parameters	Operation Parameter	DL	Preset Deviation Limit	TRUE	Operation Parameter	-
		MODE	Selection Mode	TRUE	Operation Parameter	Related parameter: OUT
	Configuration Parameter	SCH	Range Maximum Limit	-	Configuration Parameter	-
		SCL	Range Minimum Limit	-	Configuration Parameter	-
		EU	Output Engineering Unit	-	Configuration Parameter	-
		DLEN	Decimal Digits[0,5]	-	Configuration Parameter	-
Extended Parameters	Input Pin	IN1	Input 1	-	Input Pin	Connect to AI
		IN2	Input 2	-	Input Pin	Connect to AI
		IN3	Input 3	-	Input Pin	Connect to AI
		IN1ERR	Input 1 Quality Direction(OFF=input is good)	-	Input Pin	Connect to AI.ERR
		IN2ERR	Input 2 Quality Direction(OFF=input is good)	-	Input Pin	Connect to AI.ERR
		IN3ERR	Input 3 Quality Direction(OFF=input is good)	-	Input Pin	Connect to AI.ERR
	Output Pin	OUT	When MODE=0, $OUT=(IN1+IN2+IN3)/3$ When MODE=1, OUT=minimum	-	Output Pin	Refer to ^{Note1}

Table 7.24 THRSELX parameter instruction (continued)

Name			Description	Upload	Properties	Application Reference
			When MODE=2, OUT=maximum When MODE=3, OUT=medium When MODE=4, OUT=IN1 When MODE=5, OUT=IN2 When MODE=6, OUT=IN3 When MODE=7 is satisfied, the value is as- signed manu- ally. When MODE=8 is satisfied, the value is as- signed as the mean value of the median and the aver- age value			
		ERR	Module Illegal Alarm ^{Note1}	-	Output Pin	Related IN1ERR/ IN2ERR/IN3ERR/DL
		FLAG	Flag	TRUE	Output Pin	Set to be "ON" when function block is downloaded first time
	OperationPa- rameter	SWOOS	Whether Function Block Is In OOS State (ON stands for OOS State)	TRUE	Operation Parameter	Refer to "Alarm"
		AOF	Suppress Module Alarm When AOF=ON, It Is Not Dis-	TRUE	Operation Parameter	Set to be "ON" when function block is downloaded first time

Table 7.24 THRSELX parameter instruction (continued)

Name			Description	Upload	Properties	Application Reference
	Supervision-Parameter		playing The Real-Time Alarm.			
		ADP-TIN1	ADP-TIN1=ON, then IN1is valid	-	Monitoring Parameter	-
		ADP-TIN2	ADP-TIN2=ON , then IN2is valid	-	Monitoring Parameter	-
		ADP-TIN3	ADP-TIN3=ON , then IN3is valid	-	Monitoring Parameter	-
		DEV12	Difference Between IN1 And IN2 Overlimit	-	Monitoring Parameter	-
		DEV23	Difference Between IN2 And IN3 Overlimit	-	Monitoring Parameter	-
		DEV13	OVERLIMIT-Difference Between IN1 And IN3 Overlimit	-	Monitoring Parameter	-

Note 1. Selection instruction

- When MODE=0,1,2 or 3:
 1. If all of the three input signals are invalid, meaning the output is incredible, set ERR=ON, and hold the output value of last period.
 2. If two of the three input signals are invalid, output the value of the value of the valid one.
 3. If one of the three input signals is invalid:
 - If the deviation between the two valid input signals does not exceed the deviation limit (DL), output the corresponding value according to the value of MODE: when MODE=0, output the average; MODE=1, output the minimum; when MODE=2,

- output the maximum; when MODE=3, if IN1 and IN3 are invalid, output the value of IN2, if IN2 is invalid, output the value of IN1.
- If the deviation between the two valid input signals exceeds the deviation limit (DL), meaning the output is incredible, set ERR=ON, and hold the output value of last period.
4. If all of the three input signals are valid:
- If all of the deviations between every two input signals exceed the deviation limit (DL), set ERR=ON, and hold the output value of last period.
 - If one deviation between two input signals does not exceed the deviation limit (DL), while the other two deviations between the third input signal and these two signals exceed the deviation limit (DL), output the corresponding value according to the value of MODE: when MODE=0, output the average of the two input signals whose deviation does not exceed the deviation limit (DL); when MODE=1, output the minimum value of the two input signals; when MODE=2, output the maximum value of the two input signals; when MODE=3, output IN2 if IN1 and IN3 exceed, or output IN1 if IN2 exceeds.
 - If one deviation between two input signals exceeds the deviation limit (DL), while the other two deviations between the third input signal and these two signals do not exceed the deviation limit (DL), output the value of the third input signal, median value of the three input signals.
 - If all of the deviations between every two input signals do not exceed the deviation limit, output the average, minimum maximum or median value of the three input signals according to the value of MODE.
- When MODE=4, output the input value of the specified transmitter, value of IN1. If IN1ERR=ON, meaning input 1 is invalid, set error alarm ERR=ON, and hold the output value of last period.
 - When MODE=5, output the input value of the specified transmitter, value of IN2. If IN2ERR=ON, meaning input 2 is invalid, set ERR=ON, and hold the output value of last period.
 - When MODE=6, output the input value of the specified transmitter, value of IN3. If IN3ERR=ON, meaning input 3 is invalid, set ERR=ON, and hold the output value of last period.
 - When MODE=7, set error alarm ERR=ON, and the output could be set manually.
 - When MODE=8, if one of the 3 inputs is bad, and the difference of the other two are not over set limit, output the average value of the 2 good points. Otherwise, output as MODE=3.

7.15.2 Panel Parameter

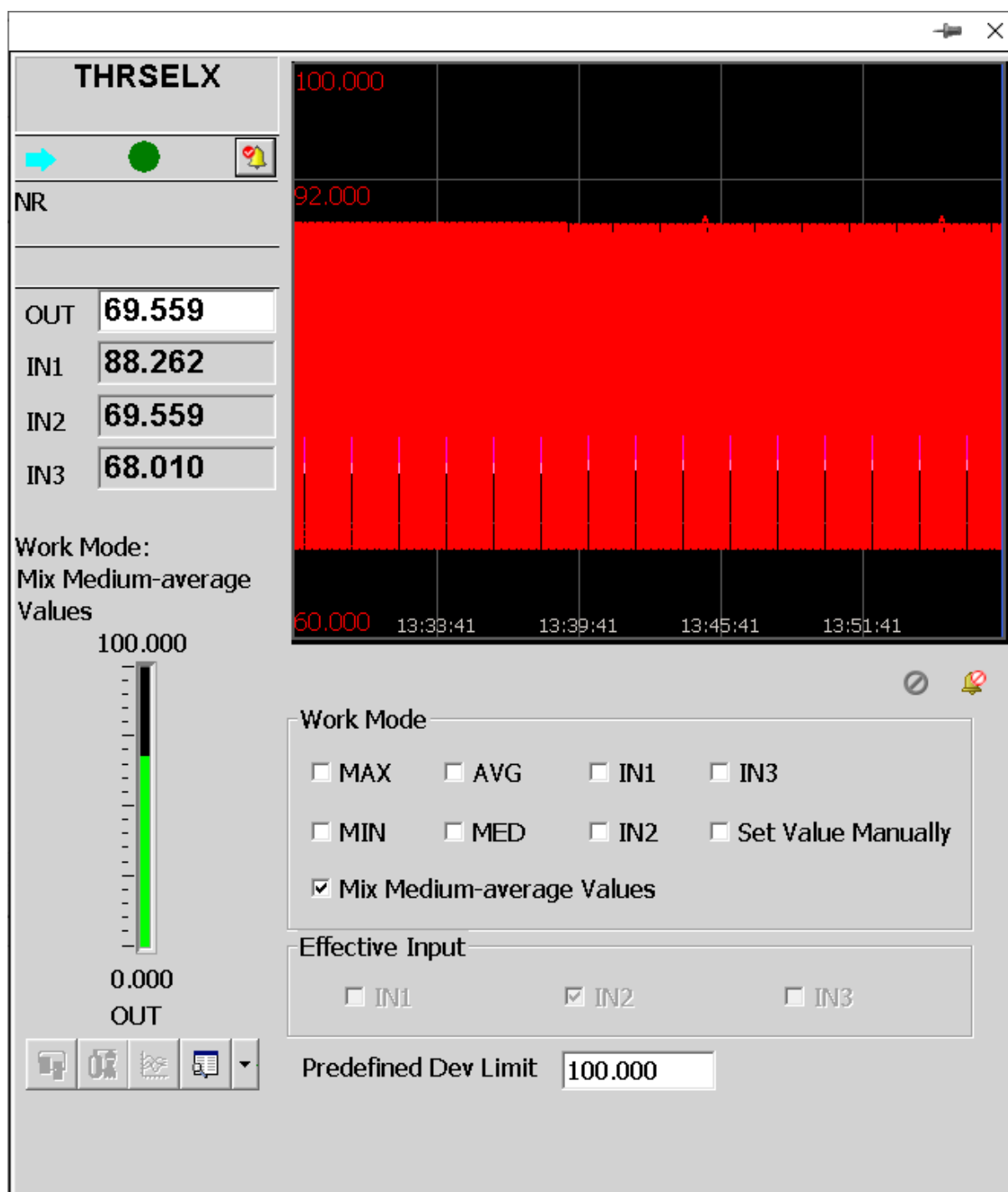


Table 7.25 Parameters list

Panel Parameter Name	Function Block Parameter Name	Initial Value	Value Range	Application Instruction
Work Mode	MAX	MODE	-	If chosen, stands for setting MODE= in function block Properties MODE=2
	MIN	MODE	-	If chosen, stands for setting MODE= in function block Properties MODE=1

Table 7.25 Parameters list (continued)

Panel Parameter Name		Function Block Parameter Name	Initial Value	Value Range	Application Instruction
	AVG	MODE	√	-	If chosen, stands for setting MODE= in function block Properties MODE=0
	MID	MODE	-	-	If chosen, stands for setting MODE= in function block Properties MODE=3
	IN1	MODE	-	-	If chosen, stands for setting MODE= in function block Properties MODE=4
	IN2	MODE	-	-	If chosen, stands for setting MODE= in function block Properties MODE=5
	IN3	MODE	-	-	If chosen, stands for setting MODE= in function block Properties MODE=6
	Set Value Manually	MODE	-	-	If chosen, stands for setting MODE= in function block Properties MODE>6
Effective Input	IN1	ADPTIN1=ON, then IN1 is valid	√	ON/OFF	If chosen, input 1 is valid, read only, modify in function block Properties
	IN2	ADPTIN2=ON, then IN2 is valid	√	ON/OFF	If chosen, input 2 is valid, read only, modify in function block Properties
	IN3	ADPTIN3=ON, then IN3 is valid	√	ON/OFF	If chosen, input 3 is valid, read only, modify in function block Properties
Predefined Error		DL	100.000	0~(SCH - SCL)	Refer to "Parameter Description"
Work Mode		MODE	-	-	When MODE=1, display the minimum. When MODE=2, display the maximum. When MODE=3, display the medium. When MODE=4, display the value of IN1. When MODE=5, display the value of IN2. When MODE=6, display the value of IN3. When MODE>6, display "Set value Manually".

7.15.3 Flag

Table 7.26 FLAG list

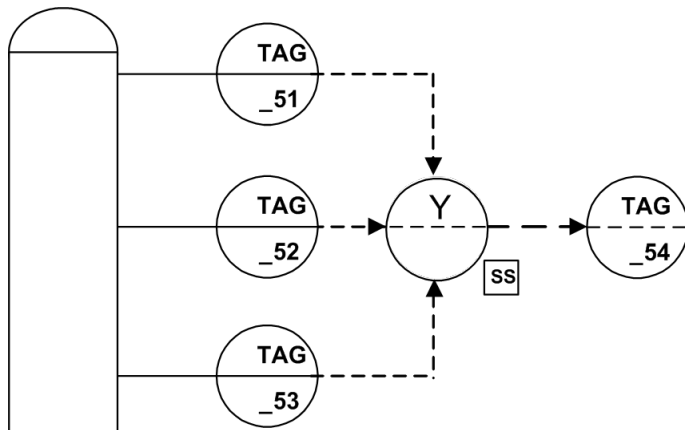
Flag	Alarm	Description
D0	OOS	Disable
D1	ERR	Fault
D2	IN1ERR	Quality of input 1 is bad

Table 7.26 FLAG list (continued)

Flag	Alarm	Description
D3	IN2ERR	Quality of input 2 is bad
D4	IN3ERR	Quality of input 3 is bad
D5	REVSCL	Span H/L Limit Reverse
D6	DEV12	Input 12 Deviation Over Limit
D7	DEV13	Input 13 Deviation Over Limit
D8	DEV23	Input 23 Deviation Over Limit
D9	DEV123	Input 123 Deviation Over Limit
D10	AOF	Suppress Alarm

7.15.4 Application Example

As shown in the figure below, output the medium value of signals TE_0610, TE_0611 and TE_0612 for technical fields can be achieved. Operator can select output method in the flow chart.

**Figure 7.4 Diagram of analog select-one-from-three**

Its programming is shown below and can be performed via THRSELX. The host computer interface can select and output the 3 analog signals via function block tag. According to the 3 REAL type input signals and by selecting the value of type parameter MODE, the function block can select and output the average, minimum, maximum, medium, input signal 1, input signal 2 and input signal 3.

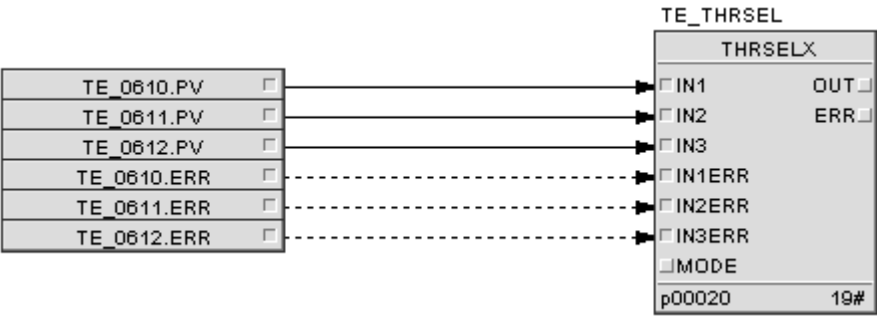


Figure 7.5 Programming of THRSELX

The function block instruction and examples are shown below.

Table 7.27 Function block instruction and examples

NO.	Example	Type	Instruction
001	TE_0610	AI (Input)	Analog Input Tag 1
002	TE_0611	AI (Input)	Analog Input Tag 2
003	TE_0612	AI (Input)	Analog Input Tag 3
005	TE_THRSEL	Tag of Function Block	Select-one-from-three Output Tag

Parameter settings of THRSELX:

- SCH: keep the same with designed I/O tag.
- SLH: keep the same with designed I/O tag.
- EU: keep the same with designed I/O tag.
- MODE: 3
- If one input error occurs to THRSELX, it will be ignored, and THRSELX will figure out the average of other two normal inputs.
- If two input errors occur to THRSELX, they will be ignored, and THRSELX will take the other normal input value.
- If the deviation of the two input values is larger than the preset DL (set DL=100 in default), THRSELX will ignore the two incredible inputs, and take the other normal input value.
- If three errors occur to THRSELX, it will keep the value before error, and the loop error alarm (ERR) generates.
- If the deviations between each two input values of three are larger than the preset DL (set DL=100 in default), THRSELX will keep the last value in normal deviation, and the loop error alarm (ERR) generates.

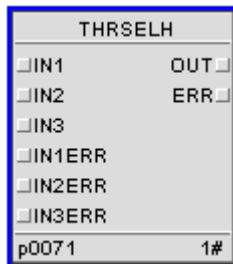
Notice:

MODE can only be set in program in the THRSEL. The MODE pin of THRSELX can be select and used. The related tag can be invoked by pin. Operator can select at the monitoring interface.

7.16 Maximum Selection Function Block (THRSELH)

Function Block THRSELH can select to output the available maximum value of three input signals, according to their qualities, deviations and values.

It is a simple function block, whose running time is 12µs.



7.16.1 Parameter Description

Table 7.28 THRSELH parameter instruction

Name			Description	Upload	Properties	Application Reference
Basic Parameters	OperationParameter	DL	Preset Deviation Limit	TRUE	Operation Parameter	Output will be affected if deviation is larger than DL
	ConfigurationParameter	SCH	Range Maximum Limit	-	Configuration Parameter	-
		SCL	Range Minimum Limit	-	Configuration Parameter	-
		EU	Output Engineering Unit	-	Configuration Parameter	-
		DLEN	Decimal Digits[0,5]	-	Configuration Parameter	-
Extended Parameters	Input Pin	IN1	Input 1	-	Input Pin	Connect to AI
		IN2	Input 2	-	Input Pin	Connect to AI
		IN3	Input 3	-	Input Pin	Connect to AI
		IN1ERR	Input 1 Quality Direction(OFF=input is good)	-	Input Pin	Connect to AI.ERR Note1
		IN2ERR	Input 2 Quality Di-	-	Input Pin	Connect to AI.ERR Note1

Table 7.28 THRSELH parameter instruction (continued)

Name			Description	Upload	Properties	Application Reference
			rection(OF-F=input is good)			
		IN3ERR	Input 3 Quality Direction(OF-F=input is good)	-	Input Pin	Connect to AI.ER-R ^{Note1}
	OutputPin	OUT	Choose the largest one of the three inputs as output.	-	Output Pin	-
		ERR	Module Illegal Alarm- ^{Note1}	-	Output Pin	Related IN1ERR/IN2ERR/IN3ERR/DL
		FLAG	Flag	-	Output Pin	-
	OperationParameter	SWOOS	WHETHER FUNCTION BLOCK IS IN OOS STATE(ON stands for OOS STATE)	TRUE	Operation Parameter	Refer to "Alarm"
		AOF	Suppress Module AlarmWHEN AOF=ON, IT IS NOT DISPLAYING THE REAL-TIME ALARM.	TRUE	Operation Parameter	Set to be "ON" when function block is downloaded first time
	Supervision-Parameter	ADPTIN1	ADP-TIN1=ON, then IN1is valid	-	Monitoring Parameter	-
		ADPTIN2	ADP-TIN2=ON , then IN2is valid	-	Monitoring Parameter	-
		ADPTIN3	ADP-TIN3=ON , then IN3is valid	-	Monitoring Parameter	-

Table 7.28 THRSELH parameter instruction (continued)

Name			Description	Upload	Properties	Application Reference
		DEV12	DIFFERENCE BETWEEN IN1 AND IN2 OVER-LIMIT	-	Monitoring Parameter	-
		DEV23	DIFFERENCE BETWEEN IN2 AND IN3 OVER-LIMIT	-	Monitoring Parameter	-
		DEV13	DIFFERENCE BETWEEN IN1 AND IN3 OVER-LIMIT	-	Monitoring Parameter	-

Note: selection instruction

1. If all of the three input signals are invalid, meaning the output is incredible, set ERR=ON, and hold the output value of last period.
2. If two of the three input signals are invalid, output the value of the valid one.
3. If one of the three input signals is invalid:
 - If the deviation between the two valid input signals does not exceed the deviation limit (DL), output their maximum value
 - If the deviation between the two valid input signals exceeds the deviation limit (DL), meaning the output is incredible, set ERR=ON, and hold the output value of last period.
4. If all of the three input signals are valid:
 - If all of the deviations between every two input signals exceed the deviation limit (DL), set ERR=ON, and hold the output value of last period.
e.g. If DL=4, IN1=2, IN2=8, IN3=14. IN3-IN1=12, IN3-IN2=6, IN2-IN1=6, the deviation between each two of the three values exceed 4, thus the output value is equal to the value of last cycle.
 - If one deviation between two input signals does not exceed the deviation limit (DL), while the other two deviations between the third input signal and these two signals exceed the deviation limit (DL), output the maximum value of the two input signals.
e.g. If DL=4, IN1=2, IN2=8, IN3=10. IN3-IN1=8, IN3-IN2=2, IN2-IN1=6, the deviations between IN1-IN2 and IN1-IN3 exceed the limit, IN3 > IN2, thus the output value is equal to the value of IN3, and OUT=10.

- If one deviation between two input signals exceeds the deviation limit (DL), while the other two deviations between the third input signal and these two signals do not exceed the deviation limit (DL), output the value of the third input signal, median value of the three input signals.
e.g. If DL=4, IN1=2, IN2=5, IN3=8. IN3-IN1=6, IN3-IN2=3, IN2-IN1=3, the deviation between IN1-IN3 exceeds the limit, while the deviations between IN1-IN2 and IN2-IN3 do not exceed the limit, IN3 > IN2, thus the output value is equal to the medium value IN2, and OUT=5.
- If all of the deviations between every two input signals do not exceed the deviation limit, output the average, minimum maximum or median value of the three input signals according to the value of MODE.
e.g. If DL=4, IN1=2, IN2=3, IN3=4. IN3-IN1=2, IN3-IN2=1, IN2-IN1=1, all deviations between the three values do not exceed the limit 4, thus the output value is equal to the maximum value IN3, and OUT=4.

7.16.2 Flag

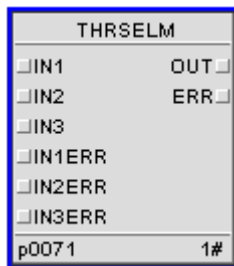
Table 7.29 Flag list

Flag	Instruction
D4	IN3 Quality is Bad
D3	IN2 Quality is Bad
D2	IN1 Quality IS Bad
D5	Alarm for Range High/Low Limit Reversal (REVSCL)
D1	Error
D0	Disabled
D6	IN12 Error Exceeds Limit
D7	IN13 Error Exceeds Limit
D8	IN23 Error Exceeds Limit
D9	IN123 Error Exceeds Limit
D10	Alarm Suppression (AOF)

7.17 Median Selection Function Block (THRSELM)

Function Block THRSELM can select to output the available median value of three input signals, according to their qualities, deviations and values.

It is a simple function block, whose running time is 12µs.



7.17.1 Parameter Description

Table 7.30 THRSELM parameter instruction

Name			Description	Upload	Properties	Application Reference
Basic Parameters	OperationParameter	DL	Preset Deviation Limit	TRUE	Operation Parameter	-
	ConfigurationParameter	SCH	Range Maximum Limit	-	Configuration Parameter	-
		SCL	Range Minimum Limit	-	Configuration Parameter	-
		EU	Output Engineering Unit	-	Configuration Parameter	-
		DLEN	Decimal Digits[0,5]	-	Configuration Parameter	-
Extended Parameters	Input Pin	IN1	Input 1	-	Input Pin	Connect to AI
		IN2	Input 2	-	Input Pin	Connect to AI
		IN3	Input 3	-	Input Pin	Connect to AI
		IN1ERR	Input 1 Quality Direction(OFF=input is good)	-	Input Pin	Connect to AI.ERR
		IN2ERR	Input 2 Quality Direction(OFF=input is good)	-	Input Pin	Connect to AI.ERR
		IN3ERR	Input 3 Quality Direction	-	Input Pin	Connect to AI.ERR

Table 7.30 THRSELM parameter instruction (continued)

Name			Description	Upload	Properties	Application Reference
	OutputPin		tion(OFF=input is good)			
		OUT	Choose the median of the three inputs as output. ^{Note1}	-	Output Pin	-
		ERR	Module Illegal Alarm	-	Output Pin	Related IN1ERR/IN2ERR/IN3ERR/DL
		FLAG	Flag	-	Output Pin	-
	OperationParameter	SWOOS	WHETHER FUNCTION BLOCK IS IN OOS STATUS(ON stands for OOS Status)	TRUE	Operation Parameter	Refer to "Alarm"
		AOF	Suppress Module Alarm WHEN AOF=ON, IT IS NOT DISPLAYING THE REAL-TIME ALARM.	TRUE	Operation Parameter	Set to be "ON" when function block is downloaded first time
	Supervision-Parameter	ADP-TIN1	ADP-TIN1=ON, then IN1is valid	-	Monitoring Parameter	-
		ADP-TIN2	ADP-TIN2=ON , then IN2is valid	-	Monitoring Parameter	-
		ADP-TIN3	ADP-TIN3=ON , then IN3is valid	-	Monitoring Parameter	-
		DEV12	DIFFERENCE BETWEEN IN1 AND IN2 OVERLIMIT	-	Monitoring Parameter	-
		DEV23	DIFFERENCE BETWEEN IN2	-	Monitoring Parameter	-

Table 7.30 THRSELM parameter instruction (continued)

Name			Description	Upload	Properties	Application Reference
			AND IN3 OVERLIMIT			
		DEV13	DIFFERENCE BETWEEN IN1 AND IN3 OVERLIMIT	-	Monitoring Parameter	-

Note1: selection instruction

1. If all of the three input signals are invalid, meaning the output is incredible, set ERR=ON, and hold the output value of last period.
2. If two of the three input signals are invalid, output the value of the valid one.
3. If one of the three input signals is invalid:
 - If the deviation between the two valid input signals does not exceed the deviation limit (DL), output IN2 if IN1 and IN3 are invalid, or output IN1 if IN2 is invalid.
 - If the deviation between the two valid input signals exceeds the deviation limit (DL), meaning the output is incredible, set ERR=ON, and hold the output value of last period.
4. If all of the three input signals are valid:
 - If all of the deviations between every two input signals exceed the deviation limit (DL), set ERR=ON, and hold the output value of last period.
e.g. If DL=4, IN1=2, IN2=8, IN3=14. IN3-IN1=12, IN3-IN2=6, IN2-IN1=6, the deviations between each two of the three values exceed 4, thus the output value is equal to the value of last cycle.
 - If one deviation between two input signals does not exceed the deviation limit (DL), while the other two deviations between the third input signal and these two signals exceed the deviation limit (DL), output IN2 if IN1 and IN3 exceed, or output IN1 if IN2 exceeds.
 - If one deviation between two input signals exceeds the deviation limit (DL), while the other two deviations between the third input signal and these two signals do not exceed the deviation limit (DL), output the value of the third input signal, median value of the three input signals.
e.g. If DL=4, IN1=2, IN2=5, IN3=8. IN3-IN1=6, IN3-IN2=3, IN2-IN1=3, the deviation between IN1-IN3 exceed the limit, while the deviations between IN1-IN2 and IN2-IN3 do not exceed the limit, thus the output value is equal to the medium value IN2, and OUT=5.

- If all of the deviations between every two input signals do not exceed the deviation limit, output the average, minimum maximum or median value of the three input signals according to the value of MODE.
e.g. If DL=4, IN1=2, IN2=3, IN3=4. N3-IN1=2, IN3-IN2=1, IN2-IN1=1, all deviations between the three values do not exceed the limit 4, thus the output value is equal to the maximum value IN3, and OUT=4.

7.17.2 Flag

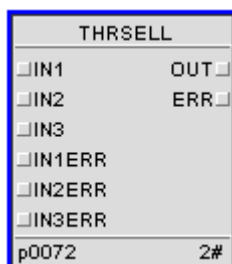
Table 7.31 Flag list

Flag	Instruction
D4	IN3 Quality is Bad
D3	IN2 Quality is Bad
D2	IN1 Quality is Bad
D5	Alarm for Range High/Low Limit Reversal (REVSCL)
D1	Error
D0	Disabled
D6	IN12 Error Exceeds Limit
D7	IN13 Error Exceeds Limit
D8	IN23 Error Exceeds Limit
D9	IN123 Error Exceeds Limit
D10	Alarm Suppression (AOF)

7.18 Minimum Selection Function Block (THRSELL)

Function Block THRSELL can select to output the available minimum value of three input signals, according to their qualities, deviations and values.

It is a simple function block, whose running time is 12μs.



7.18.1 Parameter Description

Table 7.32 THRELL parameter instruction

Name			Description	Upload	Properties	Application Reference
Basic Parameters	OperationParameter	DL	Preset Deviation Limit	TRUE	Operation Parameter	-
	ConfigurationParameter	SCH	Range Maximum Limit	-	Configuration Parameter	-
		SCL	Range Minimum Limit	-	Configuration Parameter	-
		EU	Output Engineering Unit	-	Configuration Parameter	-
		DLEN	Decimal Digits[0,5]	-	Configuration Parameter	-
Extended Parameters	Input Pin	IN1	Input 1	-	Input Pin	Connect to AI
		IN2	Input 2	-	Input Pin	Connect to AI
		IN3	Input 3	-	Input Pin	Connect to AI
		IN1ERR	Input 1 Quality Direction(OFF=input is good)	-	Input Pin	Connect to AI.ERR
		IN2ERR	Input 2 Quality Direction(OFF=input is good)	-	Input Pin	Connect to AI.ERR
		IN3ERR	Input 3 Quality Direction(OFF=input is good)	-	Input Pin	Connect to AI.ERR
	OutputPin	OUT	Choose the smallest of the three input as output ^{Note1}	-	Output Pin	-
		ERR	Module Illegal Alarm	-	Output Pin	Related IN1ERR/IN2ERR/IN3ERR/DL
		FLAG	Flag	-	Output Pin	-

Table 7.32 THRSELL parameter instruction (continued)

Name			Description	Upload	Properties	Application Reference
	OperationParameter	SWOOS	WHETHER FUNCTION BLOCK IS IN OOS STATE (ON stands for OOS STATE)	TRUE	Operation Parameter	Refer to "Alarm"
		AOF	Suppress Module Alarm WHEN AOF=ON, IT IS NOT DISPLAYING THE REAL-TIME ALARM.	TRUE	Operation Parameter	Set to be "ON" when function block is down-loaded first time
	SupervisionParameter	ADP-TIN1	ADP-TIN1=ON, then IN1is valid	-	Monitoring Parameter	-
		ADP-TIN2	ADP-TIN2=ON , then IN2is valid	-	Monitoring Parameter	-
		ADP-TIN3	ADP-TIN3=ON , then IN3is valid	-	Monitoring Parameter	-
		DEV12	DIFFERENCE BETWEEN IN1 AND IN2 OVERLIMIT	-	Monitoring Parameter	-
		DEV23	DIFFERENCE BETWEEN IN2 AND IN3 OVERLIMIT	-	Monitoring Parameter	-
		DEV13	DIFFERENCE BETWEEN IN1 AND IN3 OVERLIMIT	-	Monitoring Parameter	-

Note: definition of mode selected

1. If all of the three input signals are invalid, meaning the output is incredible, set ERR=ON, and hold the output value of last period.
2. If two of the three input signals are invalid, output the value of the valid one.
3. If one of the three input signals is invalid:
 - If the deviation between the two valid input signals does not exceed the deviation limit (DL), output their minimum value
 - If the deviation between the two valid input signals exceeds the deviation limit (DL), meaning the output is incredible, set ERR=ON, and keep the output value of last period.
4. If all of the three input signals are valid:
 - If all of the deviations between every two input signals exceed the deviation limit (DL), set ERR=ON, and keep the output value of last period.
e.g. If DL=4, IN1=2, IN2=8, IN3=14. IN3-IN1=12, IN3-IN2=6, IN2-IN1=6, the deviation between each two of them exceeds 4, thus the output value is the same as last period.
 - If the deviation between two input signals does not exceed the deviation limit (DL), while the other two deviations between the third input signal and these two signals exceed the deviation limit (DL), output the minimum value of the two input signals.
e.g. If DL=4, IN1=2, IN2=8, IN3=10. IN3-IN1=8, IN3-IN2=2, IN2-IN1=6, the deviations between IN1-IN2, and IN1-IN3 exceed the limit, the deviation between IN2-IN3 does not exceed the limit, IN3 > IN2, the output value is the same as IN2, OUT=8.
 - If the deviation between two input signals exceeds the deviation limit (DL), while the other two deviations between the third input signal and these two signals do not exceed the deviation limit (DL), output the value of the third input signal, median value of the three input signals.
e.g. If DL=4, IN1=2, IN2=5, IN3=8. IN3-IN1=6, IN3-IN2=3, IN2-IN1=3, the deviation between IN1-IN3 exceeds the limit, while the deviations between IN1-IN2 and IN2-IN3 do not exceed the limit, the output value is median value IN2, OUT=5.
 - If all of the deviations between every two input signals do not exceed the deviation limit, output minimum value of the three input signals.
e.g. If DL=4, IN1=2, IN2=3, IN3=4. IN3-IN1=2, IN3-IN2=1, IN2-IN1=1, the deviations between them do not exceed the limit 4, thus the output value is the maximum IN1, OUT=2.

7.18.2 Flag

Table 7.33 Flag list

Flag	Instruction
D4	IN3 Quality is Bad
D3	IN2 Quality is Bad
D2	IN1 Quality is Bad
D5	Alarm for Range High/Low Limit Reversal (REVSCL)
D1	Error
D0	Disabled
D6	IN12 Error Exceeds Limit
D7	IN13 Error Exceeds Limit
D8	IN23 Error Exceeds Limit
D9	IN123 Error Exceeds Limit
D10	Alarm Suppression (AOF)

8 Arithmetic Operation Function Block Library

There are 44 simple function blocks in arithmetic function block library.

8.1 ADD Function Block (ADD)

Function block ADD implements the addition and correct of the two REAL inputs. Parameter instruction refers to table below.

The running time of this function block is 4μs.

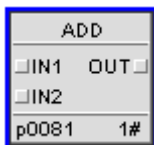


Table 8.1 Parameter Instruction of ADD

Name			Description	Upload	Properties
Basic Parameters	Input Pin	IN1	Input 1 of ADD	-	Input Pin
		IN2	Input 2 of ADD	-	Input Pin
	Output Pin	OUT	$OUT = (IN1 \times K1 + C1) + (IN2 \times K2 + C2)$	-	Output Pin
	Operation Parameter	K1	Offset Coefficient of Input 1	TRUE	Operation Parameter
		K2	Offset Coefficient of Input 2	TRUE	Operation Parameter
		C1	Offset of Input 1	TRUE	Operation Parameter
		C2	Offset of Input 2	TRUE	Operation Parameter

8.2 ADD Function Block (ADDEX)

If FCU811-S is applied, ADDEX can implement the addition of multiple REAL inputs. By default, ADDEX contains 2 input pins. You can click and drag the bottom border of the function block (see figure below) to expand the pins. Up to 32 inputs can be supported. For parameter descriptions, refer to the table below.

The running time of this function block is 4μs.

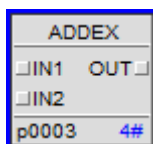


Table 8.2 Parameter Instruction of ADDEX

Name			Description	Upload	Properties
Basic Parameters	Input Pin	IN1	Input 1 of ADD	-	Input Pin
		-	Input Pin
		INn	Input n of ADD	-	Input Pin
	Output Pin	OUT	$OUT = \sum INn$	-	Output Pin

Empty pin is not allowed; otherwise, the compilation might encounter an error.

8.3 Eight-Channel ADD Function Block (ADD8)

Function block ADD8 implements the addition of the eight REAL inputs. Parameter instructions please refer to table below.

The running time of this block is 8μs.

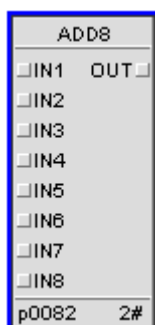


Table 8.3 ADD8 parameter instruction

Name			Description	Upload	Properties
Basic Parameters	Input Pin	IN1	Input 1	-	Input Pin
		IN2	Input 2	-	Input Pin
		IN3	Input 3	-	Input Pin
		IN4	Input 4	-	Input Pin
		IN5	Input 5	-	Input Pin
		IN6	Input 6	-	Input Pin
		IN7	Input 7	-	Input Pin

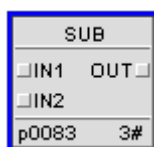
Table 8.3 ADD8 parameter instruction (continued)

Name			Description	Upload	Properties
		IN8	Input 8	-	Input Pin
	OutputPin	OUT	OUT=IN1+IN2+IN3+IN4+IN5+IN6+IN7+IN8		Output Pin

8.4 Subtraction Function Block (SUB)

Function block SUB implements the correct and subtraction of the two REAL inputs. Parameter instructions please refer to table below.

The running time of this block is 4μs.



8.4.1 Parameter Description

Table 8.4 SUB parameter instruction

Name			Description	Upload	Properties
Basic Parameters	Input Pin	IN1	Input 1 of ADD	-	Input Pin
		IN2	Input 2 of ADD	-	Input Pin
	Output Pin	OUT	OUT = (IN1 × K1 + C1) - (IN2 × K2 + C2)	-	Output Pin
	OperationParameter	K1	Offset Coefficient of Input 1	TRUE	Operation Parameter
		K2	Offset Coefficient of Input 2	TRUE	Operation Parameter
		C1	Offset of Input 1	TRUE	Operation Parameter
		C2	Offset of Input 2	TRUE	Operation Parameter

8.4.2 Application Example

As shown in the figure below, the D-values between former and later temperature, pressure, flow rate and water level of tank and pipe need to be calculated often. The system in the figure below

can achieve the calculation and display of the D-value of two pressure signals (signal difference signal) and enable the alarm of pressure difference signal.

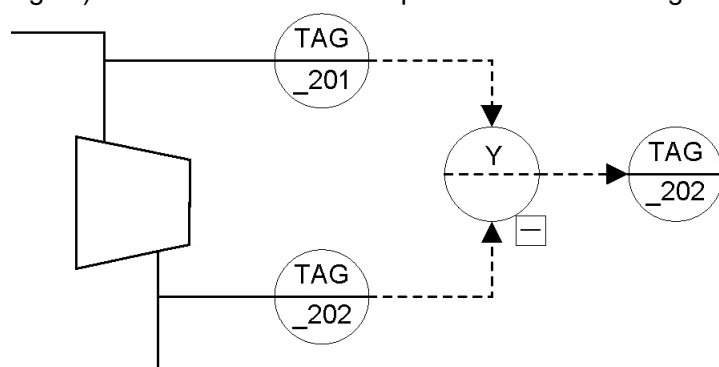


Figure 8.1 Diagram of D-value

Apply SUB for D-value calculation, and apply PVIEX for data display to achieve fault process and alarm. The display for D-values of host computer interface can be achieved via function block tag. The instruction of function block and examples are shown below.

Table 8.5 Function block instruction and examples

NO.	Example	Type	Instruction	Remark
001	PI_101	AI (Input)	Analog Input Tag	Field AI
002	PI_102	AI (Input)	Analog Input Tag	Field AI
003	DPI_101	Tag of Function Block	Pressure Difference Display	Tag Display

Its programming is shown below.

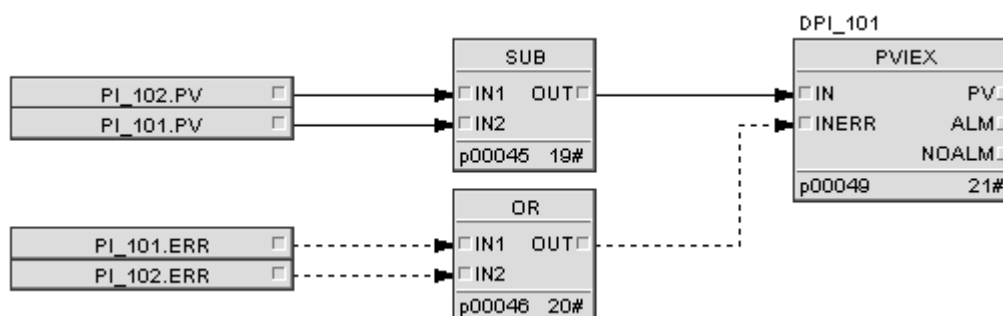


Figure 8.2 Programming of pressure difference calculation

Parameter settings of PVEX:

- INSCH: keeps the same as the range and unit of I/O signal
- INSCL: keeps the same as the range and unit of I/O signal
- INEU: keeps the same as the range and unit of I/O signal
- When input error occurs to either of the two input signal, and the input error status "ERR" will be sent to PVIEX, and the loop error alarm will be generated. The D-value is the same with the value before error occurred.

- The three levels H/L limits alarms of analog input tag can be set when required. The general definitions for three levels alarms: H/L third-level alarms, disabled; HH/LL alarms, interlock action alarm; H/L alarm, general alarms. The two levels alarms mentioned below refer to the HH/LL alarms and H/L alarm.
- Other alarms, such as change rate alarm and extended range alarm, etc., are often not used and set as disabled in default.

Notice:

The input process variables should be same (such as relative temperature and absolute temperature, relative pressure and absolute pressure).

8.5 (Multiplication) Function Block (MUL)

Function block MUL implements the correct and multiplication of the two REAL inputs. Parameter instructions please refer to table below.

The running time of this block is 4μs.



Table 8.6 MUL parameter instruction

Name			Description	Upload	Properties
Basic Parameters	Input Pin	IN1	Input 1 of ADD	-	Input Pin
		IN2	Input 2 of ADD	-	Input Pin
	Output Pin	OUT	$OUT = (IN1 * K1 + C1) * (IN2 * K2 + C2)$		Output Pin
	Operation Parameter	K1	Offset Coefficient of Input 1	TRUE	Operation Parameter
		K2	Offset Coefficient of Input 2	TRUE	Operation Parameter
		C1	Offset of Input 1	TRUE	Operation Parameter
		C2	Offset of Input 2	TRUE	Operation Parameter

8.6 Division Function Block (DIV)

Function block DIV implements the correct and division of the two REAL inputs. Parameter instructions please refer to table below.

Its running time is 5μs.

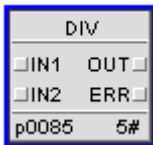


Table 8.7 DIV parameter instruction

Name			Description	Upload	Properties	Application Reference
Basic Parameters	Input Pin	IN1	Input 1 of ADD	-	Input Pin	-
		IN2	Input 2 of ADD	-	Input Pin	-
	Output Pin	OUT	$OUT = (IN1 * K1 + C1) / (IN2 * K2 + C2)$	-	Output Pin	$IN2 * K2 + C2 = 0$ $OUT = 0$
		ERR	Set Error Alarm	-	Output Pin	$IN2 * K2 + C2 = 0$ ERR=ON
	Operation Parameter	K1	Offset Coefficient of Input 1	TRUE	Operation Parameter	-
		K2	Offset Coefficient of Input 2	TRUE	Operation Parameter	-
		C1	Offset of Input 1	TRUE	Operation Parameter	-
		C2	Offset of Input 2	TRUE	Operation Parameter	-

DIV implements the following algorithm:

- When $IN1 * IN2 + C2 \neq 0$, $OUT = (IN1 * K1 + C1) / (IN2 * K2 + C2)$, ERR=OFF;
- When $IN2 * K2 + C2 = 0$, $OUT = 0.00$ (when 2 places are set in decimal part), ERR=ON.

8.7 Square Root Function Block (SQRT)

Function block SQRT works out the square root of the REAL input and has the function of small-signal cutting. Parameter instructions refer to table below.

The running time of this block is 11μs.



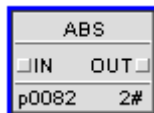
Table 8.8 SQRT parameter instruction

Name			Description	Upload
Basic Parameters	Input Pin	IN	Input	-
	Output Pin	OUT	When $IN < DB $, $OUT = 0$ When $IN \geq DB $, $OUT = \sqrt{IN} * K + C$	-
	Operation Parameter	K	Offset Coefficient	TRUE
		C	Offset Of Input	TRUE
		DB	Small-Signal Cutting no smaller than(0.0)	TRUE

8.8 Absolute Value Function Block (ABS)

Function block ABS works out the absolute value of the REAL input. Parameter instructions refer to table below.

The running time of this block is 5μs.

**Table 8.9 ABS parameter instruction**

Name			Description	Upload
Basic Parameters	Input Pin	IN	Input	-
	Output Pin	OUT	$OUT = IN \times K + C$	-
	Operation Parameter	K	Offset Coefficient	TRUE
		C	Offset Of Input	TRUE

8.9 EXP Function Block (EXP)

Function block works out the exponent of the REAL input. Parameter instructions refer to table below.

The running time of this block is 31μs.

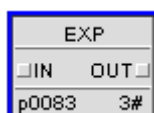


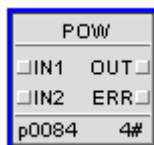
Table 8.10 EXP parameter instruction

Name			Description	Upload
Basic Parameters	Input Pin	IN	Input	-
	Output Pin	OUT	$OUT = e^{IN} \times K + C$	-
	Operation Parameter	K	Offset Coefficient	TRUE
		C	Offset Of Input	TRUE

8.10 POW Function Block (POW)

Function block POW works out the power of the two REAL inputs. Parameter instructions refer to table below.

The running time of this block is 110μs.

**Table 8.11 POW parameter instruction**

Name			Description	Upload
Basic Parameters	Input Pin	IN1	Input 1 of ADD	-
		IN2	Input 2 of ADD	-
	Output Pin	OUT	When IN1=0.0 and IN2<0.0, OUT = 0 and ERR = ON When IN1<0.0, IN2 is not integer, OUT = 0, ERR = ON Otherwise, $OUT = K \times IN1^{IN2} + C$, ERR = OFF	-
		ERR	Set Error Alarm	-
	Operation Parameter	K	Offset Coefficient	TRUE
		C	Offset Of Input	TRUE

8.11 Natural Logarithm Function Block (LN)

Function block LN works out the natural logarithm of the REAL input. Parameter instructions refer to table below.

The running time of this block is 40μs.

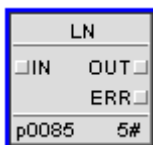


Table 8.12 LN parameter instruction

Name			Description	Upload
Basic Parameters	Input Pin	IN	Input	-
	OutputPin	OUT	When $IN \leq 0.0$, $OUT = 0$, $ERR = ON$ Otherwise, $OUT = K \times LN(IN) + C$, $ERR = OFF$	-
		ERR	Set Error Alarm	-
	OperationParameter	K	Offset Coefficient	TRUE
		C	Offset Of Input	TRUE

8.12 Logarithm Function Block (LOG)

Function block LOG works out the logarithm of the REAL input. Parameter instructions refer to table below.

The running time of this block is 41μs.

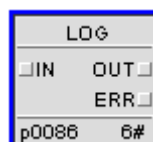


Table 8.13 LOG parameter instruction

Name			Description	Upload
Basic Parameters	Input Pin	IN	Input	-
	OutputPin	OUT	When $IN \leq 0.0$, $OUT = 0$, $ERR = ON$ Otherwise, $OUT = K \times LOG(IN) + C$, $ERR = OFF$	-
		ERR	Set Error Alarm	-
	OperationParameter	K	Offset Coefficient	TRUE
		C	Offset Of Input	TRUE

8.13 Module Function Block (MOD)

Function block MOD works out the modulus of the REAL inputs. Parameter instructions refer to table below.

The running time of this block is 7μs.

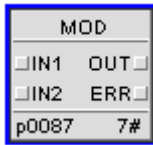


Table 8.14 MOD parameter instruction

Name			Description	Upload
Basic Parameter	Input Pin	IN1	Input 1 of ADD	-
		IN2	Input 2 of ADD	-
	OutputPin	OUT	Result $OUT = (K1 \times IN1 + C1) \text{ MOD } (K2 \times IN2 + C2)$ When $(K2 \times IN2 + C2) = 0$, Set Error Alarm $ERR = ON$, $OUT=0$	-
		ERR	Set Error Alarm	-
	OperationParameter	K1	Offset Coefficient of Input 1	TRUE
		K2	Offset Coefficient of Input 2	TRUE
		C1	Offset of Input 1	TRUE
		C2	Offset of Input 2	TRUE

8.14 Polynomial Function Block (POLY)

Function block POLY works out the six polynomials of the REAL input. Parameter instructions refer to table below.

The running time of this block is 420μs.

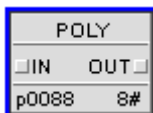


Table 8.15 POLY parameter instruction

Name			Description	Upload
Basic Parameters	Input Pin	IN	Input	-
	OutputPin	OUT	Result $OUT = C0 + C1 \times IN + C2 \times IN^2 + C3 \times IN^3 + C4 \times IN^4 + C5 \times IN^5 + C6 \times IN^6$	-
	OperationParameter	C0	Polynomial Coefficient	TRUE

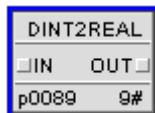
Table 8.15 POLY parameter instruction (continued)

Name			Description	Upload
		C1	Polynomial Coefficient	TRUE
		C2	Polynomial Coefficient	TRUE
		C3	Polynomial Coefficient	TRUE
		C4	Polynomial Coefficient	TRUE
		C5	Polynomial Coefficient	TRUE
		C6	Polynomial Coefficient	TRUE

8.15 DINT to REAL Function Block (DINT2REAL)

Function Block DINT2REAL converts the type of the DINT input to REAL. Parameter instructions refer to table below.

The running time of this block is 2μs.

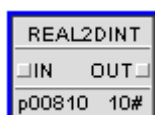
**Table 8.16 DINT2REAL parameter instruction**

Name			Description	Upload	Application Reference
Basic Parameters	Input Pin	IN	Input	-	Polynomial Coefficient: DINT
	Output Pin	OUT	OUT=IN	-	Polynomial Coefficient: REAL

8.16 REAL to DINT Function Block (REAL2DINT)

Function block REAL2DINT converts the type of the REAL input to DINT. Parameter instructions refer to table below.

The running time of this block is 2μs.

**Table 8.17 REAL2DINT parameter instruction**

Name			Description	Upload	Application Reference
Basic Parameters	Input Pin	IN	Input	-	Polynomial Coefficient: REAL

Table 8.17 REAL2DINT parameter instruction (continued)

Name			Description	Upload	Application Reference
	Output Pin	OUT	Result OUT=IN	-	Polynomial Coefficient: DINT

When REAL is converted to DINT, the number after the decimal point is omitted during the round-off process. For example, converts 1.8 to 1.

8.17 DOUBLE to REAL Function Block (DOUBLE2REAL)

Function block DOUBLE2REAL combines 2 unsigned integer data of 4-byte as a dual-precision float, and converts it to single precision float to output.

The running time of this block is 2μs.

DOUBLE2REAL	
<input type="checkbox"/> INL	<input type="checkbox"/> OUT
<input type="checkbox"/> INH	<input type="checkbox"/> ERR
p0002	2#

Table 8.18 DOUBLE2REAL parameter instruction

Name			Description	Upload	Application Reference
Basic Parameters	Input Pin	INL	Low 4-byte Integer Original Code Input	-	-
		INH	High 4-byte Integer Original Code Input	-	-
	Output Pin	OUT	Single Precision Float Output	-	Output keeps the value of last period when float error happens.
		ERR	Float Error Indication (OFF: No Error; ON: Float Error)	-	Errors of float: error of parsing integer data to dual-precision float. Overflow when dual precision converting to single precision float.

8.18 INT to REAL Function Block (INT2REAL)

Function block INT2REAL converts the type of the INT input to REAL. Parameter instructions refer to table below.

The running time of this block is 2μs.

INT2REAL	
<input type="checkbox"/> IN	<input type="checkbox"/> OUT
p00811	11#

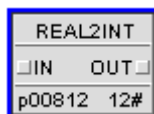
Table 8.19 INT2REAL parameter instruction

Name			Description	Upload	Application Reference
Basic Parameters	Input Pin	IN	Input	-	Polynomial Coefficient: INT
	Output Pin	OUT	Result OUT=IN	-	Polynomial Coefficient: REAL

8.19 REAL to INT Function Block (REAL2INT)

Function block REAL2INT converts the type of the REAL input to INT. Parameter instructions refer to table below.

The running time of this block is 4μs.

**Table 8.20 REAL2INT parameter instruction**

Name			Description	Upload	Application Reference
Basic Parameters	Input Pin	IN	Input	-	Polynomial Coefficient: REAL
	Output Pin	OUT	Result OUT=IN	-	Polynomial Coefficient: INT

When REAL is converted to INT, the number after the decimal point is omitted during the round-off process. For example, converts 1.8 to 1.

8.20 REAL to LREAL Function Block (REAL2LREAL)

Function block REAL2LREAL converts the type of the REAL input to LREAL. Parameter instructions refer to table below.

In the user program window, if FCU731 is used, REAL2LREAL function block is named as REAL2LREAL_X, which shares the same functions as REAL2LREAL.

The running time of this block is 2μs.

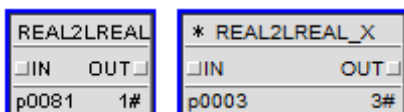


Table 8.21 REAL2LREAL parameter instruction

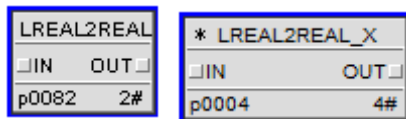
Name			Description	Upload	Application Reference
Basic Parameters	Input Pin	IN	Input	-	Polynomial Coefficient: REAL
	Output Pin	OUT	Result OUT=IN	-	Polynomial Coefficient: LREAL

8.21 LREAL to REAL Function Block (LREAL2REAL)

Function block LREAL2REAL converts the type of the LREAL input to REAL. Parameter instructions refer to table below.

In the user program window, if FCU731 is used, LREAL2REAL function block is named as LREAL2REAL_X, which shares the same functions as LREAL2REAL.

The running time of this block is 2μs.

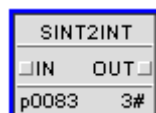
**Table 8.22 LREAL2REAL parameter instruction**

Name			Description	Upload
Basic Parameters	Input Pin	IN	Input	-
	Output Pin	OUT	Result OUT=IN	-

8.22 SINT to INT Function Block (SINT2INT)

Function block SINT2INT converts the type of the SINT input to INT. Parameter instructions refer to table below.

The running time of this block is 1μs.

**Table 8.23 SINT2INT parameter instruction**

Name			Description	Upload
Basic Parameters	Input Pin	IN	Input	-
	Output Pin	OUT	Result OUT=IN	-

8.23 INT to SINT Function Block (INT2SINT)

Function block INT2SINT converts the type of the INT input to SINT. Parameter instructions refer to table below.

The running time of this block is 1 μ s.

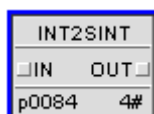


Table 8.24 INT2SINT parameter instruction

Name			Description	Upload
Basic Parameters	Input Pin	IN	Input	-
	Output Pin	OUT	Result OUT=IN	-

8.24 UDINT to DINT Function Block (UDINT2DINT)

Function block UDINT2DINT converts the type of the UDINT input to DINT. Parameter instructions refer to table below.

The running time of this block is 1 μ s.

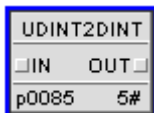


Table 8.25 UDINT2DINT parameter instruction

Name			Description	Upload
Basic Parameters	Input Pin	IN	Input	-
	Output Pin	OUT	Result OUT=IN	-

8.25 DINT to UDINT Function Block (DINT2UDINT)

Function block DINT2UDINT converts the type of the DINT input to UDINT. Parameter instructions refer to table below.

The running time of this block is 1 μ s.

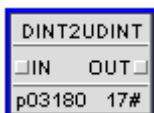


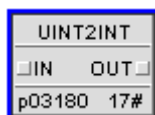
Table 8.26 DINT2UDINT parameter instruction

Name			Description	Upload
Basic Parameters	Input Pin	IN	Input	-
	Output Pin	OUT	Result OUT=IN	-

8.26 UINT to INT Function Block (UINT2INT)

Function block UNIT2INT converts the type of the UNIT input to INT. Parameter instructions refer to table below.

The running time of this block is 1μs.

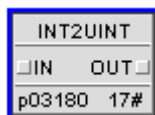
**Table 8.27 UNIT2INT parameter instruction**

Name			Description	Upload
Basic Parameters	Input Pin	IN	Input	-
	Output Pin	OUT	Calculate the output value OUT=IN	-

8.27 INT to UNIT Function Block (INT2UNIT)

Function block INT2UNIT converts the type of the INT input to UNIT. Parameter instructions refer to table below.

The running time of this block is 1μs.

**Table 8.28 INT2UNIT parameter instruction**

Name			Description	Upload
Basic Parameters	Input Pin	IN	Input	-
	Output Pin	OUT	Result OUT=IN	-

8.28 USINT to SINT Function Block (USINT2SINT)

Function block USINT2SINT converts the type of the USINT to SINT. Parameter instructions refer to table below.

The running time of this block is 1μs.

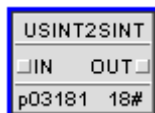


Table 8.29 USINT2SINT parameter instruction

Name			Description	Upload
Basic Parameters	Input Pin	IN	Input	-
	Output Pin	OUT	Result OUT=IN	-

8.29 SINT to USINT Function Block (SINT2USINT)

Function block SINT2USINT converts the type of the SINT input to USINT. Parameter instructions refer to table below.

The running time of this block is 1μs.

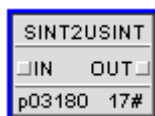


Table 8.30 SINT2USINT parameter instruction

Name			Description	Upload
Basic Parameters	Input Pin	IN	Input	
	Output Pin	OUT	Result OUT=IN	

8.30 INT to DINT Function Block (INT2DINT)

Function block INT2DINT converts the type of the INT input to DINT. Parameter instructions refer to table below.

The running time of this block is 1μs.

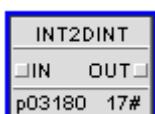


Table 8.31 INT2DINT parameter instruction

Name			Description	Upload
Basic Parameters	Input Pin	IN	Input	-
	Output Pin	OUT	Result OUT=IN	-

8.31 DINT to INT Function Block (DINT2INT)

Function block DINT2INT converts the type of the DINT input to INT. Parameter instructions refer to table below.

The running time of this block is 1μs.

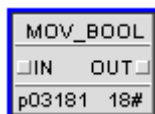
Table 8.32 DINT2INT parameter instruction

Name			Description	Upload
Basic Parameters	Input Pin	IN	Input	-
	Output Pin	OUT	Result OUT=IN	-

8.32 BOOL Assignment Sentence Function Block (MOV_BOOL)

Function block MOV_BOOL assigns a BOOL output for the BOOL input. Parameter instructions refer to table below.

The running time of this block is 1μs.

**Table 8.33 MOV_BOOL parameter instruction**

Name			Description	Upload
Basic Parameters	Input Pin	IN	Input	-
	Output Pin	OUT	When HOLD=OFF, OUT=IN; When HOLD=ON, Hold the Output	-
	Operation Parameter	HOLD	HOLD=ON, hold the Output	-

8.33 SINT Assignment Function Block (MOV_SINT)

Function block MOV_SINT assigns a SINT output for the SINT input. Parameter instructions refer to table below.

The running time of this block is 1μs.



Table 8.34 MOV_SINT function block

Name			Description	Upload
Basic Parameters	Input Pin	IN	Input	-
	Output Pin	OUT	When HOLD=OFF, OUT=IN; When HOLD=ON, Hold the Output	-
	Operation Parameter	HOLD	HOLD=ON, hold the Output	-

8.34 INT Assignment Function Block (MOV_INT)

Function block MOV_INT assigns an INT output for the INT input. Parameter instructions refer to table below.

The running time of this block is 1μs.

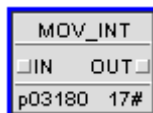


Table 8.35 MOV_INT parameter instruction

Name			Description	Upload
Basic Parameters	Input Pin	IN	Input	-
	Output Pin	OUT	When HOLD=OFF, OUT=IN; When HOLD=ON, Hold the Output	-
	Operation Parameter	HOLD	When HOLD=ON, Hold the Output	-

8.35 DINT Assignment Function Block (MOV_DINT)

Function block MOV_DINT assigns a DINT output for the DINT input. Parameter instructions refer to table below.

The running time of this block is 2μs.

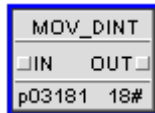


Table 8.36 MOV_DINT parameter instruction

Name			Description	Upload
Basic Parameters	Input Pin	IN	Input	-
	Output Pin	OUT	When HOLD=OFF, OUT=IN; When HOLD=ON, Hold the Output	-
	Operation Parameter	HOLD	When HOLD=ON, Hold the Output	-

8.36 REAL Assignment Function Block (MOV_REAL)

Function block MOV_REAL assigns a REAL output for the REAL input. Parameter instructions refer to table below.

The running time of this block is 2μs.

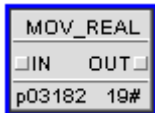


Table 8.37 MOV_REAL parameter instruction

Name			Description	Upload
Basic Parameters	Input Pin	IN	Input	-
	Output Pin	OUT	When HOLD=OFF, OUT=IN; When HOLD=ON, Hold the Output	-
	Operation Parameter	HOLD	When HOLD=ON, Hold the Output	-

8.37 LREAL Assignment Function Block (MOV_LREAL)

Function block MOV_LREAL assigns a LREAL output for the LREAL input. Parameter instructions refer to table below.

In the user program window, if FCU731 is used, MOV_LREAL function block is named as MOV_LREAL_X, which shares the same functions as MOV_LREAL.

The running time of this block is 2μs.

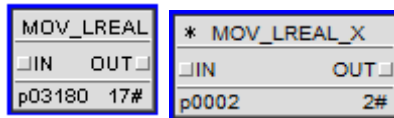


Table 8.38 MOV_LREAL parameter instruction

Name			Description	Upload
Basic Parameters	Input Pin	IN	Input	-
	Output Pin	OUT	When HOLD=OFF, OUT=IN; When HOLD=ON, Hold the Output	-
	Operation Parameter	HOLD	When HOLD=ON, Hold the Output	-

8.38 UINT Assignment Function Block (MOV_UINT)

Function block MOV_UINT assigns an UINT output for the UINT input. Parameter instructions refer to table below.

The running time of this block is 1 μ s.

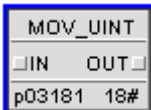


Table 8.39 MOV_UNIT parameter instruction

Name			Description	Upload
Basic Parameters	Input Pin	IN	Input	-
	Output Pin	OUT	When HOLD=OFF, OUT=IN; When HOLD=ON, Hold the Output	-
	Operation Parameter	HOLD	When HOLD=ON, Hold the Output	-

8.39 UDINT Assignment Function Block (MOV_UDINT)

Function block MOV_UDINT assigns an UDINT output for the UDINT input. Parameter instructions refer to table below.

The running time of this block is 2 μ s.

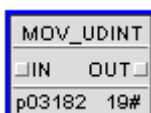


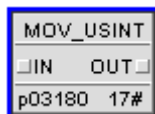
Table 8.40 MOV_UDINT parameter instruction

Name			Description	Upload
Basic Parameters	Input Pin	IN	Input	-
	Output Pin	OUT	When HOLD=OFF, OUT=IN; When HOLD=ON, Hold the Output	-
	Operation Parameter	HOLD	When HOLD=ON, Hold the Output	-

8.40 USINT Assignment Function Block (MOV_USINT)

Function block MOV_USINT assigns an USINT output for the USINT input. Parameter instructions refer to table below.

The running time of this block is 1μs.

**Table 8.41 MOV_USINT parameter instruction**

Name			Description	Upload
Basic Parameters	Input Pin	IN	Input	-
	Output Pin	OUT	When HOLD=OFF, OUT=IN; When HOLD=ON, Hold the Output	-
	Operation Parameter	HOLD	When HOLD=ON, Hold the Output	-

8.41 Matrix Add Function Block (MADD)

Function block MADD implements the addition of two 3×3 matrixes. Parameter instructions refer to table below.

The running time of this block is 10μs.

MADD	
<input type="checkbox"/> A11	AB11
<input type="checkbox"/> A12	AB12
<input type="checkbox"/> A13	AB13
<input type="checkbox"/> A21	AB21
<input type="checkbox"/> A22	AB22
<input type="checkbox"/> A23	AB23
<input type="checkbox"/> A31	AB31
<input type="checkbox"/> A32	AB32
<input type="checkbox"/> A33	AB33
<input type="checkbox"/> B11	
<input type="checkbox"/> B12	
<input type="checkbox"/> B13	
<input type="checkbox"/> B21	
<input type="checkbox"/> B22	
<input type="checkbox"/> B23	
<input type="checkbox"/> B31	
<input type="checkbox"/> B32	
<input type="checkbox"/> B33	
p03181	18#

Table 8.42 MADD parameter instruction

Name		Description		Upload
Basic Parameters	Input Pin	A11	Parameter of Row1 and Column1 in Matrix A	-
		A12	Parameter of Row1 and Column2 in Matrix A	-
		A13	Parameter of Row1 and Column3 in Matrix A	-
		A21	Parameter of Row2 and Column1 in Matrix A	-
		A22	Parameter of Row2 and Column2 in Matrix A	-
		A23	Parameter of Row2 and Column3 in Matrix A	-
		A31	Parameter of Row3 and Column1 in Matrix A	-
		A32	Parameter of Row3 and Column2 in Matrix A	-
		A33	Parameter of Row3 and Column3 in Matrix A	-
		B11	Parameter of Row1 and Column1 in Matrix B	-
		B12	Parameter of Row1 and Column2 in Matrix B	-

Table 8.42 MADD parameter instruction (continued)

Name			Description	Upload
		B13	Parameter of Row1 and Column3 in Matrix B	-
		B21	Parameter of Row2 and Column1 in Matrix B	-
		B22	Parameter of Row2 and Column2 in Matrix B	-
		B23	Parameter of Row2 and Column3 in Matrix B	-
		B31	Parameter of Row3 and Column1 in Matrix B	-
		B32	Parameter of Row3 and Column2 in Matrix B	-
		B33	Parameter of Row3 and Column3 in Matrix B	-
Extended Parameters	Output Pin	AB11	Parameter of Row1 and Column1 in Matrix AB	-
		AB12	Parameter of Row1 and Column2 in Matrix AB	-
		AB13	Parameter of Row1 and Column3 in Matrix AB	-
		AB21	Parameter of Row2 and Column1 in Matrix AB	-
		AB22	Parameter of Row2 and Column2 in Matrix AB	-
		AB23	Parameter of Row2 and Column3 in Matrix AB	-
		AB31	Parameter of Row3 and Column1 in Matrix AB	-
		AB32	Parameter of Row3 and Column2 in Matrix AB	-
		AB33	Parameter of Row3 and Column3 in Matrix AB	-

Note: MADD implements the following algorithm:

$$\begin{bmatrix} A_{11} & A_{12} & A_{13} \\ A_{21} & A_{22} & A_{23} \\ A_{31} & A_{32} & A_{33} \end{bmatrix} + \begin{bmatrix} B_{11} & B_{12} & B_{13} \\ B_{21} & B_{22} & B_{23} \\ B_{31} & B_{32} & B_{33} \end{bmatrix} = \begin{bmatrix} A_{11} + B_{11} & A_{12} + B_{12} & A_{13} + B_{13} \\ A_{21} + B_{21} & A_{22} + B_{22} & A_{23} + B_{23} \\ A_{31} + B_{31} & A_{32} + B_{32} & A_{33} + B_{33} \end{bmatrix}$$

8.42 Matrix Multiply Function Block (MMUL)

Function block MMUL implements the multiplication of two 3×3 matrixes. Parameter instructions refer to table below.

The running time of this block is 30μs.



Table 8.43 MMUL parameter instruction

Name			Description	Upload
Basic Parameters	Input Pin	A11	Parameter of Row1 and Column1 in Matrix A	-
		A12	Parameter of Row1 and Column2 in Matrix A	-
		A13	Parameter of Row1 and Column3 in Matrix A	-
		A21	Parameter of Row2 and Column1 in Matrix A	-
		A22	Parameter of Row2 and Column2 in Matrix A	-
		A23	Parameter of Row2 and Column3 in Matrix A	-
		A31	Parameter of Row3 and Column1 in Matrix A	-
		A32	Parameter of Row3 and Column2 in Matrix A	-
		A33	Parameter of Row3 and Column3 in Matrix A	-

Table 8.43 MMUL parameter instruction (continued)

Name			Description	Upload
		B11	Parameter of Row1 and Column1 in Matrix B	-
		B12	Parameter of Row1 and Column2 in Matrix B	-
		B13	Parameter of Row1 and Column3 in Matrix B	-
		B21	Parameter of Row2 and Column1 in Matrix B	-
		B22	Parameter of Row2 and Column2 in Matrix B	-
		B23	Parameter of Row2 and Column3 in Matrix B	-
		B31	Parameter of Row3 and Column1 in Matrix B	-
		B32	Parameter of Row3 and Column2 in Matrix B	-
		B33	Parameter of Row3 and Column3 in Matrix B	-
Extended Parameters	Output Pin	AB11	Parameter of Row and Column1 in Matrix AB	-
		AB12	Parameter of Row and Column2 in Matrix AB	-
		AB13	Parameter of Row and Column3 in Matrix AB	-
		AB21	Parameter of Row and Column1 in Matrix AB	-
		AB22	Parameter of Row and Column2 in Matrix AB	-
		AB23	Parameter of Row and Column3 in Matrix AB	-
		AB31	Parameter of Row and Column1 in Matrix AB	-
		AB32	Parameter of Row and Column2 in Matrix AB	-
		AB33	Parameter of Row and Column3 in Matrix AB	-

Note: MMUL implements the following algorithm:

$$\begin{bmatrix} A_{11} & A_{12} & A_{13} \\ A_{21} & A_{22} & A_{23} \\ A_{31} & A_{32} & A_{33} \end{bmatrix} * \begin{bmatrix} B_{11} & B_{12} & B_{13} \\ B_{21} & B_{22} & B_{23} \\ B_{31} & B_{32} & B_{33} \end{bmatrix}$$
$$= \begin{bmatrix} A_{11}B_{11} + A_{12}B_{21} + A_{13}B_{31} & A_{11}B_{12} + A_{12}B_{22} + A_{13}B_{32} & A_{11}B_{13} + A_{12}B_{23} + A_{13}B_{33} \\ A_{21}B_{11} + A_{22}B_{21} + A_{23}B_{31} & A_{21}B_{12} + A_{22}B_{22} + A_{23}B_{32} & A_{21}B_{13} + A_{22}B_{23} + A_{23}B_{33} \\ A_{31}B_{11} + A_{32}B_{21} + A_{33}B_{31} & A_{31}B_{12} + A_{32}B_{22} + A_{33}B_{32} & A_{31}B_{13} + A_{32}B_{23} + A_{33}B_{33} \end{bmatrix}$$

8.43 UINT Add Function Block (ADD_UINT)

Function block ADD_UINT implements the addition of the two UINT inputs. Parameter instructions refer to table below.

The running time of this block is 4µs.

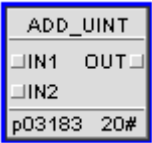


Table 8.44 ADD_UINT parameter Instruction

Name			Description	Upload
Basic Parameters	Input Pin	IN1	Input 1 of ADD	-
		IN2	Input 2 of ADD	-
	Output Pin	OUT	OUT = (IN1 + C1) +(IN2 + C2)	-
	Operation Parameters	C1	Offset of Input 1	TRUE
		C2	Offset of Input 2	TRUE

8.44 INT Add Function Block (ADD_INT)

Function block ADD_INT implements the addition of the two INT inputs. Parameter instructions refer to table below

The running time of this block is 4µs.

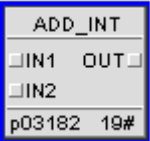


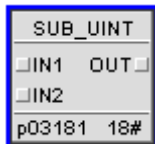
Table 8.45 ADD_INT parameter Instruction

Name			Description	Upload
Basic Parameters	Input Pin	IN1	Input 1 of ADD	-
		IN2	Input 2 of ADD	-
	Output Pin	OUT	$OUT = (IN1 + C1) + (IN2 + C2)$	-
	Operation Parameters	C1	Offset of Input 1	TRUE
		C2	Offset of Input 2	TRUE

8.45 UINT Subtraction Function Block (SUB_UINT)

Function block SUB_UINT implements the subtraction of the two UINT inputs. Parameter instructions refer to table below.

The running time of this block is 4μs.

**Table 8.46 SUB_UINT parameter Instruction**

Name			Description	Upload
Basic Parameters	Input Pin	IN1	Input 1 of SUB	-
		IN2	Input 2 of SUB	-
	Output Pin	OUT	$OUT = (IN1 + C1) - (IN2 + C2)$	-
	Operation Parameters	C1	Offset of Input 1	TRUE
		C2	Offset of Input 2	TRUE

8.46 INT Subtraction Function Block (SUB_INT)

Function block SUB_INT implements the subtraction of the two INT inputs. Parameter instructions refer to table below.

The running time of this block is 4μs.

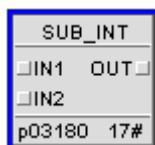


Table 8.47 SUB_INT parameter Instruction

Name			Description	Upload
Basic Parameters	Input Pin	IN1	Input 1 of SUB	-
		IN2	Input 2 of SUB	-
	Output Pin	OUT	$OUT = (IN1 + C1) - (IN2 + C2)$	-
	Operation Parameters	C1	Offset of Input 1	TRUE
		C2	Offset of Input 2	TRUE

9 Logical Operation Function Block Library

Logical operation function block library includes 19 simple function blocks and 1 complex function block.

9.1 AND Function Block

Function block AND implements logical AND operation of two BOOL inputs. This function block is a simple function block, and its running time is 1μs. The parameter description of this function block is shown in the table below.



Table 9.1 AND parameter description

Name			Description	Upload
Basic Parameters	Input Pin	IN1	Input 1	-
		IN2	Input 2	-
	Output Pin	OUT	OUT = IN1 AND IN2	-

The logic relation is shown below.

Table 9.2 Table 9-2 Relation between input and output of AND

IN1	OFF	OFF	ON	ON
IN2	OFF	ON	OFF	ON
OUT	OFF	OFF	OFF	ON

9.2 ANDEX Function Block

When FCU811-S is applied, ANDEX can implement logical AND operation of multiple BOOL inputs. By default, ANDEX has 2 input pins. Click and drag the function block bottom border to expand the pins. Up to 32 pins can be added.

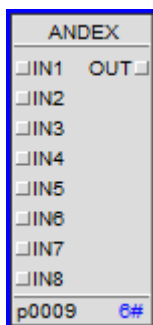


Table 9.3 ANDEX parameter description

Name			Description	Upload
Basic Parameters	Input Pin	IN1	Input 1	-
		-
		INn	Input n	-
	Output Pin	OUT	OUT = IN1 AND IN2 AND ... INn	-

Empty pin is not allowed; otherwise, the compilation might encounter an error.

9.3 OR Function Block

Function block OR implements logic OR operation of two BOOL inputs.

This function block is a simple function block, its running time is 1μs.

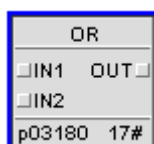


Table 9.4 OR parameter instruction

Name			Description	Upload
Basic Parameters	Input Pin	IN1	Input 1	-
		IN2	Input 2	-
	Output Pin	OUT	OUT = IN1 OR IN2	-

The logic relation is shown below.

Table 9.5 Relation between input and output of OR

IN1	OFF	OFF	ON	ON
IN2	OFF	ON	OFF	ON

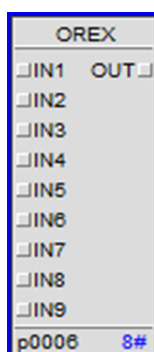
Table 9.5 Relation between input and output of OR (continued)

IN1	OFF	OFF	ON	ON
OUT	OFF	ON	ON	ON

9.4 OREX Function Block

When FCU811-S is applied, function block OREX implements logic OR operation of multiple BOOL inputs. By default, OREX has 2 input pins. Click and drag the function block bottom border to expand the pins. Up to 32 pins can be added.

This function block is a simple function block, its running time is 1μs.

**Table 9.6 OREX parameter instruction**

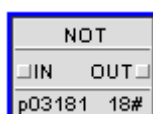
Name			Description	Upload
Basic Parameters	Input Pin	IN1	Input 1	-
		-
		Inn	Input n	-
	Output Pin	OUT	OUT = IN1 OR IN2.....OR INn	-

Empty pin is not allowed; otherwise, the compilation might encounter an error.

9.5 NOT Function Block

Function block NOT implements logical NOT operation of two BOOL inputs.

This function block is a simple function block, and its running time is 1μs.



9.5.1 Parameter Descripton

Table 9.7 NOT parameter instruction

Name			Description	Upload
Basic Parameters	Input Pin	IN	Input	-
	Output Pin	OUT	OUT = NOT(IN)	-

The logic relation is shown below.

Table 9.8 Relation between input and output of NOT

IN	OFF	ON
OUT	ON	OFF

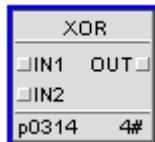
9.5.2 Application Example

Refer to "Application Example".

9.6 XOR Function Block

Function block XOR implements logical XOR operation of two BOOL inputs.

This function block is a simple function block, and its running time is 1μs.

**Table 9.9 XOR parameter instruction**

Name			Description	Upload
Basic Parameters	Input Pin	IN1	Input 1	-
		IN2	Input 2	-
	Output Pin	OUT	OUT = IN1 XOR IN2	-

The logic relation is shown below.

Table 9.10 Relation between input and output of XOR

IN1	OFF	OFF	ON	ON
IN2	OFF	ON	OFF	ON
OUT	OFF	ON	ON	OFF

9.7 XOREX Function Block

When FCU811-S is applied, XOREX implements logical XOR operation of multiple BOOL inputs. By default, XOREX has 2 input pins. Click and drag the function block bottom border to expand the pins. Up to 32 pins can be added.

This function block is a simple function block, and its running time is 1μs.

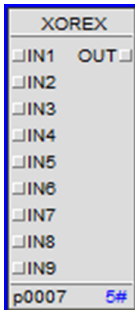


Table 9.11 XOR parameter instruction

Name			Description	Upload
Basic Parameters	Input Pin	IN1	Input 1	-
		-
		Inn	Input n	-
	Output Pin	OUT	OUT = IN1 XOR IN2.....XOR INn	-

Empty pin is not allowed; otherwise, the compilation might encounter an error.

9.8 AND8 Function Block

Function block AND8 implements logical AND operation of eight BOOL inputs. Parameter instructions refer to Table 1.

This function block is a simple function block, and its running time is 2μs.

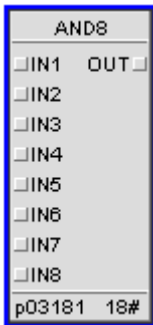


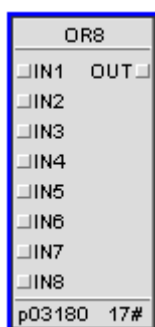
Table 9.12 AND8 parameter instruction

Name			Description	Upload
Basic Parameters	Input Pin	IN1	Input 1	-
		IN2	Input 2	-
		IN3	Input 3	-
		IN4	Input 4	-
		IN5	Input 5	-
		IN6	Input 6	-
		IN7	Input 7	-
		IN8	Input 8	-
	OutputPin	OUT	Output OUT = IN1 AND IN2 AND IN3 AND IN4 AND IN5 AND IN6 AND IN7 AND IN8	-

9.9 OR8 Function Block

Function block OR8 implements logical OR operation of eight BOOL inputs. Parameter instructions refer to Table 1.

This function block is a simple function block, and its running time is 2μs.

**Table 9.13 OR8 parameter instruction**

Name		Description	Upload	Properties
Basic Parameters	Input Pin	IN1	Input 1	-
		IN2	Input 2	-
		IN3	Input 3	-
		IN4	Input 4	-
		IN5	Input 5	-

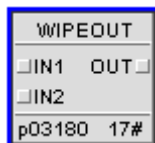
Table 9.13 OR8 parameter instruction (continued)

Name		Description	Upload	Properties
		IN6	Input 6	-
		IN7	Input 7	-
		IN8	Input 8	-
	OutputPin	OUT	Output OUT = IN1 OR IN2 OR IN3 OR IN4 OR IN5 OR IN6 OR IN7 OR IN8	-

9.10 WIPEOUT Function Block

Function Block WIPEOUT implements logical AND of the first BOOL input and NOT of the second BOOL input.

This function block is a simple function block, and its running time is 1μs.

**Table 9.14 WIPEOUT parameter instruction**

Name			Description	Upload
Basic Parameters	Input Pin	IN1	Input 1	-
		IN2	Input 2	-
	OutputPin	OUT	Output OUT=IN1 AND (NOT(IN2))	-

The logic relation is shown below.

Table 9.15 Relation between input and output of WIPEOUT

IN1	OFF	OFF	ON	ON
IN2	OFF	ON	OFF	ON
OUT	OFF	OFF	ON	OFF

9.11 PVDI Function Block

Function block PVDI implements rising edge count of the BOOL input. Number of rising edges counted can be displayed on the faceplate.

This function block is a complex function block, and its running time is 30μs.



9.11.1 Parameter Description

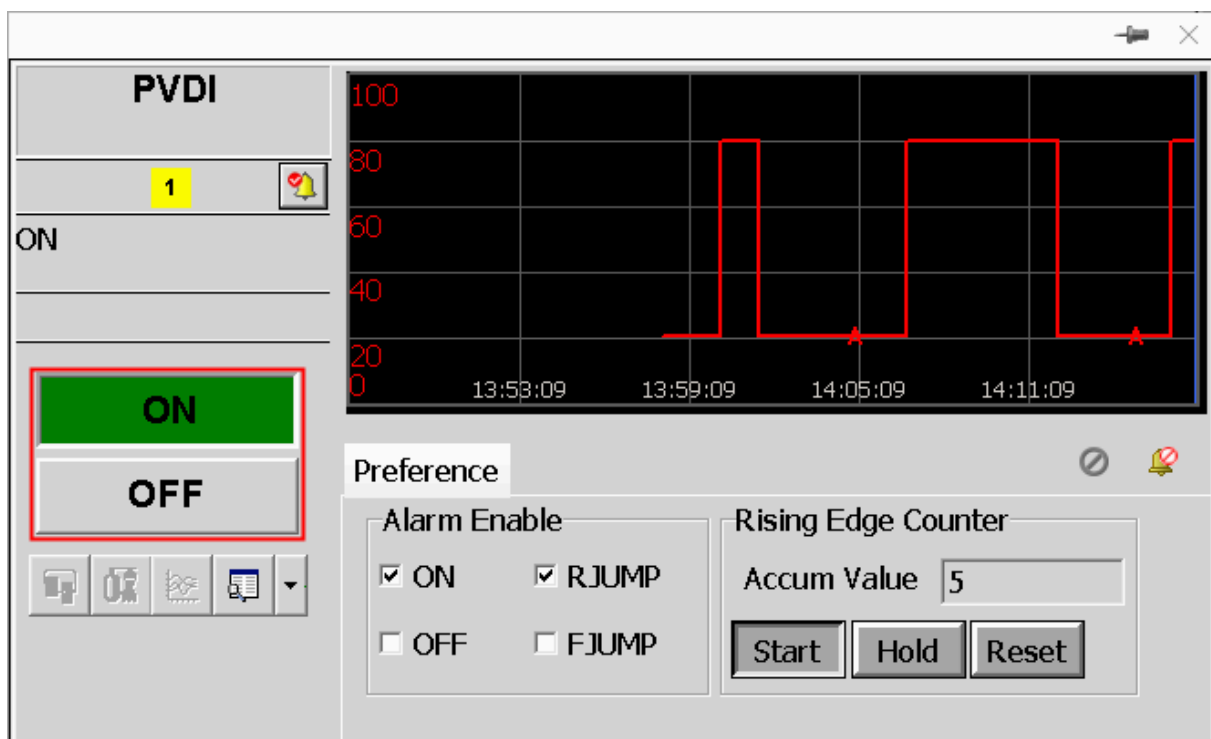
Table 9.16 PVDI parameter instruction

Name			Description	Upload	Properties	Application Reference
Basic Parameters	Input Pin	IN	Input	-	Input Pin	-
		PRST	Program Set Rising Edge Counter	-	Input Pin	PRST=ON , reset the AV result.
		RST_-OPT	Reset Source SelectionWhen RST_OPT=ON, carry out program reset control, panel follows the result of program control;When RST_OPT=OFF, carry out panel reset control, program follows the result of panel control	-	Input Pin	-
		PHOLD	Jump Accumulate Program Suspension	-	Input Pin	-
		HOLD_-OPT	Cumulative Suspension Control Source SelectionWhen HOLD_OPT=ON, carry out program pause control, panel follows the result of program control.When HOLD_-OPT=OFF, carry out panel pause control, program follows the result of panel control.	-	Input Pin	-
	OperationParameter	RST	Panel Set Rising Edge Counter	-	Operation Parameter	When RST=ON, reset AV
		HOLD	Jump Accumulate Panel Suspension	-	Operation Parameter	-
		AV	Rising Edge Jump Accumulation When SWOOS=OFF, if panel preset HOLD=OFF or program preset PHOLD=OFF, count the times of IN switch	TRUE	Operation Parameter	Display the result of rising edge jump accumulation

Table 9.16 PVDI parameter instruction (continued)

Name			Description	Upload	Properties	Application Reference
			from OFF to ON, result display as AV.			
	Alarm Enable and Suppress	AOF	Suppress Module Alarm	TRUE	Operation Parameter	-
		ENALM	Alarm Enable	TRUE	Alarm Parameter	-
		FLAG	Flag	-	Output Pin	-
	OOS Settings	SWOOS	Prohibited Function Block(ON stands for mode OOS) ^{Note1}	TRUE	Operation Parameter	Set to be ON when function block is downloaded first time

9.11.2 Parameter of Function Block Panel



As shown in the figure above, the button name in the red box can be modified in the macro parameters of the function block, and the maximum length is 0~64 characters (including Chinese, English, numbers and special characters). If the button name is not modified, the original default description will be displayed on the panel. When the length of the custom description exceeds the actual length of the button on the panel, it will be truncated and displayed according to the actual length of the button.

Table 9.17 Panel parameter instruction

Panel Parameter Name			Function Block Parameter Name	Initial Value	Value Range	Application Instruction
Preference	Alarm-Enable	ON	ENALM	-	-	For the selected item in the program "ON Status Alarm(ON)"
		OFF	ENALM	-	-	For the selected item in the program "OFF Status Alarm(OFF)"
		RJump	ENALM	-	-	For the selected item in the program " Positive Jump Alarm(RJUMP)"
		FJump	ENALM	-	-	For the selected item in the program " Negative Jump Alarm(FJUMP)"
	Rising Edge Counter	Accum Value	AV	0	Natural Number	Count the jump from OF to ON
		Start	PHOLD/HOLD	-	ON/OFF	Rising Edge Jump Accumulation StartCorresponding function block parameter set to be OFF
		Hold	PHOLD/HOLD	-	ON/OFF	Corresponding function block parameter set to be ON
		Reset	PHOLD/HOLD	-	ON/OFF	Corresponding function block parameter set to be OFF

9.11.3 Flag

Table 9.18 Flag list

Flag	Alarm	Description
D0	OOS	Disable
D1	ON	ON Status Alarm
D2	OFF	OFF Status Alarm
D3	RJUMP	Positive Transition-sensing Alarm
D4	FJUMP	Negative Jump Alarm
D5	AOF	Suppress Alarm

9.12 RS Function Block

Function block RS is a reset-preferred and the most basic time-sequence logical device.

Whenever it is, its output is decided not only by the this-time BOOL input, but also by the previous status. It is a bitable trigger. Triggered by the input signal, RS switches its output from one stable status to another stable status, and holds on until the next trigger signal. It has a function of memory.

This function block is a simple function block, and its running time is 3μs.



Table 9.19 RS parameter instruction

Name			Description	Upload
Basic Parameters	Input Pin	R	Reset Input	-
		S	Set Input	-
	OutputPin	DV	Output	-
		RV	Trigger Another Status Output RV = NOT DV	-

The logic relation is shown below.

Table 9.20 Relation between input and output of RS

Set Input S	OFF	OFF	ON	ON
Reset Input R	OFF	ON	OFF	ON
Status Output DV	Unchanged	OFF	ON	OFF
Another Status Out-put RV	Unchanged	ON	OFF	ON

Time-sequence graph is shown in the figure below:

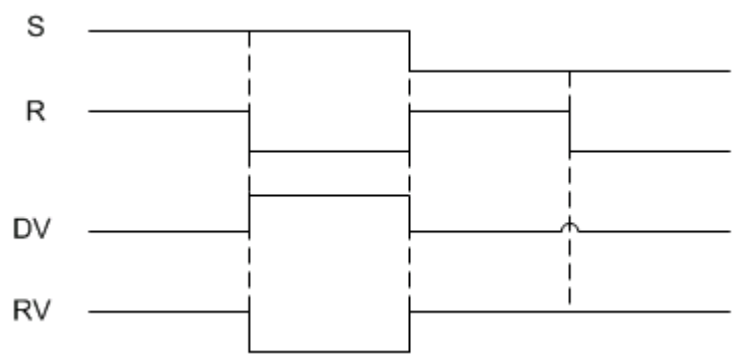


Figure 9.1 Time-sequence graph of RS function block

9.13 SR Function Block

Function block SR is a reset-preferred and the most basic time-sequence logical device. Whenever it is, its output is decided not only by the this-time BOOL input, but also by the previous status. It is a bitable trigger. Triggered by the input signal, SR switches its output from one stable status to another stable status, and holds on until the next trigger signal. It has a function of memory.

This function block is a simple function block, and its running time is 3μs.



Table 9.21 SR parameter instruction

Name			Description	Upload
Basic Parameters	Input Pin	S	SET INPUT	-
		R	RESET INPUT	-
	OutputPin	DV	Output	-
		RV	Trigger Another Status Output RV = NOT DV	-

The logic relation is shown below.

Table 9.22 Relation between input and output of SR

Set Input S	OFF	OFF	ON	ON
Reset Input R	OFF	ON	OFF	ON
Status Output DV	ON	ON	OFF	Unchanged

Table 9.22 Relation between input and output of SR (continued)

Set Input S	OFF	OFF	ON	ON
Another Status Out-put RV	OFF	OFF	ON	Unchanged

Time-sequence graph is shown in the b=figure below:

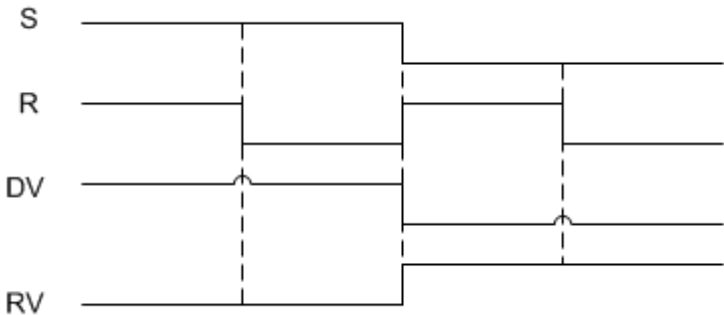


Figure 9.2 Time-sequence graph of SR function block

9.14 DFF Function Block

Function block DFF is an analog of hardware D trigger. Main parameters: input signal IN, clock signal input CLK, reset signal R, set signal S, positive output DV, negative output RV. Parameter instructions refer to table below.

This function block is a simple function block, and its running time is 3μs.



Table 9.23 DFF parameter instruction

Name			Description	Upload
Basic Parameters	Input Pin	IN	Input	-
		CLK	Clock Input	-
		R	RESET INPUT	-
		S	SET INPUT	-
	OutputPin	DV	Output ^{Note1}	-
		RV	Trigger Another Status Output RV = NOT DV ^{Note1}	-

Implementation steps of D trigger:

- If set signal S=ON, output DV=ON and its priority is higher than CLK"s.
- If reset signal R=ON, output DV=OFF and its priority is higher than CLK"s.
- If R=ON and S=ON at the same time, RS holds. If this time comes the rising-edge of CLK, then output DV=IN.
- Otherwise, DV holds.
- RV is the negative of DV.

Time-sequence graph is shown in figure

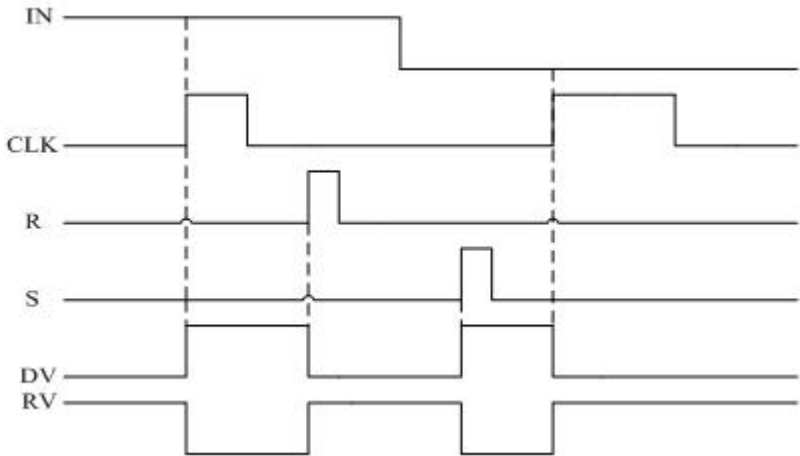


Figure 9.3 Time sequence graph (DFF)

9.15 COUNTER Function Block

Function block COUNTER is used to count the input pulses and it has increasing counting and decreasing counting. When MODE=OFF, it is increasing counting. When MODE=ON, it is decreasing counting. Parameter instructions refer to table below.

This function block is a simple function block, and its running time is 3μs.

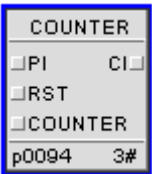


Table 9.24 COUNTER parameter instruction

Name			Description	Upload	Properties	Application Refer- ence
Basic Para- meters	Input Pin	PI	Impulse Signal Input	-	Input Pin	Impulse Signal In- put is counted by its rising edge
		RST	Reset Signal	-	Input Pin	Rising edge counts

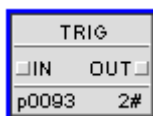
Table 9.24 COUNTER parameter instruction (continued)

Name			Description	Upload	Properties	Application Reference
		COUNTER	Pre-Set Value: The Counting Pause Value of Increasing Counting, and Initial Value of Decreasing.	-	Input Pin	-
	OutputPin	CI	Counting Output Marking. For increasing counting, when CV=COUNTER, CI=ON. For decreasing counting, when CV=0 CI=ON	-	Output Pin	Stop counting when rising edge of RST arrives, reset CV to its initial and CI=OFF
	ConfigurationParameter	MODE	Working Mode of Counter: When MODE=OFF, It is Increasing Counting. When MODE=ON, It is Decreasing Counting.	-	Configuration Parameter	-
		CV	Counting Unit	-	Configuration Parameter	For increasing counter, CV=0. For decreasing counter, CV=COUNTER.

9.16 TRIG Function Block

Function block TRIG is an edge-trigger and can output a pulse lasting for a program period according to the changes of input. Parameter instructions refer to table below.

This function block is a simple function block, and its running time is 2μs.

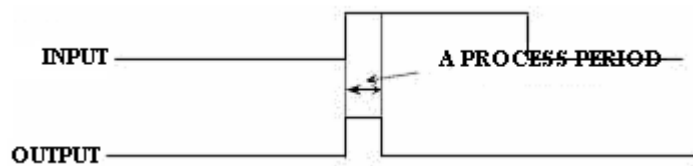
**Table 9.25 TRIG parameter instruction**

Name			Description	Upload
Basic Parameters	Input Pin	IN	Input	-
	Output Pin	OUT	Output	-
	Configuration Parameter	MODENote1	Mode Switch When MODE=0, Rising-Edge is Triggering. When MODE=1, Falling-Edge is Triggering. When MODE=2, Edge is Triggering ^{Note1} .	-

Note:

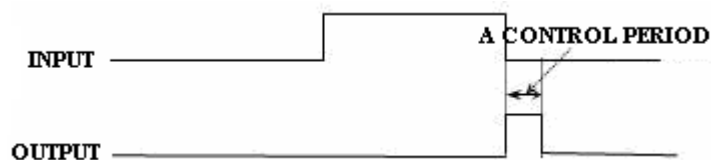
- MODE=0

Relation between input and output is:



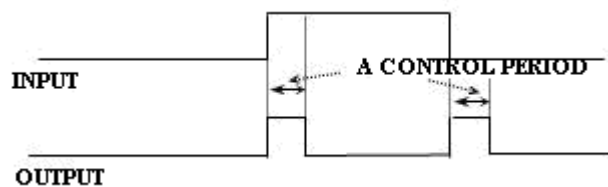
- MODE=1

Relation between input and output is:



- MODE=2

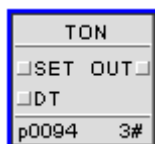
Relation between input and output is:



9.17 TON Function Block

Function block TON is a standard timer and can generate a delay output when input jumps from OFF to ON. Parameter instructions refer to table below.

This function block is a simple function block, its running time is 8μs.



9.17.1 Parameter Description

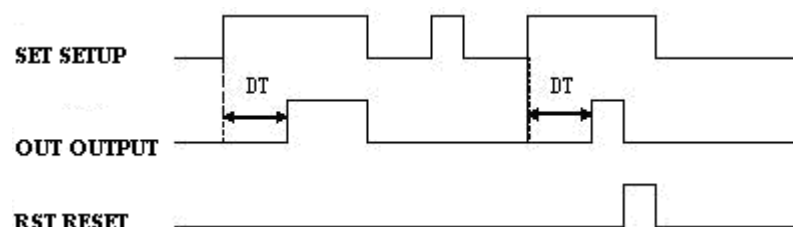
Table 9.26 TON parameter instruction

Name			Description	Upload	Properties	Application Reference
Basic Parameters	Input Pin	SET	Set Signal	-	Input Pin	-

Table 9.26 TON parameter instruction (continued)

Name			Description	Upload	Properties	Application Reference
		RST	Reset Signal	-	Input Pin	Force reset of output
		DT	Holding Time and the Unit is Second	TRUE	Input Pin	-
	Output Pin	OUT	Output Note1	-	Output Pin	-
		ET	The Passed time	-	Output Pin	If there's the float abnormal, the ET outputs the value of DT or 0. Please refer to "Application Illustration" for details.

When SET jumps from OFF to ON and holds for sufficient time, then DT time later, OUT become high level and holds until SET resets. If the length of SET=ON is less than DT, OUT remains 0. When the rising-edge of RST coming, OUT resets immediately. Time-sequence graph is shown in 6 Time-sequence graph 6.

**Figure 9.4 Time-sequence graph (TON)**

9.17.2 Application Illustration

The float abnormal of output values means that the output values are not float format, or a meaningless output value is produced in a calculation that performs a divide-by-zero operation. When float abnormal happened, the function block is processed according to the following rules:

- If the OUT outputs ON, the ET outputs the value of DT.
- If the OUT outputs OFF, the ET outputs 0.

9.17.3 Application Example

When the digital signal is set as ON (the digital is "1"), it flashes in the flow chart.

The digital signal changes between 0 and 1 in low frequency. It can meet the requirements of flash and dynamic effect for picture.

Its programming is shown below, which can be achieved by normal logic function block. The flash cycle and pulse width can be set via TIME1 and TIME2.

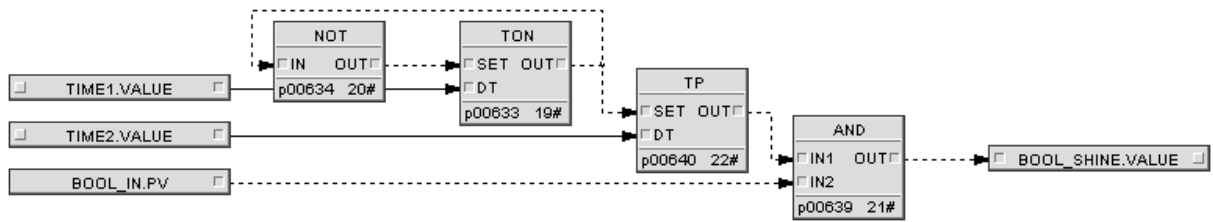


Figure 9.5 Programming of flash

The function block instruction and examples are shown below.

Table 9.27 Function block instruction and examples

NO.	Example	Type	Instruction	Remark
001	TIME1	Custom REAL	Period Setting	-
002	TIME2	Custom REAL	Pulse Width Setting	-
003	BOOL_IN	DI (Input)	Flash Enabled Target	-
004	BOOL_SHINE	Custom BOOL	Flash Variable	Monitoring Tag

Parameter settings:

- TIME1: 2.0
- TIME2: 1.0

As parameters set above, the flash period is 2s and the pulse width is 1s.

9.18 TOFF Function Block

Function block TOFF is a standard timer and can generate a delay output when input falls from ON to OFF. Parameter instructions refer to table below.

This function block is a simple function block, and its running time is 8μs.



Table 9.28 TOFF parameter instruction

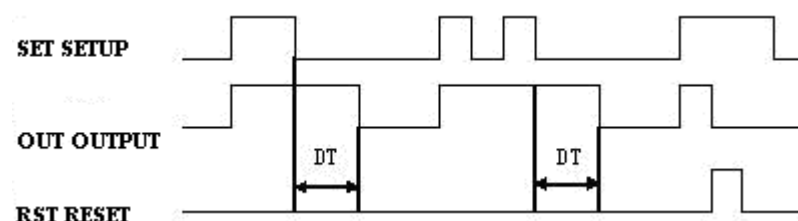
Name			Description	Upload	Properties	Application Refer- ence
Basic Para- meters	Input Pin	SET	Set Signal	-	Input Pin	-
		RST	Reset Signal	-	Input Pin	-

Table 9.28 TOFF parameter instruction (continued)

Name			Description	Upload	Properties	Application Reference
	Output-Pin	DT	Holding Time and the Unit is Second	TRUE	Input Pin	-
		OUT	Output Note1	-	Output Pin	-
		ET	Passed time	-	Output Pin	If there's the float abnormal, the ET outputs the value of DT or 0. Please refer to "Application" for details.

Note: function block description

When SET from OFF to ON, OUT become high level and holds. When a falling-edge of SET comes and SET remains low level, then after a DT delay, OUT resets. If the holding time is shorter than DT, OUT remains high level even the falling-edge of SET comes. OUT resets as long as the rising-edge of RST comes. Time-sequence is shown in figure below Time-sequence graph.

**Figure 9.6 Time-sequence graph (TOFF)**

Application

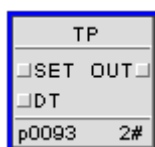
The float abnormal of output values means that the output values are not float format, or a meaningless output value is produced in a calculation that performs a divide-by-zero operation. When float abnormal happened, the function block is processed according to the following rules:

- If the OUT outputs ON, the ET outputs the value of DT.
- If the OUT outputs OFF, the ET outputs 0.

9.19 TP Function Block

Function block TP is a standard timer and can generate fixed length pulses. Parameter instructions refer to table below.

This function block is a simple function block, its running time is 8μs.



9.19.1 Parameter Description

Table 9.29 TP parameter instruction

Name			Description	Upload	Application Reference
Basic Parameters	Input Pin	SET	Set Signal	-	-
		RST	Reset Signal	-	Compel output reset
		DT	Holding Time and the Unit is Second	TRUE	-
	Output Pin	OUT	Output ^{Note1}	-	-
		ET	Passed time	-	If there's the float abnormal, the ET outputs the value of DT or 0. Please refer to "Application Illustration" for details.

As long as SET jumps from OFF to ON and there is no reset signal, OUT is a series of pulses whose length is DT. During the timing, if the rising-edge of RST comes, OUT resets immediately until the next rising-edge of SET. Time-sequence graph is shown in figure below.

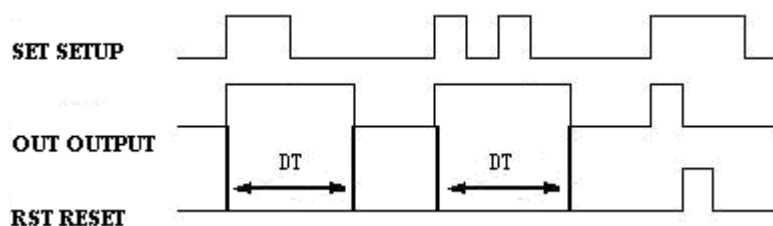


Figure 9.7 Time-sequence graph (TP)

9.19.2 Application Illustration

The float abnormal of output values means that the output values are not float format, or a meaningless output value is produced in a calculation that performs a divide-by-zero operation. When float abnormal happened, the function block is processed according to the following rules:

- If the OUT outputs ON, the ET outputs the value of DT.
- If the OUT outputs OFF, the ET outputs 0.

9.19.3 Application Example

Refer to "Application Example" and "Application Example" .

9.20 TIMER Function Block

Function block TIMER is a basic timer, and it can generate a period of pulse according to the changes of the input.

This function block is a simple function block, its running time is 8μs. Parameter instructions refer to table below.



Table 9.30 *TIMER parameter instruction*

Name			Description	Upload	Application Reference
Basic Parameters	Input Pin	SET	Set Signal	-	-
		RST	Reset Signal	-	-
		DT	Holding Time and the Unit is Second	TRUE	-
	Output Pin	OUT	Output	-	-
		ET	Passed time ^{Note1}	-	Generally, ET<DT.If there's the float abnormal, the ET outputs the value of DT or 0.Please refer to "Application" for details.

When SET jumps from OFF to ON, then DT time later, OUT becomes high level and holds for an operation period. When the rising-edge of RST comes, timer stops and resets OUT, and waits for the next rising-edge of SET. If SET jumps from OFF to ON, and within DT, another rising-edge of SET arrives, and then the second jump would be shielded. Time-sequence graph is shown in figure below Time-sequence graph.

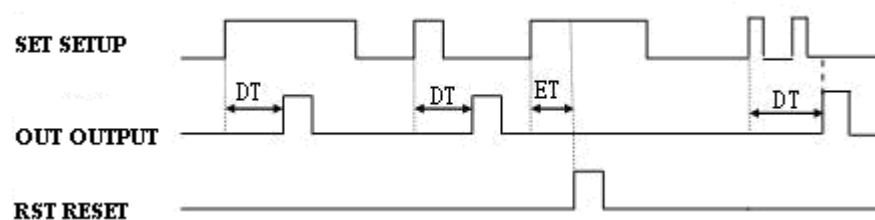


Figure 9.8 *Time-sequence graph (TIMER)*

Application

The float abnormal of output values means that the output values are not float format, or a meaningless output value is produced in a calculation that performs a divide-by-zero operation. When float abnormal happened, the function block is processed according to the following rules:

- If the OUT outputs ON, the ET outputs the value of DT.
- If the OUT outputs OFF, the ET outputs 0.

9.21 TIMERSE Function Block

Imperative extended timer function block, which is a complex function block with a running time of 50μs. The external can execute operations such as run, stop, pause and so on, and support cycle timer. The description of each parameter is shown in the table below.

* TIMERSE	
OUT <input type="checkbox"/>	
p0007	2#

Table 9.31 TIMERSE function block parameter illustration

Parameter name			Description	Upload	Parameter property	Application
Basic parameter	Configuration parameter	INIT_OPT	cold start initialization option	-	configuration parameter	(OFF=Initial, ON=Hold)
		POUT_OPT	pre-alarm option	-	configuration parameter	OFF=Pre-Alarm when time is up, ON=Not Pre-Alarm when time is up
Extended parameter	Input pin	RUN	run command	-	input pin	-
		STOP	stop command	-	input pin	-
		PAUSE	pause command	-	input pin	-
		RESUME	resume command	-	input pin	-
	output Pin	OUT	output value	-	output pin	-
		POUT	pre-alarm output	-	output pin	-
		RT	remaining time	-	output pin	-
		ET	elapsed time	-	output pin	-
	operation parameter	CMD	command	-	operating parameter	0=IDLE, 1=RUN, 2=STOP, 3=PAUSE, 4=RESUME. it is reset by the function block after each period
		DT	delay set time	TRUE	operating parameter	maximum 1000000

Table 9.31 TIMERSE function block parameter illustration (continued)

Parameter name			Description	Upload	Parameter property	Application
		PT	pre-alarm count-down time	TRUE	operating parameter	maximum 1000000
		UNIT	time unit	TRUE	operating parameter	0=second, 1=minute
		RUN_OPT	running mode	TRUE	operating parameter	0=normal, 1=cycle
		SWOOS	switch out of service	TRUE	operating parameter	ON=disable
	alarm enable and shield	AOF	suppress alarm	-	operating parameter	ON=Suppress
		ENALM	alarm enable settings	-	operating parameter	-
	monitor parameter	FLAG	flag	-	operating parameter	-
		MODE	mode	-	operating parameter	1=OOS; 5=AUTO
		STATUS	status	-	operating parameter	0=STOP; 1=RUN; 2=PAUSE; 3=END

9.21.1 Function Illustration

Input pin process

Enter pin RUN / STOP / PAUSE / RESUME uses level signals.

- If there is a pin in four pins to be ON, the mode switch corresponding to this pin is executed. If run = ON, enter into RUN mode.
- If there of the four pins are OFF, it is maintained as the current mode.
- If there are two or more pins in the four pins to be ON, it is maintained as the current mode and the command blocking alarm is reported.

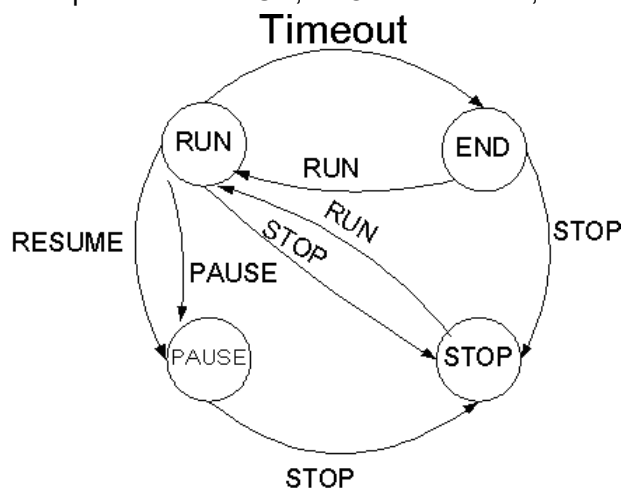
CMD command process

The value of CMD is 0 ~ 4, and the meaning is 0 = no action, 1 = switch to Run, 2 = Switch to STOP, 3 = Switch to Pause, 4 = Switch to Resume. The end per cycle is reset to 0 by the function block.

If the CMD command is (1, 2, 3, 4), the input pin command is valid, the mode switching of the input pin is executed.

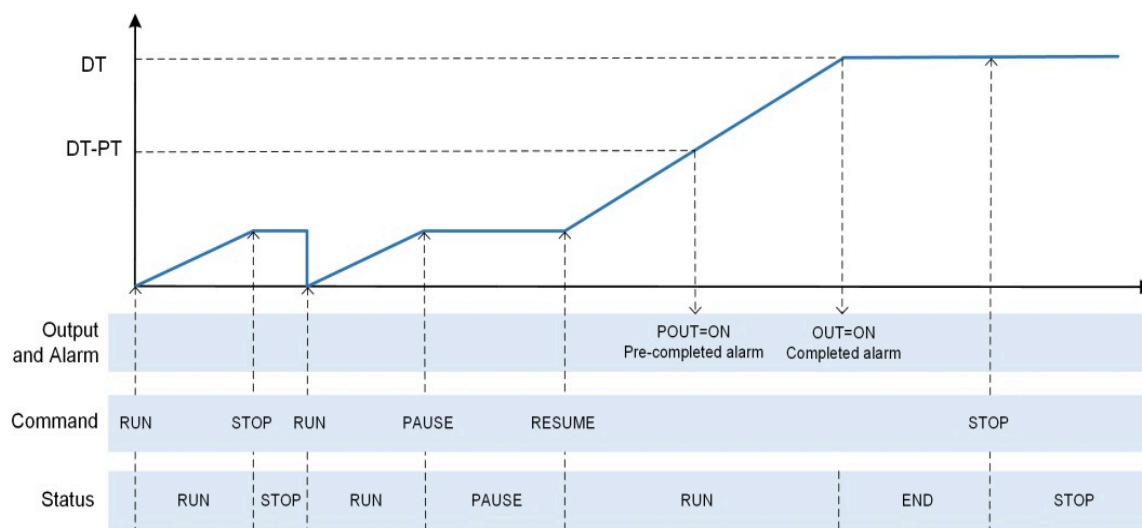
command switch status

After the Timerse function block receives the CMD command, the status switch will be made as shown below. In the status of the STOP, only the Run command is responsive. In the RUN status, you can respond to the STOP, the pause command. In the PAUSE status, you can respond to the STOP, the resume command, and you cannot respond to the Run command. In the END status, in response to the RUN, STOP commands, it cannot respond to the PAUSE command.

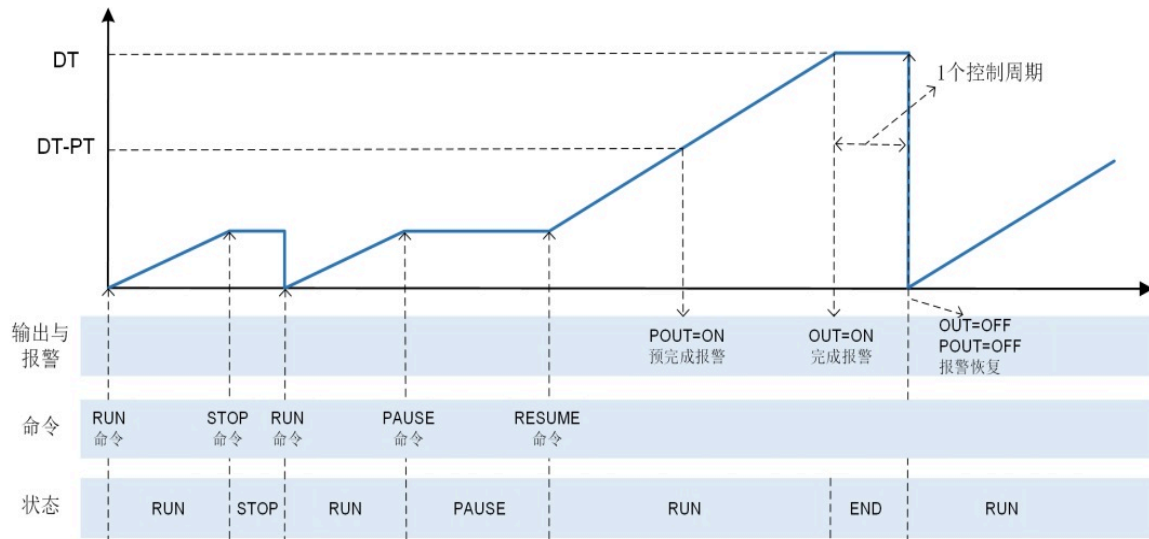


Mode illustration

- Under normal mode ($\text{run_opt} = 0$), processed according to the following figure.



- In the loop mode (`run_opt = 1`), processed according to the following figure.



Alarm process

- Alarm bar

The alarm bar shows all the alarms of the current event (which can be configured, the default is not enabled), including:

Description	Symbol	Whether to enable	Trigger condition
Timeout alarm	OUT_ALM	enable	timeout
Timeout prealarm	POUT_ALM	enable	Prealarm timeout Or POUT_OPT=OFF and timeout
Command back alarm	CMD_ALM	enable	Command input pins have two or more than two are ON

- Status bar display

Tag status includes:

Description	Symbol
Tag prohibit	OOS
Running status	RUN
Stop status	STOP

Description	Symbol
Pause status	PAUSE
End status	END
Alarm shield	AOF

9.21.2 Panel Parameter

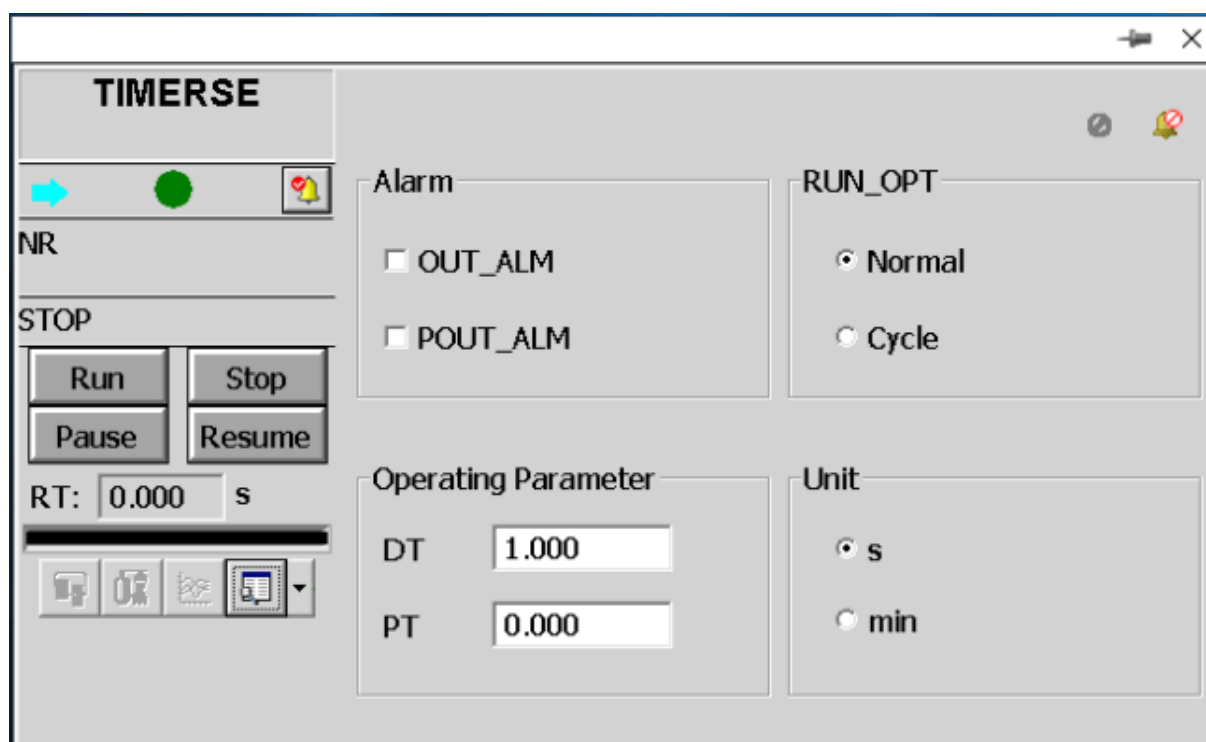


Figure 9.9 Panel parameter operation illustration

Table 9.32 Panel parameter operation illustration

Panel parameter name		Parameter name	Initial value	Value range	Application
But- ton	run, stop, re- sume, pause	After pressing the button, the parameters CMD will be written to 1, 2, 3, and 4, respectively. When entering parameters run, stop, pause, and resume are OFF, the button can be operated. After the CMD is written, its value will be automatically reset to 0, so the panel will automatically reset after four buttons.			
Alarm	timeout	OUT_ALM	OFF	ON/OFF	Check, enable timing time to alarm. Conversely, disabled.
	timeout pre- alarm	POUT_OPT	OFF	ON/OFF	Check the timing time forecast. Conversely, disabled.
Oper- ation	timeout	DT	1.000	[0.0~11000000.0]	-
	prealarm time	PT	0.000	[0.0~11000000.0]	-

Table 9.32 Panel parameter operation illustration (continued)

Panel parameter name	Parameter name	Initial value	Value range	Application
parameter				
Mode	RUN_OPT	0	0/1	0=normal,1=cycle
Unit	UNIT	0	0/1	0=second,1=minute

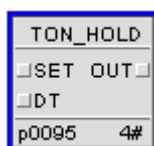
9.21.3 Flag

FLAG	Monitor Assignment	Description
D0	Allow(SWOOS)	Prohibit OOS
D1	Prohibit	RUN status
D2	Prohibit	STOP status
D3	Prohibit	PAUSE status
D4	Prohibit	END status
D5	Prohibit	OUT_ALM timeout alarm
D6	Prohibit	POUT_ALM time out pre alarm
D7	Prohibit	CMD_ALM command block alarm
D8	Allow	AOF alarm shield

9.22 TON_HOLD Function Block

Function block TON_HOLD is a lag-set and hold function block.

This function block is a simple function block, and sits running time is 8μs. Parameter instructions refer to below.

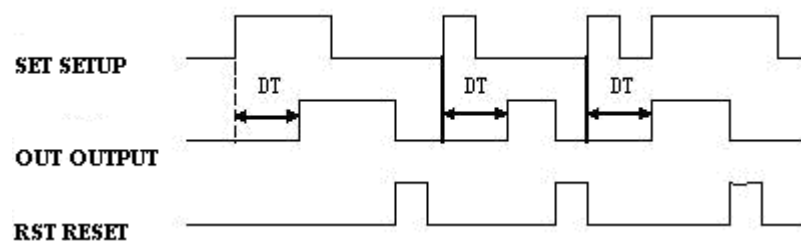
**Table 9.33 TON_HOLD parameter instruction**

Name	Description	Upload	Application Reference
Basic Parameters	SET	Set Signal	-
	RST	Reset Signal	-
Input Pin			Input Pin

Table 9.33 TON_HOLD parameter instruction (continued)

Name			Description	Upload	Application Reference
	OutputPin	DT	Timing Time (s)	TRUE	Input Pin
		OUT	Calculate output value	-	Output Pin
		ET	Passed time (s)	-	If there's the float abnormal, the ET outputs the value of DT or 0. Please refer to "Application" for details.

When the rising-edge of SET comes, then DT time later, OUT become high level and holds until the rising-edge of RST arrives. After OUT resets, OUT remains low level, even SET is high level, until the next rising-edge of SET arrives

**Figure 9.10 Time-sequence graph (TON_HOLD)**

Application

The float abnormal of output values means that the output values are not float format, or a meaningless output value is produced in a calculation that performs a divide-by-zero operation. When float abnormal happened, the function block is processed according to the following rules:

- If the OUT outputs ON, the ET outputs the value of DT.
- If the OUT outputs OFF, the ET outputs 0.

9.23 TP_TR Function Block

Function block TP_TR is a pulse-following timer.

This function block is a simple function block, and its running time is 8μs. Parameter instructions refer to table below.

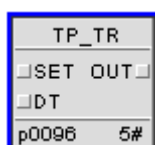
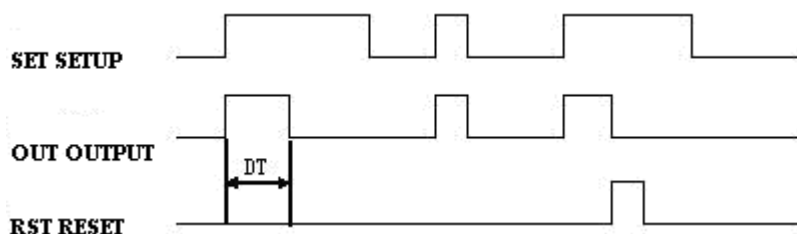


Table 9.34 TP_TR parameter instruction

Name			Description	Upload	Application Reference
Basic Parameters	Input Pin	SET	Set Signal	-	-
		RST	Reset Signal	-	-
		DT	Holding Time and the Unit is Second	TRUE	-
	Output Pin	OUT	Output ^{Note1}	-	-
		ET	Passed time	-	Generally, $ET < DT$. If there's the float abnormal, the ET outputs the value of DT or 0..Please refer to "Application" for details.

When SET jumps from OFF to ON and holds, OUT follows SET and generates a pulse whose length is DT. If the time when SET remains ON is shorter than DT, OUT would follow SET to fall to OFF. When timing, OUT resets as soon as the rising-edge of RST arrives, and holds until the next rising-edge of SET. If DT is longer than 0 but shorter than a control period, the time of OUT remaining as ON will last a control period. Time-sequence is shown in 7-36 Time-sequence graph.

**Figure 9.11 Time-sequence graph (TP_TR)**

Application

The float abnormal of output values means that the output values are not float format, or a meaningless output value is produced in a calculation that performs a divide-by-zero operation. When float abnormal happened, the function block is processed according to the following rules:

- If the OUT outputs ON, the ET outputs the value of DT.
- If the OUT outputs OFF, the ET outputs 0.

9.24 TIMEREX Function Block

Extended Timer Function Block generates fixed width pulse by delaying a fix time for input command. Parameter instructions refer to table below.

This function block is a simple function block, and its running time is 8μs.



9.24.1 Parameter Description

Table 9.35 *TIMEREX Parameter Instruction*

Name			Description	Upload	Application Reference
Basic Parameters	Input-Pin	SET	Set Signal	-	-
		RST	Reset Signal	-	-
		DT	Holding Time and the Unit is Second	TRUE	-
		TLAG	Delay Reset Time (Unit: s)	TRUE	Refer to the application reference
	Out-putPin	OUT	Output ^{Note1}	-	-
		ET	Passed time	-	If the floating point is normal, $ET < DT$. If the floating point is abnormal, the ET is equal to DT or 0. Please refer to "Application" for details.

When the rising-edge of SET comes, then DT time later, OUT becomes high level and resets after holding for TLAG time. When a positive transmission is made in RST, timer stops and resets OUT, and waits for the next rising-edge of SET. If SET jumps from OFF to ON, and within $DT + TLAG$, another rising-edge of SET arrives, and then the second jump would be shielded. Time-sequence graph is shown as follows.

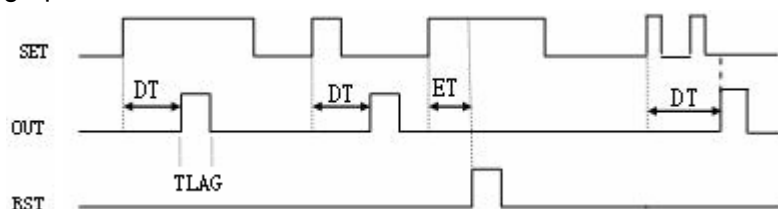


Figure 9.12 *Time-sequence graph (TIMEREX)*

9.24.2 Application

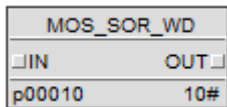
The float abnormal of output values means that the output values are not float format, or a meaningless output value is produced in a calculation that performs a divide-by-zero operation. When float abnormal happened, the function block is processed according to the following rules:

- If the OUT outputs ON, the ET outputs the value of DT.
- If the OUT outputs OFF, the ET outputs 0.

9.25 Bypass Monitoring Function Block (MOS_SOR_WD)

Bypass monitoring function block MOS_SOR_WD has functions of timing monitoring, notification and condition restore. One MOS_SOR_WD correspond to one bypass switch. SOR and MOS apply the same function block, and can be set in configuration parameter.

MOS_SOR_WD is complex function block with running time of 50μs.



9.25.1 Parameter Description

Table 9.36 Parameter instruction of MOS_SOR_WD

Name		Description	Upload	Properties	Application Reference
Input	IN	Input	-	OFF	-
Output	OUT	Output	-	-	-
Monitoring Parameter	ET	Timing of IN=ON	-	-	Unit can be set as minute or hour.
	DET	Timing of Operation Delay	-	-	Unit can be set as minute.
	HT	Operation Hold Times	-	-	-
	BPT	Bypass Total Time	-	-	Unit can be set as minute or hour.
	OT	Overtime Alarm Total Time	-	-	Unit can be set as minute or hour.
	FLAG	Flag	-	-	-
Operation Parameter	DT	Set Time	TRUE	-	Unit can be set as minute or hour.
	DDT	Set Time of Delay	TRUE	-	Unit can be set as minute.
	KEEP	Hold Bypass Status	TRUE	-	-

Table 9.36 Parameter instruction of MOS_SOR_WD (continued)

Name		Description	Upload	Properties	Application Reference
	BYPASS	Bypass Operation Signal	TRUE	-	-
	LCK	Input Lock Signal	TRUE	-	-
	AUTLCK_C	Auto Unlock Alarm Acknowledge	TRUE	-	-
	AOF	Module Alarm Shield	TRUE	-	-
Alarm Parameter	ENALM	Alarm Enable	-	-	Select overtime alarm, serious overtime alarm and auto unlock alarm, and unselect bypass alarm in default.
Configuration Parameter	DT_UNIT	DT unit, OFF= Minute, ON= Hour	-	-	-
	TYPE_IN	Input Type, OFF= Hard Input, ON= Soft Input	-	-	-
	MODE_LCK	Interlock Mode, OFF=MOS, ON=SOR	-	-	-
	DLEN	Decimal Digits	-	-	-

9.25.2 Usage

Bypass monitoring function block has functions of timing monitoring, notification and condition restore, and is a custom function block (FB). One FB correspond to one bypass switch. SOR (Startup Overrides) and MOS (Maintenance Override Switch) apply the same function block, while usages for software and hardware are different.

For Hardware Switch (DI Signal)

1. Set time when increasing jump happening to IN, ET starts to count.
2. When ET counted time reaches DT, overtime alarm will generated.
3. If IN= ON after DDT time of overtime alarm generated, generate bypass overtime serious alarm.

4. If operator select holding bypass before overtime, ET starts to count again, until the overtime alarm is generated again when reaching DT. If operator select holding bypass after overtime, the function will generate overtime alarm while panel will show as alarm acknowledged. Count the bypass total time, operation hold times and record all events. Overtime alarm will flash after count time again and until reaching DT (i.e. overtime alarm will continue to flash after 1s), as shown in Figure 1.
5. If operator selects hard reset (i.e. input IN generates decreasing signal), eliminate the bypass and overtime alarm, and record data.
6. OUT= IN

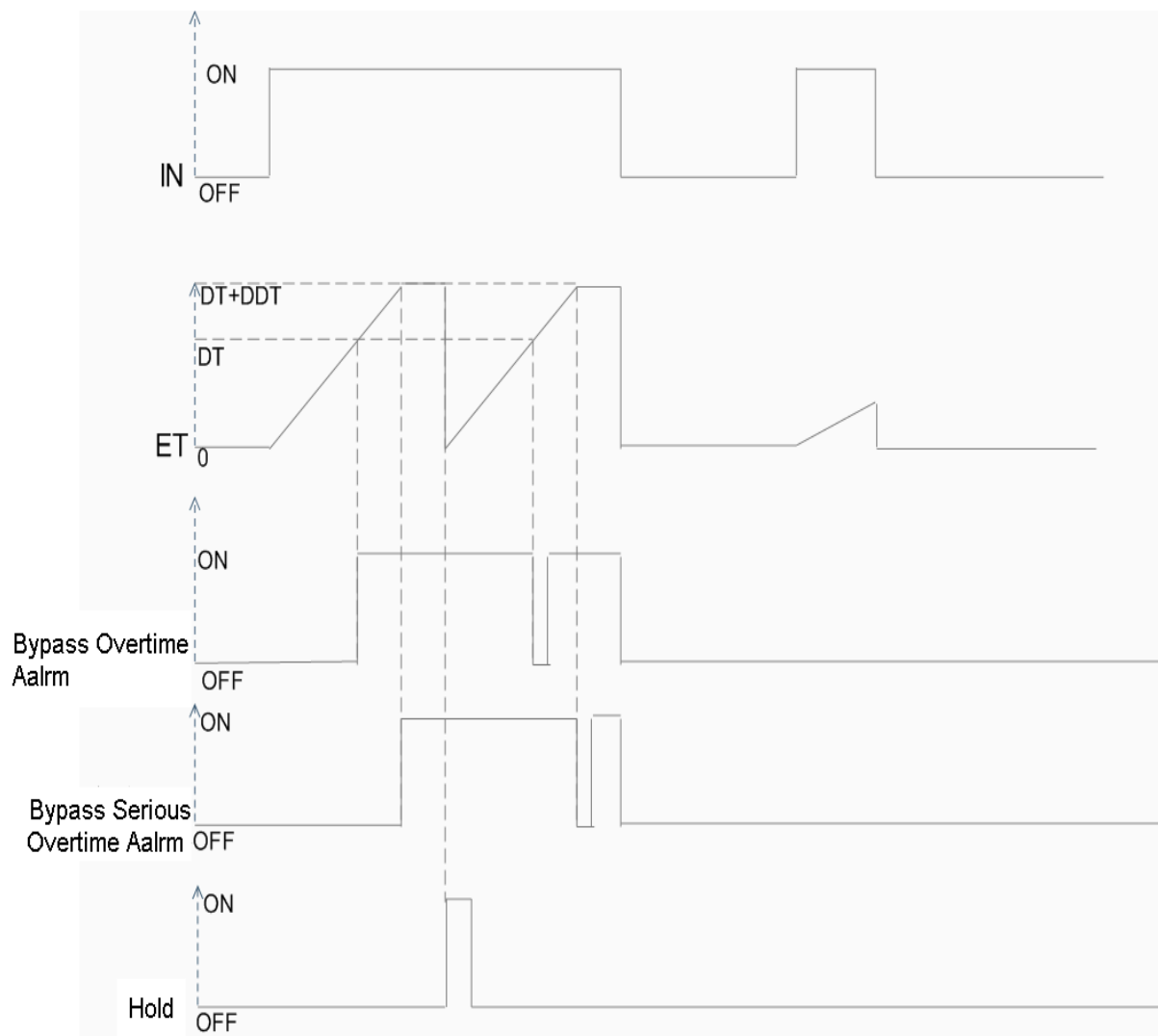


Figure 9.13 MOS_SOR_WD for hardware switch (DI signal)

For Software Switch

1. Set time when increasing jump happening to IN, ET starts to count.
2. When ET counted time reaches DT, overtime alarm will generated.

3. If operator does nothing after DDT time of overtime alarm generated, and when TYPE_IN=ON, so OUT= OFF, ET and IN become OFF, and generate “Auto Eliminate” alarm.
4. If operator select holding bypass before overtime, ET starts to count again, until the overtime alarm is generated again when reaching DT. If operator select holding bypass after overtime, the function will generate overtime alarm while panel will show as alarm acknowledged. Count the bypass total time, operation hold times and record all events. Overtime alarm will flash after count time again and until reaching DT (i.e. overtime alarm will continue to flash after 1s), as shown in Figure 2.
5. During counting time or DDT of overtime alarm, if operator selects to reset bypass ((LCK=ON), eliminate the bypass and overtime alarm, output OUT as OFF, and record data.
6. If IN=OFF, BYPSS=ON, so IN=ON, OUT=ON, start to count time. If during counting time IN=ON, BYPSS=ON will not influence the time sequence logic.

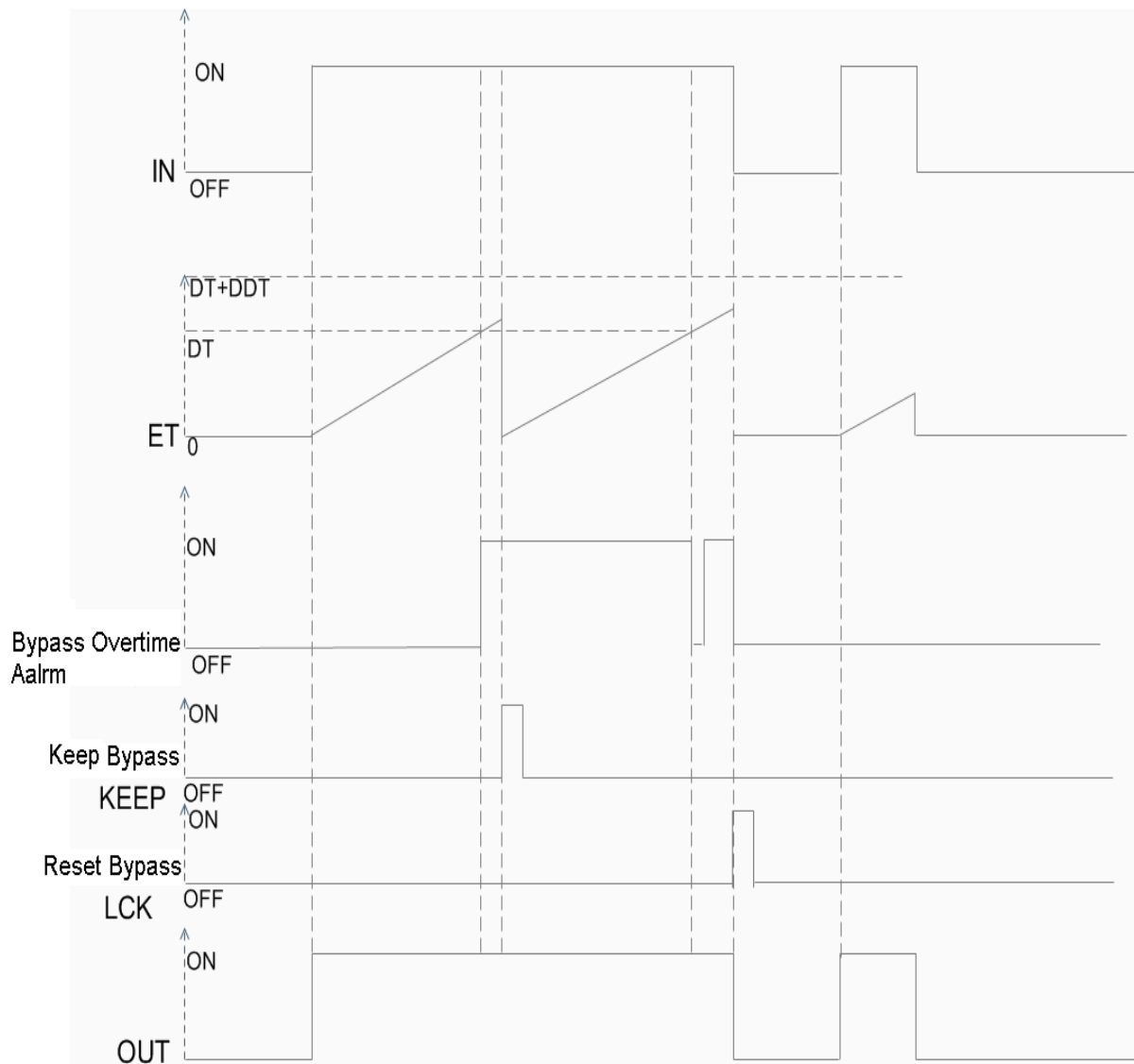


Figure 9.14 MOS_SOR_WD for software switch

9.25.3 Panel Parameter

Bypass monitoring function block MOS_SOR_WD's panel is shown in the figure below. Note: this function block panel has no tuning image.

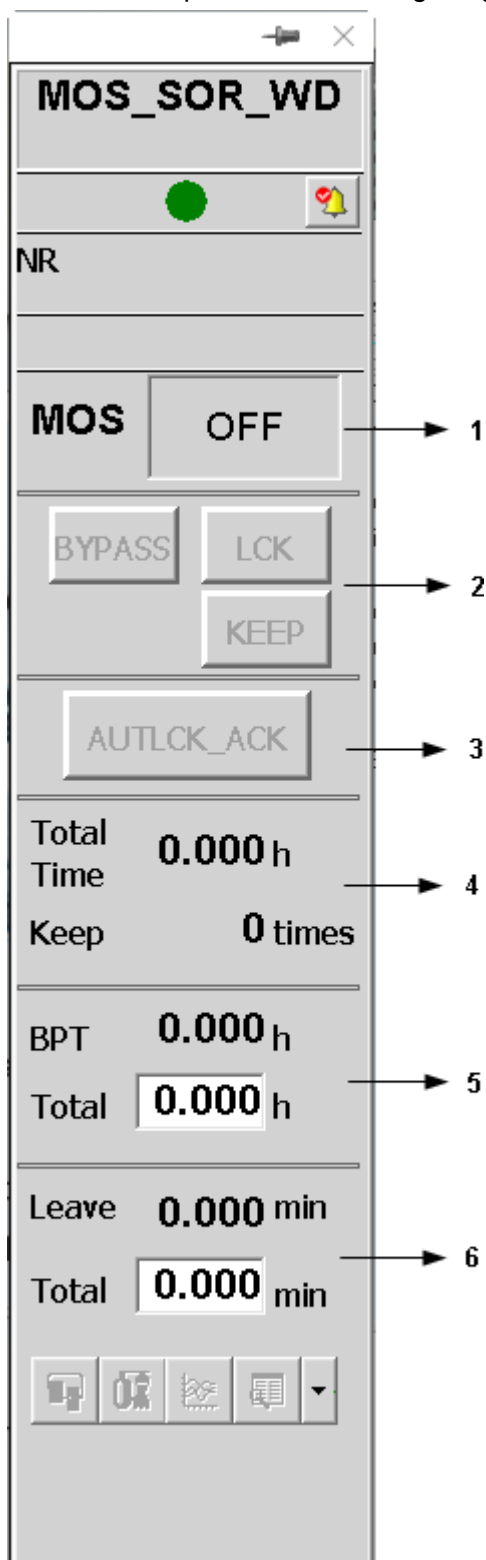


Figure 9.15 Panel

The function block's parameter descriptions are shown in the table below.

Table 9.37 Panel parameters

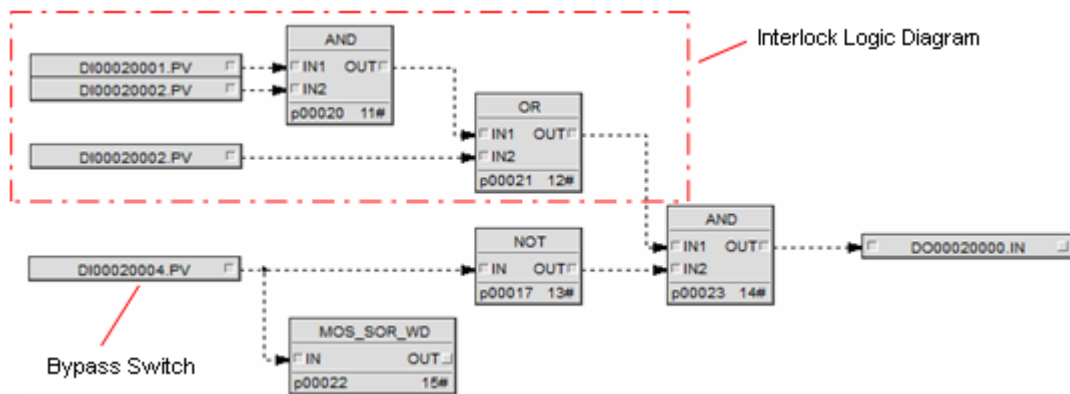
NO.	Parameter	Name	Initial Value	Value Range	Application Description
1	MOS	IN	OFF	ON, OFF	Interlock mode selection ON=MOS, OFF=SOR
2	BYPASS	BYPASS	OFF	ON, OFF	Pressing button means keeping bypass status
	LCK	LCK	OFF	ON, OFF	Pressing button means interlock signal
	KEEP	KEEP	OFF	ON, OFF	Pressing button means holding bypass status, accumulation is HT.
3	AUTLCK_-ACK	AUTLCK_C	OFF	ON, OFF	Pressing button means eliminating auto unlocked alarm
4	TOTAL TIME	BPT	0.000	-	Displaying bypass total time
	KEEP	HT	0.000	-	Record operation holding time
5	BPT	ET	0.000	-	Displaying bypass time
	TOTAL	DT	0.000	-	Displaying bypass Define Time
6	LEAVE	-	0.000	-	Displaying the left delay time, and its value is equal to DDT minus DET
	TOTAL	DDT	0.000	-	Displaying the delay time.

9.25.4 Flag

Flag	Alarm	Instruction
D0	AOF	Suppress Alarm
D1	OVRT	Overtime Alarm
D2	SOVRT	Serious Overtime Alarm
D3	AUTLCK	Automatically Unlock Alarm
D4	BYPASS	Trigger Bypass Status
D5	KEEP	Keep Bypass Status
D6	LCK	Interlock Status
D7	BYPASS_ALM	Bypass Alarm

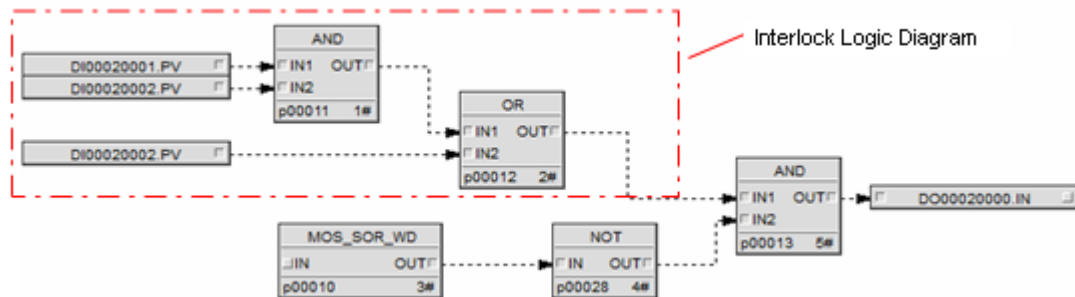
9.25.5 Examples

Parallel Connection

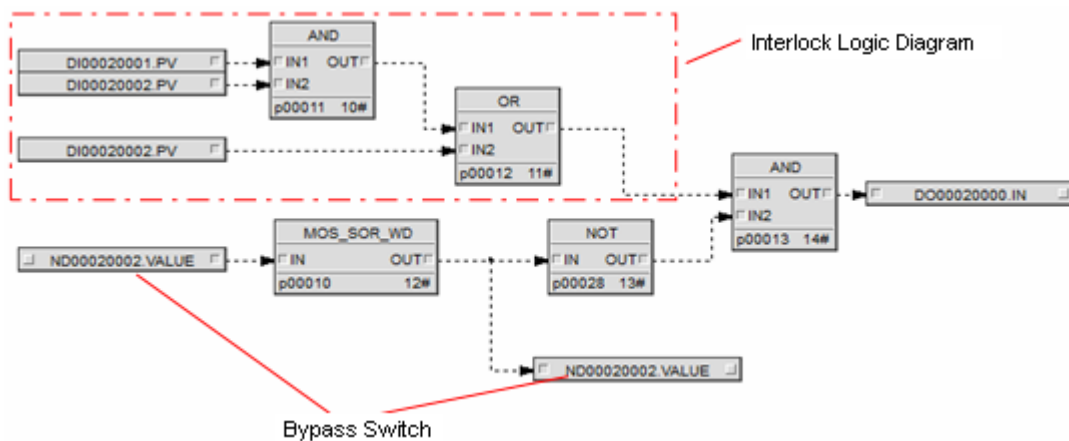


Serial Connection

- IN Null



- IN from Software Switch



10 Comparison Function Block Library

Comparison function block library contains 18 simple function blocks.

10.1 NE Function Block

Function block NE can implement unequal-to comparison of two inputs. Parameter instructions please refer to Table 1.

This function block is a simple function block, its running time is 2μs.



Table 10.1 NE parameter instruction

Name			Description	Upload
Basic Parameters	Input Pin	IN1	Input	-
		IN2	Input	-
	Output Pin	OUT	When IN1 ≠ IN2, output OUT = ON. Otherwise, output OUT = OFF	-

10.2 EQ Function Block

Function block EQ can implement equal-to comparison of two inputs. Parameter instructions please refer to Table 1.

This function block is a simple function block, its running time is 2μs.

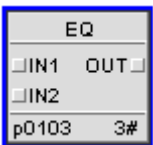


Table 10.2 EQ parameter instruction

Name			Description	Upload
Basic Parameters	Input Pin	IN1	Input	-
		IN2	Input	-
	Output Pin	OUT	When IN1=IN2, output OUT= ON. Otherwise, output OUT= OFF	-

10.3 GT Function Block

Function block can implement greater-than comparison of two inputs. Parameter instructions please refer to Table 1.

This function block is a simple function block, its running time is 2μs.

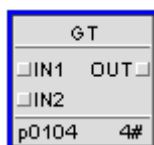


Table 10.3 GT parameter instruction

Name			Description	Upload
Basic Parameters	Input Pin	IN1	Input	-
		IN2	Input	-
	Output Pin	OUT	When IN1>IN2, output OUT= ON. Otherwise, in other words IN1≤IN2, output OUT= OFF	-

10.4 GE Function Block

Function block GE can implement greater-than-or-equal-to comparison of two inputs. Parameter instructions please refer to Table 1.

This function block is a simple function block, its running time is 2μs.

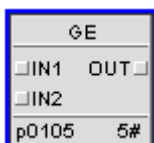


Table 10.4 GE parameter comparison

Name			Description	Upload
Basic Parameters	Input Pin	IN1	Input	-
		IN2	Input	-
	Output Pin	OUT	When IN1 > =IN2, output OUT= ON. Otherwise, output OUT= OFF	-

10.5 LT Function Block

Function block can implement less-than comparison of two inputs. Parameter instructions please refer to Table 1.

This function block is a simple function block, its running time is 2 μ s.

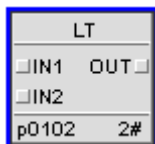


Table 10.5 LT parameter instruction

Name			Description	Upload
Basic Parameters	Input Pin	IN1	Input	-
		IN2	Input	-
	Output Pin	OUT	When IN1 < IN2, output OUT= ON. Otherwise, output OUT= OFF	-

10.6 LE Function Block

Function block LE can implement less-than-or-equal-to comparison of two inputs. Parameter instructions please refer to Table 1.

This function block is a simple function block, its running time is 2 μ s.

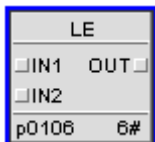


Table 10.6 LE parameter instruction

Name			Description	Upload
Basic Parameters	Input Pin	IN1	Input	-
		IN2	Input	-
	Output Pin	OUT	When IN1≤IN2, output OUT= ON. Otherwise, output OUT= OFF	-

10.7 NE_INT Function Block

Function block NE_INT can implement unequal-to comparison of two INT inputs. Parameter instructions please refer to Table 1.

This function block is a simple function block, its running time is 2 μ s.

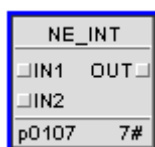


Table 10.7 NE_INT parameter instruction

Name			Description	Upload
Basic Parameters	Input Pin	IN1	Input	-
		IN2	Input	-
	OutputPin	OUT	When IN1≠IN2, output OUT= ON. Otherwise, output OUT= OFF	-

10.8 EQ_INT Function Block

Function block can implement equal-to comparison of two INT inputs. Parameter instructions please refer to Table 1.

This function block is a simple function block, its running time is 2μs.

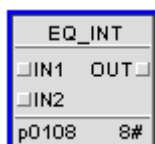


Table 10.8 EQ_INT parameter instruction

Name			Description	Upload
Basic Parameters	Input Pin	IN1	Input	-
		IN2	Input	-
	OutputPin	OUT	When IN1=IN2, output OUT= ON. Otherwise, output OUT= OFF	-

10.9 GT_INT Function Block

Function block GT_INT can implement greater-than comparison of two INT inputs. Parameter instructions please refer to Table 1.

This function block is a simple function block, its running time is 2μs.

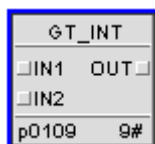


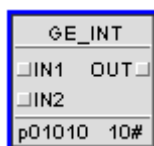
Table 10.9 GT_INT parameter instruction

Name			Description	Upload
Basic Parameters	Input Pin	IN1	Input	-
		IN2	Input	-
	OutputPin	OUT	When IN1 > IN2, output OUT= ON. Otherwise, output OUT= OFF	-

10.10 GE_INT Function Block

Function block can implement greater-than-or-equal-to comparison of two INT inputs. Parameter instructions please refer to Table 1.

This function block is a simple function block, its running time is 2μs.

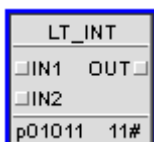
**Table 10.10 GE_INT parameter instruction**

Name			Description	Upload
Basic Parameters	Input Pin	IN1	Input	-
		IN2	Input	-
	OutputPin	OUT	When IN1 ≥ IN2, output OUT= ON. Otherwise, output OUT= OFF	-

10.11 LT_INT Function Block

Function block can implement less-than comparison of two INT input. Parameter instructions please refer to Table 1.

This function block is a simple function block, its running time is 2μs.

**Table 10.11 LT_INT parameter instruction**

Name			Description	Upload
Basic Parameters	Input Pin	IN1	Input	-
		IN2	Input	-

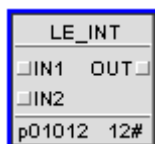
Table 10.11 LT_INT parameter instruction (continued)

Name			Description	Upload
	OutputPin	OUT	When $IN1 < IN2$, output OUT= ON. Otherwise, output OUT= OFF	-

10.12 LE_INT Function Block

Function block can implement less-than-or-equal-to comparison of two INT inputs. Parameter instructions please refer to Table 1.

This function block is a simple function block, its running time is 2μs.

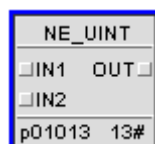
**Table 10.12 LE_INT parameter instruction**

Name			Description	Upload
Basic Parameters	Input Pin	IN1	Input	-
		IN2	Input	-
	OutputPin	OUT	When $IN1 \leq IN2$, output OUT= ON. Otherwise, output OUT= OFF	-

10.13 NE_UNIT Function Block

Function block can implement unequal-to comparison of two UNIT inputs. Parameter instructions please refer to Table 1.

This function block is a simple function block, its running time is 2μs.

**Table 10.13 NE_UNIT parameter instruction**

Name			Description	Upload
Basic Parameters	Input Pin	IN1	Input	-
		IN2	Input	-

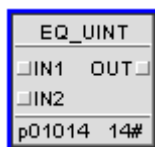
Table 10.13 NE_UNIT parameter instruction (continued)

Name			Description	Upload
	OutputPin	OUT	When IN1≠IN2, output OUT= ON. Otherwise, output OUT= OFF	-

10.14 EQ_UNIT Function Block

Function block can implement equal-to comparison of two UNIT inputs. Parameter instructions please refer to Table 1.

This function block is a simple function block, its running time is 2μs.

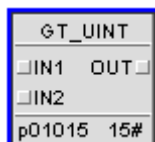
**Table 10.14 EQ_UNIT parameter instruction**

Name			Description	Upload
Basic Parameters	Input Pin	IN1	Input	-
		IN2	Input	-
	OutputPin	OUT	When IN1 =IN2, output OUT= ON. Otherwise, output OUT= OFF	-

10.15 GT_UNIT Function Block

Function block can implement greater-than comparison of two UNIT inputs. Parameter instructions please refer to Table 1.

This function block is a simple function block, its running time is 2μs.

**Table 10.15 GT_UNIT parameter instruction**

Name			Description	Upload
Basic Parameters	Input Pin	IN1	Input	-
		IN2	Input	-
	OutputPin	OUT	When IN1>IN2, output OUT= ON. Otherwise, output OUT= OFF	-

10.16 GE_UNIT Function Block

Function block can implement greater-than-or-equal-to comparison of two UNIT inputs.

Parameter instructions please refer to Table 1.

This function block is a simple function block, its running time is 2μs.

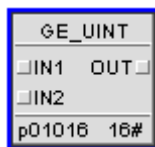


Table 10.16 GE_UNIT parameter instruction

Name			Description	Upload
Basic Parameters	Input Pin	IN1	Input	-
		IN2	Input	-
	OutputPin	OUT	When $IN1 \geq IN2$, output OUT= ON. Otherwise, output OUT= OFF	-

10.17 LT_UNIT Function Block

Function block can implement less-than comparison of two UNIT inputs. Parameter instructions please refer to Table 1.

This function block is a simple function block, its running time is 2μs.

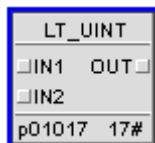


Table 10.17 LT_UNIT parameter instruction

Name			Description	Upload
Basic Parameters	Input Pin	IN1	Input	-
		IN2	Input	-
	OutputPin	OUT	When $IN1 < IN2$, output OUT= ON. Otherwise, output OUT= OFF	-

10.18 LE_UNIT Function Block

Function block LE_UNIT can implement less-than-or-equal-to comparison of two UNIT inputs.

Parameter instructions please refer to Table 1.

This function block is a simple function block, its running time is 2μs.

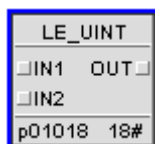


Table 10.18 LE_UNIT parameter instruction

Name		Description		Upload
Basic Parameters	Input Pin	IN1	Input	-
		IN2	Input	-
	OutputPin	OUT	When $IN1 \leq IN2$, output OUT= ON. Otherwise, output OUT= OFF	-

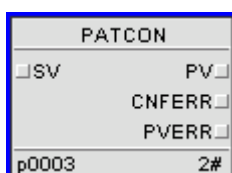
11 I/O Special Process Function Block Library

I/O special process and sequence control function block library contains 18 function blocks, 7 of them are complex function blocks and the other 11 are simple function blocks. When talking about complex function blocks, we refer to those which has specific function faceplate, and whose parameters can be set in supervision windows.

11.1 PATCON Function Block

Function block PATCON is used to control AM711 module. Using this function block, elementary Properties and parameters should be set. While setting parameters, the information of node and rack of the very channel must be set. Meanwhile, information such as dead zone and manually changed step value of channel which are already included in I/O builder can only be observed but not changed.

This function block is a complex function block, its running time is 50μs.



11.1.1 Parameter Description

Table 11.1 PATCON parameter description

Name			Description	Upload	Properties	Application Reference
Basic Parameters	SV Limits	SVH	UPPER LIMIT OF SET VALUE	TRUE	Operation Parameter	range[SCH,SCL]
		SVL	LOWER LIMIT OF SET VALUE	TRUE	Operation Parameter	range[SCH,SCL]
	Range Settings	SCH	Upper Limit of Measuring Range	-	Configuration Parameter	-
		SCL	Lower Limit of Measuring Range	-	Configuration Parameter	-
		EU	Engineering Unit	-	Configuration Parameter	set in function block Properties interface
		DLEN	Decimal Digits[0,5]	-	Configuration Parameter	use to display data on function block panel, default value is 3

Table 11.1 PATCON parameter description (continued)

Name			Description	Upload	Properties	Application Reference
	Hardware Settings	NODE	Address of Node[0~31]	-	Configura- tion Para- meter	keep identical with ad- dress of block builder AM711. Otherwise, CNFERR=ON alarm is on
		RACK	Address of Rack[0~3]	-	Configura- tion Para- meter	
		IOM	Address of Mod- ule[0~15]	-	Configura- tion Para- meter	
		CH	Address of I/O Channel[0~3]	-	Configura- tion Para- meter	
Extended Param- eters	Input Pin	SV	Set Value of Valve	-	Input Pin	-
	Output Pin	PV	Feedback of Valve	-	Output Pin	Connect to AI
		CN- FERR	Flag of Configura- tion Error	-	Output Pin	BKINERR of the func- tion blocks after
		PVERR	ON=PV Fault	-	Output Pin	Connect to AI.ERR
	OOS Set- tings	SWOOS	Out of Service Flag, ON=OOS	TRUE	Operation Parameter	Set to be ON when function block is down- loaded first time
	Configu- ration Pa- rameter	DB	Dead Zone	-	Monitoring Parameter	Dead Zone must be smaller than Threshold
		TH	Threshold	-	Monitoring Parameter	Threshold must be larger than Dead Zone
		MFV	Fast Increase Step Value Manu- ally(S)	-	Monitoring Parameter	-
		MSV	Slowly Increase Step Value Manu- ally (Ms)	-	Monitoring Parameter	-
		TSTD	Time of Threshold Stability (Ms)	-	Monitoring Parameter	-
		TF	Filtering Time (S)	-	Monitoring Parameter	-
		TS	Control Period (S)	-	Monitoring Parameter	-
	Alarm En- able and Suppress	AOF	Suppress Module Alarm(AOF=ON:	TRUE	Operation Parameter	-

Table 11.1 PATCON parameter description (continued)

Name			Description	Upload	Properties	Application Reference
			Not to Display the Real-Time Alarm)			
		ENALM	Alarm Enable	TRUE	Alarm Parameter	Click on “Settings” to set, if chosen, alarm is valid, otherwise neglected
		FLAG	Flag	-	Output Pin	-
	Status	NLALM	Negative Limit Alarm(ON=Alarm)	-	Monitoring Parameter	-
		PLALM	Positive Limit Alarm(ON=Alarm)	-	Monitoring Parameter	-
		AS-CEND	Increasing status(ON=increasing)	-	Monitoring Parameter	-
		DES-CEND	Decreasing status(ON=decreasing)	-	Monitoring Parameter	-
		BLALM	Disconnection Alarm Status(ON=Alarm)	-	Monitoring Parameter	-
		FB_-OPN	Feedback of Interlock Open(ON=Alarm)	-	Monitoring Parameter	-
		FB_-CLS	Feedback of Interlock Closed(ON=Alarm)	-	Monitoring Parameter	-
		FB_S-TOP	Feedback of Interlock stopped(ON=Alarm)	-	Monitoring Parameter	-
		FB_-MAN	Feedback of Manual Status(ON=Manual)	-	Monitoring Parameter	-
	Operator Command	STOP	When STOP=ON, stop all the functions towards the corresponding PAT channel to the function block. When STOP switch from ON to OFF, enter “manual status” first.	TRUE	Operation Parameter	-
		MAN	MAN=ON stands for block PATen-	TRUE	Operation Parameter	-

Table 11.1 PATCON parameter description (continued)

Name			Description	Upload	Properties	Application Reference
			ters "manual status", DO of block PAT only responds to user commands			
		AUTO	Compare set value with feedback value, and control through add short pulse to long pulse	TRUE	Operation Parameter	-
		INC	Command of Manual Increase. Can only be used under manual status. INC valid indicates an increasing pulse output from PAT block, length of pulse is decided by setting "Command of Manual Increase" in hardware builder.	TRUE	Operation Parameter	-
		DEC	Command of Manual Decrease. Refer to INC, instead of increasing pulse, we use decreasing pulse here. Definition of length of pulse is the same with that of INC.	TRUE	Operation Parameter	-
		SINC	Command of Manual Increase Slowly. Refer to INC, but here length of pulse is decided by setting "Command of Manual Increase/decrease slowly" in hardware builder.	TRUE	Operation Parameter	-
		SDEC	Command of Manual decrease Slowly. Refer to INC, but here length of pulse is decided by setting "Command of Manual In-	TRUE	Operation Parameter	-

Table 11.1 PATCON parameter description (continued)

Name			Description	Upload	Properties	Application Reference
			crease/decrease slowly" in hardware builder.			
		LCK_- OPN	When LCK_OPN=ON, function block outputs open signal directly. Threshold keep increasing, until totally open.	TRUE	Operation Parameter	-
		LCK_- CLS	When LCK_CLS=ON, function block outputs close signal directly. Threshold keep decreasing, until totally closed.	TRUE	Operation Parameter	-
		LCK_- STOP	When LCK_STOP = ON, jump out of "LCK_OPN/LCK_CLS" status, DO of function block output stop immediately. This button is valid under "LCK_OPN/LCK_CLS" status.	TRUE	Operation Parameter	-
		ALM_- OPT	Select negative/positive limit alarm status 0: alarm. When a negative/positive limit alarm occurs, the alarm bar on the panel and the process alarm list display its alarm information. 1: status. When a negative/positive limit alarm occurs, the status bar on the panel displays its status. Status table does not show the corresponding information.	TRUE	Operation Parameter	-

11.1.2 Panel Parameter

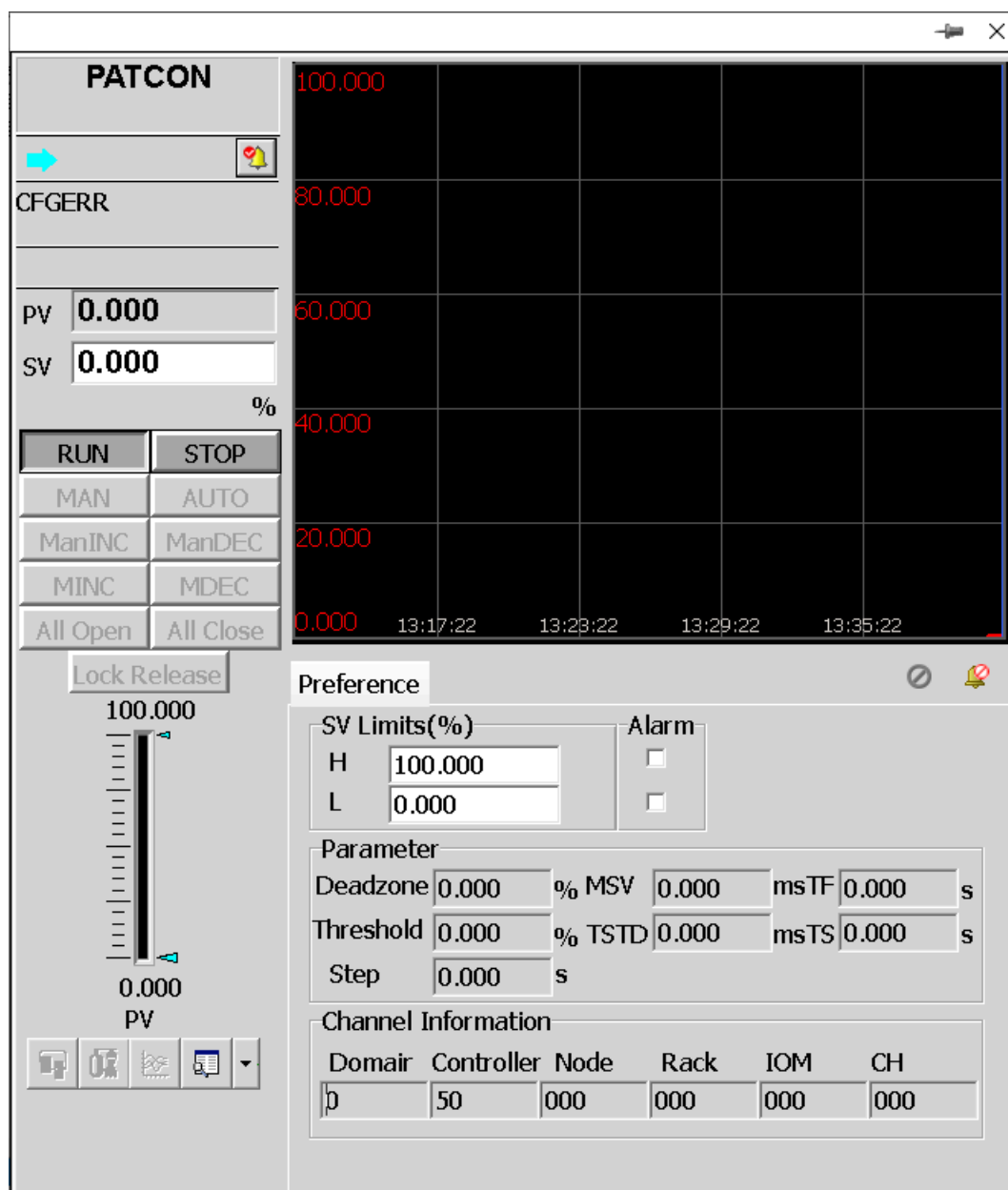


Table 11.2 PATCON Panel parameter instruction

Panel Parameter Name		Parameter Name	Initial Value	Value Range	Application Instruction
SV Limit (%)	H	SVH	90.0000	[SCH,SCL]	Set upper limit of value. (Alarm is valid when “ENALM” is chosen, otherwise neglected)
	L	SVL	0.0000	[SCH,SCL]	Set lower limit of value.(Alarm is valid when “ENALM” is chosen, otherwise neglected)
Parameter	Dead-zone(%)	DB	0.0000	-	Read only, set in function block Properties interface or in program.

Table 11.2 PATCON Panel parameter instruction (continued)

Panel Parameter Name		Parameter Name	Initial Value	Value Range	Application Instruction
	MSV(ms)	MSV	0.0000	-	Read only, set in function block Properties interface or in program.
	TF(s)	TF	0.0000	-	Read only, set in function block Properties interface or in program.
	Thresh- old (%)	TH	0.0000	-	Read only, set in function block Properties interface or in program.
	TST- D(ms)	TSTD	0.0000	-	Read only, set in function block Properties interface or in program.
	TS	TS	0.0000	-	Read only, set in function block Properties interface or in program.
	Step	MFV	0.0000	-	Read only, set in function block Properties interface or in program.
Address Information	Domain	-	-	-	Read only, set while structure building.
	Con- troller	-	0	-	Read only, set while structure building.
	Node	NODE	0	[0,31]	Read only, set in function block Properties interface
	Rack	RACK	0	[0,3]	Read only, set in function block Properties interface
	IOM	IOM	0	[0,15]	Read only, set in function block Properties interface.
	CH	CH	0	[0,3]	Read only, set in function block Properties interface.

11.1.3 Flag

Table 11.3 Flag list

Flag	Alarm	Instruction
D0	OOS	Disable
D1	PVERR	PV Fault
D3	CFGERR	Configuration Error
D5	MAN	Manual
D6	NLALM	Negative Limit Alarm
D7	PLALM	Positive Limit Alarm

Table 11.3 Flag list (continued)

Flag	Alarm	Instruction
D8	ASCEND	Ascending Status
D9	DESCEND	Decreasing Status
D10	BLALM	Disconnection Alarm
D11	LCK_OPN	Interlock Open Feedback
D12	LCK_CLS	Interlock Close Feedback
D13	LCK_STOP	Interlock Stop Feedback
D14	SVL	SV L Limit Alarm
D15	SVH	SV H Limit Alarm
D16	AOF	Suppress Alarm

11.2 TC_CJC Function Block

Function block TC_CJC is used to control the cold junction temperature of AI721-S and AI722-S modules when FCU711-S, FCU712-S, or FCU713-S is used. In the following two conditions, TC_CJC must be used when AI721-S or AI722-S is used.

1. If Cold Junction Compensation is set as “Local”, Temperature Amend is set as “ON”, the function block will take the output of TC_CJC as the amended value of local cold junction temperature, and use it to calculate the final test result.
2. If Cold Junction Compensation is set as “Remote”, no matter the Temperature Amend is set as “ON” or “OFF”, modules AI721-S and AI722-S both apply the “SV of Remote Cold Junction Temperature” as the cold junction temperature.

The function block is a simple function block, and its running time is 15μs.

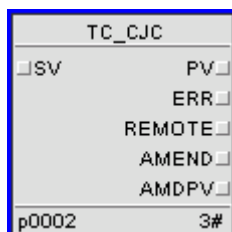


Table 11.4 TC_CJC parameter instruction

Name		Description	Upload	Properties	Application Reference
Input Pin	SV	Set Value of Remote Cold Junction Temperature	-	Input Pin	-
Output Pin	PV	Real-Time Value of Situ Cold Junction Temperature	-	Output Pin	Connect to AI
	ERR	Alarm of Wrong Calculation	-	Output Pin	Connect to BKINERR of next block
	REMOTE	Cold Junction Compensation: ON=Remote, OFF=In Situ	-	Output Pin	-
	AMEND	Temperature Amend: ON=Amend, OFF=Disable	-	Output Pin	-
	AMDPV	Cold Junction TemperatureUnit: °C	-	Output Pin	Connect to BKIN of next block
Configuration Parameter	NODE	Address of NodeNon-APL: [0,31]APL: [1,31]	-	Configuration Parameter	Need to be identical to block builder address
	RACK	Address of RackNon-APL: [0,3]APL: [0,15]	-	Configuration Parameter	
	IOM	Address of ModuleNon-APL: [0,15]APL: [0,3]IOM must be even when block is redundant	-	Configuration Parameter	
	FIELD_PV	Enital Situ Cold Junction Temperature	-	Configuration Parameter	-
	FIELD_SV	Enital Remote Cold Junction Temperature	-	Configuration Parameter	-
	RDDFLAG	RDDFLAG comes from hardware builder, indicates whether there is redundancy(ON=redundant, OFF= not redundant),IOM must be even when block is redundant, oth-	-	Configuration Parameter	-

Table 11.4 TC_CJC parameter instruction (continued)

Name		Description	Upload	Properties	Application Reference
		erwise set ER- R=ON			
	TYPE	Module type0 (de- fault): Non-APL1: APL	-	Configuration Parameter	-

11.3 TC_CJC_N Function Block

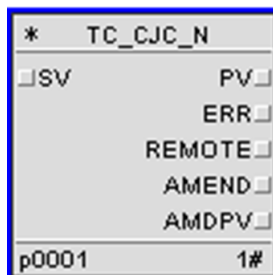
Function block TC_CJC_N is used to control the cold junction temperature of AI821-S module when FCU811-S is used.

In the following two conditions, TC_CJC_N must be applied when AI821-S is used.

1) If Cold Junction Compensation is set as “Local” (REMOTE=OFF), Temperature Amend (AMEND) is set as “ON”, the function block will take the output of TC_CJC_N as the amended value of local cold junction temperature, and use it to calculate the final test result (AMDPV=PV +SV).

2) If Cold Junction Compensation is set as “Remote” (REMOTE=ON), no matter the Temperature Amend (AMEND) is set as “ON” or “OFF”, AI821-S applies the “SV of Remote Cold Junction Temperature” as the cold junction temperature.

The function block is a simple function block, and its running time is 15μs.

**Table 11.5 TC_CJC_N parameter instruction**

Name		Description	Upload	Properties	Application Reference
Input Pin	SV	Set Value of Re- mote Cold Junc- tion Temperature	-	Input Pin	-
Output Pin	PV	Real-Time Val- ue of Local Cold Junction Temper- ature	-	Output Pin	Connect to AI
	ERR	Alarm of Wrong Calculation	-	Output Pin	Connect to BKINERR of next block
	REMOTE	Cold Junction Compensa-	-	Output Pin	-

Table 11.5 TC_CJC_N parameter instruction (continued)

Name		Description	Upload	Properties	Application Reference
		tion:ON=Remote, OFF=Local			
	AMEND	Temperature Amend: ON=Amend, OFF=Disable	-	Output Pin	-
	AMDPV	Cold Junction TemperatureUnit: °C	-	Output Pin	Connect to BKIN of next block
Configuration Parameter	RACK	Address of Rack[0,11]	-	Configuration Parameter	Need to be identical to module configuration address
	IOM	Address of Module[0,15], IOM must be even when block is redundant	-	Configuration Parameter	
	FIELD_PV	Initial Local Cold Junction Temperature	-	Configuration Parameter	-
	FIELD_SV	Initial Remote Cold Junction Temperature	-	Configuration Parameter	-
	RDDFLAG	RDDFLAG comes from hardware builder, indicates whether there is redundancy (ON=redundant, OFF=not redundant). IOM must be even when block is redundant, otherwise set ERR=ON	-	Configuration Parameter	-

11.4 CABALM Function Block

Function block CABALM is used to check the assist power source, system power source and cabinet temperature in the cabinet and alarm. Node number, rack number and block number needs to be set in the function block builder parameters, basing on the address of CN733. Parameter instructions refer to Table 1.

CABLAM is normally used for cabinet alarm block's debugging, rack number should be set as "3" while block number should be set as "15" when building basing one the address of CN733.

This function block is a simple function block, its running time is 15μs.

CABALM	
SPS1HALM	<input type="checkbox"/>
SPS1LALM	<input type="checkbox"/>
SPS2HALM	<input type="checkbox"/>
SPS2LALM	<input type="checkbox"/>
MPS1HALM	<input type="checkbox"/>
MPS1LALM	<input type="checkbox"/>
MPS2HALM	<input type="checkbox"/>
MPS2LALM	<input type="checkbox"/>
FAN1ERR	<input type="checkbox"/>
FAN2ERR	<input type="checkbox"/>
FAN3ERR	<input type="checkbox"/>
FAN4ERR	<input type="checkbox"/>
TMPRT	<input type="checkbox"/>
ERR	<input type="checkbox"/>
p0002	2#

Table 11.6 CABALM parameter instruction

Name			Description	Upload	Properties	Application Reference
Basic Parameters	Configuration Parameter	NODE	Address of Node[0~31]	-	Configuration Parameter	Match with hardware builder
		RACK	Address of Rack[0~3]	-	Configuration Parameter	Set to be 3
		IOM	Address of Module[0~15]	-	Configuration Parameter	Set to be 5
Extended Parameters	Output Pin	SPS1HALM	Auxiliary Power 1 upper limit alarm	-	Output Pin	connect to BKIN
		SPS1LALM	Auxiliary Power 1 lower limit alarm	-	Output Pin	connect to BKIN
		SPS2HALM	Auxiliary Power 2 upper limit alarm	-	Output Pin	connect to BKIN
		SPS2LALM	Auxiliary Power 2 lower limit alarm	-	Output Pin	connect to BKIN
		MPS1HALM	System Power 1 upper limit alarm	-	Output Pin	connect to BKIN
		MPS1LALM	System Power 2 lower limit alarm	-	Output Pin	connect to BKIN
		MPS2HALM	System Power 1 upper limit alarm	-	Output Pin	connect to BKIN

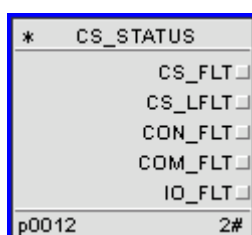
Table 11.6 CABALM parameter instruction (continued)

Name			Description	Upload	Properties	Application Reference
		MPS2LALM	System Power 2 lower limit alarm	-	Output Pin	connect to BKIN
		FAN1ERR	Fan Flag 1 err alarm	-	Output Pin	connect to BKINERR
		FAN2ERR	Fan Flag 2 err alarm	-	Output Pin	connect to BKINERR
		FAN3ERR	Fan Flag 3 err alarm	-	Output Pin	connect to BKINERR
		FAN4ERR	Fan Flag 4 err alarm	-	Output Pin	connect to BKINERR
		TMPRT	Closet temperature	-	Output Pin	Connect to AI
		ERR	Abnormal Operation	-	Output Pin	connect to BKINERR

11.5 CS_STATUS Function Block

This function block is used to obtain the overall status information of the current control station, including the control station, the controller in the control station, and the communication module and IO module in the control station.

The function block is a simple function block with a running time of 50μs.

**Table 11.7 CS_STATUS function block parameter illustration**

Output pin	Description	Type	Application
CS_FLT	Control system heavy fault	BOOL	It is used to indicate the serious failure of the working control station and the standby control station.
CS_LFLT	Control system light fault	BOOL	It is used to indicate the minor fault conditions of the working control station and the standby control station.
CON_FLT	working/backup controller status	USINT	bit0:Minor failure of work card bit1:Major failure of work card

Table 11.7 CS_STATUS function block parameter illustration (continued)

Output pin	Description	Type	Application
			bit2:Minor failure of backup card bit3:Major failure of work card
COM_FLT	Communicate module status	USINT	bit0:Minor faultbit1:Major fault
IO_FLT	IO modul status	USINT	bit0:Minor faultbit1:Major fault

In the table below, definitions of major and minor faults are listed according to the module type in the control station.

Module Type	Fault Type	Fault Detailed Illustration
Controller	Major fault	Configuration fault, dual network communication fault, 24V power fault, CPU voltage abnormal, IO pin voltage abnormal, controller FAULT, controller overload, PPS second pulse fault (FCU711 doesn't have this diagnosis item)
	Minor fault	Battery fault, 24V single power fault, period update error, redundant error, single network fault, address conflict.
Communication module	Major fault	24V power fault, node fault, redundant side module lost or E-BUS dual network fault.
	Minor fault	Node address conflict, A/B side network port fault, CAN0-4 communication fault, 24V single power fault.
IO module	Major fault	Module lost, module type indifference, module major fault.
	Minor fault	Module minor fault, module address conflict, module A/B bus fault, configuration validity check not difference.

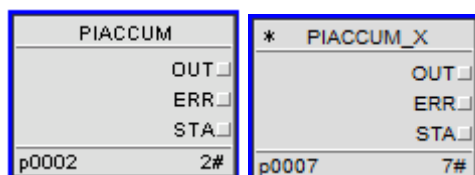
11.6 PIACCUM Function Block

PIACCUM function block implements calculation of the accumulation of tags within the PI module. It applies to FCU711-S, FCU712-S, FCU713-S, FCU763-S, and FCU731-S.

When FCU713-S is used, PIACCUM supports calculating the accumulation of PI tags generated by UIO811 and UIO831 modules.

In the user program window, if FCU731 is used, PIACCUM function block is named as PIACCUM_X, which shares the same functions as PIACCUM.

This function block is a complex function block, its running time is 30μs.



11.6.1 Parameter Description

Table 11.8 PIACCUM parameter instruction

Name		Description	Upload	Properties	Application Reference
Output Pin	OUT	Accumulate output	-	Output Pin	connect to BKIN
	ERR	Abnormal Operation. Alarm when ERR=ON	-	Output Pin	Connect to BKINERR. When block status alarm, illegal block ID or float exception occurs, alarm if ERR=ON.
	STA	Status of Function Block. <ul style="list-style-type: none"> When fetal error, lost of block, or channel error occurs, set STA=16 When floating exception occurs, set STA=64 When module address is inconsistent with the configuration, refer to descriptions of "RACK" parameter. 	-	Output Pin	connect to BKINSTA
	FLAG	Flag	-	Output Pin	refer to "Flag"
Operation Parameter	SWOOS	Out of Service Flag, ON=OOS	-	Operation Parameter	Set to be ON when function block is downloaded first time
	AOF	Suppress Module Alarm	-	Operation Parameter	-
	GAIN	Pulse Equivalence	-	Operation Parameter	Indicates value of each pulse, set according to situation
	RST	When set RST=ON, reset accumulate output OUT	TRUE	Operation Parameter	Reset as OFF after keeping ON for a period.
	HOLD	Set HOLD=OFF and start accumulation. While accumulation set HOLD=ON and pause accumulation.	TRUE	Operation Parameter	-

Table 11.8 PIACCUM parameter instruction (continued)

Name		Description	Upload	Properties	Application Reference
		Set HOLD=OFF and continue with accumulation.			
	HLIM	High Limit of Accumulation	TRUE	Operation Parameter	Reference parameter: HALM
Supervision Parameter	HALM	If accumulation exceeds HLIM, engenders HALM	-	Monitoring Parameter	-
Alarm Parameter	ENALM	Alarm Enable	-	Alarm Parameter	Click on "Settings" to set, if chosen, alarm is valid, otherwise neglected
Configuration Parameter	NODE	Address of Node-Non-APL: [0,31]APL: [1,31]	-	Configuration Parameter	Need to be identical to address of function builder PI711. Otherwise, engender ERR=ON alarm and set STA=2. Meanwhile, display function block ID error or illegal function block error alarm on panel.
	RACK	Address of Rack-Non-APL: [0,3]APL: [0,15]	-	Configuration Parameter	
	IOM	Address of Module-Non-APL: [0,15]APL: [0,3]	-	Configuration Parameter	
	CH	Address of I/O Channel[0,31]	-	Configuration Parameter	
	EU	Unit of Accumulation	-	Configuration Parameter	-
	DLEN	Decimal Digitals[0,5]	-	Configuration Parameter	-
	TYPE	Module type0: Non-APL1: APL			

11.6.2 Application Illustration

The output value exception means if the output value is in the non-float format or a pointless output occurs after a division by 0. When float exception occurs, the function block will process the exception according to the following rules:

- OUT=0.
- Other: ERR=ON and the 7th bit of STA is 1 (bit6=1).

11.6.3 Panel Parameter

Table 11.9 PIACCUM parameter instruction

Panel Parameter Name		Parameter Name	Initial Value	Value Range	Application Instruction
Pulse Coefficient	Gain (%)	GAIN	1.0000	-	Indicate the value each pulse stands for, set according to situation.
Alarm Enable	HALM(%)	HALM	OFF	-	Set accumulation exceeds HLIM alarm.(Alarm is valid when “ENALM” is chosen, otherwise neglected)
Address Information	DO-MAIN	-	-	-	Read only, set while structure building.
	CON	-	0	-	Read only, set while structure building.
	NODE	NODE	0	Non-APL: [0,31] APL: [1,31]	Read only, set in function block Properties interface.
	RACK	RACK	0	Non-APL: [0,3] APL: [1,15]	Read only, set in function block Properties interface.
	IOM	IOM	0	Non-APL: [0,15] APL: [1,3]	Read only, set in function block Properties interface.
	CH	CH	0	[0,31]	Read only, set in function block Properties interface.

11.6.4 Flag

Table 11.10 Flag list

Flag	Alarm	Instruction
D0	OOS	Disable
D1	ID_ERR	Module Mismatch
D2	ERR	Fault
D3	HALM	Accumulation Over Limit Alarm
D4	UNCOMM	Communication Error Alarm
D5	AOF	Suppress Alarm
D6	REVSCL	Output value float exception

11.6.5 Application Example

Suppose there is a flowmeter (50pulses/gallon), whose maximum rate of flow is 100gallons/minute. And the requirement for resolution is 0.1Hz.

First of all, the maximum of frequency must be checked so that we can decided if the resolution is reachable. According to the performance of block PI711-S, to reach the resolution 0.1Hz, the frequency being tested cannot be higher than 1kHz. In this specific condition, the maximum frequency is

$$50\text{pulses/gallon} \times 100\text{gallons/minute} \div 60\text{second/minute} = 83.33 \text{ pulses/second} = 83.33\text{Hz}$$

Set parameters in PIACCUM function block's Properties interface as follow:

- GAIN: Pulse equivalent is $1/50=0.02$. In other words, each one of the pulse stands for 0.2 gallon of flow.
- NODE: Stay identical to PI711's function module builder address.
- RACK: Stay identical to PI711's function module builder address.
- IOM: Stay identical to PI711's function module builder address.
- CH: Stay identical to PI711's function module builder address.
- EU: Hz.
- DLEN: 2
- Default values of other parameters remain unchanged.

When debugging the program, open the panel of the function block, as shown in below figure .

The accumulative total status is equal to HOLD mode, click on "RUN" to start the accumulation process.

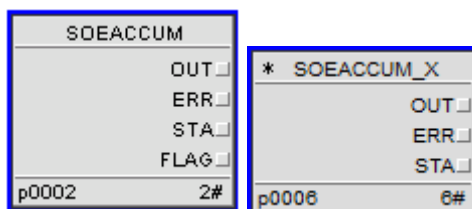
11.7 SOEACCUM Function Block

When controller types are FCU711-S, FCU712-S, FCU713-S, FCU763-S, and FCU731-S, computing process is conducted on the accumulation of DI713 and DI714 through SOEACCUM function block.

When FCU713-S is applied, SOEACCUM supports the calculating of the accumulated SOE data of DI tags (with SOE enabled) of the UIO811 and UIO831.

In the user program window, if FCU731 is used, SOEACCUM function block is named as SOEACCUM_X, which shares the same functions as SOEACCUM.

This function block is a complex function block, its running time is 30μs.



11.7.1 Parameter Description

Table 11.11 SOEACCUM parameter instruction

Name		Description	Upload	Properties	Application Reference
Output Pin	OUT	Accumulate output	-	Output Pin	connect to BKINIf there's a float abnormal happened to the OUT, the OUT outputs 0. Please refer to "Application" for details.
	ERR	Abnormal Operation. alarm when ER-R=ON	-	Output Pin	connect to BKINERR.If block status alarm or illegal block ID occurs, alarm when ERR=ON
	STA	Status of Function Block. When fetal err, lost of block or channel err occurs, set STA=16	-	Output Pin	connect to BKINSTA
	FLAG	Flag	-	Output Pin	refer to "Panel Parameter"
Operation Parameter	SWOOS	Out of Service Flag, ON=OOS	TRUE	Operation Parameter	Set to be ON when function block is downloaded first time
	AOF	Suppress Module Alarm	TRUE	Operation Parameter	-

Table 11.11 SOEACCUM parameter instruction (continued)

Name		Description	Upload	Properties	Application Reference
	GAIN	Pulse Equivalence		Operation Parameter	Indicate the value each pulse stands for, set according to situation.
	RST	When RST=ON, reset accumulate output OUT	TRUE	Operation Parameter	Reset as OFF after keeping ON for a period.
	HOLD	Set HOLD=OFF and start accumulation. While accumulation set HOLD=ON and pause accumulation. Set HOLD=OFF and continue with accumulation.	TRUE	Operation Parameter	-
	HLIM	High Limit of Accumulation	TRUE	Operation Parameter	-
Supervision Parameter	HALM	If accumulation exceeds HLIM, engenders HALM	-	Monitoring Parameter	-
Alarm Parameter	ENALM	Alarm Enable	-	Alarm Parameter	-
Configuration Parameter	NODE	Address of Node[0,31]	-	Configuration Parameter	Need to be identical to address of function builder DI713 or DI714. Otherwise, engender ERR=ON alarm and set STA=2. Meanwhile, display function block ID error or illegal function block error alarm on panel.
	RACK	Address of Rack[0,3]	-	Configuration Parameter	
	IOM	Address of Module[0,15]	-	Configuration Parameter	
	CH	Address of I/O Channel[0,31]	-	Configuration Parameter	
	EU	Unit of Accumulation	-	Configuration Parameter	-
	DLEN	Decimal Digits[0,5]	-	Configuration Parameter	-

11.7.2 Application Illustration

The float abnormal of output values means that the output values are not float format, or a meaningless output value is produced in a calculation that performs a divide-by-zero operation. When float abnormal happened, the function block is processed according to the following rules:

- OUT= 0.
- Other values: ERR=ON and the 7th bit of STA is 1 (bit6=1).

11.7.3 Panel Parameter

Table 11.12 SOEACCUM parameter instruction

Panel Parameter Name	Parameter Name	Initial Value	Value Range	Application Instruction
Pulse Coefficient	GAIN(%)	GAIN	1.0000 -	Indicate the value each pulse stands for, set according to situation.
Alarm Enable	HALM(%)	HALM	OFF -	Set accumulation exceeds HLIM alarm.(Alarm is valid when "ENALM" is chosen, otherwise neglected)
Address Information	DOMAIN	-	-	Read only, set while structure building.
	CON	-	0 -	Read only, set while structure building.

Table 11.12 SOEACCUM parameter instruction (continued)

Panel Parameter Name		Parameter Name	Initial Value	Value Range	Application Instruction
	NODE	NODE	0	Non-APL: [0,31] APL: [1,31]	Read only, set in function block Properties interface.
	RACK	RACK	0	Non-APL: [0,3] APL: [1,15]	Read only, set in function block Properties interface.
	IOM	IOM	0	Non-APL: [0,15] APL: [0,3]	Read only, set in function block Properties interface.
	CH	CH	0	[0,31]	Read only, set in function block Properties interface.

11.7.4 Flag

Table 11.13 Flag list

Flag	Alarm	Instruction
D0	OOS	Disable
D1	ID_ERR	Module Mismatch
D2	ERR	Fault
D3	HALM	Accumulation Over Limit Alarm
D4	UNCOMM	Communication Error Alarm
D5	AOF	Suppress Alarm
D6	REVSCL	Output value floating abnormal

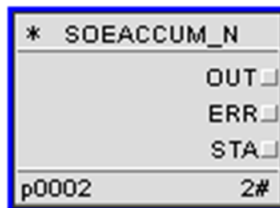
11.7.5 Application Example

Refer to "Application Example".

11.8 SOEACCUM_N Function Block

In the user program window, if FCU811 is used, SOEACCUM_N can be used to calculate on the accumulation of DI713 and DI714.

This function block is a complex function block, its running time is 30μs.



11.8.1 Parameter Description

Table 11.14 *SOEACCUM_N parameter instruction*

Name		Description	Upload	Properties	Application Reference
Output Pin	OUT	Accumulate output	-	Output Pin	Connect to BKINIf there's a float-number exception happened to the OUT, the OUT outputs 0, ERR is set to ON, and the 7 th position of STA is 1 (which is bit 6=1)
	ERR	Abnormal Operation. alarm when ER-R=ON	-	Output Pin	connect to BKINERR.If block status alarm or illegal block ID occurs, alarm when ERR=ON
	STA	Status of Function Block. When major error, lost of module or channel error occurs, set STA=16	-	Output Pin	Connect to BKINSTA
	FLAG	Flag	-	Output Pin	Refer to "Flag"
Operation Parameter	SWOOS	Out of Service Flag, ON=OOS	TRUE	Operation Parameter	Set to be ON when function block is downloaded first time
	AOF	Suppress Module Alarm	TRUE	Operation Parameter	-
	GAIN	Pulse Equivalence		Operation Parameter	Indicate the value each pulse stands for, set according to situation.
	RST	When RST=ON, reset accumulate output OUT	TRUE	Operation Parameter	Reset as OFF after keeping ON for a period.
	HOLD	Set HOLD=OFF and start accumulation. While accumulation set	TRUE	Operation Parameter	-

Table 11.14 SOEACCUM_N parameter instruction (continued)

Name		Description	Upload	Properties	Application Reference
		HOLD=ON and pause accumulation. Set HOLD=OFF and continue with accumulation.			
	HLIM	High Limit of Accumulation	TRUE	Operation Parameter	-
Supervision Parameter	HALM	If accumulation exceeds HLIM, engenders HALM	-	Monitoring Parameter	-
Alarm Parameter	ENALM	Alarm Enable	TRUE	Operation Parameter	-
	RACK	Address of Rack [0,11]	-	Configuration Parameter	Need to be identical to address of DI813 module. Otherwise, engender ER-R=ON alarm and set STA=2. Meanwhile, display function block ID error or illegal function block error alarm on panel.
	IOM	Address of Module [0,15]	-	Configuration Parameter	
	CH	Address of I/O Channel [0,15]	-	Configuration Parameter	
	EU	Unit of Accumulation	-	Configuration Parameter	
	DLEN	Decimal Digits [0,5]	-	Configuration Parameter	

11.8.2 Panel Parameter

Table 11.15 SOEACCUM_N parameter instruction

Panel Parameter Name		Parameter Name	Initial Value	Value Range	Application Instruction
Pulse Coefficient	GAIN(%)	GAIN	1.0000	-	Indicate the value each pulse stands for, set according to situation.
Alarm Enable	HALM(%)	HALM	OFF	-	Set accumulation exceeds HLIM alarm. (Alarm is valid when "HALM" is chosen, otherwise neglected)
Address Information	DOMAIN	-	-	-	Read only, set while structure building.

Table 11.15 SOEACCUM_N parameter instruction (continued)

Panel Parameter Name		Parameter Name	Initial Value	Value Range	Application Instruction
	CON	-	-	-	Read only, set while structure building.
	RACK	RACK	0	[0,3]	Read only, set in function block properties interface.
	IOM	IOM	0	[0,15]	Read only, set in function block properties interface.
	CH	CH	0	[0,31]	Read only, set in function block properties interface.

11.8.3 Flag

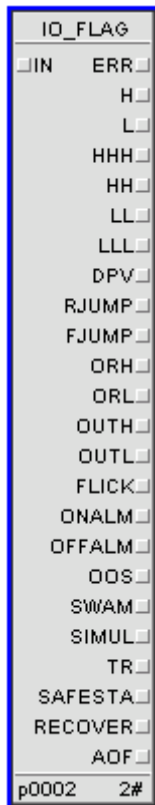
Table 11.16 Flag list

Flag	Alarm	Instruction
D0	OOS	Disable
D1	ID_ERR	Module Mismatch
D2	ERR	Fault
D3	HALM	Accumulation Over Limit Alarm
D4	UNCOMM	Communication Error Alarm
D5	AOF	Suppress Alarm

11.9 IO_FLAG Function Block

Function block implements decoding of flags of AI, AO, DI, and DO. Set the tag type of the connecting IO, then flag information of this type would be output in BOOL. Parameter Instructions refer to "Table 11.19".

This function block is a simple function block, its running time is 50μs.



11.9.1 Parameter Description

Table 11.17 IO_FLAG parameter instruction

Name		Description	Upload	Properties	Application Reference
Input Pin	IN	IO flag input	-	Input Pin	Connect to FLAG
Output Pin	ERR	Tag err alarm	-	Output Pin	Connect to BKINERR of last block
	HHH	High High High Alarm	-	Monitoring Parameter	-
	HH	High upper limit alarm	-	Monitoring Parameter	-
	H	upper limit alarm	-	Output Pin	-
	L	lower limit alarm	-	Output Pin	-
	LL	Low lower limit alarm	-	Monitoring Parameter	-
	LLL	Low low low alarm	-	Monitoring Parameter	-
	DPV	Rate Alarm	-	Monitoring Parameter	-

Table 11.17 IO_FLAG parameter instruction (continued)

Name		Description	Upload	Properties	Application Reference
	RJUMP	Rise-Jump Alarm	-	Monitoring Parameter	-
	FJUMP	Fall-Jump Alarm	-	Monitoring Parameter	-
	ORH	Over Upper Limit of Measuring Range alarm	-	Monitoring Parameter	-
	ORL	Over lower limit of measuring range alarm	-	Monitoring Parameter	-
	OUTH	Output upper limit alarm	-	Monitoring Parameter	-
	OUTL	Output lower limit alarm	-	Monitoring Parameter	-
	FLICK	Fluctuate alarm	-	Monitoring Parameter	-
	ONALM	ON alarm	-	Monitoring Parameter	DI=ON, alarm
	OFFALM	OFF alarm	-	Monitoring Parameter	DI=OFF, alarm
	OOS	Disable or Not(ON=disable)	-	Monitoring Parameter	-
	SWAM	Force or Not (ON=Force)	-	Monitoring Parameter	-
	SIMUL	Simulate or Not (ON=Simulate)	-	Monitoring Parameter	-
	TR	Track or Not (ON=Track)	-	Monitoring Parameter	-
	SAFESTA	Safety Error Status or Not (ON=Safety Error Status)	-	Monitoring Parameter	-
	RECOVER	Error Recovery Status (ON=Error Recovery)	-	Monitoring Parameter	-

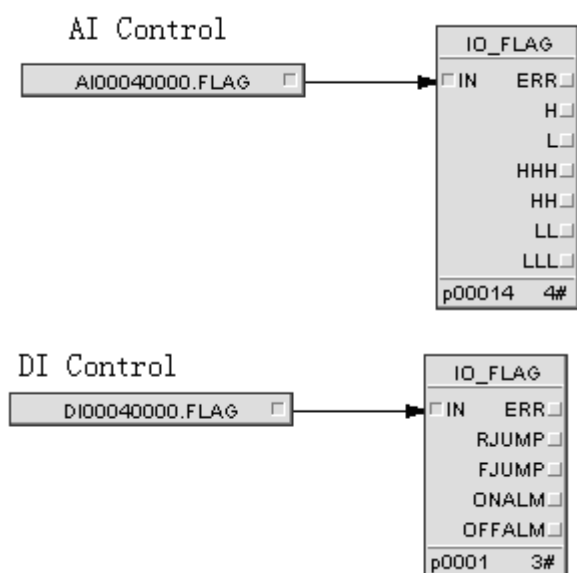
Table 11.17 IO_FLAG parameter instruction (continued)

Name		Description	Upload	Properties	Application Reference
	AOF	Suppress Module Alarm	TRUE	Operation Parameter	-
Configuration Parameter	TYPE	0=AI,1=AO,2=DI,3=DO		Configuration Parameter	-

11.9.2 Application Example

To achieve I/O flag analysis determination, and participate in interlock via I/O flag analysis value. The module achieves tag alarm signal invoking and outputting functions by system tag FLAG with AIALM module. The alarm H/L limits settings of AI tag can be set in tag table or set the alarm area in device panel.

Details of programming is shown below. It applies IO_FLAG, and the tag input interlock program can achieve interlock program via output pins “H, L, HH, LL” of the module.

**Figure 11.1 Program of IO_FLAG**

Instructions of function block and example are shown below.

Table 11.18 Instructions of Function Block and Example

No.	Function Block Pin	Description	Related Tag Type	Remarks
Input Parameter				
001	IN	FLAG Type	AI/AO/DI/DO Input	
Output Parameter				

Table 11.18 Instructions of Function Block and Example (continued)

No.	Function Block Pin	Description	Related Tag Type	Remarks
001	H	(AI) Tag H Alarm	Custom BOOL	Alarm generates when ON.
002	L	(AI) Tag L Alarm	Custom BOOL	
003	HH	(AI) Tag HH Alarm	Custom BOOL	
004	LL	(AI) Tag LL Alarm	Custom BOOL	
005	RJUMP	(DI) Positive Jump Alarm	Custom BOOL	
006	FJUMP	(DI) Negative Jump Alarm	Custom BOOL	
007	ONALM	(DI) Alarm generates when DI is ON.	Custom BOOL	
008	OFFALM	(DI) Alarm generates when DI is OFF.	Custom BOOL	
Configuration Parameter				
001	TYPE	Input Tag Type of IN Pin	Set in Module	Configure Based on Inout IN Type: 0-AI;1-AO;2-DI;3-DO

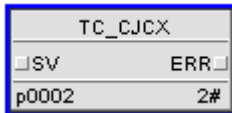
- Parameter settings of IO_FLAG:
In configuration parameter of basic parameter, TYPE sets the parameter based on input parameter type, 0=AI, 1=AO, 2=DI, 3=DO.
- Alarm Settings
Set AI tag alarm range in tag device panel and tag table.

11.10 TC_CJCX Function Block

Function block TC_CJCX implements cold junction temperature compensation of FW352, XP314, SP314, FW358 modules. According to the channel setting of hardware configuration, the cold junction temperature compensation function has two situations as follows.

- If cold junction compensation mode is set as “Local”, the temperature acquired by its own sensor is used as cold junction temperature.
- If cold junction compensation mode is set as “Remote”, “*remote cold junction temperature set value*” set in the function block is used as cold junction temperature.

This function block is a simple function block, its running time is 15μs.



Parameter Instruction

Table 11.19 TC_CJCX parameter instruction

Name		Description	Upload	Properties	Application Reference
Input Pin	SV	Set Value of Remote Cold Junction Temperature(°C)	-	Output Pin	-
Output Pin	ERR	Alarm of Wrong Calculation. alarm when ERR=ON	-	Output Pin	-
Configuration Parameter	NODE	Address of Node [0,31]	-	Configuration Parameter	Stay identical to hardware builder address
	RACK	Address of Rack [0,3]	-	Configuration Parameter	
	IOM	Address of Module [0,15]	-	Configuration Parameter	
	FIELD_ - SV	Enitial value of Remote Cold Junction Temperature	-	Configuration Parameter	-
	RDDFLAG	RDDFLAG comes from hardware builder, indicates whether there is redundancy(ON=redundent,OFF= not redundant),IOM must be even when block is redundant, otherwise set ERR=ON	-	Configuration Parameter	-

11.11 PTM Function block

Function block PTM corresponds to position input module AM713. Before using it, please read reference of AM713.

All data configuration and supervision of AM713 module are implemented through FBD programming and *Graphics* programming.

The parameters contained in hardware configuration such as Digits of coder, comparison values, etc. could only be observed but not be modified. The forceful modification of them does not make any sense. Parameter instructions refer to "Parameter Instruction".

This function block is a simple function block, its running time is 50μs.

PTM	
<input type="checkbox"/> Q5	DTV
<input type="checkbox"/> Q6	RELADIST
<input type="checkbox"/> Q7	Q5STA
<input type="checkbox"/> Q8	Q6STA
<input type="checkbox"/> RSTCIR	Q7STA
<input type="checkbox"/> UPLIMIT	Q8STA
<input type="checkbox"/> LOWLIMIT	
p0101	1#

Table 11.20 PTM parameter instruction

Name			Description	Upload	Properties	Application Reference
Basic Parameters	Hardware Settings	NODE	Address of Node[0~31]	-	Configuration Parameter	stay identical to block builder address of AM713
		RACK	Address of Rack[0~3]	-	Configuration Parameter	
		IOM	Address of Module[0~15]	-	Configuration Parameter	
Extended Parameters	Output Pin	DTV	on-time address	-	Output Pin	On-time address
	Configuration Data Monitor	COKIND	Output Mode of Coder Signal(OF=F=Parallel output, ON=SSI output, only parallel output is available now)	-	Monitoring Parameter	Can only be set in hardware builder.
		CD-KIND	Input Mode of Coder Signal(OF=F=Gray cold, ON=binary)	-	Monitoring Parameter	-
		CD-NUM	Digits of Coder Input Signal	-	Monitoring Parameter	Recommended range[8,13]
	Output1Setting	CMP1V	Compare value1	-	Monitoring Parameter	Can only be set in hardware builder. Reference parameter: Q1WAY
		Q1TIME	DO1 output pulse time	-	Monitoring Parameter	Can only be set in hardware builder. (Reserved, not available now)
		Q1STA	DO1status	-	Monitoring Parameter	ON indicates output is closed.

Table 11.20 PTM parameter instruction (continued)

Name			Description	Upload	Properties	Application Reference
		Q1EN	DQ1 input flag (OFF=closed)	-	Input Pin	-
		Q1WAY	DO1 output mode (When DO1 input flag-Q1EN=ON 0: address value is larger than Compare value1, DO1 output closed. Smaller than Compare value1, output open. 1: address value is larger than Compare value1, DO1 output open. Smaller than Compare value1, output closed.	-	Input Pin	-
	Output2 Setting	CMP2V	Compare value	-	Monitoring Parameter	Can only be set in hardware builder. Reference parameter: Q2WAY
		Q2TIME	DO2 Output pulse time	-	Monitoring Parameter	Can only be set in hardware builder. (Reserved, not available now)
		Q2STA	DO2 status	-	Monitoring Parameter	ON indicates output is closed.
		Q2EN	DQ2 input flag (OFF=closed)	-	Input Pin	-
		Q2WAY	DO2 output mode	-	Input Pin	-

Table 11.20 PTM parameter instruction (continued)

Name			Description	Upload	Properties	Application Reference
	Output3 Setting		(DO2 input flag Q2EN is ON: 0: address value is larger than Compare value2, DO2output closed. Smaller than Compare value2, output open. 1: address value is larger than Compare value2, DO2output open. Smaller than Compare value2, output closed.			
		CMP3V	Compare value3	-	Monitoring Parameter	Can only be set in hardware builder. Reference parameter: Q3WAY
		Q3TIME	DO3 Output pulse time	-	Monitoring Parameter	Can only be set in hardware builder. (Reserved, not available now)
		Q3STA	DO3 status	-	Monitoring Parameter	ON indicates output is closed.
		Q3EN	DQ3 input flag (OFF=closed)	-	Input Pin	-
		Q3WAY	DO3 output mode (DO3 input flag Q3EN is ON, :0: address value is larger than Compare value3, DO3output closed.	-	Input Pin	-

Table 11.20 PTM parameter instruction (continued)

Name			Description	Upload	Properties	Application Reference
	Output4 Setting		Smaller than Compare value3, output open. 1: address value is larger than Compare value3, DO3 output open. Smaller than Compare value3, output closed.			
		CMP4V	Compare value4	-	Monitoring Parameter	Can only be set in hardware builder. Reference parameter: Q4WAY
		Q4TIME	DO4 Output pulse time	-	Monitoring Parameter	Can only be set in hardware builder. (Reserved, not available now)
		Q4STA	DO4 status	-	Monitoring Parameter	ON indicates output is closed.
		Q4EN	DQ4 input flag (OFF=closed)	-	Input Pin	-
		Q4WAY	DO4 output mode (DO4 input flag Q4EN is ON: 0: address value is larger than Compare value4, DO4 output closed. Smaller than Compare value4, output open. 1: address value is larger than Compare value4, DO4 out-	-	Input Pin	-

Table 11.20 PTM parameter instruction (continued)

Name			Description	Upload	Properties	Application Reference
	Normal DOOutput Setting		put open. Smaller than Compare value4, output closed.			
		Q5STA	DO5status	-	Monitoring Parameter	-
		Q6STA	DO6status	-	Monitoring Parameter	-
		Q7STA	DO7status	-	Monitoring Parameter	-
		Q5	DO5 output	-	Input Pin	If ON, close output DO5
		Q6	DO6 output	-	Input Pin	If ON, close output DO6
		Q7	DO7 output	-	Input Pin	If ON, close output DO7
		Q8	DO8 output	-	Input Pin	If ON, close output DO8
	Reserved Param	RUPRES1	Function Reserve	-	Monitoring Parameter	-
		RUPRES2	Function Reserve	-	Monitoring Parameter	-
		CF-GRES1	Function Reserve	-	Monitoring Parameter	-
		CF-GRES2	Function Reserve	-	Monitoring Parameter	-
		RD-WRES1	Function Reserve	TRUE	Operation Parameter	-
		RD-WRES2	Function Reserve	TRUE	Operation Parameter	-
	Moto Status Monitor	RE-LADIST	Relative displacement	-	Monitoring Parameter	-
		PULPS	Coder Rotation Rate	-	Monitoring Parameter	-
	Coil Reset	RSTCIR	Circle reset	-	Input Pin	While processing, can set RSTCIR=ON, and clear circle of coder to 0. When block is charged first time, RSTCIR=ON, initiate block input signal,

Table 11.20 PTM parameter instruction (continued)

Name			Description	Upload	Properties	Application Reference
						pass on-time output of coder.
	Position Signal Limit	UP-LIMIT	Upper limit of address signal	TRUE	Operation Parameter	Upper limit of address can be reached in reality.
		LOWLIMIT	Lower limit of address signal	TRUE	Operation Parameter	Lower limit of address can be reached in reality.

11.12 HCM Function Block

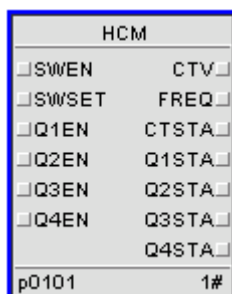
Function block HCM corresponds to rapid count module AM714-S. Before using it, please read reference of AM714-S.

All data configuration and supervision of AM714 module are implemented through FBD programming and *Graphics* programming.

HCM function block parameters such as Node No., Rack No., Model No., Channel No. should be filled in. The parameters contained in hardware configuration such as pulse type, set value, comparison value, etc. could only be observed but not be modified. The forceful modification of them does not make any sense.

Tags are not required to configure to every channel of AM714-S, but the specified function block HCM should be configured in custom program.

This is a simple function block, its running time is 50μs.



Parameter Instruction

Table 11.21 HCM parameter instruction

Name			Description	Upload	Properties	Application Reference
Basic Parameters	Output Mode Settings	Q1WAY	DO1 output mode (DO1 input flag Q1EN is ON, :0:on-time value is Smaller than	TRUE	Operation Parameter	-

Table 11.21 HCM parameter instruction (continued)

Name			Description	Upload	Properties	Application Reference
			Compare value1, DO1 output open. Otherwise, output closed. 1: on-time value is larger than Compare value1, DO1 output open. Otherwise, output closed.			
		Q2WAY	DO2 output mode (DO2 input flag Q2EN is ON, :0: on-time value is smaller than Compare value2, DO2 output open. Otherwise, output closed. 1: on-time value is larger than Compare value2, DO2 output open. Otherwise, output closed.	TRUE	Operation Parameter	-
		Q3WAY	DQ3 output mode	TRUE	Operation Parameter	Reserved, each channel of AM714-S still only have 2 DO output now.
		Q4WAY	DQ4 output mode	TRUE	Operation Parameter	Reserved, each channel of AM714-S still only have 2 DO output now.
	Hardware Settings	NODE	Address of Node[0~31]	-	Configuration Parameter	Need to be identical to block builder address of AM714
		RACK	Address of Rack[0~3]	-	Configuration Parameter	
		IOM	Address of Module[0~15]	-	Configuration Parameter	
		CH	Address of I/O Channel[0~1]	-	Configuration Parameter	

Table 11.21 HCM parameter instruction (continued)

Name			Description	Upload	Properties	Application Reference
Extended Parameters	Output Pin	CTV	Channel on-time value	-	Output Pin	-
		FREQ	Channel Pulse Frequency Value	-	Output Pin	Only valid in continuous counting mode. Reference parameter: CTS-TA
		CTSTA	Channel counter status (OFF=stop counting)	-	Output Pin	-
	Config Settings	PIKIND	0 = 5V difference AB pulse; 1 = 24V single end AB pulse; 2 = 24V direction pulse; 3 = 24V up and down pulse-+	-	Monitoring Parameter	-
		CTMODE	Channel counting mode(0 = continuous counting; 1 = cyclicity counting)	-	Monitoring Parameter	-
		GATKIND	Channel enable mode(0 = inner enable mode; 1 = outer enable mode; 2 = outer enable mode)	-	Monitoring Parameter	-
		SETKIND	Channel setting mode(0 = inner directly set; 1 = outer directly set)	-	Monitoring Parameter	-
	Input Pin	SWEN	Channel software counting enable(ON=counting enabled)	-	Input Pin	-
		SWSET	Channel counting software setting(ON=Set the value of counter)	-	Input Pin	-

Table 11.21 HCM parameter instruction (continued)

Name			Description	Upload	Properties	Application Reference
		Q1EN	Channel DO1 input flag (OF-F=not output)	-	Input Pin	-
		Q2EN	Channel DO2 input flag (OF-F=output invalid)	-	Input Pin	-
		Q3EN	Channel DO3 input flag (OF-F=output invalid)	-	Input Pin	Reserved, each channel of AM714-S still only have 2 DO output now.
		Q4EN	Channel DO4 input flag (OF-F=output invalid)	-	Input Pin	Reserved, each channel of AM714-S still only have 2 DO output now.
	Status Monitor	LOADV	Channel setting value	-	Monitoring Parameter	-
		ALMV	Channel alarm value	-	Monitoring Parameter	Reserved, this function is still invalible now.
		CMP1V	Channel Compare value1	-	Monitoring Parameter	Can only be set in hardware builder.
		CMP2V	Channel Compare value2	-	Monitoring Parameter	
		CMP3V	Channel Compare value3	-	Monitoring Parameter	Can only be set in hardware builder. Reserved, each channel of AM714-S still only have 2 DO output now.
		CMP4V	Channel Compare value4	-	Monitoring Parameter	
		Q1TIME	Channel DO1Output pulse time	-	Monitoring Parameter	Can only be set in hardware builder. Reserved, this function is still invalible now.
		Q2TIME	Channel DO2Output pulse time	-	Monitoring Parameter	
		Q3TIME	Channel DO3Output pulse time	-	Monitoring Parameter	
		Q4TIME	Channel DO4Output pulse time	-	Monitoring Parameter	
		Q1STA	Channel DO1 status(ON=output closed.	-	Monitoring Parameter	-

Table 11.21 HCM parameter instruction (continued)

Name			Description	Upload	Properties	Application Reference
		Q2STA	Channel DO2 status(ON= output closed.	-	Monitoring Parameter	-
		Q3STA	Channel DO3 status(ON= output closed.	-	Monitoring Parameter	Reserved, each channel of AM714-S still only have 2 DO output now.
		Q4STA	Channel DO4 status(ON= output closed.	-	Monitoring Parameter	
	Other	RUPRES	Reserve	-	Monitoring Parameter	-
		RDWRES	Reserve	TRUE	Operation Parameter	-
		CF-GRES1	Reserve	-	Monitoring Parameter	-
		CF-GRES2	Reserve	-	Monitoring Parameter	-

11.13 SSIM Function Block

Function block SSIM corresponds to rapid count module AM715-S. Before using it, please read reference of AM715-S.

All data configuration and supervision of AM715-S module are implemented through FBD programming and *Graphics* programming.

SSIM function block parameters such as Node No., Rack No., Model No., Channel No. should be filled in. The parameters contained in hardware configuration such as pulse type, set value, comparison value, etc. could only be observed but not be modified. The forceful modification of them does not make any sense.

Tags are not required to configure to every channel of AM715-S, but the specified function block HCM should be configured in custom program.

This is a simple function block, its running time is 50μs.

SSIM	
<input type="checkbox"/> EXTCNTEN	CPV
<input type="checkbox"/> PSALMRELADIST	
<input type="checkbox"/> Q1EN	ERR
<input type="checkbox"/> Q2EN	Q1STA
<input type="checkbox"/> Q3EN	Q2STA
<input type="checkbox"/> Q4EN	Q3STA
<input type="checkbox"/> Q1WAY	Q4STA
<input type="checkbox"/> Q2WAY	LOWALM
<input type="checkbox"/> Q3WAY	UPALM
<input type="checkbox"/> Q4WAY	
<input type="checkbox"/> UPLIM	
<input type="checkbox"/> LOWLIM	
<input type="checkbox"/> CMPV1	
<input type="checkbox"/> CMPV2	
<input type="checkbox"/> CMPV3	
<input type="checkbox"/> CMPV4	
p0101	1#

Table 11.22 SSIM parameter instruction

Name			Description	Upload	Properties	Application Reference
Basic Parameters	Output1 Setting	Q1EN	DO1output enable(OFF=output invalid)	-	Input Pin	-
		Q1WAY	DO1output mode(0-address value is larger than or equal to CMPV1, output closed. Otherwise, output open. 1-address valueSmaller than CMPV1, output closed. Otherwise, output open.	-	Input Pin	Reference parameter:Q1EN
	Output2 Setting	Q2EN	DO2output enable(OFF=output invalid)	-	Input Pin	-
		Q2WAY	DO2output mode(0-address value is larger than or equal to CMPV2, output closed. Otherwise, output open. 1-address valueSmaller than CMPV2, output closed. Otherwise, output open.	-	Input Pin	Reference parameter:Q2EN
	Output3 Setting	Q3EN	DO3output enable(OFF=output invalid)	-	Input Pin	Reserved, each channel of AM714-S still only have 2 DO output now.

Table 11.22 SSIM parameter instruction (continued)

Name			Description	Upload	Properties	Application Reference	
		Q3WAY	DO3output mode(0-address value is larger than or equal to CM-PV3, output closed. Otherwise, output open. 1-address valueSmaller than CMPV3, output closed. Otherwise, output open.	-	Input Pin	Reference parameter: Q3EN	
	Output4 Setting	Q4EN	DO4output enable(OFF=output invalid)	-	Input Pin	Reserved, each channel of AM714-S still only have 2 DO output now.	
		Q4WAY	DO4output mode(0-address value is larger than or equal to CM-PV4, output closed. Otherwise, output open. 1-address valueSmaller than CMPV4, output closed. Otherwise, output open.	-	Input Pin	Reference parameter:Q4EN	
	Hardware Settings	NODE	Address of Node[0~31]	-	Configuration Parameter	Need to be identical to block builder address of AM715	
		RACK	Address of Rack[0~3]	-	Configuration Parameter		
		IOM	Address of Module[0~15]	-	Configuration Parameter		
		CH	Address of I/O Channel[0~1]	-	Configuration Parameter		
	Extended Parameters	Input Pin	EXTC-NTEN	Extend counting enable	-	Input Pin	-
		Output Pin	CPV	on-time address	-	Output Pin	-
			ERR	Fault	-	Output Pin	-

Table 11.22 SSIM parameter instruction (continued)

Name			Description	Upload	Properties	Application Reference
		RE-LADIST	Relative displacement	-	Output Pin	The range of displacement of the block to the whole range(%), value is between -25 and 125
		FLAG	Flag	-	Output Pin	-
	Position Signal Limit	PSAL-MEN	Address status alarm enable(ON=open)	-	Input Pin	-
		UPLIM	Upper limit of actual address setting value	-	Input Pin	-
		LOWLIM	Lower limit of actual address setting value	-	Input Pin	-
		LOWALM	Address over lower limit alarm	-	Output Pin	-
		UPALM	Address over upper limit alarm	-	Output Pin	-
	Output1 Setting	CMPV1	Address Compare value1	-	Input Pin	Can only be set in hardware builder.
		Q1STA	DO1status(ON indicates output is closed.)	-	Output Pin	-
	Output2 Setting	CMPV2	Address Compare value2	-	Input Pin	Can only be set in hardware builder.
		Q2STA	DO2status(ON indicates output is closed.)	-	Output Pin	-
	Output3 Setting	CMPV3	Address Compare value3	-	Input Pin	Can only be set in hardware builder.
		Q3STA	DO3status(ON indicates output is closed.)	-	Output Pin	-
	Output4 Settings	CMPV4	Address Compare value4	-	Input Pin	Can only be set in hardware builder.
		Q4STA	DO4status(ON indicates output is closed.)	-	Output Pin	-

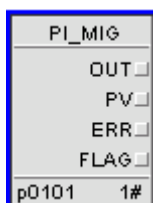
Table 11.22 SSIM parameter instruction (continued)

Name			Description	Upload	Properties	Application Reference
	Config- uration Data Monitor	CODE- TYPE	Code type of coder (0 Gray code, 1 bi- nary)	-	Monitor- ing Para- meter	Can only be set in hardware builder.
		CHECK- TYP	Coder signal check type(0=no check, 1=odd check, 2=even check)	-	Monitor- ing Para- meter	-
		CODE- NUM	Code number of coder	-	Monitor- ing Para- meter	Can only be set in hardware builder.
		CLK- FREQ	Clock frequency(U- nit is KHz)	-	Monitor- ing Para- meter	-

11.14 PI_MIG Function Block (Calculation PI Signal Process)

This function block processes calculation signals of modules FW368, XP335 and SP335. Thus channels of the hardware configuration corresponding to the address must be “Cumulation” signal. When the channel is set as “Frequency”, tags corresponding to the channel can be used directly.

This is a complex function block, its running time is 5μs.



11.14.1 Parameter Description

Table 11.23 Parameter Instruction

Name			Description	Upload	Properties	Application Reference
Basic Pa- rameters	Pulse Equivalent	GAIN	Pulse Equiv- alence	TRUE	Operation Parameter	For example, if 1 pulse stands for 0.1L flow, to display unit L/s, set Pulse Equivalence=0.1
	PV Limit Settings	PVH	PV upper limit alarm	TRUE	Operation Parameter	-

Table 11.23 Parameter Instruction (continued)

Name			Description	Upload	Properties	Application Reference
		PVL	PV lower limit alarm	TRUE	Operation Parameter	-
		HLIM	High Limit of Accumulation	TRUE	Operation Parameter	-
	Range Settings	DLEN	Decimal Digitals[0,5]	-	Configuration Parameter	-
		PVEU	Unit of average flow	-	Configuration Parameter	-
		OUTEU	Unit accumulate value	-	Configuration Parameter	-
	Hardware Settings	NODE	Address of Node[1~31]	-	Configuration Parameter	Need to Match with hardware builder. When ID is illegal, engender ERR alarm. FLAG correspondent Address bit, then panel will display CFGERR.
		RACK	Address of Rack[0~3]	-	Configuration Parameter	
		IOM	Address of Module[0~15]	-	Configuration Parameter	
		CH	Address of I/O Channel[0~7]	-	Configuration Parameter	
Extended Parameters	Output Pin	OUT	Accumulate output. Output values that are processed by Pulse Equivalence	-	Output Pin	-
		PV	Average output. Accumulate pulses of module for 10 seconds, then divide it by time. After processed by Pulse Equivalence, output PV.	-	Output Pin	If average is larger than upper limit alarm, engender PVH upper limit alarm. If average is smaller than lower limit alarm, engender PVL lower limit alarm

Table 11.23 Parameter Instruction (continued)

Name			Description	Upload	Properties	Application Reference
		ERR	When block duplicate fault, block missing, channel Fault or function block status alarm occurs, function block engenders ERR alarm(ERR=ON)	-	Output Pin	ERR=ON, correspondent flag address bit, panel displays ERR alarm
		RST	Set RST=ON, reset accumulate output OUT	-	Operation Parameter	Reset as OFF after keeping ON for a period.
	Operator Command	HOLD	Set HOLD=OFF start accumulate;while accumulation, set HOLD=ON stop accumulation. When HOLD=OFF, go on with accumulation.	-	Operation Parameter	-
	OOS Settings	SWOOS	Out of Service Flag, ON=OOS	TRUE	Operation Parameter	-
	Alarm	HALM	When accumulation exceeds High Limit of Accumulation, engender(HALM)	-	Monitoring Parameter	Relevant to ENALM
	Alarm Enable and Suppress	AOF	Suppress Module Alarm	TRUE	Operation Parameter	-
		ENALM	Alarm Enable	TRUE	Alarm Parameter	-
		FLAG	Flag	-	Output Pin	-

11.14.2 Panel Parameter

Table 11.24 Panel Parameter Instruction

Panel Parameter Name		Parameter Name	Initial Value	Value Range	Application Instruction
Pulse Coef- ficient	Pulse	GAIN	1.0000	-	Indicate the value each pulse stands for, set according to situa- tion.
AVE Alarm	PVL	PVL	0.0000	-	PV lower limit alarm value.(Alarm is valid when "ENALM" is chosen, otherwise neglected)
	PVH	PVH	100.0000	-	PV upper limit alarm value.(Alarm is valid when "ENALM" is chosen, otherwise neglected)
AV Alarm	AV Alarm	HALM	OFF	-	Set accumulation exceeds HLIM alarm.(Alarm is valid when "ENALM" is chosen, otherwise neglected)
Address In- formation	DOMAIN	-	-	-	Read only, set while structure building.
	CON	-	0	-	Read only, set while structure building.
	NODE	NODE	0	[0,31]	Read only, set in function block Properties interface.
	RACK	RACK	0	[0,3]	Read only, set in function block Properties interface.

Table 11.24 Panel Parameter Instruction (continued)

Panel Parameter Name		Parameter Name	Initial Value	Value Range	Application Instruction
	IOM	IOM	0	[0,15]	Read only, set in function block Properties interface.
	CH	CH	0	[0,31]	Read only, set in function block Properties interface.

11.14.3 Flag

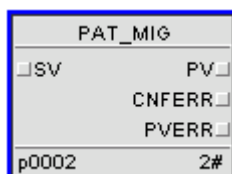
Table 11.25 Flag list

Flag	Alarm	Instruction
D0	OOS	Disable
D1	CFGERR	Configuration Error
D2	ERR	Fault
D4	HALM	Accumulation Over Limit Alarm
D5	PVH	PV H Limit Alarm
D6	PVL	PV L Limit Alarm
D15	AOF	Suppress Alarm

11.15 PAT_MIG Function Block (PAT Position Adjust Function Block)

This function block is used to control modules FW342, XP341, SP341. The basic Properties and parameter setting of the function block must be filled in after adding. In parameter setting, address information of the channel like node and rack, and module information like signal type, deadband and channel fast increase step value manually must be filled in.

This is a complex function block, its running time is 5μs.



11.15.1 Parameter Instruction

Table 11.26 Parameter Instruction of PAT_MIG

Name			Description	Upload	Properties	Application Reference
Basic Parameters	SV Limits	SVH	Upper limit OF SET VALUE	TRUE	Operation Parameter	range [SCH,SCL]
		SVL	Lower limit OF SET VALUE	TRUE	Operation Parameter	range [SCH,SCL]
	Valve Position Limits	MVH	Upper limit of threshold	-	Operation Parameter	-
		MVL	Lower limit of threshold	-	Operation Parameter	-
	Range Settings	EU	Engineering Unit	-	Configuration Parameter	set in function block Properties interface
		DLEN	Decimal Digits[0,5]	-	Configuration Parameter	use to display data on function block panel, default value is 3
		SCH	Upper Limit of Measuring Range	-	Configuration Parameter	-
		SCL	Lower Limit of Measuring Range	-	Configuration Parameter	-
	Hardware Settings	TYPE	Address feedback signal type(1:resistance,2:4~20mA current,3:0~10mA current)	-	Configuration Parameter	(Must be filled)
		NODE	Address of Node[1~31]	-	Configuration Parameter	Match with hardware builder(Must be filled)
		RACK	Address of Rack[0~3]	-	Configuration Parameter	
		IOM	Address of Module[0~15]	-	Configuration Parameter	
		CH	Address of I/O Channel[0~3]	-	Configuration Parameter	
Extended Parameters	Input Pin	SV	Setting value. User expected threshold, this setting value can be set manually by user	-	Input Pin	-

Table 11.26 Parameter Instruction of PAT_MIG (continued)

Name			Description	Upload	Properties	Application Reference
	Output Pin		or set automatically by function block program			
		PV	Threshold feedback value. Can increase/decrease according to feedback, or enter auto-control.	-	Output Pin	Connect to AI
		CN-FERR	Flag of Configuration Error, ON=Fault	-	Output Pin	-
		PVERR	ON=PV Fault	-	Output Pin	-
	Operator Command	STOP	When positive transmission occurs, engender stop command. When negative transmission occurs, engender start command.	TRUE	Operation Parameter	-
		AUTO	When positive transmission occurs, engender auto command. Meanwhile, function block by comparing setting value with feedback value, carry out auto control through long pulse and short pulse.	TRUE	Operation Parameter	-
		MAN	When positive transmission occurs, engender manual control command. Meanwhile output DO on mod-	TRUE	Operation Parameter	-

Table 11.26 Parameter Instruction of PAT_MIG (continued)

Name			Description	Upload	Properties	Application Reference
			ule is only affected by user command(like INC and DEC)			
		INC	When positive transmission occurs, engender manual increase command. Module outputs a increasing pulse, length of the pulse is "manual function step time"	TRUE	Operation Parameter	-
		DEC	When positive transmission occurs, engender manual decrease command. Module outputs a decreasing pulse, length of the pulse is "manual function step time"	TRUE	Operation Parameter	-
		LEARN	When positive transmission occurs, engender learn command, module enters learning status.	TRUE	Operation Parameter	-
		UPDATA	When positive transmission occurs, engender upload learning parameters command. When negative transmission occurs, engender upload user set	TRUE	Operation Parameter	When module upload its own parameters, it will upload on-time threshold, dead zone and stable time.

Table 11.26 Parameter Instruction of PAT_MIG (continued)

Name			Description	Upload	Properties	Application Reference
	OOS Settings		parameters command			
		SWOOS	Out of Service Flag, ON=OOS	TRUE	Operation Parameter	-
	Parameter Settings	DB	Dead Zone(%)	TRUE	Operation Parameter	(Must be filled)
		INTVAL	Dynamo change interval(unit is ms)	TRUE	Operation Parameter	-
		TH	threshold(%)	TRUE	Operation Parameter	-
		TSTD	Threshold stable time(unit is ms)	TRUE	Operation Parameter	-
		MSTEP	Minimum step time(unit is ms)	TRUE	Operation Parameter	-
		TSTEP	Manual function step time(unit is s)	TRUE	Operation Parameter	(Must be filled)
		TOC	SP341 module process time(unit is s)	TRUE	Operation Parameter	-
	Status	NLALM	Negative Limit Alarm(ON=Alarm)	-	Monitoring Parameter	-
		PLALM	Positive Limit Alarm(ON=Alarm)	-	Monitoring Parameter	-
		ASCEND	Increasing status(ON=increasing)	-	Monitoring Parameter	-
		DESCEND	Decreasing status(ON=decreasing)	-	Monitoring Parameter	-
		BLALM	Disconnection Alarm Status(ON=Alarm)	-	Monitoring Parameter	-
		MAN_STA	Feedback of Manual Sta-	-	Monitoring Parameter	-

Table 11.26 Parameter Instruction of PAT_MIG (continued)

Name			Description	Upload	Properties	Application Reference
			tus(ON=Manual)			
		LRN_S-TA	Learning status flag(ON=learning)	-	Monitoring Parameter	-
		DBLN	Dead zone of learning(%)	-	Monitoring Parameter	-
		THLN	Threshold of learning(%)	-	Monitoring Parameter	-
		TST-DLN	Stable time of learning(unit is ms)	-	Monitoring Parameter	-
		MSTEPLN	Minimum step of learning(unit is ms)	-	Monitoring Parameter	-
	Alarm Enable and Suppress	AOF	Suppress Module Alarm	TRUE	Operation Parameter	-
		ENALM	Alarm Enable	TRUE	Alarm Parameter	-
		FLAG	Flag	-	Output Pin	-

11.15.2 Panel Parameter

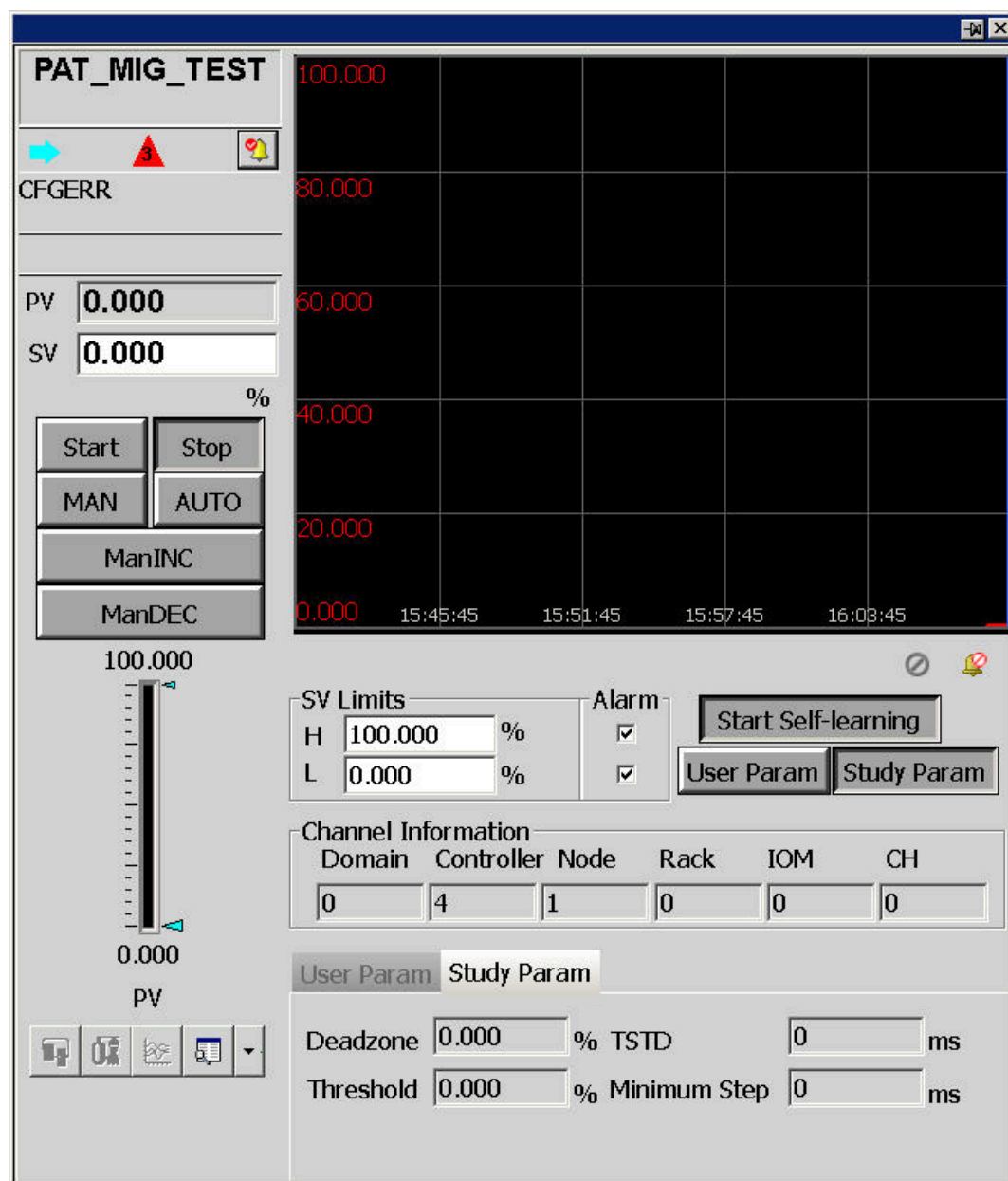


Table 11.27 panel parameter instruction

Panel Parameter Name		Parameter Name	Initial Value	Value Range	Application Instruction
Pulse Co-efficient	Pulse	GAIN	1.0000	-	Indicate the value each pulse stands for, set according to situation.
AVE Alarm	PVL	PVL	0.0000	-	PV lower limit alarm value. (Alarm is valid when “ENALM” is chosen, otherwise neglected).
	PVH	PVH	100.0000	-	PV upper limit alarm value. (Alarm is valid when “ENALM” is chosen, otherwise neglected).

Table 11.27 panel parameter instruction (continued)

Panel Parameter Name		Parameter Name	Initial Value	Value Range	Application Instruction
AV Alarm	AV Alarm	HALM	OFF	-	Set accumulation exceeds HLIM alarm. (Alarm is valid when “ENALM” is chosen, otherwise neglected).
Address Information	DOMAIN	-	-	-	Read-only. Set in the VFSys-Builder.
	CON	-	-	-	Read-only. Set in the VFSys-Builder.
	NODE	NODE	0	[1,31]	Read-only. Set in the function block properties interface.
	RACK	RACK	0	[0,3]	Read-only. Set in the function block properties interface.
	IOM	IOM	0	[0,15]	Read-only. Set in the function block properties interface.
	CH	CH	0	[0,31]	Read-only. Set in the function block properties interface.

11.15.3 Flag

Table 11.28 Flag list

Flag	Alarm	Instruction
D0	OOS	Disable
D1	PVERR	PV Fault
D3	CFGERR	Configuration Error
D4	AUTO	Auto
D5	MAN	Manual
D6	NLALM	Negative Limit Alarm
D7	PLALM	Positive Limit Alarm
D8	LEARN	Self-learn Status
D9	ASCEND	Ascending Status
D10	DESCEND	Descensing Status
D11	BLALM	Disconnection Alarm
D14	SVL	SV L Limit Alarm

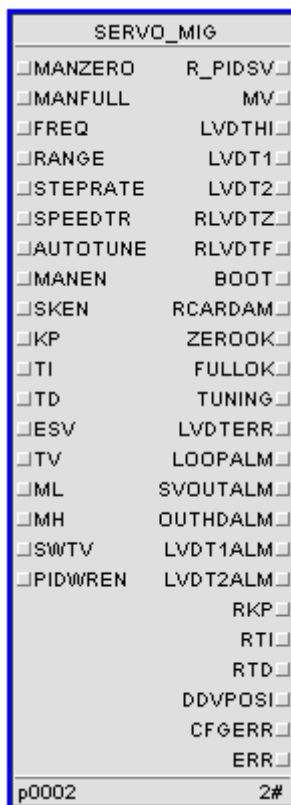
Table 11.28 Flag list (continued)

Flag	Alarm	Instruction
D15	SVH	SV H Limit Alarm
D16	AOF	Suppress Alarm

11.16 SERVO_MIG Function Block (Valve Servo Control Module)

This function block controls module FW346 and displays its status information.

This function block is a simple function block, its running time is 100μs.

**Table 11.29 Parameter Instruction of SERVO_MIG**

Name			Description	Upload	Properties	Application Reference
Basic Parameters	Configuration Parameter	NODE	Address of Node[1~31]	-	Configuration Parameter	Need to Match with hardware builder
		RACK	Address of Rack[0~3]	-	Configuration Parameter	
		IOM	Address of Module[0~15]	-	Configuration Parameter	

Table 11.29 Parameter Instruction of SERVO_MIG (continued)

Name			Description	Upload	Properties	Application Reference
Extended Parameters	Input Pin	MANZE-RO	LVDT manually clear value(%)	-	Input Pin	-
		MANFULL	LVDT manually turn full value(%)	-	Input Pin	-
		FREQ	Signal frequency that would avoid jam.(10Hz or 20Hz)	-	Input Pin	-
		RANGE	Signal range that would avoid jam.(%)	-	Input Pin	-
		STEPRATE	Manually function step rate(%)	-	Input Pin	-
		SPEEDTR	Speed of change when clear or change range(%/s)	-	Input Pin	-
		AUTO-TUNE	Auto clear or range change enable(OFF=stop,ON=start)	-	Input Pin	-
		MANEN	LVDT manually setting zero valid(OFF=not valid, ON=valid)	-	Input Pin	-
		SKEN	Avoid jam function enable(OFF=not allowed,ON=allow)	-	Operation Parameter	-
		KP	Scale parameter(0.01~655.35)	-	Input Pin	-
		TI	Integrate parameter	-	Input Pin	-

Table 11.29 Parameter Instruction of SERVO_MIG (continued)

Name			Description	Upload	Properties	Application Reference
			ter(0.0s~6553-.5s)			
		TD	Differen- tial param- eter(0.0s~6553-.5s)	-	Input Pin	-
		ESV	Outer set val- ue	-	Input Pin	-
		TV	Output trac- ing value(%)	-	Input Pin	-
		ML	Output lower limit(%)	-	Input Pin	-
		MH	Output upper limit(%)	-	Input Pin	-
		SWTV	Output tracing switch(OFF=not trace,ON=trace)	-	Input Pin	-
		PIDWREN	Enable serve module to up- load PID val- ue(OFF=not allowed, ON=allow)	-	Input Pin	-
	Output Pin	R_PIDSV	Feedback of spacific threshold of DEH	-	Output Pin	-
		MV	DEH thread- hold output	-	Output Pin	-
		LVDT1	LVDT high selected val- ue	-	Output Pin	-
		LVDT1	LVDT1 sam- ple value(%)	-	Output Pin	-
		LVDT2	LVDT2 sam- ple value(%)	-	Output Pin	-
		RLVDTZ	LVDT zero position read- back value	-	Output Pin	-
		RLVDTF	LVDT range and phase	-	Output Pin	-

Table 11.29 Parameter Instruction of SERVO_MIG (continued)

Name			Description	Upload	Properties	Application Reference
			readback value			
		BOOT	Logic flag of module(0=not in start logic, 1=in start logic)	-	Output Pin	-
		RCAR-DAM	Feedback of manual/auto status of module(0=module, 1=auto)	-	Output Pin	-
		ZEROOK	LVDT auto set zero success flag(0=success, 1=fail)	-	Output Pin	-
		FULLOK	LVDT auto set range success flag(0=success, 1=fail)	-	Output Pin	-
		TUNING	LVDT auto set zero /set range status(0=not started or ended, 1=proceeding)	-	Output Pin	-
		LVDTER	Alarm when difference between LVDT1 and LVDT2 is too large(0=no alarm, 1=alarm)	-	Output Pin	-
		LOOPALM	manually set zero /set range status err alarm(0=no alarm, 1=alarm)	-	Output Pin	-
		SVOUTALM	circle output alarm(0=no alarm, 1=alarm)	-	Output Pin	-

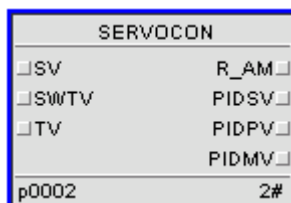
Table 11.29 Parameter Instruction of SERVO_MIG (continued)

Name			Description	Upload	Properties	Application Reference
		OUTH-DALM	Reserve	-	Output Pin	-
		LVDT1ALM	LVDT1offline alarm	-	Output Pin	-
		LVDT2ALM	LVDT2 offline alarm	-	Output Pin	-
		RKP	readback KP	-	Output Pin	-
		RTI	readback TI	-	Output Pin	-
		RTD	readback TI	-	Output Pin	-
		DDVPOSI	DD tap Address feedback	-	Output Pin	-
		CFGERR	Flag of Configuration Error	-	Output Pin	-
		ERR	Function block alarm	-	Output Pin	-

11.17 SERVOCON Function Block (Valve Servo Control Module)

This function block controls module AM722-S and displays its status information. Before using it, please read reference of AM722-S.

This function block is a simple function block, its running time is 100μs.



11.17.1 Parameter Description

Table 11.30 Parameter Instruction of SERVOCON

Name			Description	Upload	Properties	Application Reference
Basic Parameters	Hardware Settings	NODE	Address of Node[0~31]	-	Configuration Parameter	Need to Match with hardware builder
		RACK	Address of Rack[0~3]	-	Configuration Parameter	
		IOM	Address of Module[0~15]	-	Configuration Parameter	
Extended Parameters	Input Pin	SV	preset value	-	Input Pin	-
		SWTV	output tracing switch (OFF=not tracing, ON=trace)	-	Input Pin	-
		TV	output tracing value(%)	-	Input Pin	-
	Output Pin	R_AM	module manual flag(OFF=auto, ON=manual)	-	Output Pin	-
		PIDSV	circle setting value(%)	-	Output Pin	-
		PIDPV	circle measured value(%)	-	Output Pin	-
		PIDMV	circle output value(%)	-	Output Pin	-
	Operator Command	ACK-LVDT1	LVDT1 offline recover flag	-	Input Pin	-
		ACK-LVDT2	LVDT2 offline recover flag	-	Input Pin	-
	Auto Zero-adjust and Amplitude-adjust	AUTO-TUNE	auto set zero/set range enable(OFF=stop, ON=start)	-	Input Pin	-
		OILTR-PEN	oil switch tripout respond enable(OFF=not respond, ON=respond)	TRUE	Input Pin	-
		SPEEDTR	preset value rate of change of set zero/set range (%/s)	TRUE	Input Pin	-
		PERCENT	auto set zero/set range complete rate	-	Output Pin	-
		ZEROBAD	auto set zero/set range success flag(OFF=success, ON=fail)	-	Output Pin	-

Table 11.30 Parameter Instruction of SERVOCON (continued)

Name			Description	Upload	Properties	Application Reference
	Manual Zero-adjust and Amplitude-adjust	MAN-WREN	manual writing LVDT set zero/set range enable(OFF=unchangable,ON=changable)	-	Input Pin	-
		MANZERO	LVDT manual set zero value(%)	TRUE	Input Pin	-
		MANFULL	LVDT manual full value(%)	TRUE	Input Pin	-
	Anti-jamming	SKEN	avoid jam function enable(OFF=not allowed,ON=allowed)	-	Input Pin	-
		FREQ	Signal frequency that would avoid jam. (10Hz or 20Hz)	TRUE	Operation Parameter	-
		RANGE	Signal range that would avoid jam. (%)	TRUE	Operation Parameter	-
	Acceleration Feedforward	ACCFBEN	Accelerated velocity feedforward control enable(OFF=not feedforward,ON=feedforward)	TRUE	Input Pin	-
		ACCRATE	Accelerate parameter	TRUE	Input Pin	-
		R_ACC	Accelerate rate(r/min/s)	-	Output Pin	-
	PID Setting	PB	Rate parameter(0.01~655.35)	TRUE	Input Pin	-
		TI	Accumulate parameter(0.0s~6553.5s)	TRUE	Input Pin	-
		TD	Differential parameter(0.0s~6553.5s)	TRUE	Input Pin	-
		PIDPEI	PID circle positive deviation alarm	-	Output Pin	-
		PIDNEI	PID circle negative deviation alarm	-	Output Pin	-
	Output Limits	MH	Output upper limit(%)	TRUE	Input Pin	-
		ML	Output lower limit(%)	TRUE	Input Pin	-

Table 11.30 Parameter Instruction of SERVOCON (continued)

Name			Description	Upload	Properties	Application Reference
	Hand-Held Setting	STEPRATE	Manual function step value(%)	TRUE	Input Pin	-
	Debug	DE-BUGAM	Module Manual/auto switch (OFF=auto,ON= manual)	-	Input Pinr	-
		DEBUG	Debug switch (OFF=not debug,ON=debug)	-	Input Pin	-
		MANMV	Threshold manual setting value(%Debug)	-	Input Pin	-
	Alarm Limit	DLLVDT	LVDT large deviation alarm limit(%)	TRUE	Input Pin	-
		HYSLVDT	LVDT large deviation alarm hold-up circle value(%)	TRUE	Input Pin	-
		DLSVPV	Setting value deviation alarm limit(%)	TRUE	Input Pin	-
		TIMESVPV	Setting value deviation alarm time limit(s)	TRUE	Input Pin	-
	Alarm Enabled and Suppress	ENALM	Alarm Enable	TRUE	Operation Parameter	-
		AOF	Suppress Module Alarm	TRUE	Operation Parameter	-
		FLAG	Flag	-	Output Pin	-
	LVDT Monitor	LVDT1	LVDT1 sample value(%)	-	Output Pin	-
		LVDT2	LVDT2 sample value(%)	-	Output Pin	-
		R_-LVDTZ	LVDT zero position readback value(%)	-	Output Pin	-
		R_-LVDTF	LVDT range readback value(%)	-	Output Pin	-
		LVDT1BAD	LVDT1 check (OFF=normal,ON=offline)	-	Output Pin	-
		LVDT2BAD	LVDT2 check (OFF=normal,ON=offline)	-	Output Pin	-

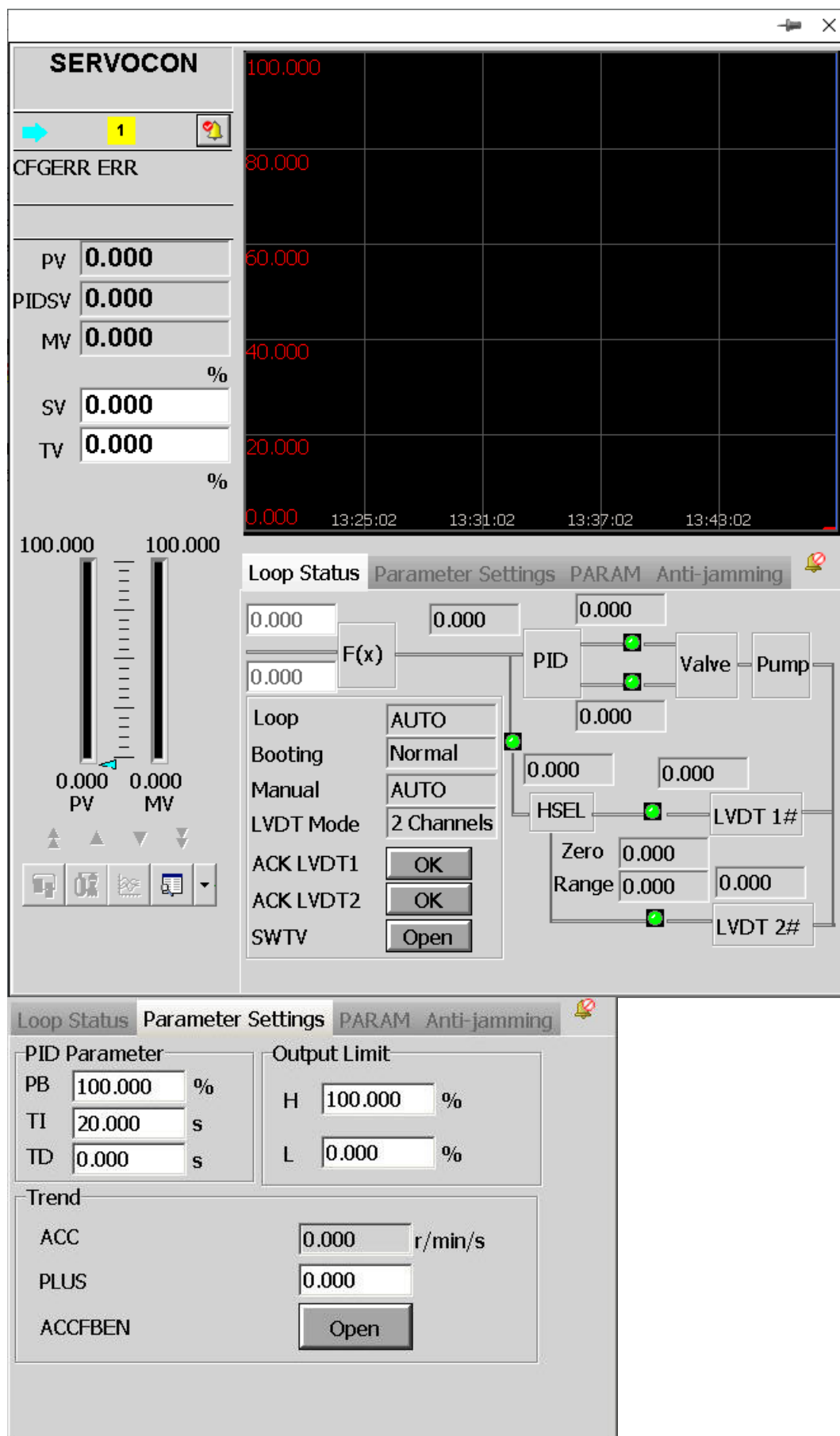
Table 11.30 Parameter Instruction of SERVOCON (continued)


Name			Description	Upload	Properties	Application Reference
	Module Status Monitor	SAMP-MODE	LVDT input mode:0=double high;1=LVDT2single;2=LVDT1single	-	Output Pin	-
		MV1	First output value(%)	-	Output Pin	-
		MV2	Second output value(%)	-	Output Pin	-
		BOOTING	Module is in start status(OFF=start finished,ON=starting)	-	Output Pin	-
		HDW-MAN	Auto/manual set (OFF=auto,ON= manual)	-	Output Pin	-
	Module Fault Monitor	PIDTR	PIDtrace status(OFF=auto,ON=trace)	-	Output Pin	-
		LVDTM-BAD	LVDT display output circuit Fault(OFF=normal,ON=Fault)	-	Output Pin	-
		DDV2BAD	DDV2 output circuit Fault(OFF=normal,ON=Fault)	-	Output Pin	-
		DDV1BAD	DDV1 output circuit Fault(OFF=normal,ON=Fault)	-	Output Pin	-
		LVDTP-BAD	LVDT module 15V power fault(OFF=normal,ON=Fault)	-	Output parameter	-
		AUXP-BAD	Auxiliary Power Fault(OFF=normal,ON=Fault)	-	Output parameter	-
		EILVDT	LVDT large deviation alarm	-	Output parameter	-
		FAIL	Check channel Fault(OFF=normal,ON=Fault)	-	Monitoring Parameter	-
		CFGERR	Flag of Configuration Error	-	Monitoring Parameter	-
		COM-ERR	Communication fault	-	Monitoring Parameter	-
		ERR	Function block alarm	-	Monitoring Parameter	-

Table 11.30 Parameter Instruction of SERVOCON (continued)

Name			Description	Upload	Properties	Application Reference
		SM1DISM	Speed meter module 1 match flag(OF-F=match, ON=not match)	-	Output Parameter	-
		SM2DISM	Speed meter module 2 match flag(OF-F=match, ON=not match)	-	Output Pin	-
		SM3DISM	Speed meter module 3 match flag(OF-F=match, ON=not match)	-	Output Parameter	-

11.17.2 Panel Parameter



Loop Status
Parameter Settings
PARAM
Anti-jamming


Auto Tuning

Rate
 %/s

Zero
 %

Range
 %

Step Manual
 %

Complete
 %
Succeeded to
Zero-adjust and
Amplitude-adjust

Loop Status
Parameter Settings
PARAM
Anti-jamming


JAM Test

Frequency
☒ 10Hz
☐ 20Hz

Range
 %

Table 11.31 Panel Parameter of SERVOCON

Panel Parameter Name		Parameter Name	Initial Value	Value Range	Application Instruction
STATE	Loop	R_AM	OFF	-	Read only, set in function block Properties interface or in program.
	Booting	BOOTING	OFF	-	Read only, set in function block Properties interface.
	Manual	HDWMAN	OFF	-	Read only, set in function block Properties interface.
	LVDT Module	SAMPMODE	0	-	Read only, set in function block Properties interface.
	ACK LVDT1	ACK LVDT1	OFF	-	-

Table 11.31 Panel Parameter of SERVOCON (continued)

Panel Parameter Name		Parameter Name	Initial Value	Value Range	Application Instruction
	ACK LVDT2	ACK LVDT2	OFF	-	-
	SWTV	SWTV	OFF	-	-
Parameter Settings	PID Parameter	PB(%)	PB	100.0000	-
		TI(s)	TI	20.0000	-
		TD(s)	TD	0.0000	-
	Output Limits	H(%)	MH	100.000	-
		L(%)	ML	0.000	-
	Trend	ACC(r/min/s)	R_ACC	0.000	-
		PLUS	ACCRATE	0.0000	-
		ACCFBEN	ACCFBEN	OFF	-
PARAM	Auto Tuning		AUTOTUNE	OFF	-
	Start		PERCENT	0	-
	Rate(%/s)		SPEEDTR	5.0000	-
	Complete(%)		ZEROBAD	OFF	-
	Zero(%)		MANZERO	0.0000	-
	Range(%)		MANFULL	0.0000	-
	Manual Set		MANWREN	OFF	-
	Step Manual		STEPRATE	0.1000	-
Anti-jamming	JAM Test		SKEN	OFF	-
	Frequency		FREQ	10Hz	-
	Range (%)		RANGE	0.0100	-

11.17.3 Flag

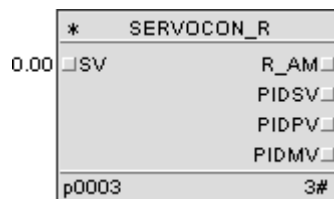
Table 11.32 Flag list

Flag	Alarm	Instruction
D0	ERR	Fault
D1	CFGERR	Configuration Error
D2	UNCOMM	Communication Error Alarm
D4	AOF	Suppress Alarm
D5	EILVDT	LVDT Large-deviation Alarm
D6	NEI	Negative Deviation Alarm
D7	PEI	Positive Deviation Alarm
D8	LVDT1BL	LVDT1 Disconnect Alarm
D9	LVDT2BL	LVDT2 Disconnect Alarm
D10	MAN	Manual

11.18 SERVOCON_R Function Block

When the controller type is FCU712-S and FCU713-S, redundant DEH servo control can be realized through SERVOCON_R and electro-hydraulic servo module AM723-S. Before using this function block, please read the "*AM723-S User Manual*" carefully.

The default pin diagram of SERVOCON_R function block is as shown in the figure below.



11.18.1 Parameter Description

The parameters, meanings and setting precautions of the function blocks are shown in Table 11.33.

Table 11.33 SERVOCON_R parameter table

Parameter Name			Type	Description	Upload	Application
Basic parameter	Hardware setting	NODE	USINT	Node ID [0~31]	-	-When the controller type is FCU713-S ranges [0,31], when the controller type is

Table 11.33 SERVOCON_R parameter table (continued)

Parameter Name			Type	Description	Upload	Application
						FCU711-S / FCU712-S ranges: [0, 7].
		RACK	USINT	Rack ID [0~3]	-	-
		IOM	USINT	Module ID [0~15]	-	-
Ex- tended para- meter	Input pin	SV	REAL	valve open degree setting value(%)	-	corresponding to adjust the valve 0% to 100% opening
		SWTV	BOOL	output track switch(OFF=not track,ON=track)	-	When the SWTV is turned on, the PID operation invalid, MV = TVDo not open tracking mode without special circumstances
		TV	REAL	output track value(%)	-	range 0 ~ 100
	Output pin	R_AM	BOOL	module manual-auto sw(OFF=auto,ON>manual)	-	-
		PIDSV	REAL	loop SV(%)	-	-
		PIDPV	REAL	loop PV(%)	-	-
		PIDMV	REAL	loop output value(%)	-	-
	Auto zero adjusting	AUTOTUNE	BOOL	The enable of auto zero-adjust and amplitude-adjust (OFF=stop, ON=start)	-	-
		OILTRPEN	BOOL	Enable oil switch trip response(OFF=disable, ON=enable)	true	When the value is ON, the oil switch trip signal will be in response to the oil switch trip, then PIDSV, PIDPV, PIDMV is 0%, causing the valve switch, restored after 2 seconds.
		SPEEDTR	REAL	the SV change rate of zero-adjust and amplitude-adjust(%/s)	true	Setting range 0 ~ 10, 0 corresponds to the actual change rate 5% / s, the remaining value is the actual chang
		PERCENT	USINT	The percentage of process of auto zero-adjust and amplitude-adjust	-	-

Table 11.33 SERVOCON_R parameter table (continued)

Parameter Name			Type	Description	Upload	Application
	Auto manual zero adjusting and amplitude adjusting	ZEROBAD	BOOL	The flag of auto zero-adjust and amplitude-adjust	-	OFF=Success, ON=Failed
		MANWREN	BOOL	Manual modify LVDT Zero-adjust and amplitude-adjust enable (OFF=disable,ON=enable)	-	auto zero adjusting and amplitude adjusting, must set as OFF
		MANZERO1	REAL	LVDT1 manual zero adjust value(%)	true	Manzero1 must be less than manfull1, two parameters are valid, can we write success
		MANFULL1	REAL	LVDT1 manual full-range value(%)	true	
		MANZERO2	REAL	LVDT2 manual zero adjust value(%)	true	MANZERO2 must be less than MANFULL2
		MANFULL2	REAL	LVDT2 manual full-range value(%)	true	
	Anti-jamming	SKEN	BOOL	enable Anti-jamming(OFF=disable,ON=enable)	-	Enabling does not mean that actual anti-card signal works, in general, do not enable, use precautions, see "Note" below the form.
		FREQ	USINT	frequency value of anti-jamming vibration signal(1Hz~50Hz)	true	Support 1 ~ 50Hz free setting, minimum set value, 1 Hz, default 1 Hz
		RANGE	REAL	amplitude of anti-jamming vibration signal(%), valid range:0 ~ 10	true	Support 0 ~ 10% free setting, minimum set-point is 0.01%, default 0.01%
	Acceleration feedward	ACCFBEN	BOOL	acceleration feedward control enable(OFF=not feedward, ON=feedward)	true	-
		ACCRATE	REAL	accelerate gain coefficient	true	-
		R_ACC	REAL	Acceleration(r/min/s)	-	The acceleration value from the speed module input, when receiving the value from the speed change module, take the maximum value

Table 11.33 SERVOCON_R parameter table (continued)

Parameter Name			Type	Description	Upload	Application
	PID setting	PB	REAL	proportion parameter(0.01~655.35)	true	-
		TI	REAL	Integral parameter(0.0s~6553.5s)	true	-
		TD	REAL	Derivative parameter(0.0s~6553.5s)	true	-
		PIDPEI	BOOL	PID positive deviation alarm	-	-
		PIDNEI	BOOL	PID negative deviation alarm	-	-
	Operation command	DDV_ACK	BOOL	Standby module DDV out disconnect recovery confirm	true	-
		LVDT1_EN	BOOL	LVDT1 switch(ON=used, OFF=not used)	-	-
		LVDT2_EN	BOOL	LVDT2 switch(ON=used, OFF=not used)	-	-
		FB_SEL	BOOL	feedback signal select(ON=high select, OFF=low select)	-	When LVDT1_EN and LVDT2_EN are ON, set effective
	Output limits	MH	REAL	MV output high limit (%), generally 100	true	-
		ML	REAL	MV output low limit (%), generally 0	true	-
	Handheld settings	STEPRATE	REAL	Handheld step value (%)	true	Range 0 ~ 2. That is, every time the hypotony is increased, the button is reduced, and the valve change opening is 0 ~ 2%.
	Debug	DEBUGAM	BOOL	module manual auto switch(OFF=auto, ON=manual)	-	-
		DEBUG	BOOL	debug switch(OFF=not debug ON=debug)	-	-
		MANMV	REAL	valve position manual SV(%for debug)	-	-
	alarm limit	SEILVDT	REAL	LVDT safety deviation value(%)	true	-

Table 11.33 SERVOCON_R parameter table (continued)

Parameter Name		Type	Description	Upload	Application
		DLLVDT	REAL Limit value of LVDT large-deviation alarm limit(%),range [1,100]	true	-
		HYSLVDT	REAL hysteresis of LVDT large-deviation alarm(%)	true	-
		DLSVPV	REAL SV deviation alarm limit(%)	true	That is, the circuit measurement value PIDPV and circuit setting value PIDSV deviation alarm limit
		TIMESVPV	REAL SV deviation alarm time limit(s)	true	Deviation alarm is generated when the deviation exceeds the alarm limit and the time limit set for this parameter.
	LVDT monitor	LVDT1_T	REAL LVDT1 transfer value (%)	-	The resulting value LVDT1 is converted by zero-amplitude
		LVDT2_T	REAL LVDT2 transfer value(%)	-	The resulting value LVDT2 is converted by zero-amplitude
		LVDT1	REAL LVDT1 sampling value(%)	-	-
		LVDT2	REAL LVDT2 sampling value(%)	-	-
		LVDT1BAD	BOOL LVDT1 detect(OFF=normal, ON=disconnect)	-	-
		LVDT2BAD	BOOL LVDT2 detect(OFF=normal, ON=disconnect)	-	-
		R_LVDT1Z	REAL LVDT1 zero tag readback value(%)	-	currently calculate the zero value and amplitude value used, range 0 ~ 100
		R_LVDT1F	REAL LVDT1 amplitude tag readback value(%)	-	
		R_LVDT2Z	REAL LVDT2 zero tag readback value(%)	-	
		R_LVDT2F	REAL LVDT2 amplitude tag readback value(%)	-	
		R_FB_SEL	USINT 0 = two feedback channels are all not	-	-

Table 11.33 SERVOCON_R parameter table (continued)

Parameter Name		Type	Description	Upload	Application
Module fault monitor			selected, 1 = feedback channel 1 is selected, 2 = feedback channel 2 is selected		
	LVDTMBAD	BOOL	LVDT handheld monitor output power supply fault (OFF = normal, ON = fault)	-	-
	DDV1BAD	BOOL	DDV1 power supply fault (OFF = normal, ON = fault)	-	-
	DDV2BAD	BOOL	DDV2 power supply fault (OFF = normal, ON = fault)	-	-
	LVDT1PBAD	BOOL	LVDT1 module 15V power supply fault (OFF = normal, ON = fault)	-	-
	LVDT2PBAD	BOOL	LVDT2 module 15V power fault(OFF=normal,ON=fault)	-	-
	AUXPBAD	BOOL	Auxiliary power fault(OFF=normal,ON=fault)	-	-
	EILVDT	BOOL	LVDT large deviation alarm	-	-
	RDD_ERR	BOOL	Redundant module communication fault(OFF=normal, ON=fault)	-	-
	DDV_ERR	BOOL	standby module DDV output fault (OFF=normal, ON=fault)	-	-
	CFGERR	BOOL	configuration error alarm	-	-
	COMERR	BOOL	communication fault	-	-
	ERR	BOOL	function block alarm	-	-
	SM1DISM	BOOL	Speed detection module 1 match signal (OFF=match,ON=dis-match)	-	The address of the speed module 1, 2, 3 is required in the hardware configuration parameters of the module, and when the actual address corresponds to the
	SM2DISM	BOOL	Speed detection module 2 match signal(OFF-	-	

Table 11.33 SERVOCON_R parameter table (continued)

Parameter Name		Type	Description	Upload	Application
			F=match,ON=idis-match)		module, the parameter is turned on.
		SM3DISM	Speed detection module 3 match signal(OFF=match,ON=dis-match)	-	
	Module status monitor	BOOTING	module in start status(OFF=start complete,ON=in start)	-	When it is ON, the function block does not enter the automatic control status.
		HDWMAN	handheld set manual(OFF=auto,ON=manual)	-	-
		PIDTR	PID track status(OFF=auto,ON=track)	-	-
		MV1	MV1(%)	-	-
		MV2	MV2(%)	-	-
	Alarm enabled and suppressed	AOF	suppress alarm	true	-
		ENALM	alarm enable settings	true	-
		FLAG	flag	-	-

**ATTENTION:**

Typically, when the module is operating normally, it is strictly prohibited to start the anti-check signal. The anti-card signal is allowed to start the anti-jamming signal only in the case of the steam turbine adjustment valve, and immediately turn off the anti-check signal immediately after the adjustment valve returns to normal. However, if the control object is a special control component such as an SVA9 valve, the operation is required to keep the anti-jamming signal, and use it with caution according to the control object.

11.18.2 Function Illustration

Manual / automatic logo

Module hand auto sign R_AM Indicates that the electro-hydraulic servo module is currently in manual control or auto control.

- When the power starts, the module is a manual status, and the flag is ON. The module is judged by the start-up logic, which is in accordance with the OFF condition, will automatically set OFF.
- When the module receives the hand-operator hand / automatic switching operation command, it is determined that the switching condition (i.e., the SV and PIDPV value deviation is less than 4%), the control mode is switched to manual, the flag is ON. When switching to automatic, set OFF.

Manual / Auto zero-adjust and amplitude-adjust Operation



ATTENTION:

- After starting auto zero-adjust and amplitude-adjust, it is strictly forbidden to make MANWREN as ON in the zero adjustment process.
 - If there is no special case, follow the SPEEDTR's default value to set it, it is strictly forbidden to set this parameter.
-

1. Auto zero-adjust and amplitude-adjust operation steps

The LVDT displacement sensor needs to be installed in the appropriate location according to the project, and the connection is properly wired.

- 1) Confirm that MANWREN sets OFF to ensure not to enable zero-adjusting and amplitude-adjusting.
- 2) Set the parameter SPEEDTR in the function block to control the rate of change of the automatic zero adjustment. Set to zero, the zero zero adjustment is performed according to the change rate of the default value of 5% / s.
- 3) Set the AUTOTUNE ON and start the auto zero-adjust and amplitude-adjust. The parameter PERCENT is a percentage of the progress of the display module to complete the auto zero-adjust and amplitude-adjust.
- 4) When the PERCENT is shown as 100, that is, the end of the auto zero-adjust and amplitude-adjust process.
- 5) The module determines whether the amplitude value is greater than the zero value, if satisfied, the parameter ZEROBAD sets OFF, indicates successful operation.
- 6) Set the AUTOTUNE OFF and turn off the auto zero-adjust and amplitude-adjust.

2. Manual zero-adjust and amplitude-adjust operation steps

If the auto zero-adjust and amplitude-adjust of the LVDT cannot be completed normally, the zero-adjust and amplitude-adjust of the LVDT can be completed by manual zero-adjust and amplitude-adjust.

- 1) Write the zero-tag value in MANZERO, and write the amplitude value in MANFULL. The MANZERO value should be less than the MANFULL value is a valid parameter.
- 2) Set the MANWREN ON, write a valid zero value and amplitude value under the module.
- 3) Set the MANWREN to OFF, turn off the manual zero-adjust and amplitude-adjust.

Safety deviation value instructions

When the deviation value of LVDT1_T and LVDT2_T is within SEILVDT, the high/low selection is not performed in the currently, with selected LVDT signal as a PIDPV value. When the safety deviation value range is exceeded, the high/low selection is re-selected.

For example,:

Setting the safety deviation value SEILVDT to 5%, when the two LVDT deviation values are less than 5%, as the PIDPV value of the currently selected LVDT; when the two LVDT deviation values are greater than 5%, the high and low selection is re-performed. Reselect the LVDT signal as a PIDPV value.

Acceleration feedforward accumulative value description

When the acceleration feedforward control is enabled, that is, the ACCFBEN sets ON, the electro-hydraulic servo module can calculate the pre-stack value according to the acceleration value (R_ACC) input by the acceleration gain coefficient (ACCRATE) and the speed change module, and superimpose it in the output value MV. On the value.

Calculation formula: Feedforward accumulative value = $(R_ACC \times ACCRATE) / 2000$.

PID loop deviation alarm

When the deviation of the loop measurement (PIDPV) and the loop setting value (PIDSV) is greater than (or less), the PID circuit is greater than the set value deviation alarm time limit (TIMESVPV). Positive (or negative) deviation alarm.

If the deviation rate is positive, the PID loop is the positive deviation alarm (PIDPEI) is ON, otherwise OFF.

If the deviation rate is negative, the PID loop negative deviation alarm (PIDNEI) is ON, otherwise OFF.

LVDT deviation big alarm

The LVDT deviation in this function block refers to an absolute value of the difference between the two LVDT conversion values LVDT1_T and LVDT2_T. The logic judgment of a large alarm of

the deviation is shown below. The premise of the alarm is that the two LVDT signals are in the input status, that is, LVDT1_EN and LVDT2_EN are all ON.

- When the deviation exceeds the deviation of large alarm limit (DLLVDT), a large alarm is generated, ie EILVDT is turned ON.
- When the deviation is lowered, the alarm is still generated when it is in a dead zone, that is, EILVDT is still ON.
- When the deviation is lower than (DLLVDT-HYSLVDT), the alarm can be released, ie the EILVDT is set off.

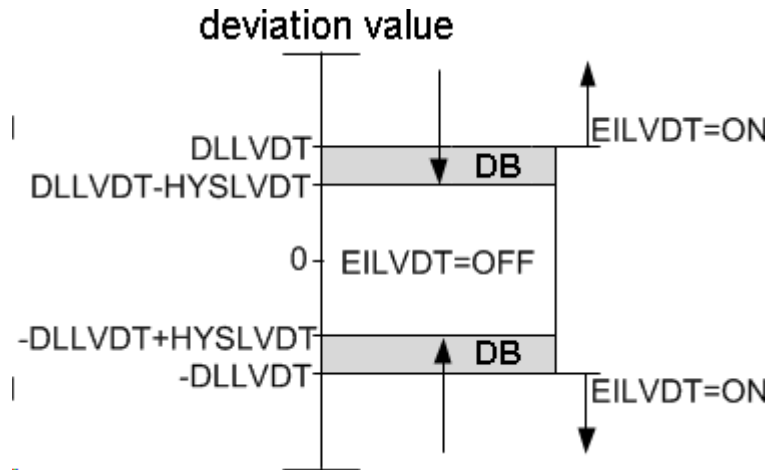


Figure 11.2 Deviation large alarm logic judgement

Example:

It is assumed that the DLLVDT deviation has a large alarm limit of 5%. The HYSLVDT deviation has a large alarm hysteresis value of 1%, and the deviation of the two sampling values LVDT1 and LVDT2 is greater than 5%, and when the deviation is less than 4%, the alarm is eliminated.



TIP:

The LVDT signal deviation value mentioned above is a deviation of the LVDT conversion value, that is, the deviation of LVDT1_T and LVDT2_T.

Module output line disconnection detection, recovery operation

When the current working module of eletircal liquid servo valve is used to control the output channel 1 or channel 2, the monitoring parameter DDV1BAD or DDV2BAD is placed ON. At this time, redundant switching occurs if the standby module is not faulty or the fault rating is lower than the working module. After switching, the fault module becomes an standby module, the parameter DDV_ERR is set ON, and the standby side module is disconnected fault alarm. Manually check whether the wiring of this module output loop has a disconnection situation, troubleshooting and confirming that the parameter DDV_ACK is turned ON, indicating that the standby side module disconnection fault has recovered.

**TIP:**

If the disconnection fault is reported when there is no disconnection in the output circuit, it is possible that the module is faulty and the module should be replaced.

LVDT sensor disconnection detection, recovery operation

If line fault exists in the electro-hydraulic servo valves for controlling output channel 1 or channel 2, the monitoring parameters DDV1BAD or DDV2BAD are set ON.

If backup module has no fault or its fault level is lower than that of the working module, the redundancy mode is switched on. After switching, the fault module is transferred to the backup module. Parameter DDV_ERR is set ON and the disconnection fault alarm of the backup module is triggered.

Only the real-time value of the unable LVDT sensor is used as the feedback value of the site. At the same time, the deviation has been eliminated, and the function block displays the LVDT fault, that is, the LVDT1BAD or LVDT2BAD will be turned ON based on the on-site loop.

After repairing the LVDT of the disconnection failure, the LVDT2 is re-input to the corresponding LVDT in the operational parameter (LVDT1_EN or LVDT2_EN) or the LVDT1 in the operation panel. The module will work normally after it is determined that the site is repaired.

Decision logic description of power failure

The electro-hydraulic servo module detects the terminal distribution status and presents the status by monitoring parameters.

- LVDT1PBAD and LVDT2PBAD are the 15VDC LVDT power supply status of terminal board 1 and terminal plate 2, respectively. When LVDT1PBAD is ON, the LVDT power supply voltage indicating the corresponding terminal board is lower than the limit inside the module.
When a fault occurs, the cable connection fault should be excluded. If the problem is still present, the terminal board is replaced.
- AUXPBAD is a secondary power failure status, input by the terminal board, power supply for the module on-site side. When AUXPBAD is ON, it indicates that the power supply voltage is lower than the module.
When a fault occurs, the cable connection fault should be excluded. If the problem is still present, the terminal board is replaced.

Debug function instructions

When the module manual switch (DEBUGAM) and debug switch (DEBUG) are ON, the loop setting value (PIDSV) can be modified by operating the parameter valve position manual setting value (MANMV).

11.18.3 Panel Parameter



Loop Status Parameter Settings PARAM Anti-jamming

PID Parameter		Output Limit	
PB	100.000 %	H	100.000 %
TI	20.000 s	L	0.000 %
TD	0.000 s		

Trend

ACC	0.000 r/min/s
PLUS	0.000
ACCFBEN	Open

Loop Status Parameter Settings PARAM Anti-jamming

Step Manual	Rate	5.000 %/s
0.100 %	Complete Schedule	0 %
	Auto Tuning	Open
	Succeeded to Zero-adjust and Amplitude-adjust	

LVDT 1#		H SEL	LVDT 2#	
Zero	0.000 %		Zero	0.000 %
Range	0.000 %		Range	0.000 %
LVDT1	0.000 %		LVDT2	0.000 %
LVDT1_T	0.000 %		LVDT2_T	0.000 %

Manual

Loop Status Parameter Settings PARAM Anti-jamming

JAM Test Open

Frequency 1 Hz (1 ~ 50Hz)

Range 0.010 % (0~10%)

Figure 11.3 SERVOCON_R panel example

Table 11.34 SERVOCON_R function block panel parameter

Panel Parameter Name		Parameter name	Initial value	Value Range	Application
Loop status	SV	SV	0.0	[0.0,100.0]	loop given value of servo module under controller
	TV	TV	0.0	[0.0,100.0]	track value of servo module under controller
	(1)	PIDSV	0.0	-	The loop of the servo card is given the value, and it is also a given value actually used by the servo card circuit.
	(2)	MV1	0.0	-	the first channel DDV output of servo module
	(3)	DDVIBAD	OFF	ON,OFF	DDV1 output circuit fault. When the DDV1 outputs a fault, the indicator is red; when the DDV1 outputs normally, the indicator is green.
	(4)	DDV2BAD	OFF	ON,OFF	DDV2 output circuit fault. When the DDV2 outputs a fault, the indicator is red; when the DDV2 outputs normally, the indicator is green.
	(5)	MV2	0.0	-	the second channel DDV output of servo module
	(6)	EILVDT	OFF	ON,OFF	LVDT deviation large alarm. When the two LVDT is invested, the deviation indicates red, and the deviation is normal. The indicator is green; when only the LVDT or no LVDT is put, the indicator is green.
	(7)	PIDPV	0.0	-	Two LVDs are adjusted by zero modulation processing (LVDTs) high selection or low selection.
	(8)	LVDT1BAD	OFF	ON,OFF	LVDT1 disconnection detection and input / cut display. When the LVDT1 is invested normally and there is no line, the indicator is green; when the LVDT1 is disconnected (it has been automatically cut off), the indicator is red; when the LVDT1 is broken, it is manually recovered (automatically detected), but not invested, indicator Gray, when you click the input button, the indicator is green.
	(9)	LVDT2BAD	OFF	ON,OFF	LVDT2 disconnection detection and input / cut display. When the LVDT2 is normally input and there is no line, the indicator is green; when the LVDT2 is disconnected (it has been automatically cut off), the indicator is red; when the LVDT2 is broken, it has been recovered (automatically detected), but not invest-

Table 11.34 SERVOCON_R function block panel parameter (continued)

Panel Parameter Name		Parameter name	Initial value	Value Range	Application	
					ed, indicator Gray, when you click the input button, the indicator is green.	
	(10)	LVDT1	0.0	-	-	
	(11)	LVDT2	0.0	-	-	
	loop status	-	OFF	-	Automatic / tracking / fault, fault refers to the "loop deviation alarm"; specifically: "Fault" is displayed when "Pidpei, Pidnei" in the function block, otherwise "Auto" or "Track" is displayed according to "PIDTR".	
	module working status	BOOTING	OFF	-	Wait / normal, if the module is starting to display "Waiting"; "Booting" pin in the function block.	
	hander manual	HDW-MAN	OFF	-	Includes both manual and automatic options.	
	LVDT1	LVDT1_-EN	0	-	Putting the LVDT1 signal to / cut the PID control loop, but the button is reversed to the actual status, the default status is displayed.	
	LVDT2	LVDT2_-EN	0	-	Put the LVDT2 signal to / cut the PID control loop, but the button is displayed in contrast, and the default status is displayed.	
	backup module DDV output	DDV_-ERR	OFF	ON/OFF	The standby side module DDV output circuit is confirmed after manually recovering, and the confirmation button can be automatically played according to the controller information.	
	backup open-circuit recovery	DDV_-ACK	OFF	ON/OFF	The standby side module DDV output circuit is confirmed after manually recovering, and the confirmation button can be automatically played according to the controller information.	
	output track switch	SWTV	OFF	-	The MV1 and MV2 values track the TV value when the output trace switch is opened.	
Parameter settings	PID parameter	PB	PB	100.0000	0.01~655.35	Proportion
		TI	TI	20.0000	0.0s~6553.5s	Integral parameter
		TD	TD	0.0000	0.0s~6553.5s	Differential parameter
	output amolitude limit	high limit	MH	100.000	-	Output high limit, unit is %.

Table 11.34 SERVOCON_R function block panel parameter (continued)

Panel Parameter Name			Parameter name	Initial value	Value Range	Application
		low limit	ML	0.000	-	Output low limit, unit is %.
	rotate speed change trend	rotate speed	R_ACC	0.000	-	Read only, set in the property window
		rotate gain	AC-CRATE	0.0000	-	-
		acceleration speed feed-forward enable	ACCF-BEN	OFF	-	-
Adjust zero adjust amplitude	hander step value		STEPRATE	0.1000	-	-
	zero adjusting amplitude adjusting speed		SPEEDTR	5.0000	-	-
	complete process		PERCENT	0	-	Read-only, in the property window
	auto zero amplitude adjusting		AUTO-TUNE	OFF	-	-
	zero adjusting and amplitude adjusting succeeds		ZER-OBAD	OFF	-	-
	LVDT1 zero		MANZE-RO1	0.0000	-	The LVDT1 manual is full of power (%), and the zero value must be less written when it is less than the amplitude.
	LVDT1 amplitude		MAN-FULL1	0.0000	-	LVDT1manual full amplitude (%).
	LVDT1 initial value		LVDT1	0.0	-	LVDT1 sampling
	LVDT1engineering		LVDT1_T	0.0	-	LVDT1 converting value
	LVDT2 zero		MANZE-RO2	0.0000	-	The LVDT2 is manually full value (%), and the zero value must be less written when it is less than the amplitude.

Table 11.34 SERVOCON_R function block panel parameter (continued)

Panel Parameter Name		Parameter name	Initial value	Value Range	Application
	LVDT2 amplitude	MAN-FULL2	0.0000	-	LVDT2 manual full amplitude (%).
	LVDT2 initial value	LVDT2	0.0	-	LVDT2 sampling
	LVDT2 engineering	LVDT2_T	0.0	-	LVDT2 conversion value
	Manual write	MAN-WREN	OFF	-	-
Anti-jamming	Anti-jamming test	SKEN	OFF	-	-
	Frequency	FREQ	1Hz	-	Optional 1Hz o 50Hz, click the selected frequency, click the "OK" button in the pop-up text box.
	Amplitude	RANGE	0.0100	-	-

11.18.4 Flag list

Flag	Alarm Code	Description
D0	ERR	Fault
D1	CFGERR	Configuration error
D2	UNCOMM	Communication fault alarm
D4	AOF	Alarm shield
D5	EILVDT	LVDT deviation large alarm
D6	NEI	Negative deviation alarm
D7	PEI	Positive deviation alarm
D8	LVDT1BL	LVDT1 offline alarm
D9	LVDT2BL	LVDT2 offline alarm
D10	MAN	Manual
D11	DDV1BAD	DDV1 deviation circuit fault
D12	DDV2BAD	DDV2 output circuit fault
D13	LVDT1PBA	LVDT1module 15V power fault
D14	LVDT2PBA	LVDT2module 15V power fault

Flag	Alarm Code	Description
D15	DDV_ERR	Backup side module DDV output fault
D16	RDD_ERR	Redundant module communication fault

11.19 SPEED_MIG Function Block (Speed Detection and Overspeed Protect Module)

This function block controls module FW345 and FW382 and displays their status information.

This function block is a simple function block, its running time is 100μs.

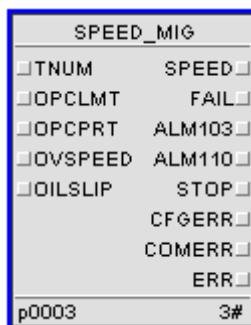


Table 11.35 Parameter Instruction

Name		Description	Upload	Properties	Application Reference
Input Pin	TNUM	Teeth number of Speed test fluted disc	-	Input Pin	60 teeth is normally used, to ensure that speed test is nice, suggest using more than 20 teeth
	OPCLMT	OPCLMT = ON:forbid 103 function.In other words, not function to signals over speed 103%.OPCLMT = OFF:Do not forbid 103 function.In other words, function to signals over speed 103%	-	Input Pin	-
	OPCPRT	OPCPRT = ON:forbid 110 function.In other words, not function to signals over speed 110%.OPCPRT = OFF:Do not forbid 110 function.In other words, function to signals over speed 110%	-	Input Pin	Not suggest to forbid over speed 110% protect function
	OVSPEED	machinery over speed test(OFF=not allowed,ON=allowed)	-	Input Pin	Under machinery over speed test status, module change protect value from 110% to 112%

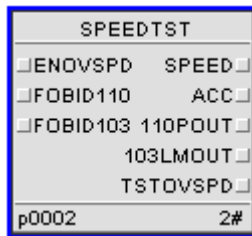
Table 11.35 Parameter Instruction (continued)

Name		Description	Upload	Properties	Application Reference
	OILSLIP	oil switch tripout signal(OFF=allowed,ON=forbid)	-	Input Pin	-
Out-put Pin	SPEED	rotation rate	-	Output Pin	-
	FAIL	Speed channel Fault(OFF=not Fault,ON=Fault)	-	Output Pin	-
	ALM103	103% alarm output(OFF=no alarm, ON=alarm)	-	Output Pin	-
	ALM110	110% alarm output(OFF=no alarm,ON=alarm)	-	Output Pin	-
	STOP	Emergency stop(OFF=none,ON=true)	-	Output Pin	-
	CFGERR	When address set by hardware builder is not module type FW345 or FW382, engender flag of Configuration Error.(OFF=no alarm,ON=alarm)	-	Output Pin	-
	COMERR	When module is in missing status for more than 10 seconds, engender communication err alarm(OFF=no alarm, ON=alarm)	-	Output Pin	-
	ERR	When function block engenders CFGERR or COMERR, engenders err alarm at the same time(OFF=no alarm,ON=alarm)	-	Output Pin	When function block engenders ERR alarm, function block does not renew data passing through it
Con-figuration Parameter	NODE	Address of Node[1,31]	-	Configuration Parameter	Need to Match with hardware builder
	RACK	Address of Rack[0,3]	-	Configuration Parameter	
	IOM	Address of Module[0,15]	-	Configuration Parameter	

11.20 SPEEDTST Function Block (Speed Detection and Overspeed Protect Module)

This function block controls module AM761-S and displays its status information.

This function block is a complex function block, its running time is 100μs.



11.20.1 Parameter Description

Table 11.36 Parameter Instruction

Name			Description	Up-load	Properties	Application Instruction
Basic Parameters	Hardware Settings	NODE	Address of Node[0~31]	-	Configuration Parameter	Need to Match with hardware builder
		RACK	Address of Rack[0~3]	-	Configuration Parameter	
		IOM	Address of Module[0~15]	-	Configuration Parameter	
Extended Parameters	Input Pin	ENOVSPD	allowed machinery over speed test (OFF=not allowed,ON=allowed)	-	Input Pin	machinary over speed test status, module change protect value from 110% to 112%
		FOBID110	110 protect forbid flag (OFF=open,ON=forbid)	-	Input Pin	Not suggest to forbid over speed 110% protect function
		FOBID103	103 limit forbid flag (OFF=open,ON=forbid)	-	Input Pin	-
	Output Pin	SPEED	rotation rate(RPS)	-	Output Pin	-
		ACC	accelerate rate(r/min/s)	-	Output Pin	-
		110POUT	110 protect output status(OFF=no output,ON=output)	-	Output Pin	-
		103LMOUT	103limit output status(OFF=no output,ON=output)	-	Output Pin	-

Table 11.36 Parameter Instruction (continued)

Name			Description	Up-load	Properties	Application Instruction
	Operation Parameter	TS-TOVSPD	machinary over speed test status(OFF=not in over speed test,ON=in over speed test)	-	Output Pin	-
		ENFREQ	jamproof frequency test enable(OFF=not enable,ON=enable)	-	Operation Parameter	-
		103DO1	103limit output1	-	Operation Parameter	-
		103DO2	103limit output2	-	Operation Parameter	-
		110DO1	110 protect output1	-	Operation Parameter	-
		110DO2	110 protect output2	-	Operation Parameter	-
		EN3SW2	2 out of 3 logic test enable(OFF=closed,ON=open)	-	Operation Parameter	-
	Alarm Enable and Suppress	ENALM	Alarm Enable	TRUE	Alarm Parameter	-
		AOF	Suppress Module Alarm	TRUE	Operation Parameter	-
		FLAG	Flag	-	Output Pin	-
	Status Monitor	TSTFREQ	jamproof frequency test status(OFF=not in jamproof frequency test status,ON=in jamproof frequency test status)	-	Monitoring Parameter	-
		110FOBID	110 protect forbid status(OFF=not forbid ,ON=forbid)	-	Monitoring Parameter	-
		103FOBID	103limit forbid status(OFF=not forbid ,ON=forbid)	-	Monitoring Parameter	-

Table 11.36 Parameter Instruction (continued)

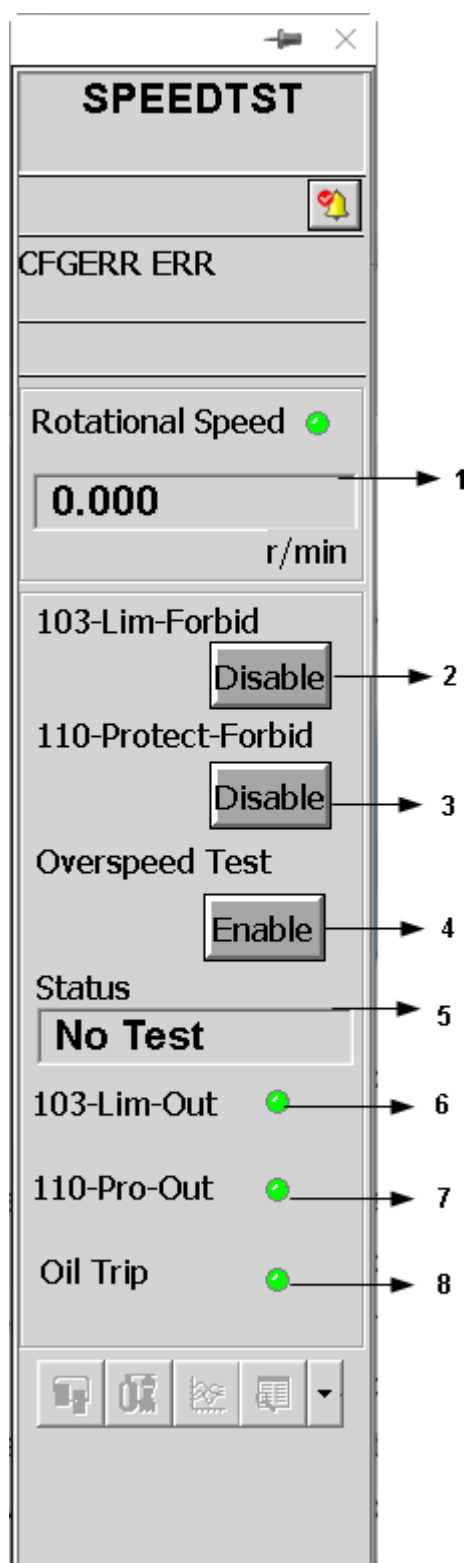
Name		Description	Up-load	Properties	Application Instruction
	OILTRIP	oil switch tripout status(OFF=not tripout,ON=tripout)	-	Monitoring Parameter	-
	EMSTOP	emergent stop function(OFF=not emergent stop,ON=emergent stop)	-	Monitoring Parameter	-
	SPD15BAD	rotation rate input 15V power Fault(OFF=normal,ON=Fault)	-	Monitoring Parameter	-
	STP24BAD	emergent stop24V power Fault(OFF=normal,ON=Fault)	-	Monitoring Parameter	-
	OIL24BAD	oil switch tripout24V power Fault(OFF=normal,ON=Fault)	-	Monitoring Parameter	-
	TU24BAD	Terminal Board 24V power fault(OFF=normal,ON=Fault)	-	Monitoring Parameter	-
	SUPLY-BAD	Auxiliary Power connection fault(OFF=normal,ON=Fault)	-	Monitoring Parameter	-
	FAIL	Speed test channel Fault(OFF=normal,ON=Fault)	-	Monitoring Parameter	-
	CFGERR	When address set by hardware builder is not module type AM721-S, engender Error CFGERR alarm)	-	Monitoring Parameter	-
	COMERR	When module is in missing status, engender communication err alarm(COM-ERR)	-	Monitoring Parameter	-

Table 11.36 Parameter Instruction (continued)

Name			Description	Up-load	Properties	Application Instruction
		ERR	When function block engenders CFGERR or COMERR, engenders err alarm at the same time(OF-F=no alarm, ON=alarm)	-	Monitoring Parameter	When function block engenders ERR alarm, function block cannot update the data transmitted through it
		IOPBAD	IOP faultOFF: normalON: fault	-	Monitoring Parameter	-
		103LMSPD	103 overspeed limit value	-	Monitoring Parameter	If the parameters of AM721 (speed test module) are updated in the hardware configuration, the parameters of this function block will be updated automatically.
		110PRSPD	110 overspeed protect value	-	Monitoring Parameter	
		MTSTSPD	Machine over-speed test protect value	-	Monitoring Parameter	
		102RVSPD	102 overspeed recovery value	-	Monitoring Parameter	
		103LMTIM	103 overspeed limit time	-	Monitoring Parameter	
		GNUM	Gear number	-	Monitoring Parameter	

11.20.2 Panel Parameter

The panel of speed test and overspeed protection function block SPEEDTST is shown in the figure below. Note: this function block has no tuning image.



Function block panel parameters are described in the table below.

Table 11.37 Panel parameter description

NO.	Parameter	Name	Initial Value	Value Range	Application
1	Rotational speed	SPEED	0.000	-	Real-time displaying turbine's rotational speed
	Light indicator	FAIL	OFF	ON, OFF	It represents whether speed test channel has fault Green: normal Red: fault
2	103-Lim-Forbid	FOBID103	OFF	ON, OFF	Press "Disable", it means forbid 103 limit prohibition, otherwise it means permission.
3	110-Protection-Forbid	FOBID110	OFF	ON, OFF	Press "Disable", it means forbid 101 protection prohibition, otherwise it means permission.
4	Overspeed Test	EN-OVSPD	OFF	ON, OFF	Press "Enable", it means forbid 101 protection prohibition, otherwise it means permission.
5	Status	TS-TOVSPD	OFF	ON, OFF	It displays overspeed test status
6	103-Lim-Out	103LMOUT	OFF	ON, OFF	It displays 103 output status Green: disable 103 limit output Red: enable 103 limit output
7	110-Pro-Out	110POUT	OFF	ON, OFF	It displays 110 protection output status Green: disable 110 protection output Red: enable 110 protection output
8	Oil Trip	OILTRIP	OFF	ON, OFF	It displays oil trip status Green: disable switch didn't trip Red: oil switch tripped

11.20.3 Flag

Table 11.38 Flag list

Flag	Alarm	Instruction
D0	ERR	Fault
D1	CFGERR	Configuration Error
D2	UNCOMM	Communication Error Alarm
D4	AOF	Suppress Alarm

11.21 MODULECOMM Function Block

Function block is used to detect and alarm display communication information of communication block.

This function block is a simple function block, its running time is 100μs.

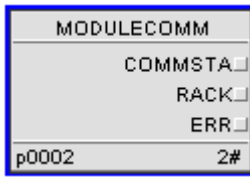


Table 11.39 MODULECOMM parameter instruction

Name		Description	Upload	Properties	Application Reference
Output Pin	COMMSTA	When module is valid and in missing status, engender communication module fault (COMMSTA=ON)alarm. When module builder is not affective, set err alarm immediately.	-	Output Pin	When COMMSTA=OFF, communication module is in normal status
	RACK	Communication port of correspondent function block that matches the address of Rack. For example, number 2 matches third port of module COM741-S	-	Output Pin	Match with hardware builder
	ERR	Alarm when node address, logic module number inner error or illegal function block alarm occurs.	-	Output Pin	-
	CANAERR	Bus A Fault	-	Output Pin	-
	CANBERR	Bus B Fault	-	Output Pin	-
Configuration Parameter	NODE	Address of Node[0,31]	-	Configuration Parameter	Match with hardware builder
	LOGICIOM	Device ID [0, 63]	-	Configuration Parameter	

Note1: Logic block number is according to the logic number displayed by the hardware builder, for instance:

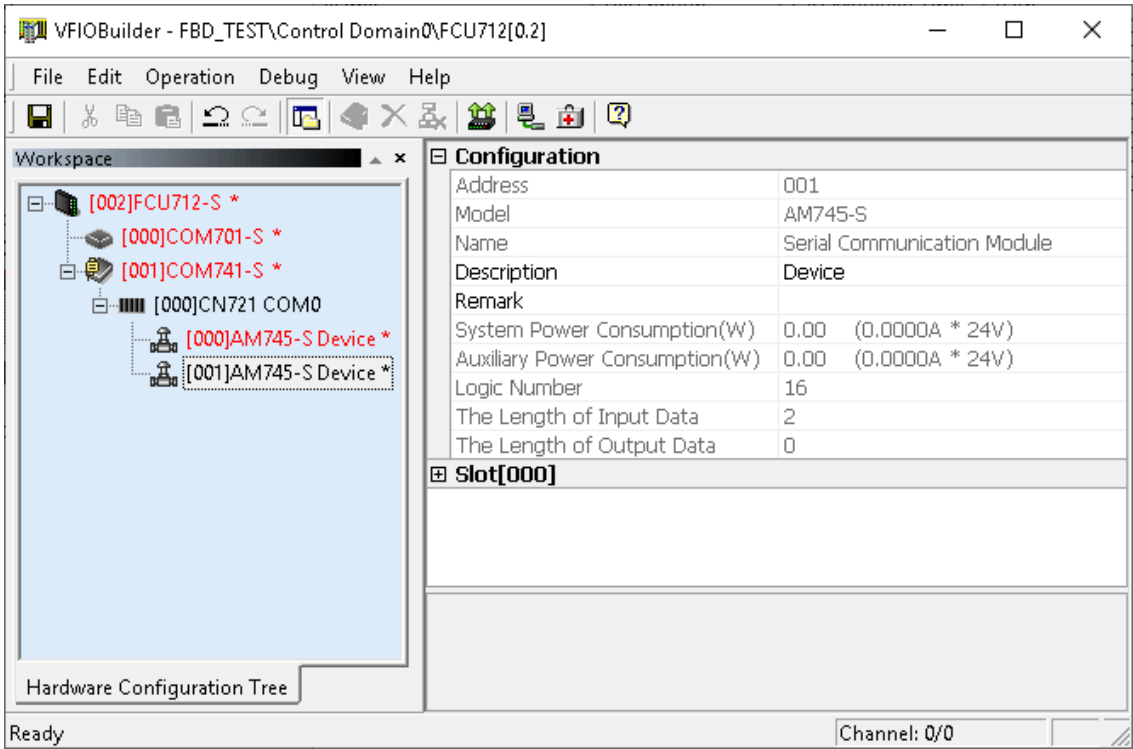


Figure 11.4 Display of logic number

11.22 MODULECOMM_N Function Block

When FCU811-S is applied, MODULECOMM_N function block is used to diagnose the communication of communication module and output alarm information. This function block is a simple function block, its running time is 100μs.

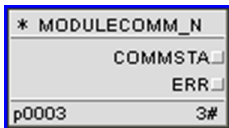


Table 11.40 MODULECOMM_N parameter instruction

Name	Description	Upload	Properties	Application Reference
Output Pin	COMMSTA	-	Output Pin	When COM-MSTA=OFF, communication module is in normal status
	ERR	-	Output Pin	-
	ECIAERR	-	Output Pin	-

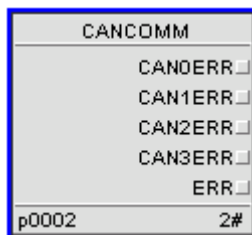
Table 11.40 MODULECOMM_N parameter instruction (continued)

Name		Description	Upload	Properties	Application Reference
	ECIBERR	ECI B Fault	-	Output Pin	-
Configuration Parameter	RACK	Node address [0,31]	-	Output Pin	Match with hardware configuration
	LOGICIOM	Device ID [0, 63]	-	Configuration Parameter	

11.23 CANCOMM Function Block

Function block CANCOMM is used to detect and display alarm information of the bus communication information of the node.

This function block is a simple function block, its running time is 100μs.

**Table 11.41 CANCOMM parameter instruction**

Name		Description	Upload	Properties	Application Reference
Output Pin	CAN0ERR	Bus0 fault(ON=Fault,OF-- F=normal)		Output Pin	-
	CAN1ERR	Bus1 fault(ON=Fault,OF-- F=normal)		Output Pin	-
	CAN2ERR	Bus2 fault(ON=Fault,OF-- F=normal)		Output Pin	-
	CAN3ERR	Bus3 fault(ON=Fault,OF-- F=normal)		Output Pin	-
	ERR	Alarm when node number inner fault or illegal function error occurs.	-	Output Pin	-
Configuration Parameter	NODE	Address of Node[0~31]	-	Configuration Parameter	Need to match with hardware builder

11.24 Cold Startup Function Block (COLD_START)

The function block can find out whether controller is cold started, and outputs single period pulse if true.



Table 11.42 Parameter of COLD_START

Name		Description	Upload	Application Instruction
Output Pin	OUT	Output Value (ON refers to controller cold startup, OFF refers to not.)	-	Output single period pulse after cold startup.

11.25 GET_BUF Function Block

The GET_BUF function block is used to read specified communication DI tag data, and output it by bit.

11.25.1 Parameter Illustration

Name		Type	Description
Output Pin	ERR	BOOL	Sequence number error
Address Setting	NODE	USINT	Node serial number, when the controller type is FCU713-S, the range is [1,31], when the controller type is FCU711-S / FCU712-S , the range is : [1, 7].
	RACK	USINT	Rack number [0,3]
	IOM	USINT	communication tag slave station address [0,255]
	DB_NUM	UINT	Data block number [0,63]
	OFFSET	UINT	offset address of tags in the data block [0,4095]
	LENGTH	UINT	read the length of tag data [0,1024]
Monitor Parameters	DATA0~DATA63	UDINT	dataWhen using data DATA, you need to use UDINT-PARSE function block to analyze DATA by bit and each bit represents one DI tag data.

11.25.2 Function Illustration

Get a certain number of communication DI data and press the output.

Serial number error

When the node serial number, the rack number, the slave address, the data block number, the offset address, and the tag are set, the output ERR is set to ON;

When the module specified by the node, the rack and the slave address does not exist, the output ERR is set to ON.

Read data

The communication DI data is obtained from the address specified from the node, rack, slave address, data block number, and offset address. Get the data of the LENGTH.

Output the acquired DI data bits to DATA0 ~ DATA31.

11.25.3 Application Example

Example: A DATA has 32 bits, parsing it, bit0 represents the first DI data.

The reference configuration is as follows:

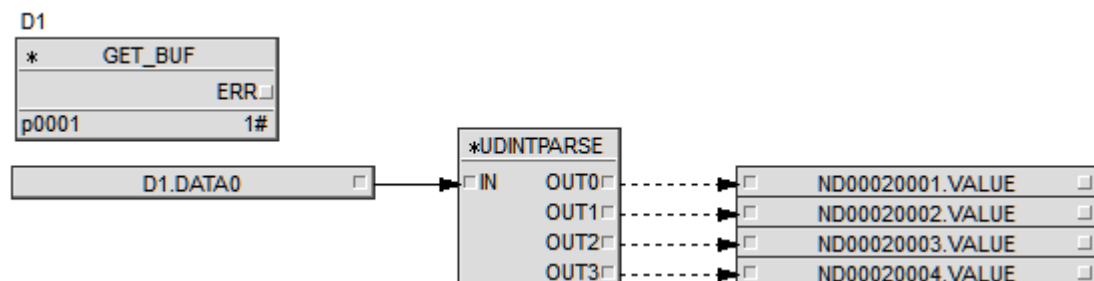


Figure 11.5 GET_BUF function block application

11.26 GET_BUF16 Function Block

GET_BUF16 is used to read the designated communication AI data, and output it by bit.

11.26.1 Parameter Description

Parameter Name	Type	Description
Output pin	ERR	BOOL Sequence number error
Address settings	NODE	USINT Node serial number, when the controller type is FCU713-S, the range is [1,31], when the controller type is FCU711-S / FCU712-S ranges: [1, 7].
	RACK	USINT Rack number [0,3]

Parameter Name		Type	Description
	IOM	USINT	communication tag slave station address[0,255]
	DB_NUM	UINT	data block number[0,63]
	OFFSET	UINT	offset address of tags in the data block [0,4095]
	LENGTH	UINT	read the length of data of tags [0,128]
Monitor parameters	DATA0~ DATA63	UINT	data When using data DATA, you need to perform byte merge according to the number of bytes of the actual AI data.

11.26.2 Function Illustration

Serial number error

When the node serial number, the rack number, the slave address, the data block number, the offset address, and the tag exceed the range, the output ERR is set to ON;

When the module specified by the node, the rack, the slave address does not exist, the output ERR is set to ON.

Read data

The communication AI data of the LENGTH length is obtained from the address specified from the node, rack, slave address, data block number, and offset address.

The obtained AI data is output to DATA0 ~ DATA63, DATA0 is low words, and DATA1 is high.

11.26.3 Application Example

Example: An AI real-time value is 4 bytes length, you need to first combine 2 consecutive 2-byte data into a 4-byte UDINT variable through the GETUDI function block, and then perform subsequent conversion processing.

- If the distribution tag group is 4-byte floating point numbers, you need to convert UDINT to the REAL type by GREAL_UDINT function block to assign a custom variable.
- If the communication tag group is 2 byte integers, it is necessary to assign the corresponding conversion processing through the UDINT to the Turn function block to assign a custom variable.

The reference configuration is as follows:

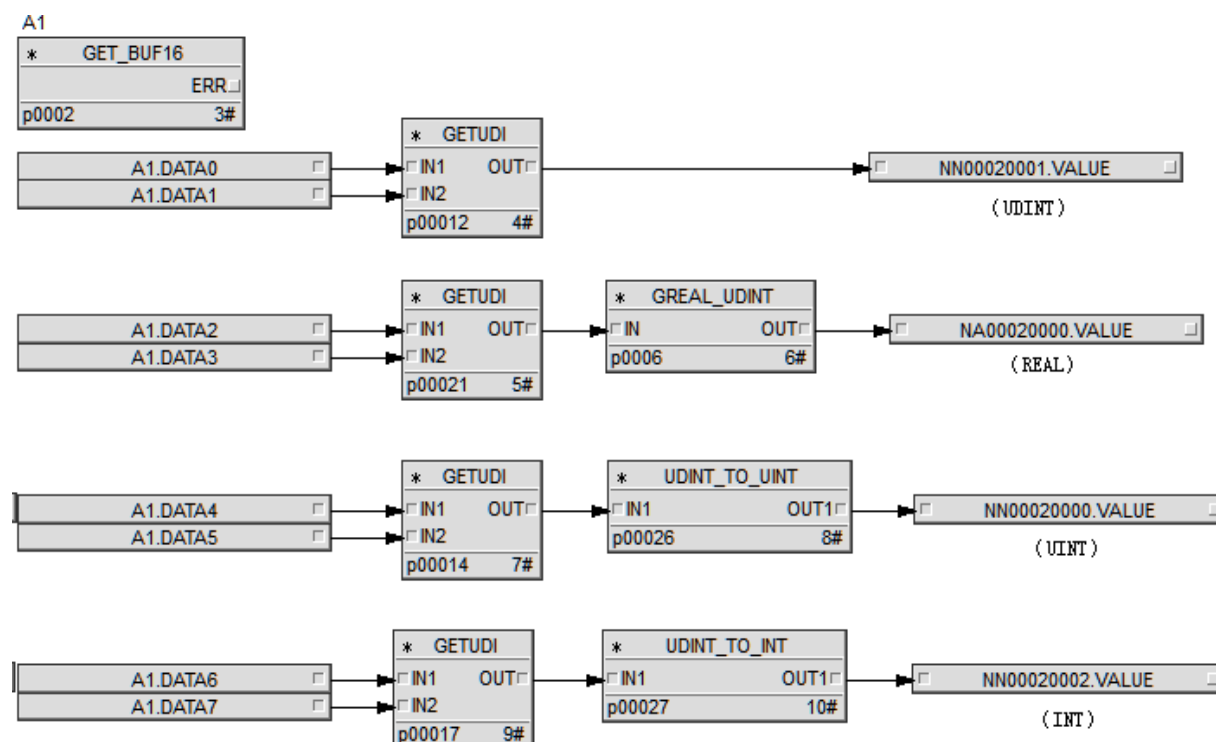


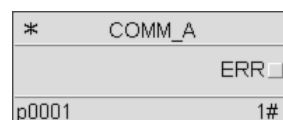
Figure 11.6 GET_BUF16 application

11.27 Analog Communication R/W Function Block (COMM_A)

For FCU712-S and FCU713 controllers, COMM_A function block can read and write the real-time tag value of COM723 (PROFINET) communication module.

For slave configuration of COM723 module, refer to *COM723-S User Manual*, *PNCon User Manual*.

This function block is a complex function block.



11.27.1 Parameter Description

Table 11.43 Basic parameters of COMM_A

Parameter Name	Description	Type	Upload	Properties	Application Reference
SCH	PV Span Maximum	REAL	-	Configuration Parameter	-
SCL	PV Span Minimum	REAL	-	Configuration Parameter	-

Table 11.43 Basic parameters of COMM_A (continued)

Parameter Name	Description	Type	Upload	Properties	Application Reference
RSCH	PV original code maximum	REAL	-	Configuration Parameter	-
RSCL	PV original code minimum	REAL	-	Configuration Parameter	-
NODE	Node No. [1,31]	USINT	-	Configuration Parameter	-
RACK	Rack No. [0,3]	USINT	-	Configuration Parameter	-
IOM	Module No. (slave station address)[0,255]	USINT	-	Configuration Parameter	-
DB_NUM	Data block No. [0,63]	UINT	-	Configuration Parameter	-
OFFSET	Offset address of data block	UINT	-	Configuration Parameter	-
MODE	Signal conversion type: 0: no conversion 1: linear conversion	USINT	-	Configuration Parameter	Refer to Note 1
SIGNAL	Data type: 0: INT 1:UINT 2:REAL	USINT	-	Configuration Parameter	-
SWFKIND	Signal properties (4 byte float) OFF=actual actual ON=percentage	BOOL	-	Configuration Parameter	-
FORM	Data format: 0: no conversion 1: byte conversion 2: word conversion 3: word internal conversion	USINT	-	Configuration Parameter	Refer to AI tag descriptions in <i>IO Tag User Manual</i> . Refer to Note 2 for its example.
EU	PV engineer unit	EU-TYPE	-	Configuration Parameter	-
DLEN	Decimal digits length [0,5]	USINT	-	Configuration Parameter	-

Table 11.44 Extended parameters of COMM_A

Parameter Name		Description	Type	Upload	Properties
Output Pin	ERR	Status flag ON: error	BOOL	-	Output Pin
Supervi- sion Para- meters	FLAG	Flag	UDINT	-	Monitoring Parameter
	RAWVAL	Original code value	REAL	-	Monitoring Parameter
	PRIMEPV	Original actual val- ue	REAL	-	Monitoring Parameter
	COMMASK	Communication original code	UDINT	-	Monitoring Parameter
Operation Para- meters	PV	Process variable value	REAL	-	Operation Parameter
	HOLIM	Output H limit val- ue	REAL	TRUE	Operation Parameter
	LOLIM	Output L limit value	REAL	TRUE	Operation Parameter
	WERR_TON	Write value fail ton(s)	REAL	TRUE	Operation Parameter
	SWOOS	Switch of out of serviceON: dis- ableOFF: enable	BOOL	-	Operation Parameter
	AOF	Suppress alarm- ON: suppress	BOOL	-	Operation Parameter
Alarm Pa- rameters	HHH	HHH limit alarm	REAL	TRUE	Alarm Parameter
	HH	HH limit alarm	REAL	TRUE	Alarm Parameter
	H	H limit alarm	REAL	TRUE	Alarm Parameter
	L	L limit alarm	REAL	TRUE	Alarm Parameter
	LL	LL limit alarm	REAL	TRUE	Alarm Parameter
	LLL	LLL limit alarm	REAL	TRUE	Alarm Parameter
	HYS	H/L limit alarm hys- teresis	REAL	TRUE	Alarm Parameter
	COMM_TON	Communication fail alarm ton(s)	REAL	TRUE	Alarm Parameter
	ENALM	Alarm enable set- tings	UDINT	-	Alarm Parameter

Note 1: in linear conversion mode (MODE=1), $PV = (RAWVAL - RSCH) / (RSCH - RSCL) * (SCH - SCL) + SCL$.

Note 2: the table below takes no conversion (MODE=0) as the example to illustrate the conversion process of the real-time value.

Parameter Name	Value
RSCH	300
RSCL	0
Signal	0 (2-byte integer with symbol)
Form	1 (byte conversion)
HOLIM	300
PLC real-time value	01 06

01 06 is stored as 00000001 00000110

For 2-byte value, only the highest and lowest bytes are displayed.

After byte conversion, the stored value is 00000110 00000001

After convert to small-endian mode, the value is 00000001 00000110

Converted to a decimal number, it equals $2^8 + 2^2 + 2 = 262$. So, PV real-time value is 262.

11.27.2 Flag

Table 11.45 Flag list

Flag	Alarm Code	Description
D0	REVSCL	Operation exception
D1	CFGERR	Configuration error
D2	OOS	Disable
D3	AOF	Suppress alarm
D4	ERR	Error
D5	HWF	Hardware Fault
D6	OUTH	Output H Limit Alarm
D7	OUTL	Output L Limit Alarm
D8	H	H Limit Alarm
D9	L	L Limit Alarm
D10	HH	HH Limit Alarm
D11	LL	LL Limit Alarm

Table 11.45 Flag list (continued)

Flag	Alarm Code	Description
D12	HHH	HHH Limit Alarm
D13	LLL	LL Limit Alarm

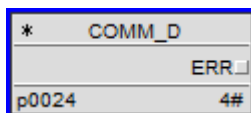
When COM723 module fails to communicate with the slave station or the slave station has a configuration error, the function blocks display error.

11.28 Digital Communication R/W Function Block (COMM_D)

For FCU712-S and FCU713 controllers, COMM_D function block can read and write the real-time tag value of COM723 (PROFINET) communication module.

For slave configuration of COM723 module, refer to *COM723-S User Manual*, *PNCon User Manual*.

This function block is a complex function block.



11.28.1 Parameter Description

Table 11.46 Basic parameters of COMM_D

Parameter Name	Description	Type	Upload	Properties	Application Reference
NODE	Node No.[1,31]	USINT	-	Configuration Parameter	-
RACK	Rack No.[0,3]	USINT	-	Configuration Parameter	-
IOM	Module NO. (slave station address) [0,255]	USINT	-	Configuration Parameter	-
DB_NUM	Data block No. [0,63]	UINT	-	Configuration Parameter	-
OFFSET	Offset address of data block	UINT	-	Configuration Parameter	-

Table 11.47 Extended parameters of COMM_D

Parameter Name		Description	Type	Upload	Properties
Output Pin	ERR	Status flagON: error	BOOL	-	Output Pin
Supervision Parameters	FLAG	Flag	UDINT	-	Monitoring Parameter
Operation Parameters	PV	Process variable	REAL	-	Operation Parameter
	WERR_TON	Write value fail ton(s)	REAL	TRUE	Operation Parameter
	SWOOS	Switch of out of service ON: disable OFF: enable	BOOL	-	Operation Parameter
	AOF	Suppress alarm ON: suppress	BOOL	-	Operation Parameter
	COMM_TON	Communication fail alarm ton(s)	REAL	TRUE	Alarm Parameter
	ENALM	Alarm enable settings	UDINT	-	Alarm Parameter

Macro

Use Macro parameters to set the text on the PV parameter buttons of the COMM_D tag panel.

- PV_ON: the text displayed on the corresponding button of the tag panel when the real-time tag value is ON
- PV_OFF: the text displayed on the corresponding button of the tag panel when the real-time tag value is OFF

11.28.2 Flag

Table 11.48 Flag list

Flag	Alarm Code	Description
D4	ERR	Error
D5	HWF	Hardware fault
D6	OOS	Disable
D8	ON	ON alarm
D9	OFF	OFF alarm

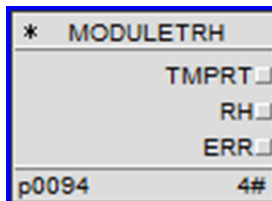
Table 11.48 Flag list (continued)

Flag	Alarm Code	Description
D10	RJUMP	Positive transition alarm
D11	FJUMP	Negative transition alarm
D12	AOF	Suppress alarm

When COM723 module fails to communicate with the slave station or the slave station has a configuration error, the function blocks display error.

11.29 Temperature And Humidity Diagnosis Function Block (MODULETRH)

When FCU713-S is applied, MODULETRH can display the humidity and temperature of system modules, UIO811 and UIO831 modules.

**Figure 11.7 Parameters of MODULETRH**

Parameter Name		Description	Upload	Properties
Input Pins	TMPRT	Temperature, ranges from -40 to 125 °C	-	Input Pin
	RH	Humidity, ranges from 0 to 100%	-	Input Pin
	ERR	Error mark, ON=error	-	Input Pin
Configuration Parameters	NODE	Node No. Non-APL: [0,31] APL: [0,31]	-	Configuration Parameter
	RACK	Rack No. Non-APL: [0,3] APL: [0,15]	-	Configuration Parameter
	IOM	Module No. Non-APL: [0,15] APL: [0,3]	-	Configuration Parameter
	TYPE	Module type 0: Non-APL 1: APL	-	Configuration Parameter

12 Sequence Control Function Block

The sequence function block contains 1 complex cause chart function block (CR), a main synthesis, and 1 simple function block (SQC), and a step function block (STP).

12.1 CR Function Block

CEM (Cause and Effect Matrix) is a commonly used method in the Process Control industry, which is mainly used to define interlock condition strategy. And the CEM realize the requirement of interlocking control and small-scale sequential control, and its control logic can be monitored. For decades, process control engineers manually identify shutdown conditions and shutdown effect, such as using chart paper and spreadsheet programs. The CEM uses the shutdown condition as the input and the shutdown effect as the output, and establishes the relationship between the condition and the effect, so as to realize the automation of the process.

- Supports 32 conditions as input, while 1 bypass conditions are supported for each condition.
- Supports 32 effects as output, while each output supports 1 bypass conditions.
- Support for act immediately and act delayed.
- Support for monitoring to the conditions, effects, and their intersections.

12.1.1 Logical Instruction

The system software realizes the CEM through the CR function block.

CR function block composition

CR function block is mainly composed of 3 parts shown below in the figure.

- The condition is used to specify the effect condition.
- The effect is used to specify the effect to be performed in the case that the CEM satisfies.
- The intersection of the conditional and the effect is used to specify whether the condition is to execute, execute immediately, or delayed execution.

Interlock Function

Function Block Property Basic

Tag	Value	Descriptic	Bypass	Reset
AI00020004.PV	==	90.0000		
AI00020005.PV	>=	90.0000		
AI00020006.PV	<	50.0000		

Condition Cn

Tag	Value	Descriptic	Bypass	Reset
DO00020000.IN	ON			
DO00020001.IN	OFF			
DO00020002.IN	ON			

Effect Em

No.	1	2	3	4	5	6	7
1	Y	Y	Y				
2	D1	D1	Y				
3	D20	Y	Y				
4							
5							
6							

Intersection of Cn and Em

Figure 12.1 CEM Composition

Logical Instruction

The interlocking relationship between the condition and the effect can be established by the CR function block. The following is an example illustrating the logical relationship between conditions, effect, and intersection of the conditional and the effect .

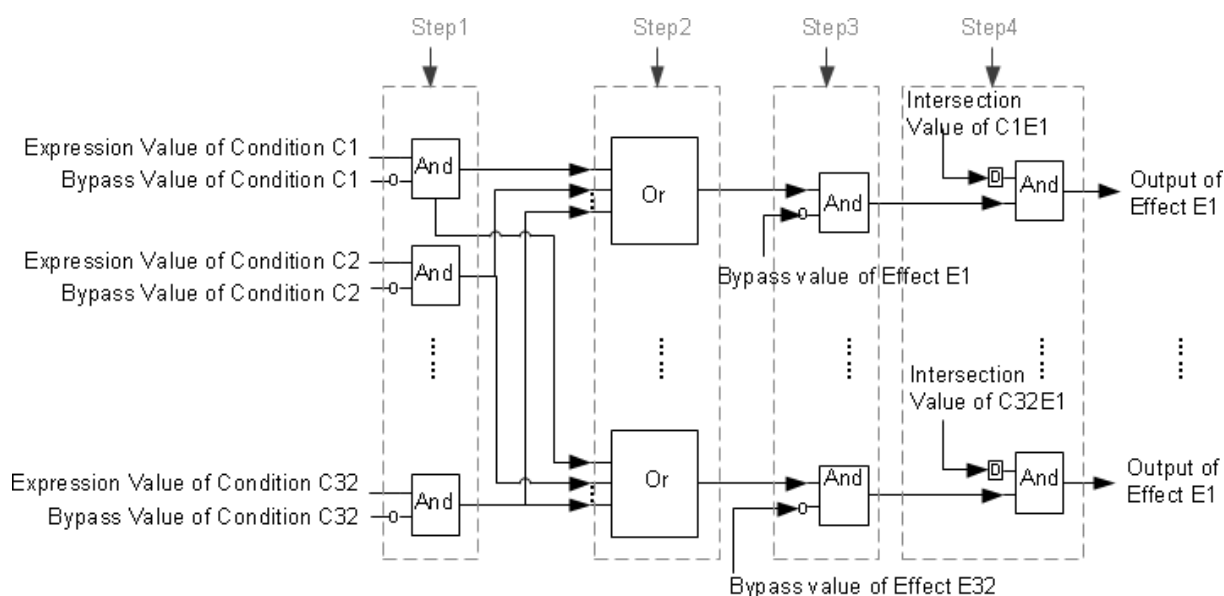


Figure 12.2 CR Internal Logic

The above figure shows the logical diagram of one input to one output in the CR function block. And taking the example of Effect1 (hereinafter referred to as E1) to explain the work rules of CR.

1. Judge each conditional expression. If the result is ON, it executes AND operation with the negation of the conditional bypass.
2. OR operation is executed between 32 conditional expressions and the calculation results of the bypass.
3. The results of step 2 execute AND operation with the negation of E1 bypass.
4. The result of step 3 executes AND operation with the intersection value of condition and effect combination area. If the result is ON, it will execute Effect E1.

12.1.2 Configuration Instruction

The system software uses functional block to implement CEM, so the function block diagram programming software is used to create and edit the CEM. This section focuses on how to create a CEM and edit it.

Create and Add CR FBD

By following steps, CR function block can be created.

1. Open the function block Diagram programming software VFFBDBuilder.
 - 1) Open the configuration management software VFExplorer and select "Control configuration > Control domain > control Station > Custom program" and select "new" in its right-click menu.
 - 2) In the pop-up dialog box, input the program "Name" and select "FBD" in "Type".
 - 3) Double-click the created custom program to open the VFFBDBuilder software.
2. Add a CR function block to the VFFBDBuilder.
 - 1) Enter "CR" in the search box of the function block library, and the CR diagram function block will appear in the results.
 - 2) Click the function block to add it to the programming area and display it as

*	CR
p0002	1#

Configure Basic Properties

Double-click the CR function block in the programming area and popup the properties configure dialog box.

The "Function Block Properties" tab is used to specify the function block name, panel, and so on. This section will not describe the detail, please refer to the "VFFBDBuilder User manual".

Configure the Matrix Content

Click the "Content" tab in the property configure dialog box of the CR function block, and the content configure page will display as shown as figure below, where you can designate the condition and effect of the CR function block.

[illegible]

Figure 12.3 Configure Interface of CR Content

Configure the Condition Expressions

The left-bottom area is used to configure conditional expressions for CR function block, supporting up to 32 conditional expressions, each of which is used to configure a conditional expression. Conditional expressions generally take the form of "Tag+ operator + value", such as "AI00020000.PV>=90."

Configure the conditional expression as described in the following table.

Item	Function	Configuration
Tag	Used to specify the tag in a condition expression.	Click the row to edit it. You can enter the tag manually, or double-click and select the tag in the popup "CS Tag Selection".
Operator	Used to specify the operator in a condition expression.	Click the row and select the operator in the expression in the drop-down list. The supported operators include ==(equal to) , !=(not equal to) , >=(greater than or equal to) , <=(less than or equal to) , <(less than) , >(greater than).

Item	Function	Configuration
		For the digital tag, the operator supports only include ==(equal to), =(not equal to!).
Value	Used to specify the expected value of the tag in the expression.	Click the row and enter the value in the expression in it. For the digital tag, the values only support ON and OFF.
Description	Used to specify the description of the expression.	Click the row and enter a description of the expression, which supports up to 64 characters.
Bypass	Used to specify that the condition is valid or invalid.	In general, the bypass should be configured as a digital tag. The condition is invalid when the tag=ON, otherwise the condition is valid. By default, the bypass is empty, that is, the condition is valid. Click the row, enter the tag manually or double-click the to select tag in the popup "CS Tag Selection" dialog box. Only the digital tag can be selected.

If one added tag needs to be deleted, select the tag and click delete.

After configured, the expression will show as following.

Tag	Oper...	Value	De...	Bypass Ena
AI00020000.PV	==	90.0000		DO00020000

The expression in the figure can be expressed as "AI00020000.PV>=90 ", that is, when the value of "AI00020000.PV" is greater than or equal to 90, the condition will be matched. In addition, the expression has a bypass configured, and when DO00020000.PV=OFF, the expression is activated.

Configure the Effect

The right-upper area is used to configure the effect of CR function block and its bypass, which supports up to 32 effects configured. Each column is used to configure an effect that relates with 32 conditions, and when the each condition is matched and active, the effect will be executed, depending on whether the execution will be judged according to the "Internal Logic".

The effect should be configured as a digital tag output ON or OFF, such as DO00020002.IN=ON, that is, when the effect is executed, the DO00020002 output ON.

Configure the effect as described in the following table.


Item	Function	Configuration
By-pass	Used to specify the effect expression valid or invalid.	In general, the bypass is configured as digital tag. The effect will be invalid when the bypass is ON. Otherwise the effect is valid. By default, the bypass is empty, that is, the effect is valid. Click the column, input the tag manually or double-click to select the tag in the pop-up "CS Tag Selection" dialog box. Only the digital tag can be selected.

Item	Function	Configuration
Value	Used to specify the output value in the effect expression.	Click the column, configure the output value when the effect is executed. The tag value supports only ON and OFF.
Tag	Used to specify tag in the effect expression.	Click the column, enter the tag manually or double-click to select the DI tag or DO tag in the popup "CS Tag Selection" dialog box. Only the digital tag can be selected. The selected tag must be writable. When select a tag, select "View Parameters" in the right-click menu to get the read-write property of the tag.
Description	Used to specify description of the expression.	Click the column and enter a description of the expression in it, which supports up to 64 characters.

When you configure an effect, the reset value of the tag in the expression also can be configured in the bottom of every column.

1. By default, the item is empty. That is, the reset value of the effect is not configured. I



2. When reset value is configured, the item will be shown as . Clicking the row, configure the reset value in the popup the "Reset" dialog box.

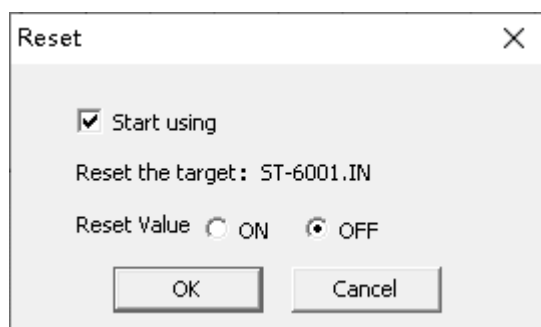


Figure 12.4 Reset Configure Dialog Box

Configure the reset value by following table.

Item	Function	Configuration
Enable	Used to configure whether the effect can be reset in monitoring.	Check, the reset is enabled. Uncheck, the reset is not enabled.
Reset the target	Used to display the tag to be reset.	It is the configurable.
Reset Value	The value used to configure the target tag after the reset is performed in the monitor.	Select the reset value after the reset is performed in the monitoring.

Configure the Output Properties

The output property of the CR function block is in the right-bottom area of its content configuration interface, which is consisted of a matrix of 32*32, each of which is used to configure the output properties of the related conditions and effect.

By following steps, the output property can be configured.

1. Click one cell in the matrix to popup the dialog shown as figure below.

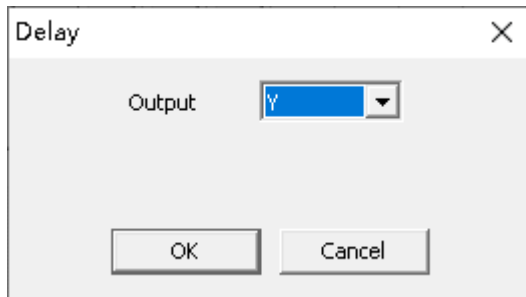


Figure 12.5 “Delay” Dialog Box

2. Select in the “Output” drop-down list to specify the output type of the effect:
 - Select "Y", the effect will be executed immediately.
 - Selecting "D" indicates that the effect will be delayed. Enter an integer for 1~65535 in the “Delay” text box to specify the delayed time, in seconds. After the configuration is delayed, the cell appears as a "Dn", where n indicates the time at which execution was delayed. When the condition is met, the delay will be active. After the delay, the action will be kept. When delay finishes, it executes actions. when the condition consistently keeps satisfactory, it consistently executes actions. when the condition turns into unsatisfactory, it doesn't delay until satisfaction is again reached and then it executes actions after the delay ends.
 - Select empty to indicate that the effect will not be executed.
3. Click “OK” to save the configuration.

Configure Trouble-Shooting

After completing the configuration of CR function block, you need to compile it. The possible error prompts and trouble-shooting methods below may pop up.

Error Type	Error Information
The tag doesn't exist.	The **tag of the ** function block doesn't exist.
The tag is not empty and the calculation operator is empty.	The **calculation operator of the ** function block is illegal.
The tag is not empty and the value is empty.	The ** value of the ** function block is illegal.

Error Type	Error Information
The bypass tag type is not BOOL.	The ** bypass tag of the ** function block is illegal.
D delay identifier exceeds the effective range	The delay in ** row and ** column of one function block is illegal.
D delay identifier is repetitive	The delay identifier in ** row and ** column of one function block is repetitive with the one in another row and column.
D delay amount exceeds the limit	The delay number of function block **D is beyond 100.

12.1.3 Panel Parameter

After configuring the CR FBD, the monitor panel of the CR FBD in the real-time monitoring screen will be shown as the following figure.

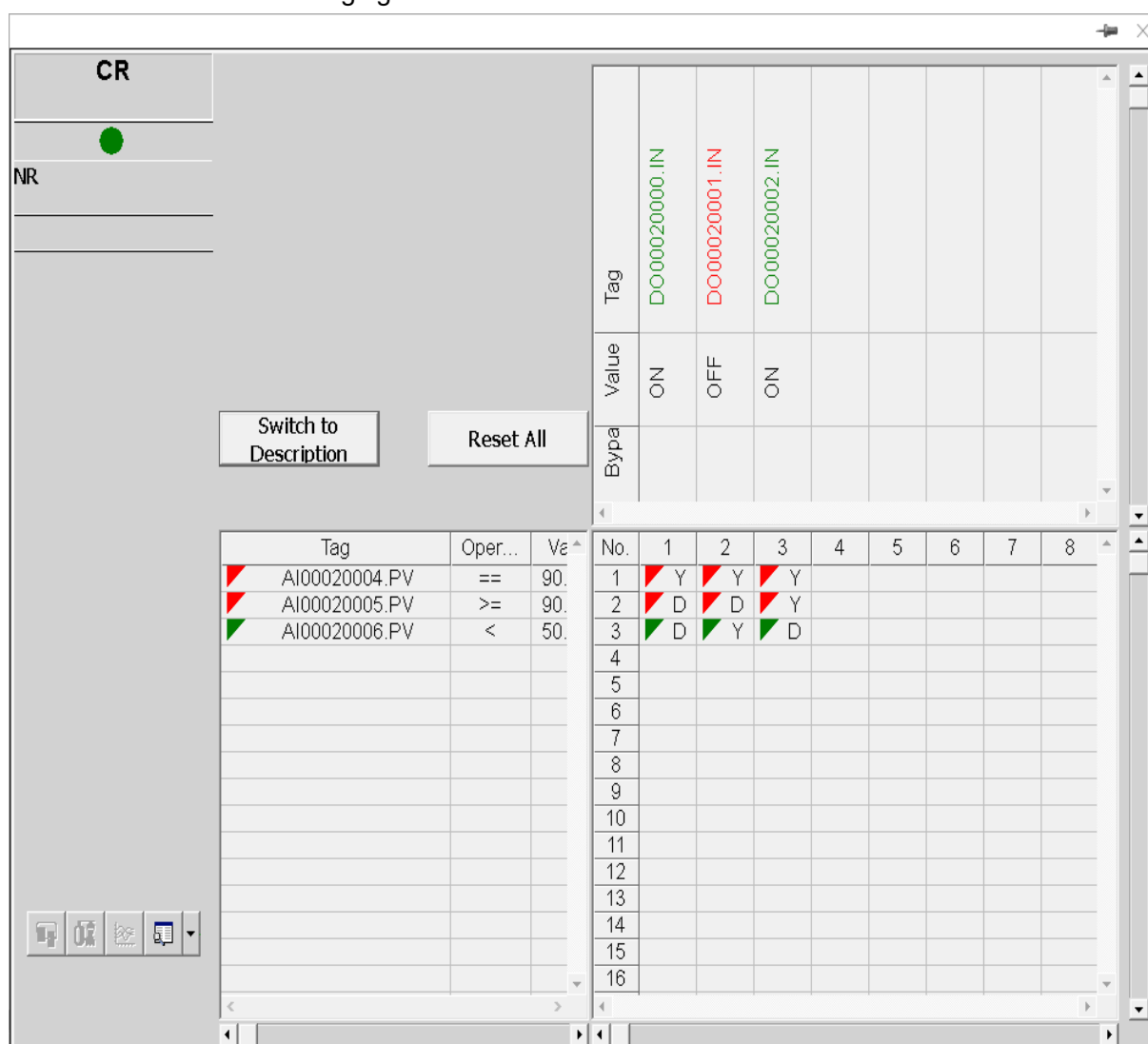












Figure 12.6 CR Monitor Panel

Monitor Status Description

The following table describes the icons in the monitor Panel.

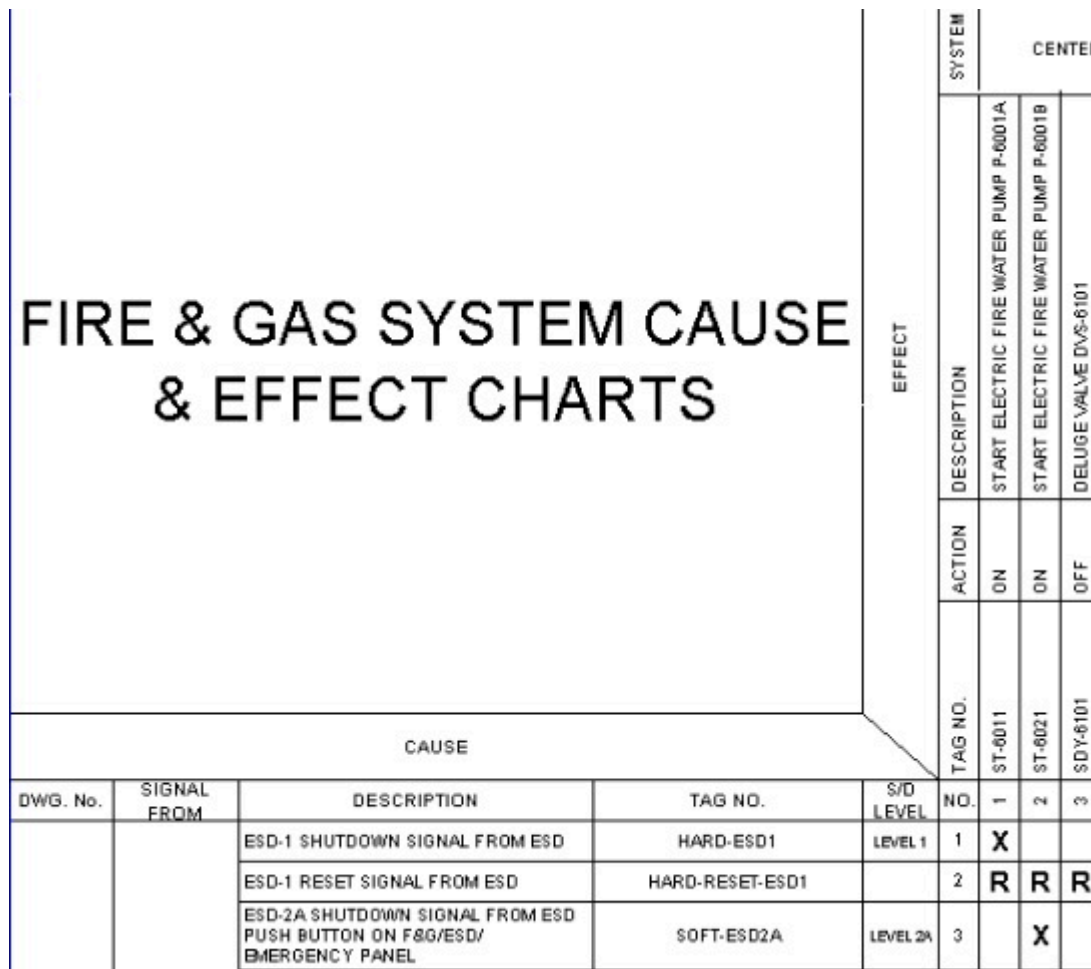
Area		Status Instruction
Condition	Expression	 means that the condition expression is satisfied. For example, Condition3 in above figure, AI00020006.PV<50.  indicates that the condition expression is not satisfied. For Example, Condition1 in above figure. When not configured, the display is empty.
	Bypass	 indicates that the bypass is not activated and the condition is valid.  indicates that the bypass is active and the condition is invalid. When not configured, the display is empty.
Effect	Expression	Green indicates that the tag's real-time value is ON, such as Effect1. Red indicates that the tag's real-time value is OFF, such as Effect2. When not configured, the display is empty.
	Bypass	 indicates that the bypass is inactive and that the effect can be executed.  indicates that the bypass is active, and the effect is not executable. When not configured, the display is empty.
	Reset	Click "Reset", and the effect tag changes to the reset value. If not enable the reset, the reset button on the monitoring panel is not available. When not configured, the display is empty.
Combination Area of Condition and Effect		 indicates that the effect executes successfully.  indicates that the effect is not executed.  indicates the effect will be executed after the delay time. When not configured, the display is empty.
General Reset		Click this button, all the tags configured the reset shall recover to the "reset value". When the "General Reset" is executed, only the tags not performing the effect can be reset.
Switch to Condition/Description		It is used to switch between condition and description. The default display is description and bypass. Click the switch button, and the interface displays the condition and bypass.

Monitor Trouble-shooting

In the field, if the  marker appears in the real-time monitor interface, it means it is not able to access the condition tag values.

12.1.4 Configuration Examples

The following figure is a design diagram of a CEM. In the system, create a new CR function block to implement the CEM.



Examples

There are 3 conditions and 3 effects in the CEM shown in the figure above, as shown in the following table.

Condition	Effect		
	ST-6001	ST-6021	SOY-6101
HARD-ESD1=ON	If Condition is met, output ON immediately.	-	-
HARD-RESET-ESD1=ON	If Condition is met, output ON after 1 second.	If Condition is met, output ON after 5 seconds.	If Condition is met, output OFF after 10 seconds.
SOFT-ESD2A=ON	-	If Condition is met, output ON immediately.	-

Configuration

After you create the conditional tags and effect t respectively, create a CR FBD and configure it as shown in the following figure.

Interlock Function

Function Block Property Basic

Tag	Oper...	Value	Descri...	Bypa...	Reset
HARD-ESD1.PV	==	ON			
HARD-RESET-...	==	ON		HAR...	
SOFT-ESD2A.PV	==	ON			

Tag	Value	Descriptio	Bypass	Reset
ST-6001.IN	ON			Reset
ST-6021.IN	ON			Reset
SOY-6101.IN	OFF		DO0001	Reset

No.	1	2	3
1	Y		
2	D1	D5	D10
3		Y	

Figure 12.7 Configuration Example of CR FBD

Monitor Image

After configured and published the CR FBD, it can be monitored in the real-time monitoring. The CR's panel in the real-time monitoring is shown as figure below.

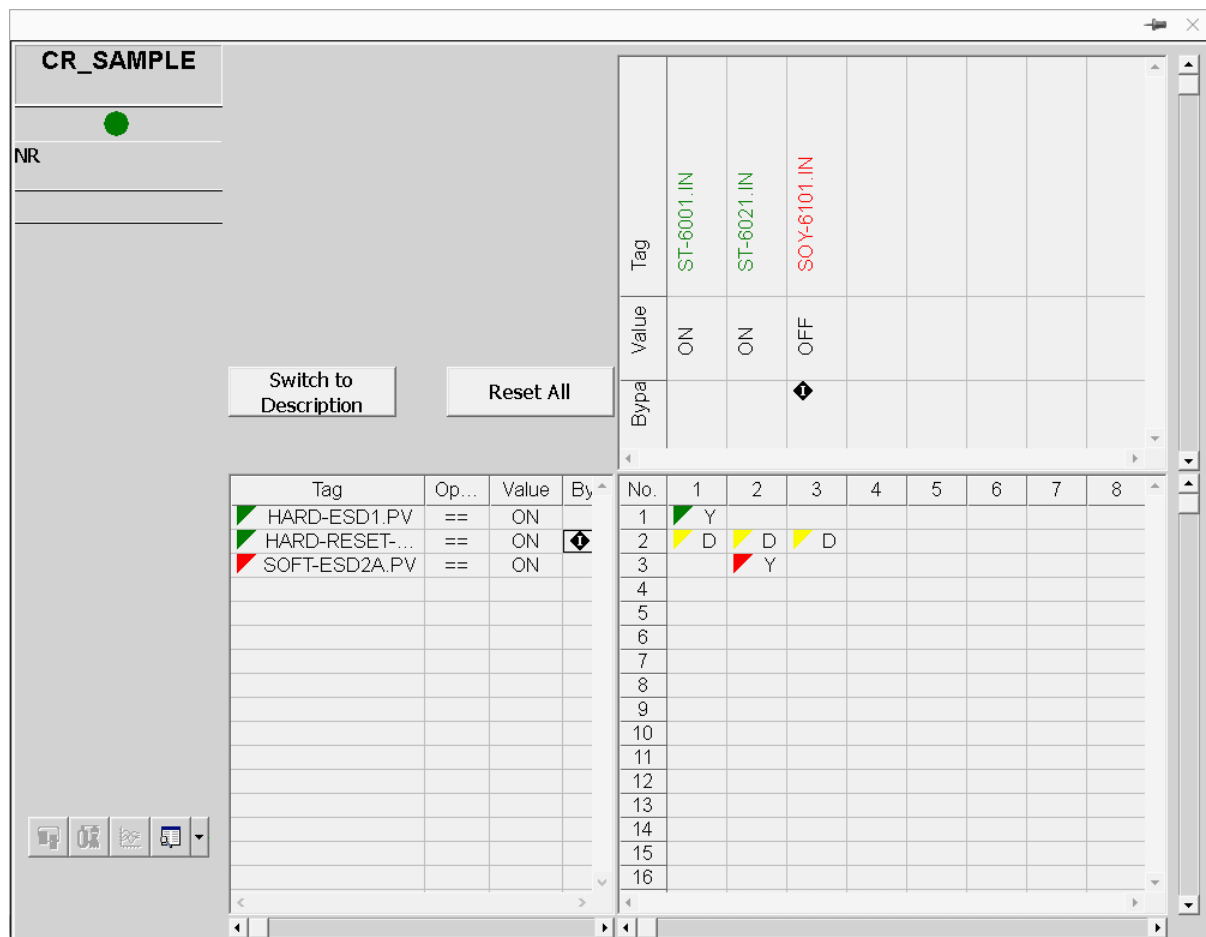



Figure 12.8 CR's Panel Example

As shown in the figure above, the Conditions and Effects are:

- Effect 1 Execute immediately
Condition 1 HARD-ESD1=ON is established and the output property is executed immediately.
Condition 2 HARD-RESET-ESD1=ON is established and the bypass is not activated (shown as ) , and the output property is 1 seconds delay execution.
Condition 1 and Condition 2 are related to the relationship, so Effect 1 is executed immediately.
- Effect 2 delay 5 seconds execution
Condition 2 HARD-RESET-ESD1=ON is established and the output property is 5 seconds delay execution.
Condition 3 SOFT-ESD2A=ON not valid.
Condition 2 and Condition 3 are related to the relationship, so Effect2 is delayed by 5 seconds execution.
- Effect3 delay 10 seconds execution
Condition 2 HARD-RESET-ESD1=ON is established and the output property is 10 seconds delay execution.

Condition 3 SOFT-ESD2A=ON not valid.

Condition 2 and Condition 3 are related to the relationship, so Effect3 is delayed by 10 seconds execution.

12.2 SQC Function Block

Function block is used to show the current status of sequential program.

This function block is a simple function block, its running time is 50μs.

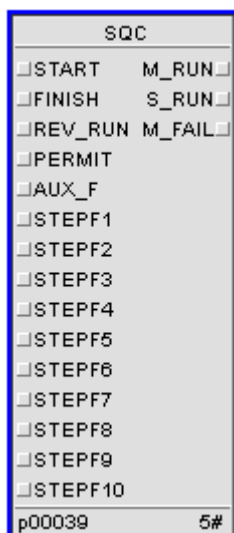


Table 12.1 SQC parameter instruction

Name			Description	Upload	Properties	Application Reference
Basic Parameters	Input Pin	START	Main Sequence Control Start	-	Input Pin	START=ON, Main Sequence Control Start
		FINISH	Main Sequence Control Finished	-	Input Pin	FINISH=ON, Main Sequence Control Finished
		REV_RUN	Reverse Sequence Control Running	-	Input Pin	REV_RUN=ON, Reverse Sequence Control Running
		PERMIT	Main Sequence Control Start Permit	-	Input Pin	PERMIT=ON, Main Sequence Control Start Permit
		AUX_F	Auxiliary Cabinet Fail	-	Input Pin	AUX_F=ON, Auxiliary Cabinet Fail
		STEPF1	Step 1 fail	-	Input Pin	Step 1 fail, STEPF1 = ON

Table 12.1 SQC parameter instruction (continued)

Name			Description	Upload	Properties	Application Reference
		STEPF2	Step 2 fail	-	Input Pin	Step 2 fails, STEPF1 = ON
		STEPF3	Step 3 fail	-	Input Pin	Step 3 fails, STEPF1 = ON
		STEPF4	Step 4 fail	-	Input Pin	Step 4 fails, STEPF1 = ON
		STEPF5	Step 5 fail	-	Input Pin	Step 5 fails, STEPF1 = ON
		STEPF6	Step 6 fail	-	Input Pin	Step 6 fails, STEPF1 = ON
		STEPF7	Step 7 fail	-	Input Pin	Step 7 fails, STEPF1 = ON
		STEPF8	Step 8 fail	-	Input Pin	Step 8 fails, STEPF1 = ON
		STEPF9	Step 9 fail	-	Input Pin	Step 9 fails, STEPF1 = ON
		STEPF10	Step 10 fail	-	Input Pin	Step 10 fails, STEPF1 = ON
	Output Pin	M_RUN	M_RUN=ON, main Sequence Control is Running	-	Output Pin	-
		S_RUN	S_RUN=ON, Sequence is Running	-	Output Pin	-
		M_FAIL	M_FAIL=ON, Main Sequence Control Fail	-	Output Pin	-
	Operation Parameter	RST	RST = ON, reset S_RUN	-	Operation Parameter	Reset time is defined by TRST
		TRST	Fault Reset Time	-	Operation Parameter	Unit is second

Algorithm

- When main sequence control is permitted (PERMIT=ON), main sequence control starts (START=ON) but not finished (FINISH=OFF), reverse sequence control is not running (REV_RUN=OFF), auxiliary cabinet has no fault (AUX_F=OFF), and there is no fault in STEPF1~ STEPF10, then M_RUN=ON, which means main sequence control is running.

- When main sequence control is running (M_RUN=ON), but not finished (FINISH=OFF), and no reset (RST=OFF), then S_RUN=ON, which means program is running.
- When there is fault in any step of STEP1~ STEP10 or in auxiliary cabinet (AUX_F=ON), or set PERMIT=OFF when program is running (S_RUN=ON), then M_FAIL=ON.
- While program is running(S_RUN=ON), if PERMIT=OFF, set M_FAIL=ON, M_RUN=OFF, and S_RUN=ON.
- If M_RUN=ON and S_RUN=ON, then when RST=ON, S_RUN=OFF(M_RUN=ON remains). After time TRST, return to S_RUN=ON.

12.3 STP Function Block

Function block STP is used to realize as many as 24 steps of sequence logic control, supporting functions such as reset, run, pause, jump, step disable and so on.

This function block is a complex function block, its running time is 50μs.

STP	
<input type="checkbox"/> RST	STPRUN
<input type="checkbox"/> PERMIT	STPFAIL
<input type="checkbox"/> STOP	STPEND
<input type="checkbox"/> STRT	STPPAUSE
<input type="checkbox"/> PAUSE	STPN
<input type="checkbox"/> JUMP	TRUN
<input type="checkbox"/> FB1	TRST
<input type="checkbox"/> FB2	D1
<input type="checkbox"/> FB3	D2
<input type="checkbox"/> FB4	D3
<input type="checkbox"/> FB5	D4
<input type="checkbox"/> FB6	D5
<input type="checkbox"/> FB7	D6
<input type="checkbox"/> FB8	D7
	D8
p00048	6#

Table 12.2 STP parameter instruction

Name			Description	Upload	Properties	Application Reference
Basic Parameters	Step Order Number Setting	STPTN	Step Order Amount	TRUE	Operation Parameter	(1~24)Steps
	Input Switch	RST	Reset Switch	-	Input Pin	Positive transition effective
		PERMIT	Step Order Run Permit Condition	-	Input Pin	PERMIT=ON, allow
		STOP	Step Order Stop Switch	-	Input Pin	STOP=ON, stop step order

Table 12.2 STP parameter instruction (continued)

Name			Description	Upload	Properties	Application Refer- ence
		STRT	Startup Switch	-	Input Pin	Positive transition effective
		PAUSE	Step Order Pause Switch	-	Input Pin	Positive transition effective
		JUMP	Jump-step Switch	-	Input Pin	JUMP=ON, jump to step indicated by JUMPN
		STPEN	Disable Flag of Step	-	Input Pin	Set step serial No. by bit.
		JUMPN	Jump-step Order	-	Input Pin	-
	Status	STPRUN	STPRUN = ON Step Order Run- ning	-	Output Pin	-
		STPFAIL	STPFAIL=ON Step Order Fault	-	Output Pin	-
		STPEND	STPEND=ON Step Order Fin- ish	-	Output Pin	-
		STP- PAUSE	STPPAUSE=ON Step Order Pause	-	Output Pin	-
		STPN	Current Step Or- der	-	Output Pin	-
		TRUN	Current Step Run Time	-	Output Pin	-
		TRST	Current Step Left Time	-	Output Pin	-
		MODE	Module Status	-	Monitoring Pa- rameter	-
	Oper- ator Com- mand	MRST	Reset Switch	-	Operation Pa- rameter	Reset as OFF af- ter keeping ON for a period.
		MSTRT	Startup Switch	-	Operation Pa- rameter	Reset as OFF af- ter keeping ON for a period.
		MPAUSE	Step Order Pause Switch	-	Operation Pa- rameter	Reset as OFF af- ter keeping ON for a period.

Table 12.2 STP parameter instruction (continued)

Name			Description	Upload	Properties	Application Reference
		MJUMP	Jump-step Switch	-	Operation Parameter	Reset as OFF after keeping ON for a period.
Extended Parameters	Feedback Signal	FB1	Feedback Signal of Step 1	-	Input Pin	Test the result of this step, if ON, carry on the next step
		FB2	Feedback Signal of Step 2	-	Input Pin	-
		FB3	Feedback Signal of Step 3	-	Input Pin	-
		FB4	Feedback Signal of Step 4	-	Input Pin	-
		FB5	Feedback Signal of Step 5	-	Input Pin	-
		FB6	Feedback Signal of Step 6	-	Input Pin	-
		FB7	Feedback Signal of Step 7	-	Input Pin	-
		FB8	Feedback Signal of Step 8	-	Input Pin	-
		FB9	Feedback Signal of Step 9	-	Input Pin	-
		FB10	Feedback Signal of Step 10	-	Input Pin	-
		FB11	Feedback Signal of Step 11	-	Input Pin	-
		FB12	Feedback Signal of Step 12	-	Input Pin	-
		FB13	Feedback Signal of Step 13	-	Input Pin	-
		FB14	Feedback Signal of Step 14	-	Input Pin	-
		FB15	Feedback Signal of Step 15	-	Input Pin	-
		FB16	Feedback Signal of Step 16	-	Input Pin	-
		FB17	Feedback Signal of Step 17	-	Input Pin	-

Table 12.2 STP parameter instruction (continued)

Name			Description	Upload	Properties	Application Reference
		FB18	Feedback Signal of Step 18	-	Input Pin	-
		FB19	Feedback Signal of Step 19	-	Input Pin	-
		FB20	Feedback Signal of Step 20	-	Input Pin	-
		FB21	Feedback Signal of Step 21	-	Input Pin	-
		FB22	Feedback Signal of Step 22	-	Input Pin	-
		FB23	Feedback Signal of Step 23	-	Input Pin	-
		FB24	Feedback Signal of Step 24	-	Input Pin	-
	Output Command	D1	Output Command of Step 1	-	Output Pin	If D1=ON, run step 1.
		D2	Output Command of Step 2	-	Output Pin	-
		D3	Output Command of Step 3	-	Output Pin	-
		D4	Output Command of Step 4	-	Output Pin	-
		D5	Output Command of Step 5	-	Output Pin	-
		D6	Output Command of Step 6	-	Output Pin	-
		D7	Output Command of Step 7	-	Output Pin	-
		D8	Output Command of Step 8	-	Output Pin	-
		D9	Output Command of Step 9	-	Output Pin	-
		D10	Output Command of Step 10	-	Output Pin	-
		D11	Output Command of Step 11	-	Output Pin	-

Table 12.2 STP parameter instruction (continued)

Name			Description	Upload	Properties	Application Reference
		D12	Output Com- mand of Step 12	-	Output Pin	-
		D13	Output Com- mand of Step 13	-	Output Pin	-
		D14	Output Com- mand of Step 14	-	Output Pin	-
		D15	Output Com- mand of Step 15	-	Output Pin	-
		D16	Output Com- mand of Step 16	-	Output Pin	-
		D17	Output Com- mand of Step 17	-	Output Pin	-
		D18	Output Com- mand of Step 18	-	Output Pin	-
		D19	Output Com- mand of Step 19	-	Output Pin	-
		D20	Output Com- mand of Step 20	-	Output Pin	-
		D21	Output Com- mand of Step 21	-	Output Pin	-
		D22	Output Com- mand of Step 22	-	Output Pin	-
		D23	Output Com- mand of Step 23	-	Output Pin	-
		D24	Output Com- mand of Step 24	-	Output Pin	-
		Step Order Set Time	TSET1	Setting Time of the 1st Step Or- der	TRUE	Operation Pa- rameter
	TSET2		Setting Time of the 2nd Step Or- der	TRUE	Operation Pa- rameter	-
	TSET3		Setting Time of the 3rd Step Or- der	TRUE	Operation Pa- rameter	-
	TSET4		Setting Time of the 4th Step Or- der	TRUE	Operation Pa- rameter	-

Table 12.2 STP parameter instruction (continued)

Name		Description	Upload	Properties	Application Reference
	TSET5	Setting Time of the 5th Step Order	TRUE	Operation Parameter	-
	TSET6	Setting Time of the 6th Step Order	TRUE	Operation Parameter	-
	TSET7	Setting Time of the 7th Step Order	TRUE	Operation Parameter	-
	TSET8	Setting Time of the 8th Step Order	TRUE	Operation Parameter	-
	TSET9	Setting Time of the 9th Step Order	TRUE	Operation Parameter	-
	TSET10	Setting Time of the 10th Step Order	TRUE	Operation Parameter	-
	TSET11	Setting Time of the 11th Step Order	TRUE	Operation Parameter	-
	TSET12	Setting Time of the 12th Step Order	TRUE	Operation Parameter	-
	TSET13	Setting Time of the 13th Step Order	TRUE	Operation Parameter	-
	TSET14	Setting Time of the 14th Step Order	TRUE	Operation Parameter	-
	TSET15	Setting Time of the 15th Step Order	TRUE	Operation Parameter	-
	TSET16	Setting Time of the 16th Step Order	TRUE	Operation Parameter	-
	TSET17	Setting Time of the 17th Step Order	TRUE	Operation Parameter	-
	TSET18	Setting Time of the 18th Step Order	TRUE	Operation Parameter	-

Table 12.2 STP parameter instruction (continued)

Name			Description	Upload	Properties	Application Reference
		TSET19	Setting Time of the 19th Step Order	TRUE	Operation Parameter	-
		TSET20	Setting Time of the 20th Step Order	TRUE	Operation Parameter	-
		TSET21	Setting Time of the 21st Step Order	TRUE	Operation Parameter	-
		TSET22	Setting Time of the 22nd Step Order	TRUE	Operation Parameter	-
		TSET23	Setting Time of the 23rd Step Order	TRUE	Operation Parameter	-
		TSET24	Setting Time of the 24th Step Order	TRUE	Operation Parameter	-
	Step Order Limit Time	TLMT1	Limit Time of the 1 st Step Order	TRUE	Operation Parameter	Step running time exceed time limit, fault alarm.
		TLMT2	Limit Time of the 2nd Step Order	TRUE	Operation Parameter	-
		TLMT3	Limit Time of the 3rd Step Order	TRUE	Operation Parameter	-
		TLMT4	Limit Time of the 4th Step Order	TRUE	Operation Parameter	-
		TLMT5	Limit Time of the 5th Step Order	TRUE	Operation Parameter	-
		TLMT6	Limit Time of the 6th Step Order	TRUE	Operation Parameter	-
		TLMT7	Limit Time of the 7th Step Order	TRUE	Operation Parameter	-
		TLMT8	Limit Time of the 8th Step Order	TRUE	Operation Parameter	-
		TLMT9	Limit Time of the 9th Step Order	TRUE	Operation Parameter	-
		TLMT10	Limit Time of the 10th Step Order	TRUE	Operation Parameter	-

Table 12.2 STP parameter instruction (continued)

Name			Description	Upload	Properties	Application Refer- ence	
		TLMT11	Limit Time of the 11th Step Order	TRUE	Operation Pa- rameter	-	
		TLMT12	Limit Time of the 12th Step Order	TRUE	Operation Pa- rameter	-	
		TLMT13	Limit Time of the 13th Step Order	TRUE	Operation Pa- rameter	-	
		TLMT14	Limit Time of the 14th Step Order	TRUE	Operation Pa- rameter	-	
		TLMT15	Limit Time of the 15th Step Order	TRUE	Operation Pa- rameter	-	
		TLMT16	Limit Time of the 16th Step Order	TRUE	Operation Pa- rameter	-	
		TLMT17	Limit Time of the 17th Step Order	TRUE	Operation Pa- rameter	-	
		TLMT18	Limit Time of the 18th Step Order	TRUE	Operation Pa- rameter	-	
		TLMT19	Limit Time of the 19th Step Order	TRUE	Operation Pa- rameter	-	
		TLMT20	Limit Time of the 20th Step Order	TRUE	Operation Pa- rameter	-	
		TLMT21	Limit Time of the 21st Step Order	TRUE	Operation Pa- rameter	-	
		TLMT22	Limit Time of the 22 nd Step Order	TRUE	Operation Pa- rameter	-	
		TLMT23	Limit Time of the 23rd Step Order	TRUE	Operation Pa- rameter	-	
		TLMT24	Limit Time of the 24th Step Order	TRUE	Operation Pa- rameter	-	
		Others	SWOOS	OOS status switch	TRUE	Operation Pa- rameter	SWOOS=ON, switch to OOS sta- tus.
			AOF	Suppress Alarm	TRUE	Operation Pa- rameter	-
			FLAG	Flag	-	Output Pin	-

- Mode processing
 - In the situation of cold startup, reset command (RST or MRST) jumping from OFF to ON, STOP=ON, or exiting from OOS status, sequence control would be in initial status, MODE = 0.
 - When sequence control is in initial status and the sequence control condition is met (PERMIT = ON), sequence control would turn in condition permitted status, MODE = 1.
 - When sequence control is in condition permitted status, pause status, fault status, the startup command(STRT or MSTRT) turns from OFF to ON, and sequence control would turn into running status, MODE = 2.
 - When sequence control is in running status, pause command (PAUSE or MPAUSE) turns from OFF to ON, sequence control would turn into pause status, MODE = 3. (If process startup command after pausing, sequence control will to on with its process)
 - When the operation time of certain step exceeds the limit time, sequence control would turn into fault status, MODE = 4. If setting time of certain step is set to be 0, setting time of certain step will not be considered and would be considered to be infinite.
 - When the largest step is finished, sequence control would turn into complete status, MODE = 5. After sequence control process, reset step number to be "0", and reset step time to be "0".
 - When SWOOS = ON, function block would turn into OOS status, MODE =6.
- Logic description
 - MODE=0
All step command output set to be OFF. Step order set to be 0. Any command would not be responded.
 - MODE=1
Maintain initial status output, only respond to startup command.
 - MODE=2
After turning into running status, sequence control would be executed from current step, and set the running mark STPRUN to ON.
If the disable mark of current step is ON, then turn into next step. If the disable mark is OFF, current step order output is set ON, and if the previous period is not in pause status, the counter would be reset and start to count.
After current step feedback becoming ON, or reaching the set time, the current step output and the counter would be reset, and the next step order command would be executed. If the feedback hasn't be received and running time exceeds limit time, the current step output would be reset, and turns into fault status. Pause, jump, reset commands would be responded.
 - MODE=3

When being pause status, maintain current step output command, step timer stop, if the feedback jump from OFF to ON, next command would not be executed. Startup, jump, reset commands would be responded.

When receiving startup command, sequence control runs from current step, and timer accumulates from current time. When receiving jump command, sequence control jumps to the pointed step order and holds pause status, and the time is reset. When receiving reset command, sequence control would turn into initial status.

- **MODE=4**

When being fault status, STPFAIL= ON, STPRUN = OFF, and output is reset. Startup, jump, reset commands would be responded.

When receiving startup command, turn into the first step to restart, and output STPFAIL is reset. When receiving jump command, jump to pointed step to run, and output STPFAIL is reset. Then reset the commands and turn into initial status.

- **MODE=5**

When being complete, status, STPFIN =ON. Startup, reset commands would be responded. When receiving startup command, turn into the first step to restart, and STPFIN is reset, set STPRUN to ON. When receiving reset command, turn into initial status, and STPFIN is reset.

- **MODE=2, 3, 4**

Respond to jump command, and jump to pointed step order. If current step is the last step, turn into complete status.

- **STOP=ON**

No matter in any status, when STOP = ON, then STPFAIL =ON, output is reset, and turn into initial status. When STOP = ON, run, pause and jump commands would not be responded. After STOP turning to OFF, the fault alarm is eliminated.

12.3.1 Flag

Table 12.3 Flag list

Flag	Alarm	Instruction
D0	OOS	Disable
D1	AOF	Suppress Alarm
D2	RESET	Reset
D3	PER	Permit Status
D4	RUN	Running
D5	PAUSE	Pause Status

Table 12.3 Flag list (continued)

Flag	Alarm	Instruction
D6	FAIL	Feedback Fault
D7	END	Finish

12.3.2 Panel Parameter

The screenshot displays the STP (Step Timing Panel) interface. It features a central area with a grid of feedback signals (FB1-FB24) and output commands (D1-D24). On the left, there are control buttons for Run, Pause, Jump, and Reset, along with a status indicator showing '1' and 'FAIL'. On the right, there are three sections for Command Parameters, including Disable, Mark, Jump Step Number, Step, Run Time, Time Left, and a set of status indicators for Run, Fault, Stop, Finish, Allow, and Pause.

STP

Feedback Signal

FB1 ○ FB2 ○ FB3 ○ FB4 ○
 FB5 ○ FB6 ○ FB7 ○ FB8 ○
 FB9 ○ FB10 ○ FB11 ○ FB12 ○
 FB13 ○ FB14 ○ FB15 ○ FB16 ○
 FB17 ○ FB18 ○ FB19 ○ FB20 ○
 FB21 ○ FB22 ○ FB23 ○ FB24 ○

Output Command

D1 ○ D2 ○ D3 ○ D4 ○
 D5 ○ D6 ○ D7 ○ D8 ○
 D9 ○ D10 ○ D11 ○ D12 ○
 D13 ○ D14 ○ D15 ○ D16 ○
 D17 ○ D18 ○ D19 ○ D20 ○
 D21 ○ D22 ○ D23 ○ D24 ○

Command Parameter

Disable
 Mark 0
 Jump Step Number 0

Command Parameter

Step 1
 Run Time 0
 Time Left 0

Command Parameter

Run ○ Finish ○
 Fault ● Allow ●
 Stop ○ Pause ○

Run Pause
 Jump Reset

Figure 12.9 STP panel

12.3.3 Program Example

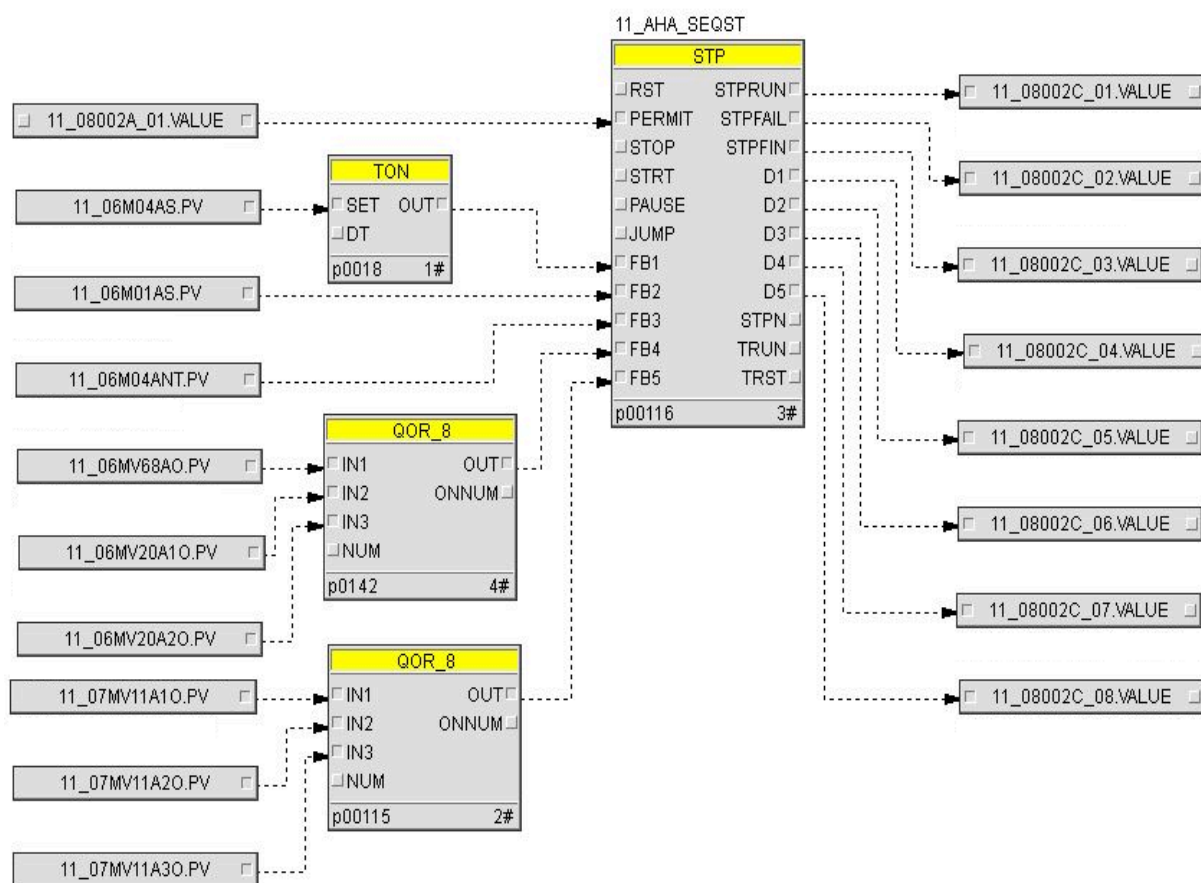


Figure 12.10 Program Example

13 Communication Auxiliary Function Block Library

Communication auxiliary function block library contains 22 simple function blocks. All conversion blocks are input by decimal number, and debugging will show decimal number too.

13.1 BCD2DEC Function Block

Function block BCD2DEC converts the 4-bit BCD input to a decimal output. The largest decimal output is 9999.

The input is required to be a BCD code and cannot be a combination of two UNSINT inputs serving as one BCD code.

The running time of this function block of this function block is 2μs.

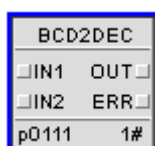


Table 13.1 BCD2DEC parameter

Name			Description	Upload
Basic Parameters	Input Pin	IN1	Input Value 1, Standing for L2 LSB	-
		IN2	Input Value 2, Standing for 2 MSB	-
	Output Pin	OUT	UNIT OutputNote1	-
		ERR	When any bit of the input BCD code is beyond 9, ERR=ON.	-

Note:

BCD2DEC separates the BCD input into two bytes. Every 4 bits consist of one BCD code.

IN1 is the l2 LSB, and IN2 is 2 MSB. If input IN2IN1=DBC A, then the changed unit is

$D*1000+C*100+B*10+A$.

Table 13.2 Conversion from BCE code to decimal code

Input	IN2		IN1	
Domain	Zone4	Zone3	Zone2	Zone1
Digit	8 7 6 5	4 3 2 1	8 7 6 5	4 3 2 1
Convert to Integer				
Digit	1000s	100s	10s	1s
Output	X	X	X	X

For example, if IN1=67(=0x43),IN2=101(=0x65),then OUT=6543.

13.2 DEC2BCD Function Block

Function block DEC2BCD converts the UNIT input to a BCD output. The largest UNIT input is 9999.

The running time is 4μs.

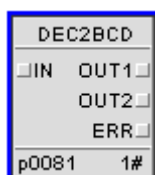


Table 13.3 DEC2BCD parameter instruction

Name		Description		Upload
Basic Parameters	Input Pin	IN	Decimal InputNote1	-
	Output Pin	OUT1	BCD Output 1, Standing for L2 LSB	-
		OUT2	BCD Output 2, Standing for 2 MSN	-
		ERR	The decimal input should be within 9999. If not, ERR=ON	-

Note:

DEC2BCD takes each digit of the decimal input, and transfers it into 4-bit code and saves in one INT variable.

For example, the decimal input is DCBA: A can be got through dividing it by 10, and B can be got through dividing it by 100, and so do C and D. Then use 4-digit binary separately to denote these four values and output it after combination.

Table 13.4 Conversion of decimal code to BCD code

Digit	1000s	100s	10s	1s
Input	X	X	X	X
Convert to BCD Code				
Output	OUT2		OUT1	
Domain	Zone4	Zone3	Zone2	Zone1
Digit	8 7 6 5	4 3 2 1	8 7 6 5	4 3 2 1

For example, if IN=8765, OUT1=101(=0x65), OUT2 = 135(=0x87).

13.3 HEX2DEC Function Block

Function block HEX2DEC converts the 4-digit hex input into a decimal output.

Because A~F of hex cannot be be input in the system, so this 4-digit hex code consists of 4 UNSINT inputs and uses 10~15 to replace A~F. Each input is limited within 0~15. If any one is beyond 15, ERR=ON.

The running time of this function block is 2μs.

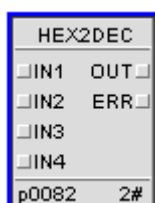


Table 13.5 HEX2DEC parameter instruction

Name			Description	Upload
Basic Parameters Parameter	Input Pin	IN1	Hex Input 1 (Lowest Digit)	-
		IN2	Hex Input 2 (Lower Digit)	-
		IN3	Hex Input 3 (Higher Digit)	-
		IN4	Hex Input 4 (Highest Digit)	-
	Output Pin	OUT	Output 2-byte unsigned integer	-
		ERR	When any input beyond 15, ERR=ON.	-

For example, if IN1=1(=0x01), IN2=02(=0x02), IN3=10(=0x0A), IN4=11(=0x0B), then OUT=47649(=0xBA21).

13.4 DEC2HEX Function Block

Function block DEC2HEX converts a UNIT decimal input to 4 UNSIT hex outputs. It takes out 4 values of the decimal input in the 4-bit unit from left to right and assigns them separately to OUT4~OUT1.

The running time of this function block is 4μs.

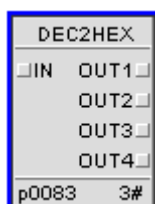


Table 13.6 DEC2HEX parameter instruction

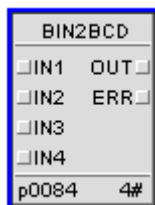
Name			Description	Upload
Basic Parameters	Input Pin	IN	UNIT Decimal Input	-
	Output Pin	OUT1	Hex Output 1 (Lowest Digit)	-
		OUT2	Hex Output 2 (Lower Digit)	-
		OUT3	Hex Output 3 (Higher Digit)	-
		OUT4	Hex Output 4 (Highest Digit)	-

For example, if IN=47649(=0xBA21), then OUT1=01(=0x01), OUT2=02(=0x02), OUT3=10(0x0A), OUT4=11(=0x0B).

13.5 BIN2BCD Function Block

Function block BIN2BCD converts the binary input to a BCD output. The largest BCD output is 9. If it is beyond 9, output 9 and set ERR=ON.

The running time of this function block is 2μs.

**Table 13.7 BIN2BCD parameter instruction**

Name			Description	Upload
Basic Parameters	Input Pin	IN1	Binary Input 1 (Lowest Digit)	-
		IN2	Binary Input 2 (Lower Digit)	-
		IN3	Binary Input 3 (Higher Digit)	-
		IN4	Binary Input 4 (Highest Digit)	-
	Output Pin	OUT	BCD Output	-
		ERR	If BCD beyond 9, output 9 and set ERR=ON	-

For example, if IN1=ON, IN2=OFF, IN3=OFF, IN4= OFF, then OUT=1;

If IN1=ON, IN2=OFF, IN3=OFF, IN4=ON, then OUT=9.

13.6 BCD2BIN Function Block

Input values from 0 to 9 to this function block and output in BOOL after resolution by bit of BCD code converted.

The running time of this function block is 2μs.

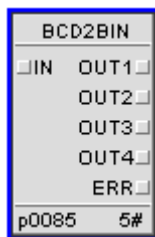


Table 13.8 BCD2BIN parameter instruction

Name		Description		Upload
Basic Parameters	Input Pin	IN	BCD Input	-
	Output Pin	OUT1	Binary Output 1 (Lowest Digit)	-
		OUT2	Binary Output 2 (Lower Digit)	-
		OUT3	Binary Output 3 (Higher Digit)	-
		OUT4	Binary Output 4 (Highest Digit)	-
		ERR	If IN beyond 9, then set ERR=ON.	-

13.7 BLOGIC_16 Function Block

Function block BLOGIC_16 implements the logical bit-operation of two 16-bit integer inputs, including AND, OR, XOR and NOT operation bitwisely.

The running time of this function block is 2μs.

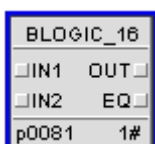


Table 13.9 BLOGIC_16 parameter instruction

Name			Description	Upload	Properties	Application Reference
Basic Parameters	Input Pin	IN1	16-Bit Integer Input 1	-	Input Pin	-
		IN2	16-Bit Integer Input 2	-	Input Pin	-
	Output Pin	OUT	Result of Logical Bit-Operation	-	Output Pin	-

Table 13.9 BLOGIC_16 parameter instruction (continued)

Name			Description	Upload	Properties	Application Reference
		EQ	If IN1 is same as IN2, EQ=ON; if IN1 is not the same as IN2, EQ=OFF.	-	Output Pin	-
	Configuration Parameter	MODE	Modes of Logical Bit-Operation: 0=Band, 1=Bor, 2=Bxor, 3=Bnot(For In1)	-	Configuration Parameter	This parameter can be set in the Function Block Properties window, and user can not set in debugging.

Operating mode as follows.

- When MODE=0
BLOGIC_16 implements BAND of the two 16-bit integer inputs, and OUT outputs the result.
OUT = (IN1) BAND (IN2)
For example: IN1=0xFF00, IN2=0x0FFF
Then: OUT=0x0F00.
- When MODE=1
BLOGIC_16 implements BOR of the two 16-bit integer inputs, and OUT outputs the result.
OUT = (IN1) BOR (IN2)
For example: IN1=0xFF00, IN2=0x000F
Then: OUT=0xFF0F.
- When MODE=2
BLOGIC_16 implements BXOR of the two 16-bit integer inputs, and OUT outputs the result.
OUT = (IN1) BXOR (IN2)
For example: IN1=0xF0F0, IN2=0x00FF
Then: OUT=0xF00F.
- When MODE=3
BLOGIC_16 implements BNOT of the two 16-bit integer inputs, and OUT outputs the result.
OUT = BNOT (IN1)
For example: IN1=0xFF00
Then: OUT=0x00FF.
When IN1=IN2, set EQ=ON, otherwise set EQ=OFF.

13.8 BLOGIC_32 Function Block

Function block BLOGIC_32 implements logical bit-operation of the two 32-bit integer inputs, including BAND, BOR, BXOR, BNOT and so on.

The running time of this function block is 2μs.

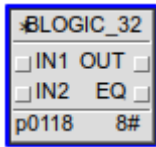


Table 13.10 BLOGIC_32 parameter instruction

Name			Description	Upload	Properties	Application Reference
Basic Parameters	Input Pin	IN1	32-Bit Integer Input 1	-	Input Pin	-
		IN2	32-Bit Integer Input 2	-	Input Pin	-
	Output Pin	OUT	32-Bit Integer Output	-	Output Pin	-
		EQ	If IN1 is same as IN2, EQ=ON; if IN1 is not the same as IN2, EQ=OFF.	-	Output Pin	-
	Configuration Parameter	MODE	Modes of Logical Bit-Operation: 0=BAND, 1=BOR, 2=BXOR, 3=BNOT (For IN1)	-	Configuration Parameter	This parameter can be set in the Function Block Properties window, and user can not set in debugging.

Operating mode as follows.

- When MODE=0
BLOGIC_32 implements BAND of the two 32-bit integer inputs, and OUT outputs the result.
OUT= (IN1) BAND (IN2)
For example: IN1=0xFFFF FF00, IN2=0x0000 0FFF
Then: OUT=0x0000 0F00.
- When MODE=1
BLOGIC_32 implements BOR of the two 32-bit integer inputs, and OUT outputs the result.
OUT= (IN1) BOR (IN2)
For example: IN1=0xFFFF FF00, IN2=0x0000 000F
Then: OUT=0xFFFF FF0F.
- When MODE=2
BLOGIC_32 implements BAND of the two 32-bit integer inputs, and OUT outputs the result.

OUT= (IN1) BXOR (IN2)

For example: IN1=0xFF0F FF00, IN2=0x0000 000F

Then: OUT=0xFF0F FF0F.

4. When MODE=3

BLOGIC_32 implements BNOT of the two 32-bit integer inputs, and OUT outputs the result.

OUT= BNOT (IN1)

For example: IN1=0xFF0F FF00

Then: OUT=0x00F0 00FF.

When IN1=IN2, set EQ=ON, otherwise set EQ=OFF.

13.9 LSH_16 Function Block

Function block LSH_16 implements logical shift operation of the 16-bit integer input, including logical left-shift and logical right-shift.

The running time of this function block is 4μs.

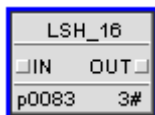


Table 13.11 LSH_16 parameter instruction

Name			Description	Upload	Properties	Application Reference
Basic Parameters	Input Pin	IN	16-Bit Integer Input	-	Input Pin	-
	Output Pin	OUT	16-Bit Integer Output	-	Output Pin	-
	Operation Parameter	N	Result of Logical Shift Operation	-	Operation Parameter	-
	Configuration Parameter	MODE	Modes of Logical Shift Operation: OFF=Logical Left-Shift, ON=Logical Right-Shift	-	Configuration Parameter	This parameter can be set in the Function Block Properties window, and user can not set in debugging

Operating mode as follows.

- When MODE=OFF,
The 16-bit integer input IN is logically left-shifted by N bits, and its right bits would be filled with zeros. OUT outputs the result.

- When MODE=ON

The 16-bit integer input IN is logically right-shifted by N bits, and its left bits would be filled with zeros. OUT outputs the result.

13.10 LSH_32 Function Block

Function block LSH_32 implements logical shift operation of the 32-bit integer input, including logical left-shift and logical right-shift.

The running time of this function block is 4μs.

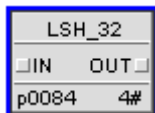


Table 13.12 LSH_32 parameter instruction

Name			Description	Upload	Properties	Application Reference
Basic Parameters	Input Pin	IN	32-Bit Integer Input	-	Input Pin	-
	Output Pin	OUT	32-Bit Integer Output	-	Output Pin	-
	Operation Parameter	N	Result of Logical Shift Operation	-	Operation Parameter	-
	Configuration Parameter	MODE	Modes of Logical Shift Operation: OFF=Logical Left-Shift, ON=Logical Right-Shift	-	Configuration Parameter	This parameter can be set in the Function Block Properties window, and user can not set in debugging

Operating mode as follows.

1. When MODE=OFF

The 32-bit integer input IN is logically left-shifted by N bits, and its right bits would be filled with zeros. OUT outputs the result.

2. When MODE=ON

The 32-bit integer input IN is logically right-shifted by N bits, and its left bits would be filled with zeros. OUT outputs the result.

13.11 RSH_16 Function Block

Function block RSH_16 implements round shift of the 16-bit integer input, including round left-shift and round right-shift.

The running time of this function block is 8μs.

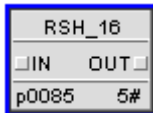


Table 13.13 RSH_16 parameter instruction

Name			Description	Upload	Properties	Application Reference
Basic Parameters	Input Pin	IN	16-Bit Integer Input	-	Input Pin	-
	Output Pin	OUT	16-Bit Integer Output	-	Output Pin	-
	Operation Parameter	N	Result of Logical Shift Operation	-	Operation Parameter	-
	Configuration Parameter	MODE	Modes of Logical Shift Operation: OFF=Round Left-Shift, ON=Round Right-Shift	-	Configuration Parameter	This parameter can be set in the Function Block Properties window, and user can not set in debugging

Operating mode as follows.

- When MODE=OFF,
The 16-bit integer input IN is round left-shifted by N bits. The bits shifted out from the left would be inserted in the right. OUT outputs the result.
- When MODE=ON,
The 16-bit integer input IN is round right-shifted by N bits. The bits shifted out from the right would be inserted in the left. OUT outputs the result.

13.12 RSH_32 Function Block

Function block RSH_32 implements round shift of the 32-bit integer input, including round left-shift and round right-shift.

The running time of this function block is 21μs.

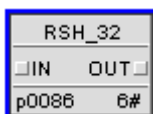


Table 13.14 RSH_32 parameter instruction

Name			Description	Upload	Properties	Application Reference
Basic Parameters	Input Pin	IN	32-Bit Integer Input	-	Input Pin	-
	Output Pin	OUT	32-Bit Integer Output	-	Output Pin	-
	Operation Parameter	N	Result of Logical Shift Operation	-	Operation Parameter	-
	Configuration Parameter	MODE	Modes of Logical Shift Operation: OFF=Round Left-Shift, ON=Round Right-Shift	-	Configuration Parameter	This parameter can be set in the Function Block Properties window, and user can not set in debugging

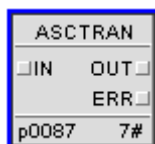
Operating mode as follows.

- When MODE=OFF,
The 32-bit integer input IN is round left-shifted by N bits. The bits shifted out from the left would be inserted in the right. OUT outputs the result.
- When MODE=ON,
The 32-bit integer input IN is round right-shifted by N bits. The bits shifted out from the right would be inserted in the left. OUT outputs the result.

13.13 ASCTRAN Function Block

Function block ASCTRAN implements ASCII conversion of 0~9 and A~F, which means the range of IN is 0~15, 10~15 stands for A~F, 0~9 and A~F shands 48~57(0x30~0x39) and 65~70(0x41~0x46).

The running time of this function block is 2μs.

**Table 13.15 ASCTRAN parameter instruction**

Name			Description	Upload
Basic Parameters	Input Pin	IN	Input Value	-
	Output Pin	OUT	Output Value	-

Table 13.15 ASCTRAN parameter instruction (continued)

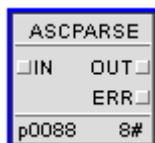
Name			Description	Upload
		ERR	If the input is out of this range, there generates an ERR alarm (ERR=ON).	-

For example, if IN=9(number 9), then OUT=57, if IN=14(capital E), then OUT=69.

13.14 ASCPARSE Function Block

ASCPARSE can parse the ACSII data in communication. The range of its input is 0~9 and A~F, and the corresponding ASCII value is 0x30~0x39 (48~57) and 0x41~0x46 (65~70). Output is the result after parsing the ASCII code.

The running time of this function block is 2μs.

**Table 13.16 ASCPARSE parameter instruction**

Name			Description	Upload
Basic Parameters	Input Pin	IN	Input Value	-
	Output Pin	OUT	Output Value	-
		ERR	If the input is out of this range, there generates an ERR alarm (ERR=ON).	-

For example, if IN=57(number 9), then OUT=9(number 9), if IN= IN=66 (capital E), then OUT=11(capital B).

13.15 USIPARSE Function Block

Function block USIPARSE can parse one USINT input into one high 4-bit and low 4-bit USINT outputs. The low 4-bit is saved in OUT1, and the high 4-bit is saved in OUT2.

The running time of this function block is 2μs.

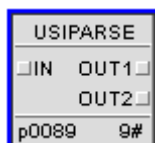


Table 13.17 USIPARSE parameter instruction

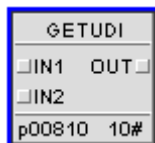
Name		Description		Upload
Basic Parameters	Input Pin	IN	Input Value	-
	Output Pin	OUT1	Output 1 (Low 4-Bit)	-
		OUT2	Output 2(High 4-Bit)	-

For example, if IN=57(0011_1001), then OUT1=9(1001), OUT2=3(0011).

13.16 GETUDI Function Block

Function block GETUDI can merge two UNIT inputs into one UDINT output.

The running time of this function block is 4 μ s.

**Table 13.18 GETUDI parameter instruction**

Name		Description		Upload
Basic Parameters	Input Pin	IN1	Input 1(How-Byte Part)	-
		IN2	Input 2(High-Byte Part)	-
	Output Pin	OUT	Output	-

In communication, the data read from counters and the like might be 32-bit. It can be divided into 2 UNIT data, one high-byte UNIT and one low-byte UNIT, and can be merged to UDINT data again by GETUDI.

For example: IN1=4779(=0x12AB), IN2=61234(=0xEF32), then

OUT=4013036203(=0xEF3212AB).

13.17 REALTRAN Function Block

Function block REALTRAN is used to implement the shift of those 4-byte float communication data during IO communication tag.

The running time of this function block is 3 μ s.

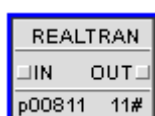


Table 13.19 REALTRAN parameter instruction

Name			Description	Upload
Basic Parameters	Input Pin	IN	Input Value	-
	Output Pin	OUT	Output Value	-

Suppose little-endian of one float data is ABCD. During communication in certain protocol, say in Modbus protocol, its coney form would be BADC, so tag AI cannot parse it with little-endian or big-endian. Then REALTRAN be used to parse this data.

For example:

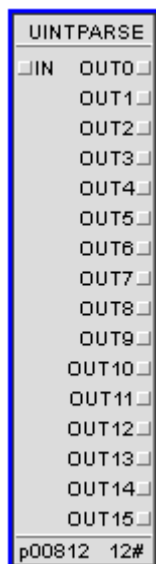
IN=223437, and its actual save form in memory is 0x40, 0x33, 0x5a, 0x48(increasing physical address).

After it is parsed by REALTRAN, its save form become 0x33, 0x40, 0x48, 0x5a(still increasing physical address). Then the float output of the transformed data is 14091395782410240.0000.

13.18 UINTPARSE Function Block

Function block UINTPARSE can parse one UINT input into 16 BOOL outputs by bit from the lowest bit to the highest one, and the results are saved in OUT0~OUT15. And OUT0 is the lowest bit, and OUT15 is the highest bit.

The running time of this function block is 2μs.



13.18.1 Parameter Instruction

Table 13.20 UNITPARSE parameter instruction

Name		Description		Upload
Basic Parameters	Input Pin	IN	Input Value	-
	Output Pin	OUT0	BIT0	-
		OUT1	BIT1	-
		OUT2	BIT2	-
		OUT3	BIT3	-
		OUT4	BIT4	-
		OUT5	BIT5	-
		OUT6	BIT6	-
		OUT7	BIT7	-
		OUT8	BIT8	-
		OUT9	BIT9	-
		OUT10	BIT10	-
		OUT11	BIT11	-
		OUT12	BIT12	-
		OUT13	BIT13	-
		OUT14	BIT14	-
		OUT15	BIT15	-

For example, if IN=6, then OUT0=OFF, OUT1=ON, OUT2=ON, OUT3=OFF, (OUT4~OUT15)=OFF.

13.18.2 Application Example

To split the communicated AI tag into 16 BOOL values, packing the 16 BOOL values into real numbers for communication with isomery intelligent device.

When communicating with isomery intelligent device, the tag table of the system will analyze all types of analog data read to real number, and transform all types of analog data to real number and send to others. The reshaped data packed by BOOL value cannot be processed directly.

This part introduces a tag splitting and packing method via program to solve the problem.

Details of program is shown below, it applies UINTPARSE to achieve tag splitting.

	Address	Format	Current Value	New Value
1	V32.0	Byte	2#1	
2	V32.1	Byte	2#1	
3	V32.2	Byte	2#0	
4	V32.3	Byte	2#0	
5	V32.4	Byte	2#0	
6	V32.5	Byte	2#0	
7	V32.6	Byte	2#0	
8	V32.7	Byte	2#0	
9	V33.0	Byte	2#0	
10	V33.1	Byte	2#0	
11	V33.2	Byte	2#0	
12	V33.3	Byte	2#0	
13	V33.4	Byte	2#0	
14	V33.5	Byte	2#0	
15	V33.6	Byte	2#0	
16	V33.7	Byte	2#0	
17	VW32	No Symbol	768	

Figure 13.1 PLC Sends Supervision

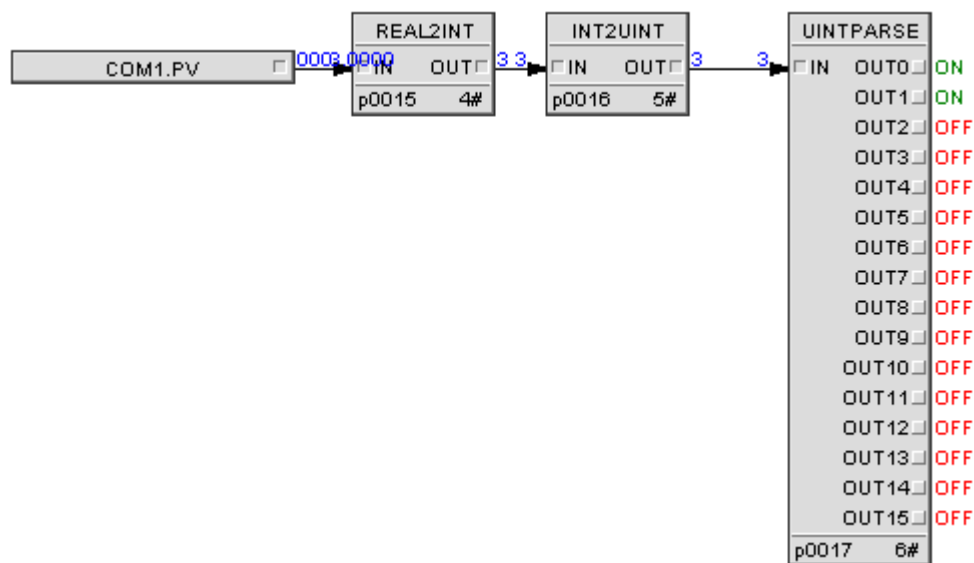


Figure 13.2 OMC Receives Program

Note: set the AI tag linear switch properties as “Not Switch”, set the maximum and minimum of original code to ensure that the communication data is in the range. OUT0~OUT7\OUT8~OUT15 of UINTPARSE corresponds to V32.0~V32.7\V33.0~V33.7.

Use BOL16 for packing BOOL tag. Details of program is shown below.

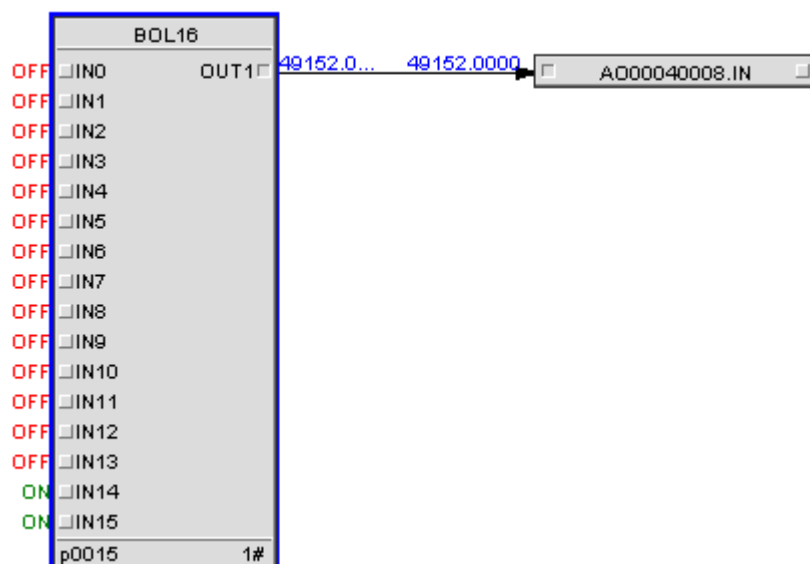


Figure 13.3 OMC Sends Supervision

	Address	Format	Current Value	New Value
1	VW0	No Symbol	192	
2	V0.0	Byte	2#0	
3	V0.1	Byte	2#0	
4	V0.2	Byte	2#0	
5	V0.3	Byte	2#0	
6	V0.4	Byte	2#0	
7	V0.5	Byte	2#0	
8	V0.6	Byte	2#0	
9	V0.7	Byte	2#0	
10	V1.0	Byte	2#0	
11	V1.1	Byte	2#0	
12	V1.2	Byte	2#0	
13	V1.3	Byte	2#0	
14	V1.4	Byte	2#0	
15	V1.5	Byte	2#0	
16	V1.6	Byte	2#1	
17	V1.7	Byte	2#1	

Figure 13.4 PLC Receives Program

Note: Set AO tag as not switch, IN0~IN7\IN8~IN15 of BOL16 corresponds to V0.0~V0.7\V1.0~V1.7, OUT1 output misplaces with high/low bytes of VW0. Instructions of function block and example are shown below.

Table 13.21 UINTPARSE

No.	Function Block Pin	Description	Corresponding Tag Type	Remarks
Input Parameter				
001	IN	Input	Communication AI Input	Use REAL2INT and IN-T2UINT to change Format of UINT.

Table 13.21 UINTPARSE (continued)

No.	Function Block Pin	Description	Corresponding Tag Type	Remarks
Output Parameter				
001	OUT0	BIT0	Custom BOOL	Double-byte 16 Bytes No.1 BOOL
002	OUT1	BIT1	Custom BOOL	
003	OUT2	BIT2	Custom BOOL	
004	OUT3	BIT3	Custom BOOL	
005	OUT4	BIT4	Custom BOOL	
006	OUT5	BIT5	Custom BOOL	
007	OUT6	BIT6	Custom BOOL	
008	OUT7	BIT7	Custom BOOL	
009	OUT8	BIT8	Custom BOOL	
010	OUT9	BIT9	Custom BOOL	
011	OUT10	BIT10	Custom BOOL	
012	OUT11	BIT11	Custom BOOL	
013	OUT12	BIT12	Custom BOOL	
014	OUT13	BIT13	Custom BOOL	
015	OUT14	BIT14	Custom BOOL	
016	OUT15	BIT15	Custom BOOL	

Table 13.22 BOL16

No.	Function Block Pin	Description	Corresponding Tag Type	Remarks
Input Parameter				
001	IN0	BIT0	Custom BOOL	Communication sends data No.1 BOOL.
002	IN1	BIT1	Custom BOOL	
003	IN2	BIT2	Custom BOOL	
004	IN3	BIT3	Custom BOOL	
005	IN4	BIT4	Custom BOOL	
006	IN5	BIT5	Custom BOOL	

Table 13.22 BOL16 (continued)

No.	Function Block Pin	Description	Corresponding Tag Type	Remarks
007	IN6	BIT6	Custom BOOL	
008	IN7	BIT7	Custom BOOL	
009	IN8	BIT8	Custom BOOL	
010	IN9	BIT9	Custom BOOL	
011	IN10	BIT10	Custom BOOL	
012	IN11	BIT11	Custom BOOL	
013	IN12	BIT12	Custom BOOL	
014	IN13	BIT13	Custom BOOL	
015	IN14	BIT14	Custom BOOL	
016	IN15	BIT15	Custom BOOL	
Output Parameter				
001	OUT1	Output	Communication AO Output	Set no byte switch in tag configuration.

13.19 UDINTPARSE Function Block

Function block UDINTPARSE can parse one UDINT input into 32 BOOL outputs by bit from lowest the bit to the highest one, and the results are saved in OUT0~OUT31. And OUT0 is the lowest bit, and OUT1 31 is the highest bit.

The running time of this function block is 2μs.

UDINTPARSE	
<input type="checkbox"/> IN	<input type="checkbox"/> OUT0
	<input type="checkbox"/> OUT1
	<input type="checkbox"/> OUT2
	<input type="checkbox"/> OUT3
	<input type="checkbox"/> OUT4
	<input type="checkbox"/> OUT5
	<input type="checkbox"/> OUT6
	<input type="checkbox"/> OUT7
	<input type="checkbox"/> OUT8
	<input type="checkbox"/> OUT9
	<input type="checkbox"/> OUT10
	<input type="checkbox"/> OUT11
	<input type="checkbox"/> OUT12
	<input type="checkbox"/> OUT13
	<input type="checkbox"/> OUT14
	<input type="checkbox"/> OUT15
	<input type="checkbox"/> OUT16
	<input type="checkbox"/> OUT17
	<input type="checkbox"/> OUT18
	<input type="checkbox"/> OUT19
	<input type="checkbox"/> OUT20
	<input type="checkbox"/> OUT21
	<input type="checkbox"/> OUT22
	<input type="checkbox"/> OUT23
	<input type="checkbox"/> OUT24
	<input type="checkbox"/> OUT25
	<input type="checkbox"/> OUT26
	<input type="checkbox"/> OUT27
	<input type="checkbox"/> OUT28
	<input type="checkbox"/> OUT29
	<input type="checkbox"/> OUT30
	<input type="checkbox"/> OUT31
p00813 13#	

Table 13.23 UDINT parameter instruction

Name		Description		Upload
Basic Parameters	Input Pin	IN	Input Pin	-
	Output Pin	OUT0	BIT0	-
		OUT1	BIT1	-
		OUT2	BIT2	-
		OUT3	BIT3	-
		OUT4	BIT4	-
		OUT5	BIT5	-
		OUT6	BIT6	-
		OUT7	BIT7	-
		OUT8	BIT8	-

Table 13.23 UDINT parameter instruction (continued)

Name		Description	Upload
	OUT9	BIT9	-
	OUT10	BIT10	-
	OUT11	BIT11	-
	OUT12	BIT12	-
	OUT13	BIT13	-
	OUT14	BIT14	-
	OUT15	BIT15	-
	OUT16	BIT16	-
	OUT17	BIT17	-
	OUT18	BIT18	-
	OUT19	BIT19	-
	OUT20	BIT20	-
	OUT21	BIT21	-
	OUT22	BIT22	-
	OUT23	BIT23	-
	OUT24	BIT24	-
	OUT25	BIT25	-
	OUT26	BIT26	-
	OUT27	BIT27	-
	OUT28	BIT28	-
	OUT29	BIT29	-
	OUT30	BIT30	-
	OUT31	BIT31	-

For example, if IN=7, then OUT0=ON, OUT1=ON, OUT2=ON, OUT3=OFF,
(OUT4~OUT31)=OFF.

13.20 BOOL2UDINT Function Block

Function block BOOL2UDINT can parse 32 BOOL input into one UDINT outputs by bit from lowest the bit to the highest one. OUT0 is the lowest bit, and OUT1 31 is the highest bit.

The running time of this function block is 2μs.

BOOL2UDINT	
□ IN0	OUT □
□ IN1	
□ IN2	
□ IN3	
□ IN4	
□ IN5	
□ IN6	
□ IN7	
□ IN8	
□ IN9	
□ IN10	
□ IN11	
□ IN12	
□ IN13	
□ IN14	
□ IN15	
□ IN16	
□ IN17	
□ IN18	
□ IN19	
□ IN20	
□ IN21	
□ IN22	
□ IN23	
□ IN24	
□ IN25	
□ IN26	
□ IN27	
□ IN28	
□ IN29	
□ IN30	
□ IN31	
p00814	14#

Table 13.24 BOOL input into UDINT BOOLoutput parameter instruction

Name		Description		Upload
Basic Parameters	Input Pin	IN0	BIT0	-
		IN1	BIT1	-
		IN2	BIT2	-
		IN3	BIT3	-
		IN4	BIT4	-
		IN5	BIT5	-
		IN6	BIT6	-
		IN7	BIT7	-

Table 13.24 BOOL input into UDINT BOOLoutput parameter instruction (continued)

Name		Description		Upload
		IN8	BIT8	-
		IN9	BIT9	-
		IN10	BIT10	-
		IN11	BIT11	-
		IN12	BIT12	-
		IN13	BIT13	-
		IN14	BIT14	-
		IN15	BIT15	-
		IN16	BIT16	-
		IN17	BIT17	-
		IN18	BIT18	-
		IN19	BIT19	-
		IN20	BIT20	-
		IN21	BIT21	-
		IN22	BIT22	-
		IN23	BIT23	-
		IN24	BIT24	-
		IN25	BIT25	-
		IN26	BIT26	-
		IN27	BIT27	-
		IN28	BIT28	-
		IN29	BIT29	-
		IN30	BIT30	-
		IN31	BIT31	-
	Output Pin	OUT	Output Value	-

For example, if IN0=OFF, IN1=ON, IN2=ON, IN3=ON, (IN4~IN31)=OFF, then 14.

13.21 Parse REAL to UDINT Function Block (SREAL_UDINT)

The function block parses and output the 4-byte float data memory as 4-byte unsigned data.

Running time of the function block is 3μs.

SREAL_UDINT	
IN	OUT
p00120	20#

Table 13.25 Parameters of SREAL_UDINT

Name		Description		Upload
Basic Parameter	Input Pin	IN	Input Value	-
	Output Pin	OUT	Output Value	-

If a float is saved in small mode, parse its 4-byte saved as UDINT and work out the output value.

For example, IN = 100.0, the 4-byte memory data is saved as 0x00 0x00 0xC8 0x42 in small mode, parse the memory as UDINT, so OUT = 0x42c80000 = 1120403456.

13.22 Parse 2 REAL to UDINT Function Block(SREAL2_UDINT)

This function block is used to analysis the two input REAL variable and convert to a UDINT to output.

The running time of the function block is 3us.

*SREAL2_UDINT	
IN1	ERR
IN2	OUT
p0005	4#

Table 13.26 Parameters Instruction of SEAL2_UDINT

Parameter		Description		Upload
Basic Parameter	Input Pin	IN1	Input 1	-
		IN2	Input 2	-
	Output Pin	OUT	Calculate Result	-
		ERR	Output Error	-
	Configuration Parameter	INSCH1	High limit of IN1	-
		INSCL1	Low limit of IN1	-

Table 13.26 Parameters Instruction of SEAL2_UDINT (continued)

Parameter			Description	Upload
		INSCH2	High limit of IN2	-
		INSCL2	Low limit of IN2	-

Relationship of input and output:

$$\text{OUT} = (\text{UDINT})((\text{IN1}-\text{INSCL1})/(\text{INSCH1}-\text{INSCL1}) * 4096) + (((\text{UDINT})((\text{IN2}-\text{INSCL2})/(\text{INSCH2}-\text{INSCL2}) * 4096) < 16))$$

13.23 Parse UDINT to REAL Function Block (GREAL_UDINT)

The function block parses and output the 4-byte unsigned data memory as 4-byte float data.

Running time of the function block is 3μs.

GREAL_UDINT	
IN	OUT
p00119	19#

Table 13.27 Parameters of GREAL_UDINT

Name			Description	Upload
Basic Parameter	Input Pin	IN	Input Value	-
	Output Pin	OUT	Output Value	-

If a float is saved in small mode, parse its 4-byte saved as REAL and work out the output value.

For example, IN = 1120403456, the 4-byte memory data is saved as 0x00 0x00 0xC8 0x42 in small mode, parse the memory as REAL, so OUT = 100.0.

13.24 Parse UDINT to 2 REAL Function Block (GREAL2_UDINT)

This function block is used to analysis the input UDINT variable, and convert to two REAL variable to output.

The running time of this function block is 3us.

*GREAL2_UDINT	
IN	ERR
	OUT1
	OUT2
p0004	3#

Table 13.28 Parameter Instruction of GREAL2_UDINT

Parameter			Description	Upload
Basic Parameter	Input and Output Pin	IN	Input	-
		OUT1	Output 1	-
		OUT2	Output 2	-
		ERR	Output Error	-
	Configuration Parameter	OUTSCH1	High Limit of OUT1	-
		OUTSCL1	Low Limit of OUT1	-
		OUTSCH2	High Limit of OUT2	-
		OUTSCL2	Low Limit of OUT2	-

Relationship of input and output:

- $OUT1 = (FLOAT)((INT)(IN1 \& 0xFFFF))/4096 \times (OUTSCH1 - OUTSCL1) + OUTSCL1$
- $OUT2 = (FLOAT)((INT)((IN1 \gg 16) \& 0xFFFF))/4096 \times (OUTSCH1 - OUTSCL1) + OUTSCL1$

14 Inter-station Communication Function Block Library

14.1 Introduction

The inter-station communication function block library provides 4 pairs of simple function blocks, which are: mixed inter-station sending/receiving function block, REAL type inter-station sending/receiving function block, special inter-station sending/receiving function block, UDINT type inter-station sending/receiving function block.



ATTENTION:

In the same control station, you should pay attention to the following points:

- The function block types of the sending station and the receiving station must correspond one-to-one. If the sending station uses the REAL type sending function block (SEND_REAL), the receiving station function block must be the REAL type function block (GET_REAL).
 - The SN serial numbers of the function blocks of the same type must correspond one-to-one. If the function block number SN of the sending station function block SEND_REAL is 0, the SN number of the receiving station GET_REAL function block must also be 0.
 - The function block number SN of the inter-station sending function cannot be repeated. If the SN of the SEND_MIX function block is 0, the SN of the other SEND_REAL, SENDSPEC and SEND_UDINT function blocks cannot be 0.
 - The SN sequence numbers between the same function blocks cannot be repeated. If the SN of a SEND_MIX function block is 0, the SN of other SEND_MIX function blocks cannot be 0.
-

A control station can group up to 8 sending function blocks, and the sequence numbers of the function blocks between the 8 sending function blocks cannot be repeated. When FCU711 is used as a controller in a control station, it can receive multicast data from 16 control stations. When FCU712 is used as a controller in a control station, it can receive multicast data from 64 control stations. The function block number of the receiving function block needs to be consistent with the function block number of the sending function block.

For the sending function block, when the sending is unsuccessful or the sequence number of the function block exceeds 7, the illegal function block alarm parameter ERR=ON.

If the function block number of the sending function block does not match with the receiving station, the data of the receiving function block is invalid, and STA=5, ERR=ON.

If the sending function block with the same serial number in the station does not exist but there exist sending function blocks with other serial number, then the getting function block displays mismatch and STA=4, ERR=ON.

If the domain and station addresses of the sending function block does not match with the receiving station, then the receiving function block displays a mismatch error and STA=3, ERR=ON.

If control stations whose multicast data is received by one receiving station is more than 16, then status of the 17th receiving function block is buffer area non-allocate or full, and STA=2, ERR=ON.

If the domain address (the control station address range is [0, 15] when controller is FCU711, and is [0, 59] when controller is FCU712), IP address (2~127) or serial number (0~7) of one control station is out of the range, then STA=1 and ERR=ON.

Among the status codes above, priority of STA=1 is the highest, and STA=2 is after it. Once STA=1, only STA=1 is displayed. If STA≠1 and STA=2, only STA=2 is displayed.

When both sending and getting are normal, ERR=OFF.

14.2 SEND_MIX Function Block

Function block SEND_MIX can send 10 REAL (IN1~IN10) and 24 BOOL data(IN11~IN34).

The running time of this function block is 7μs.

SEND_MIX	
<input type="checkbox"/> IN1	ERR_
<input type="checkbox"/> IN2	STA_
<input type="checkbox"/> IN3	
<input type="checkbox"/> IN4	
<input type="checkbox"/> IN5	
<input type="checkbox"/> IN6	
<input type="checkbox"/> IN7	
<input type="checkbox"/> IN8	
<input type="checkbox"/> IN9	
<input type="checkbox"/> IN10	
<input type="checkbox"/> IN11	
<input type="checkbox"/> IN12	
<input type="checkbox"/> IN13	
<input type="checkbox"/> IN14	
<input type="checkbox"/> IN15	
<input type="checkbox"/> IN16	
<input type="checkbox"/> IN17	
<input type="checkbox"/> IN18	
<input type="checkbox"/> IN19	
<input type="checkbox"/> IN20	
<input type="checkbox"/> IN21	
<input type="checkbox"/> IN22	
<input type="checkbox"/> IN23	
<input type="checkbox"/> IN24	
<input type="checkbox"/> IN25	
<input type="checkbox"/> IN26	
<input type="checkbox"/> IN27	
<input type="checkbox"/> IN28	
<input type="checkbox"/> IN29	
<input type="checkbox"/> IN30	
<input type="checkbox"/> IN31	
<input type="checkbox"/> IN32	
<input type="checkbox"/> IN33	
<input type="checkbox"/> IN34	
p0117	7#

14.2.1 Parameter Description

Table 14.1 *SEND_MIX* parameter description

Name			Description	Upload	Properties	Application Reference
Basic Parameters	Input Pin	IN1	Input Value 1	-	Input Pin	-
		IN2	Input Value 2	-	Input Pin	-
		IN3	Input Value 3	-	Input Pin	-
		IN4	Input Value 4	-	Input Pin	-
		IN5	Input Value 5	-	Input Pin	-
		IN6	Input Value 6	-	Input Pin	-
		IN7	Input Value 7	-	Input Pin	-

Table 14.1 SEND_MIX parameter description (continued)

Name		Description	Upload	Properties	Application Reference
	IN8	Input Value 8	-	Input Pin	-
	IN9	Input Value 9	-	Input Pin	-
	IN10	Input Value 10	-	Input Pin	-
	IN11	Input Value 11	-	Input Pin	-
	IN12	Input Value 12	-	Input Pin	-
	IN13	Input Value 13	-	Input Pin	-
	IN14	Input Value 14	-	Input Pin	-
	IN15	Input Value 15	-	Input Pin	-
	IN16	Input Value 16	-	Input Pin	-
	IN17	Input Value 17	-	Input Pin	-
	IN18	Input Value 18	-	Input Pin	-
	IN19	Input Value 19	-	Input Pin	-
	IN20	Input Value 20	-	Input Pin	-
	IN21	Input Value 21	-	Input Pin	-
	IN22	Input Value 22	-	Input Pin	-
	IN23	Input Value 23	-	Input Pin	-
	IN24	Input Value 24	-	Input Pin	-
	IN25	Input Value 25	-	Input Pin	-
	IN26	Input Value 26	-	Input Pin	-
	IN27	Input Value 27	-	Input Pin	-
	IN28	Input Value 28	-	Input Pin	-
	IN29	Input Value 29	-	Input Pin	-
	IN30	Input Value 30	-	Input Pin	-
	IN31	Input Value 31	-	Input Pin	-
	IN32	Input Value 32	-	Input Pin	-
	IN33	Input Value 33	-	Input Pin	-
	IN34	Input Value 34	-	Input Pin	-

Table 14.1 SEND_MIX parameter description (continued)

Name			Description	Upload	Properties	Application Reference
	Output Pin	ERR	Abnormal Operation	-	Output Pin	Refer to "Introduction"
		STA	Working Status, When STA is not equal to 0, set ERR=ON and alarm	-	Output Pin	Refer to "Introduction"
	Configuration Parameter	SN	erial Number of Function Block, Range 0~7	-	Configuration Parameter	-

14.2.2 Application Example

To achieve the analog and digital data exchange and read functions between domain 0# CS 2# and domain 1# CS 4#. Domain 0# CS 2# sends data and domain 1# CS 4# receive data.

It can achieve the data read and exchange functions between CSs and control domains of the system.

The programming is shown below. It applies SEND_MIX to send data and applies GET_MIX to receive data.

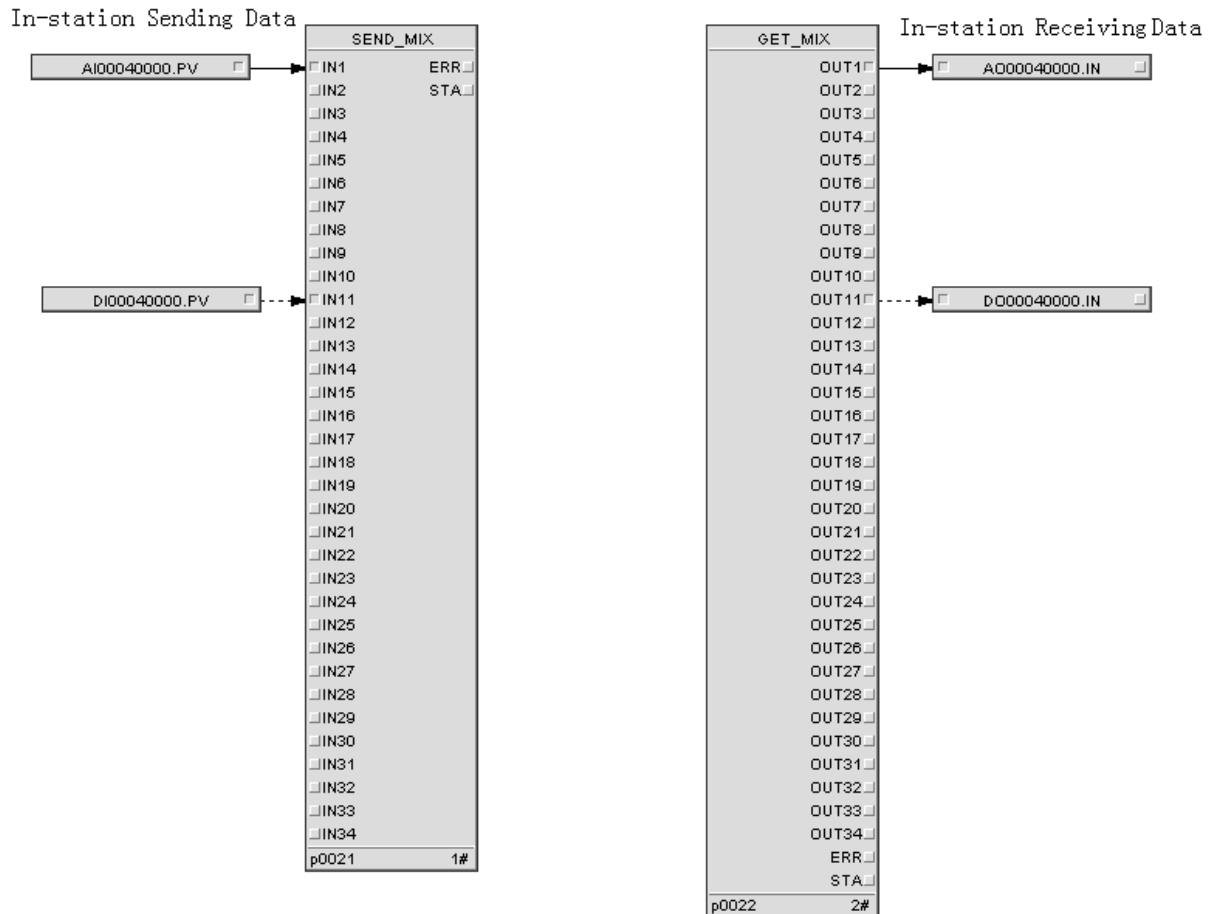


Figure 14.1 Program of In-station Communication

Instructions of function block and example are shown below.

Table 14.2 Instructions of Function Block and Example

No.	Example	Type	Instruction
001	AI00040000	AI Input	Send In-station Communication
002	DI00040000	DI Input	Send In-station Communication
003	AO00040000	AO Output	Receive In-station Communication
004	DO00040000	DO Output	Receive In-station Communication

Table 14.3 SEND_MIX

No.	Example	Type	Instruction	Remarks
Input Parameter				
001	IN1~IN10	No. 1~10 Input Pin	REAL	Corresponding to Output Pins OUT1~OUT10 of GET_MIX
002	IN11~IN34	No. 11~34 Input Pin	BOOL	Corresponding to Output Pins OUT11~OUT34 of GET_MIX

Table 14.3 SEND_MIX (continued)

No.	Example	Type	Instruction	Remarks
Configuration Parameter				
001	SN	Serial No. of Function Block [0,7]	Settings in Module	In the same control station, the SN serial numbers cannot be repetitive among the sending function blocks as well as among function blocks of the same type.

Table 14.4 GET_MIX

No.	Example	Type	Instruction	Remarks
Input Parameter				
001	OUT1~OUT10	No. 1~10 Output Pin	REAL	Corresponding to Input Pins OUT1~OUT10 of SEND_MIX
002	OUT11~OUT34	No. 11~34 Output Pin	BOOL	Corresponding to Input Pins OUT11~OUT34 of SEND_MIX
Configuration Parameter				
001	SN	Serial No. of Function Block [0,7]	Settings in Module	Set as 1Keep the same as the serial NO. of data sending station function block.
002	DMADDR1	Domain Address	Settings in Module	Set as 0Domain Address of Data Sending Station
003	IP	IP Address [2,127]	Settings in Module	Set as 2IP Address of Data Sending Station

Parameter settings of SEND_MIX: SN: 0~7

Parameter settings of GET_MIX:

- DMADDR: controller domain address of sending station. DMADDR: the range is [0, 15] when controller is FCU711, and the range is [0, 59] when controller is FCU712.
- IP: controller IP address of sending station
- SN: SEND_MIX serial No. of sending station

Alarm Settings: No alarm parameter setting.

14.3 GET_MIX Function Block

Corresponding to SEND_MIX, GET_MIX can get 10 REAL (OUT1~OUT10)and 24 (OUT11~OUT34)BOOL data.

The running time of this function block is 10μs.

GET_MIX	
OUT1	▢
OUT2	▢
OUT3	▢
OUT4	▢
OUT5	▢
OUT6	▢
OUT7	▢
OUT8	▢
OUT9	▢
OUT10	▢
OUT11	▢
OUT12	▢
OUT13	▢
OUT14	▢
OUT15	▢
OUT16	▢
OUT17	▢
OUT18	▢
OUT19	▢
OUT20	▢
OUT21	▢
OUT22	▢
OUT23	▢
OUT24	▢
OUT25	▢
OUT26	▢
OUT27	▢
OUT28	▢
OUT29	▢
OUT30	▢
OUT31	▢
OUT32	▢
OUT33	▢
OUT34	▢
ERR	▢
STA	▢
p0118	8#

14.3.1 Parameter Instruction

Table 14.5 GET_MIX parameter instruction

Name			Description	Upload	Properties	Application Reference
Basic Parameters	Output Pin	OUT1	Output Value 1	-	Output Pin	-
		OUT2	Output Value 2	-	Output Pin	-
		OUT3	Output Value 3	-	Output Pin	-
		OUT4	Output Value 4	-	Output Pin	-
		OUT5	Output Value 5	-	Output Pin	-
		OUT6	Output Value 6	-	Output Pin	-

Table 14.5 GET_MIX parameter instruction (continued)

Name			Description	Upload	Properties	Application Reference
		OUT7	Output Value 7	-	Output Pin	-
		OUT8	Output Value 8	-	Output Pin	-
		OUT9	Output Value 9	-	Output Pin	-
		OUT10	Output Value 10	-	Output Pin	-
		OUT11	Output Value 11	-	Output Pin	-
		OUT12	Output Value 12	-	Output Pin	-
		OUT13	Output Value 13	-	Output Pin	-
		OUT14	Output Value 14	-	Output Pin	-
		OUT15	Output Value 15	-	Output Pin	-
		OUT16	Output Value 16	-	Output Pin	-
		OUT17	Output Value 17	-	Output Pin	-
		OUT18	Output Value 18	-	Output Pin	-
		OUT19	Output Value 19	-	Output Pin	-
		OUT20	Output Value 20	-	Output Pin	-
		OUT21	Output Value 21	-	Output Pin	-
		OUT22	Output Value 22	-	Output Pin	-
		OUT23	Output Value 23	-	Output Pin	-
		OUT24	Output Value 24	-	Output Pin	-
		OUT25	Output Value 25	-	Output Pin	-

Table 14.5 GET_MIX parameter instruction (continued)

Name			Description	Upload	Properties	Application Reference
		OUT26	Output Value 26	-	Output Pin	-
		OUT27	Output Value 27	-	Output Pin	-
		OUT28	Output Value 28	-	Output Pin	-
		OUT29	Output Value 29	-	Output Pin	-
		OUT30	Output Value 30	-	Output Pin	-
		OUT31	Output Value 31	-	Output Pin	-
		OUT32	Output Value 32	-	Output Pin	-
		OUT33	Output Value 33	-	Output Pin	-
		OUT34	Output Value 34	-	Output Pin	-
		ERR	Abnormal Operation	-	Output Pin	Refer to "Introduction"
		STA	Working Status, When STA is not equal to 0, set ERR=ON and alarm	-	Output Pin	Refer to "Introduction"
	Configuration Parameter	DMADDR ¹	When the controller module is FCU711, DMADDR range is [0,15]. When the controller module is FCU712, DMADDR range is [0,59].	-	Configuration Parameter	corresponding to sending domain address
		IP	IP Address	-	Configuration Parameter	corresponding to sending IP res
		SN	Serial Number of Function Block, Range0~7	-	Configuration Parameter	-

DMADDR¹: the range is [0, 15] when controller is FCU711, and the range is [0, 59] when controller is FCU712.

14.3.2 Application Example

Refer to "Application Example".

14.4 SEND_REAL Function Block

Function block SEND_REAL can send 16 REAL data.
The running time of this function block is 10μs.

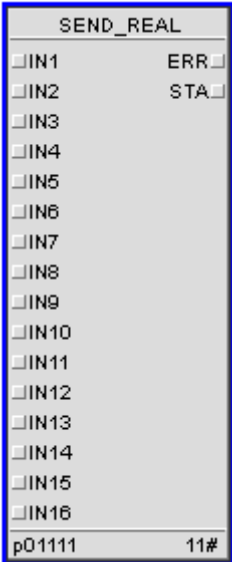


Table 14.6 SEND_REAL parameter instruction

Name			Description	Upload	Properties	Application Reference
Basic Para- meters	Input Pin	IN1	Input Value 1	-	Input Pin	-
		IN2	Input Value 2	-	Input Pin	-
		IN3	Input Value 3	-	Input Pin	-
		IN4	Input Value 4	-	Input Pin	-
		IN5	Input Value 5	-	Input Pin	-
		IN6	Input Value 6	-	Input Pin	-
		IN7	Input Value 7	-	Input Pin	-
		IN8	Input Value 8	-	Input Pin	-
		IN9	Input Value 9	-	Input Pin	-

Table 14.6 SEND_REAL parameter instruction (continued)

Name			Description	Upload	Properties	Application Reference
		IN10	Input Value 10	-	Input Pin	-
		IN11	Input Value 11	-	Input Pin	-
		IN12	Input Value 12	-	Input Pin	-
		IN13	Input Value 13	-	Input Pin	-
		IN14	Input Value 14	-	Input Pin	-
		IN15	Input Value 15	-	Input Pin	-
		IN16	Input Value 16	-	Input Pin	-
	Output Pin	ERR	Abnormal Operation	-	Output Pin	Refer to "Introduction"
		STA	Working Status, When STA is not equal to 0, set ERR=ON and alarm	-	Output Pin	Refer to "Introduction"
	Configuration Parameter	SN	Serial Number of Function Block, Range0~7	-	Configuration Parameter	-

14.5 GET_REAL Function Block

Corresponding to SEND_REAL, GET_REAL can get 16 REAL data.

The running time of this function block is 10μs.

GET_REAL	
OUT1	□
OUT2	□
OUT3	□
OUT4	□
OUT5	□
OUT6	□
OUT7	□
OUT8	□
OUT9	□
OUT10	□
OUT11	□
OUT12	□
OUT13	□
OUT14	□
OUT15	□
OUT16	□
ERR	□
STA	□
p01112	12#

Table 14.7 GET_REAL parameter instruction

Name			Description	Upload	Properties	Application Reference
Basic Parameters	Output Pin	OUT1	Output Value 1	-	Output Pin	-
		OUT2	Output Value 2	-	Output Pin	-
		OUT3	Output Value 3	-	Output Pin	-
		OUT4	Output Value 4	-	Output Pin	-
		OUT5	Output Value 5	-	Output Pin	-
		OUT6	Output Value 6	-	Output Pin	-
		OUT7	Output Value 7	-	Output Pin	-
		OUT8	Output Value 8	-	Output Pin	-
		OUT9	Output Value 9	-	Output Pin	-
		OUT10	Output Value 10	-	Output Pin	-
		OUT11	Output Value 11	-	Output Pin	-
		OUT12	Output Value 12	-	Output Pin	-
		OUT13	Output Value 13	-	Output Pin	-
		OUT14	Output Value 14	-	Output Pin	-
		OUT15	Output Value 15	-	Output Pin	-
		OUT16	Output Value 16	-	Output Pin	-
		ERR	Abnormal Operation	-	Output Pin	Refer to "Introduction"
		STA	Working Status, When STA is not equal to 0, set ERR=ON and alarm	-	Output Pin	Refer to "Introduction"
	Configuration Parameter	DMADDR ¹	When the controller module is FCU711, DMADDR range is [0,15]. When the controller module is FCU712 ,	-	Configuration Parameter	corresponding to sending domain address

Table 14.7 GET_REAL parameter instruction (continued)

Name			Description	Upload	Properties	Application Reference
			DMADDR range is [0,59].			
		IP	IP Address, Range 2~17	-	Configuration Parameter	corresponding to sending IP res
		SN	Serial Number of Function Block, Range 0~7	-	Configuration Parameter	-

DMADDR¹: the range is [0, 15] when controller is FCU711, and the range is [0, 59] when controller is FCU712.

14.6 SENDSPEC Function Block

SENDSPEC can send 2 LREAL (IN1~IN2), 3 DINT(IN3~IN5), 3 UDINT (IN6~IN8), 4 INT (IN9~IN12), 4 UNIT (IN13~IN16), 4 SINT (IN17~IN20) and 4 USINT (IN21~IN24) data.

In the user program window, if FCU731 is used, SENDSPEC function block is named as SENDSPEC_X, which shares the same functions as SENDSPEC.

The running time of this function block is 10μs.

SENDSPEC		* SENDSPEC_X	
<input type="checkbox"/> IN1	ERR <input type="checkbox"/>	<input type="checkbox"/> IN1	ERR <input type="checkbox"/>
<input type="checkbox"/> IN2	STA <input type="checkbox"/>	<input type="checkbox"/> IN2	STA <input type="checkbox"/>
<input type="checkbox"/> IN3		<input type="checkbox"/> IN3	
<input type="checkbox"/> IN4		<input type="checkbox"/> IN4	
<input type="checkbox"/> IN5		<input type="checkbox"/> IN5	
<input type="checkbox"/> IN6		<input type="checkbox"/> IN6	
<input type="checkbox"/> IN7		<input type="checkbox"/> IN7	
<input type="checkbox"/> IN8		<input type="checkbox"/> IN8	
<input type="checkbox"/> IN9		<input type="checkbox"/> IN9	
<input type="checkbox"/> IN10		<input type="checkbox"/> IN10	
<input type="checkbox"/> IN11		<input type="checkbox"/> IN11	
<input type="checkbox"/> IN12		<input type="checkbox"/> IN12	
<input type="checkbox"/> IN13		<input type="checkbox"/> IN13	
<input type="checkbox"/> IN14		<input type="checkbox"/> IN14	
<input type="checkbox"/> IN15		<input type="checkbox"/> IN15	
<input type="checkbox"/> IN16		<input type="checkbox"/> IN16	
<input type="checkbox"/> IN17		<input type="checkbox"/> IN17	
<input type="checkbox"/> IN18		<input type="checkbox"/> IN18	
<input type="checkbox"/> IN19		<input type="checkbox"/> IN19	
<input type="checkbox"/> IN20		<input type="checkbox"/> IN20	
<input type="checkbox"/> IN21		<input type="checkbox"/> IN21	
<input type="checkbox"/> IN22		<input type="checkbox"/> IN22	
<input type="checkbox"/> IN23		<input type="checkbox"/> IN23	
<input type="checkbox"/> IN24		<input type="checkbox"/> IN24	
p01110	10#	p0001	1#

Table 14.8 SENDSPEC parameter instruction

Name			Description	Upload	Properties	Application Reference
Basic Parameters	Input Pin	IN1	Input Value1	-	Input Pin	-
		IN2	Input Value2	-	Input Pin	-
		IN3	Input Value3	-	Input Pin	-
		IN4	Input Value4	-	Input Pin	-
		IN5	Input Value5	-	Input Pin	-
		IN6	Input Value6	-	Input Pin	-
		IN7	Input Value7	-	Input Pin	-
		IN8	Input Value8	-	Input Pin	-
		IN9	Input Value9	-	Input Pin	-
		IN10	Input Value10	-	Input Pin	-
		IN11	Input Value11	-	Input Pin	-
		IN12	Input Value12	-	Input Pin	-
		IN13	Input Value13	-	Input Pin	-
		IN14	Input Value14	-	Input Pin	-
		IN15	Input Value15	-	Input Pin	-
		IN16	Input Value16	-	Input Pin	-
		IN17	Input Value17	-	Input Pin	-
		IN18	Input Value18	-	Input Pin	-
		IN19	Input Value19	-	Input Pin	-
		IN20	Input Value20	-	Input Pin	-
		IN21	Input Value21	-	Input Pin	-
		IN22	Input Value22	-	Input Pin	-
		IN23	Input Value23	-	Input Pin	-
		IN24	Input Value24	-	Input Pin	-
	Output pin	ERR	Abnormal Operation	-	Output Pin	Refer to "Introduction"
		STA	Working Status, When STA is not equal to 0, set ERR=ON and alarm	-	Output Pin	Refer to "Introduction"

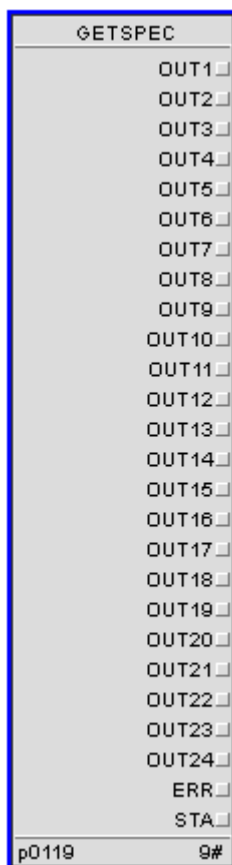
Table 14.8 SENDSPEC parameter instruction (continued)

Name			Description	Upload	Properties	Application Reference
	Configuration Parameter	SN	Serial Number of Function Block, Range 0~7	-	Configuration Parameter	-

14.7 GETSPEC Function Block

Corresponding to SENDSPEC, GETSPEC can receive 2 LREAL(IN1~IN2), 3 DINT(IN3~IN5), 3 UDINT(IN6~IN8), 4 INT(IN9~IN12), 4 UNIT(IN13~IN16), 4 SINT(IN17~IN20) and 4 USINT(IN21~IN24).

The running time of this function block is 10μs.

**Table 14.9 GETSPEC parameter instruction**

Name			Description	Upload	Properties	Application Reference
Basic Parameters	Output Pin	OUT1	Output Value 1	-	Output Pin	-
		OUT2	Output Value 2	-	Output Pin	-
		OUT3	Output Value 3	-	Output Pin	-

Table 14.9 GETSPEC parameter instruction (continued)

Name			Description	Upload	Properties	Application Reference
		OUT4	Output Value 4	-	Output Pin	-
		OUT5	Output Value 5	-	Output Pin	-
		OUT6	Output Value 6	-	Output Pin	-
		OUT7	Output Value 7	-	Output Pin	-
		OUT8	Output Value 8	-	Output Pin	-
		OUT9	Output Value 9	-	Output Pin	-
		OUT10	Output Value 10	-	Output Pin	-
		OUT11	Output Value 11	-	Output Pin	-
		OUT12	Output Value 12	-	Output Pin	-
		OUT13	Output Value 13	-	Output Pin	-
		OUT14	Output Value 14	-	Output Pin	-
		OUT15	Output Value 15	-	Output Pin	-
		OUT16	Output Value 16	-	Output Pin	-
		OUT17	Output Value 17	-	Output Pin	-
		OUT18	Output Value 18	-	Output Pin	-
		OUT19	Output Value 19	-	Output Pin	-
		OUT20	Output Value 20	-	Output Pin	-
		OUT21	Output Value 21	-	Output Pin	-
		OUT22	Output Value 22	-	Output Pin	-
		OUT23	Output Value 23	-	Output Pin	-

Table 14.9 GETSPEC parameter instruction (continued)

Name			Description	Upload	Properties	Application Reference
		OUT24	Output Value 24	-	Output Pin	-
		ERR	Abnormal Operation	-	Output Pin	Refer to "Introduction"
		STA	Working Status, When STA is not equal to 0, set ERR=ON and alarm	-	Output Pin	Refer to "Introduction"
	Configuration Parameter	DMADDR ¹	When the controller module is FCU711, DMADDR range is [0,15]. When the controller module is FCU712, DMADDR range is [0,59].	-	Configuration Parameter	corresponding to sending domain address
		IP	IP Address, Range 2~17	-	Configuration Parameter	corresponding to sending IP res
		SN	Serial Number of Function Block, Range 0~7	-	Configuration Parameter	-

DMADDR¹: the range is [0, 15] when controller is FCU711, and the range is [0, 59] when controller is FCU712.

14.8 UDINT Data Inter-station Send Function Block (SEND_UDINT)

UDINT data inter-station send function block sends 16 UDINT data.

Its running time is 10μs.

SEND_UDINT	
<input type="checkbox"/> IN1	ERR <input type="checkbox"/>
<input type="checkbox"/> IN2	STA <input type="checkbox"/>
<input type="checkbox"/> IN3	
<input type="checkbox"/> IN4	
<input type="checkbox"/> IN5	
<input type="checkbox"/> IN6	
<input type="checkbox"/> IN7	
<input type="checkbox"/> IN8	
<input type="checkbox"/> IN9	
<input type="checkbox"/> IN10	
<input type="checkbox"/> IN11	
<input type="checkbox"/> IN12	
<input type="checkbox"/> IN13	
<input type="checkbox"/> IN14	
<input type="checkbox"/> IN15	
<input type="checkbox"/> IN16	
p0007	1#

Table 14.10 Parameters of SEND_UDINT

Name			Description	Upload	Properties	Application Reference
Basic Parameter	Input Pin	IN1	Input Value 1	-	Input Pin	-
		IN2	Input Value 2	-	Input Pin	-
		IN3	Input Value 3	-	Input Pin	-
		IN4	Input Value 4	-	Input Pin	-
		IN5	Input Value 5	-	Input Pin	-
		IN6	Input Value 6	-	Input Pin	-
		IN7	Input Value 7	-	Input Pin	-
		IN8	Input Value 8	-	Input Pin	-
		IN9	Input Value 9	-	Input Pin	-
		IN10	Input Value 10	-	Input Pin	-
		IN11	Input Value 11	-	Input Pin	-
		IN12	Input Value 12	-	Input Pin	-
		IN13	Input Value 13	-	Input Pin	-
		IN14	Input Value 14	-	Input Pin	-
		IN15	Input Value 15	-	Input Pin	-
		IN16	Input Value 16	-	Input Pin	-
	Output Pin	ERR	Function Block Illegal Alarm	-	Output Pin	Refer to "Introduction"

Table 14.10 Parameters of SEND_UDINT (continued)

Name			Description	Upload	Properties	Application Reference
		STA	Function block status. When STA is not equal to 0, generate ERR=ON alarm.	-	Output Pin	Refer to "Introduction"
	Configuration Parameter	SN	Function Serial No. [0,7]	-	Configuration Parameter	-

14.9 UDINT Data Inter-station Get Function Block (GET_UDINT)

UDINT data inter-station sending function block gets 16 UDINT data.

Its running time is 10μs.

GET_UDINT

OUT1 ☐

OUT2 ☐

OUT3 ☐

OUT4 ☐

OUT5 ☐

OUT6 ☐

OUT7 ☐

OUT8 ☐

OUT9 ☐

OUT10 ☐

OUT11 ☐

OUT12 ☐

OUT13 ☐

OUT14 ☐

OUT15 ☐

OUT16 ☐

ERR ☐

STA ☐

p0006 1#

Table 14.11 Parameters of SEND_UDINT

Name			Description	Upload	Properties	Application Reference
Basic Parameter	Output	OUT1	Calculate Output Value 1	-	Output Pin	-
		OUT2	Calculate Output Value 2	-	Output Pin	-
		OUT3	Calculate Output Value 3	-	Output Pin	-
		OUT4	Calculate Output Value 4	-	Output Pin	-
		OUT5	Calculate Output Value 5	-	Output Pin	-

Table 14.11 Parameters of SEND_UDINT (continued)

Name			Description	Upload	Properties	Application Reference
		OUT6	Calculate Output Value 6	-	Output Pin	-
		OUT7	Calculate Output Value 7	-	Output Pin	-
		OUT8	Calculate Output Value 8	-	Output Pin	-
		OUT9	Calculate Output Value 9	-	Output Pin	-
		OUT10	Calculate Output Value 10	-	Output Pin	-
		OUT11	Calculate Output Value 11	-	Output Pin	-
		OUT12	Calculate Output Value 12	-	Output Pin	-
		OUT13	Calculate Output Value 13	-	Output Pin	-
		OUT14	Calculate Output Value 14	-	Output Pin	-
		OUT15	Calculate Output Value 15	-	Output Pin	-
		OUT16	Calculate Output Value 16	-	Output Pin	-
		ERR	Function Block Illegal Alarm	-	Output Pin	Refer to "Introduction"
		STA	Function Block status. When STA is not eual to 0, generate ER-R=ON alarm.	-	Output Pin	Refer to "Introduction"
	Con-figuration Parameter	DMAD-DR	When the controller module is FCU711, DMADDR range is [0,15]. When the controller module is FCU712 , DMADDR range is [0,59].	-	Configura-tion Para-meter	Correspond to Send Domain Address
		IP	IP Address [2,127]	-	Configura-tion Para-meter	Correspond to Send IP Ad-dress
		SN	Function Serial No. [0,7]	-	Configura-tion Para-meter	-

DMADDR¹: the range is [0, 15] when controller is FCU711, and the range is [0, 59] when controller is FCU712.

14.10 Inter-station Communication Programming Example

Tag FT001 is collected by controller 1(physical address 0.4), and controller 2(physical address 10.6) needs the value of this tag and compel/uncompel status to put into calculation. In controller

2, we use user-defined analog parameter FT_001 to receive the value of FT001.PV and use user-defined digital parameter FT_001_SWAM to receive the value of FT001.SWAM. Then, Controller 1 builder is shown below:

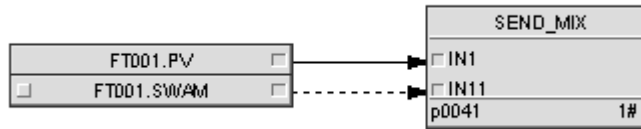


Figure 14.2 Program

Controller 2 builder is shown below:

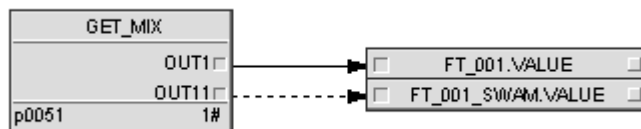


Figure 14.3 Program

Initial Setting:

- For controller 1, set the function block number of SEND_MIX SN=3. Other parameters remain unchanged.
- For controller 2, set the address of domain of GET_MIX to be 0, IP address to be 4 and function block number SN to be 3. Other parameters remain unchanged.

15 Industrial Function Block Library

The function blocks of industrial function block library are complex function block. All blocks have panel corresponding and can setup parameters in the panel.

15.1 BLDSET Function Block

The batch set control function block is a function block that combines the control of multi-component online, including flow control function block (BLDSET) and blending master control function block (BLDMST).

The BLDSET function block completes the batch control of the single component blending traffic, it's the flow setting value,, the control command and current main control module status come from the blending master function block BLDMST. BLDMST performs proportional integral control based on the cumulative deviation of the flow according to the current measured value of the component flow, and output the control valve opening signal (MV). It can also set different working modes. In the auto mode, the flow rate setting value (SV) can be manually set for proportional integral control, or the control valve opening signal (MV) can be directly set manually. The BLDMST function block will blend the blending ratio of each component multiplied by the flow setting value (SV) blended, and the result is set as the set value of the BLDSET function block of each blending component (SV) perform component flow control. BLDMST accumulates the instantaneous traffic of each set of flow control function block BLDSET, thereby implementing online batch control.

As shown in the figure below, the BLDSET function block and the BLDMST I function block is combined in the process shown below.

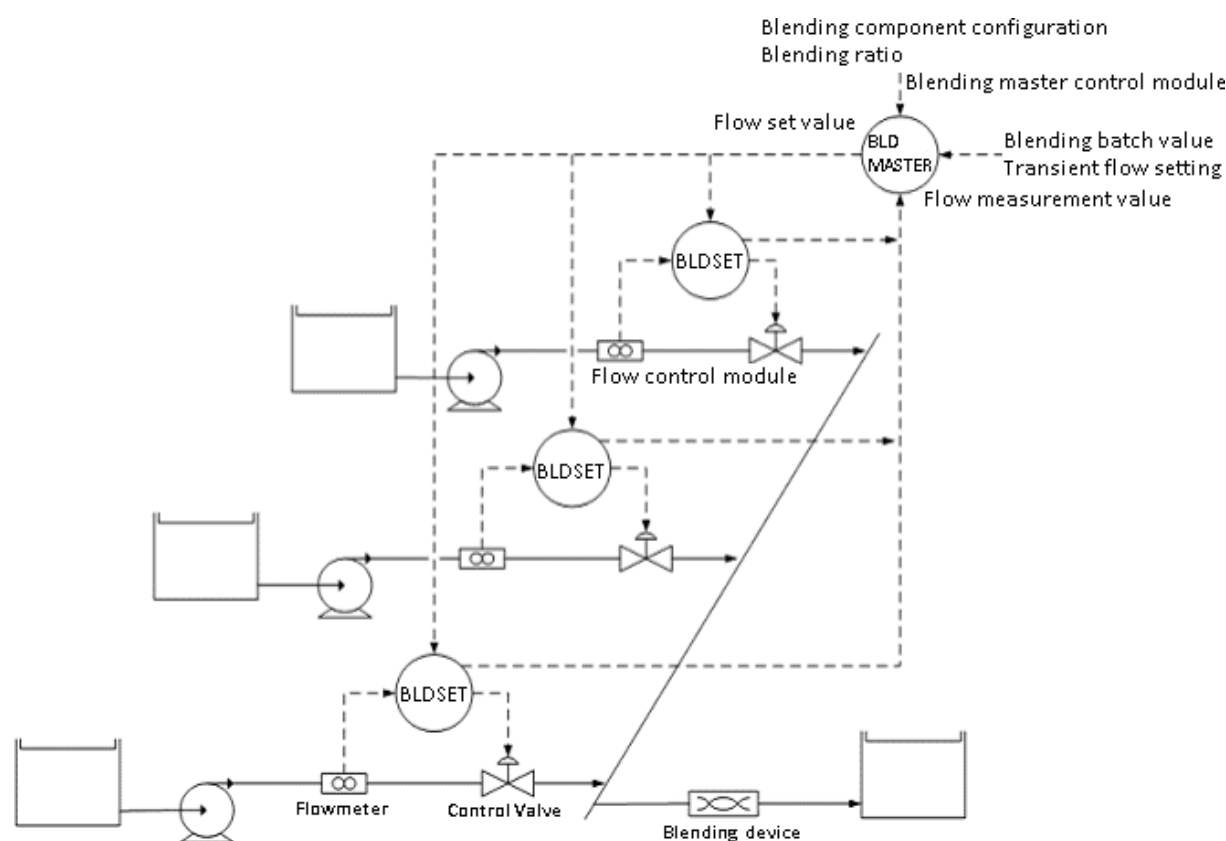


Figure 15.1 Oil blending function block work flow instance

Before using the BLDSET function block, please make sure that you have a software dongle named "Oil Blending Software".

* BLDSET	
0.00	<input type="checkbox"/> IN MV
OFF	<input type="checkbox"/> PVERR PV
OFF	<input type="checkbox"/> MVERR ALM
0	<input type="checkbox"/> M_CMD
0	<input type="checkbox"/> M_PHASE
0.00	<input type="checkbox"/> CSV
1.00	<input type="checkbox"/> K3
p0001	1#

15.1.1 Parameter Description

BLDSET function block's parameters are listed in the table below.

Parameter Name		Type	Description	Upload
Input pin	IN	REAL	Measured flow	-
	PVERR	BOOL	PV fault	-
	MVERR	BOOL	MV fault	-
	M_CMD	USINT	command issued by BLD MST	-

Parameter Name		Type	Description	Upload
	M_PHASE	USINT	BLD MST's phase	-
	CSV	REAL	cascade input issued by BLD MST	-
	K3	REAL	temperature compensate factor	-
Output pin	MV	REAL	output value, and it is required to connect to the same variable as MANMV when users are configuring	-
	PV	REAL	instantaneous flow rate to BLD MST	-
	ALM	USINT	alarm to BLD MST	-
Alarm enable and shield	FLAG	UDINT	flag	-
	AOF	BOOL	suppress alarm	TRUE
	ENALM	UDINT	alarm enable settings	TRUE
Monitoring Parameter	PHASE	USINT	control phase	TRUE
	SUM0	REAL	totalized value	-
	SUM	REAL	totalized value per batch	-
	SUM1	REAL	totalized value before compensation	-
	EI	REAL	deviation	-
	DV	REAL	accumulated deviation	-
Operation Parameter	PREMV	REAL	MV when batch started	-
	PB	REAL	proportion bond size	TRUE
	TI	REAL	integral time, unit is second	TRUE
	MVH	REAL	MV H limit value	TRUE
	MVL	REAL	MV L limit value	TRUE
	SVH	REAL	SV H limit value	TRUE
	SVL	REAL	SV L limit value	TRUE
	DMVLIM	REAL	MV output rate variety limit value	TRUE
	K1	REAL	pre process factor K1	TRUE
	K2	REAL	factor after compensation K2	TRUE
	LKH	REAL	leakage alarm limit	TRUE
	SWDV1	BOOL	deviation H limit alarm enabled	TRUE
	SWDV2	BOOL	deviation HH limit alarm enabled	TRUE

Parameter Name		Type	Description	Upload
	DL1	REAL	deviation H limit alarm limit	TRUE
	DL2	REAL	deviation HH limit alarm limit	TRUE
	SWPN	BOOL	direct/reverse switch: off=direct action, on=reverse action	TRUE
	SWAM	BOOL	manual/auto switch : off=direct, on=auto	TRUE
	SWSV	BOOL	auto cascade selection: off>manual, on=auto	TRUE
	SV	REAL	SV	TRUE
	MANMV	REAL	Manual output value	TRUE
OOS setting	SWOOS	BOOL	switch out of service	TRUE
Configura- tion param- eter	MVSCH	REAL	MV high scale	-
	MVSCL	REAL	MV low scale	-
	SVSCH	REAL	SV high scale	-
	SVSCL	REAL	SV low scale	-
	SVEU	EUNIT	SV engineer unit	-
	MVEU	EUNIT	MV engineer unit	-
	SUMEU	EUNIT	SUM engineer unit	-
	SVDLEN	USINT	SV decimal digits [0,5]	-
	MVDLEN	USINT	MV decimal digits [0,5]	-
	HORLIM	REAL	high overrange limit	-
	LORLIM	REAL	low overrange limit	-
fast slow in- crease de- crease set- ting	SMV	REAL	manual slow increase/decrease value	TRUE
	FMV	REAL	manual fast increase/decrease value	TRUE
	SSV	REAL	SV slow increase/decrease value	TRUE
	FSV	REAL	SV fast increase/decrease value	TRUE

**ATTENTION:**

The lower limits of SV and MV of BLDSET function block must be set as 0.

15.1.2 BLDSET Single Period Execution Steps

As a slave function block, BLDSET can perform related actions according to the instructions of BLDMST, and can also change SWAM and SWSV for cascade, automatic and manual switching, so as to realize individual operation. The execution process of BLDSET is shown in the figure below, where CSV is the flow setting value issued by MASTER.

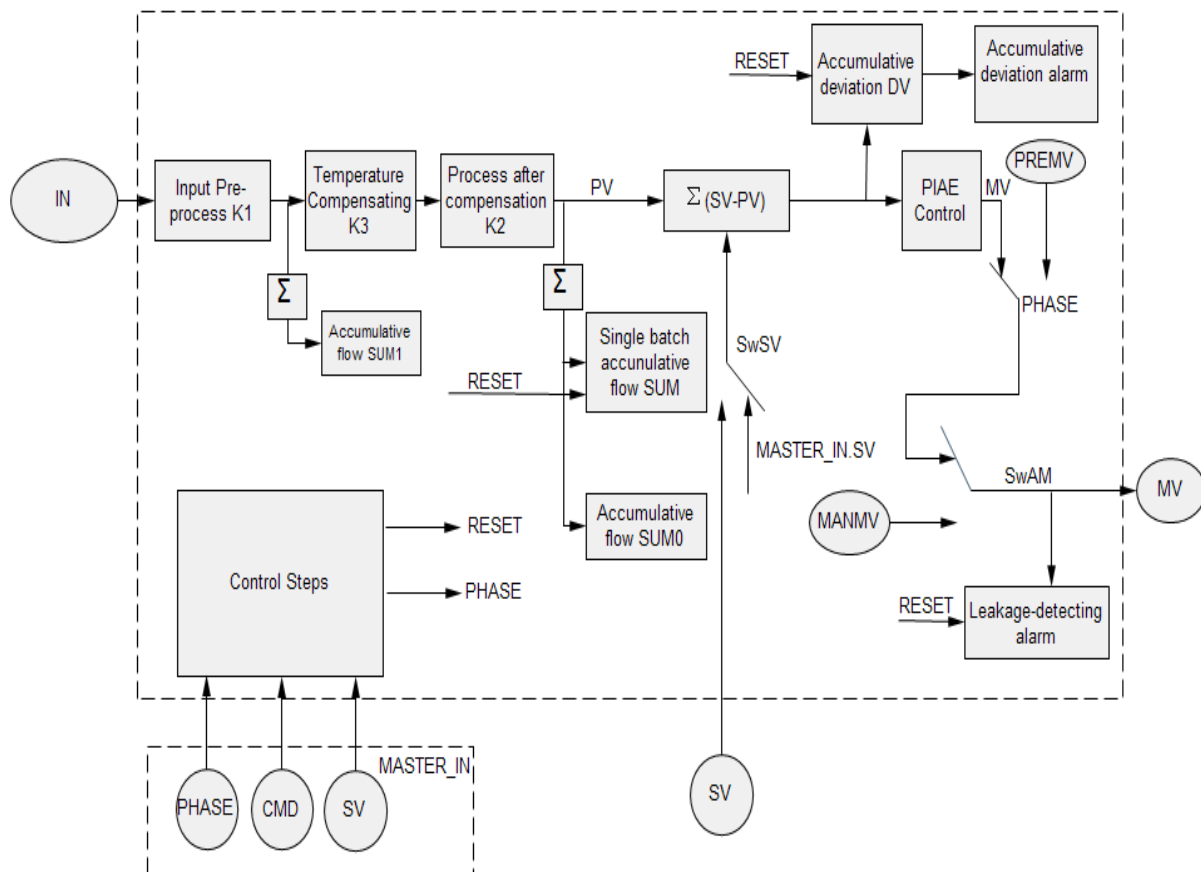


Figure 15.2 *BLDSETsingle* period execution steps

BLDSET's control process includes 8 steps, including:

PHASE	Description
0	Idle status
1	start status
2	restart status
3	blend proportionintegral control
4	pending ends
5	emergent stop
6	component release
7	release pending
8	end

A complete control process is shown as below figure.

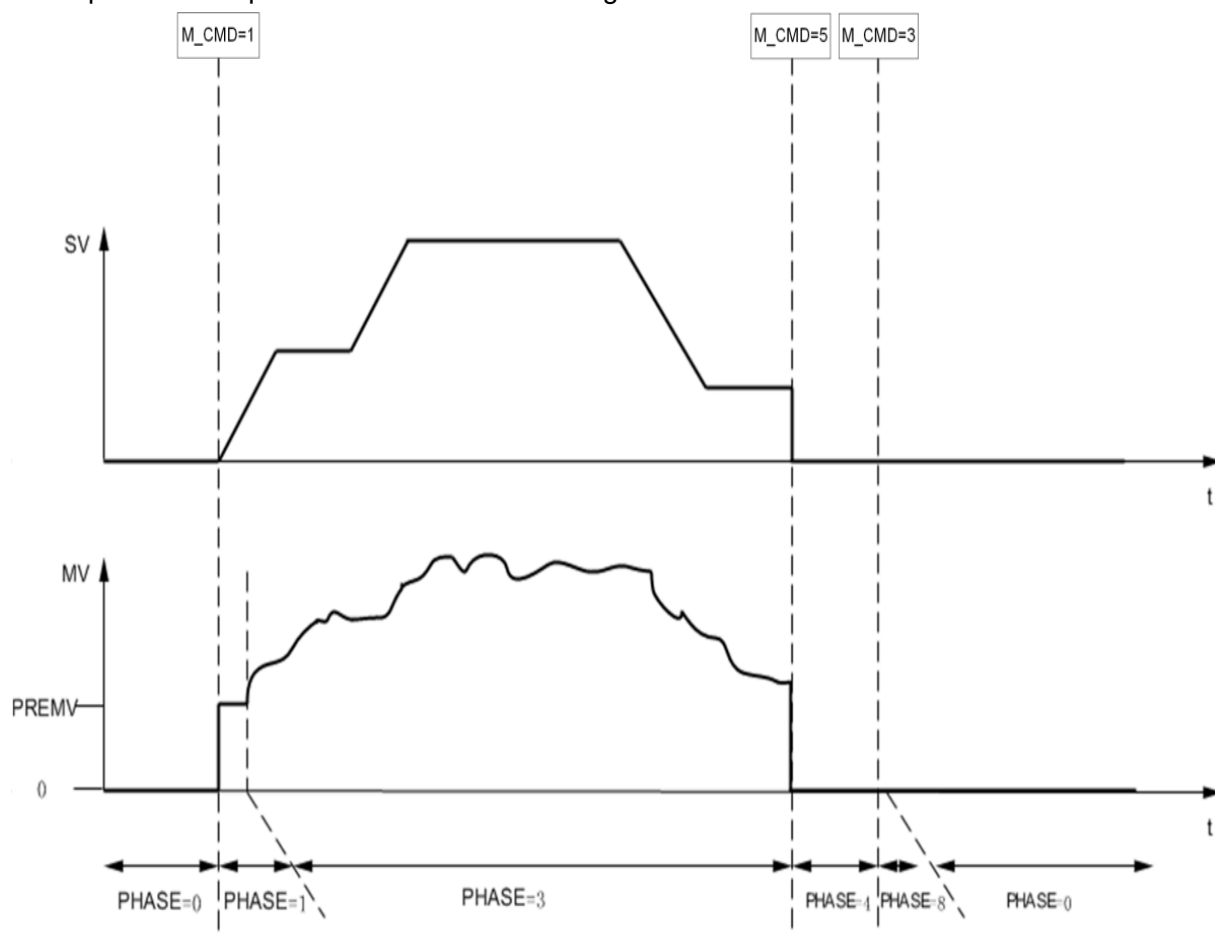


Figure 15.3 BLDSET control process after received the command of Restart (CMD=2) and Emergency Stop (CMD=4).

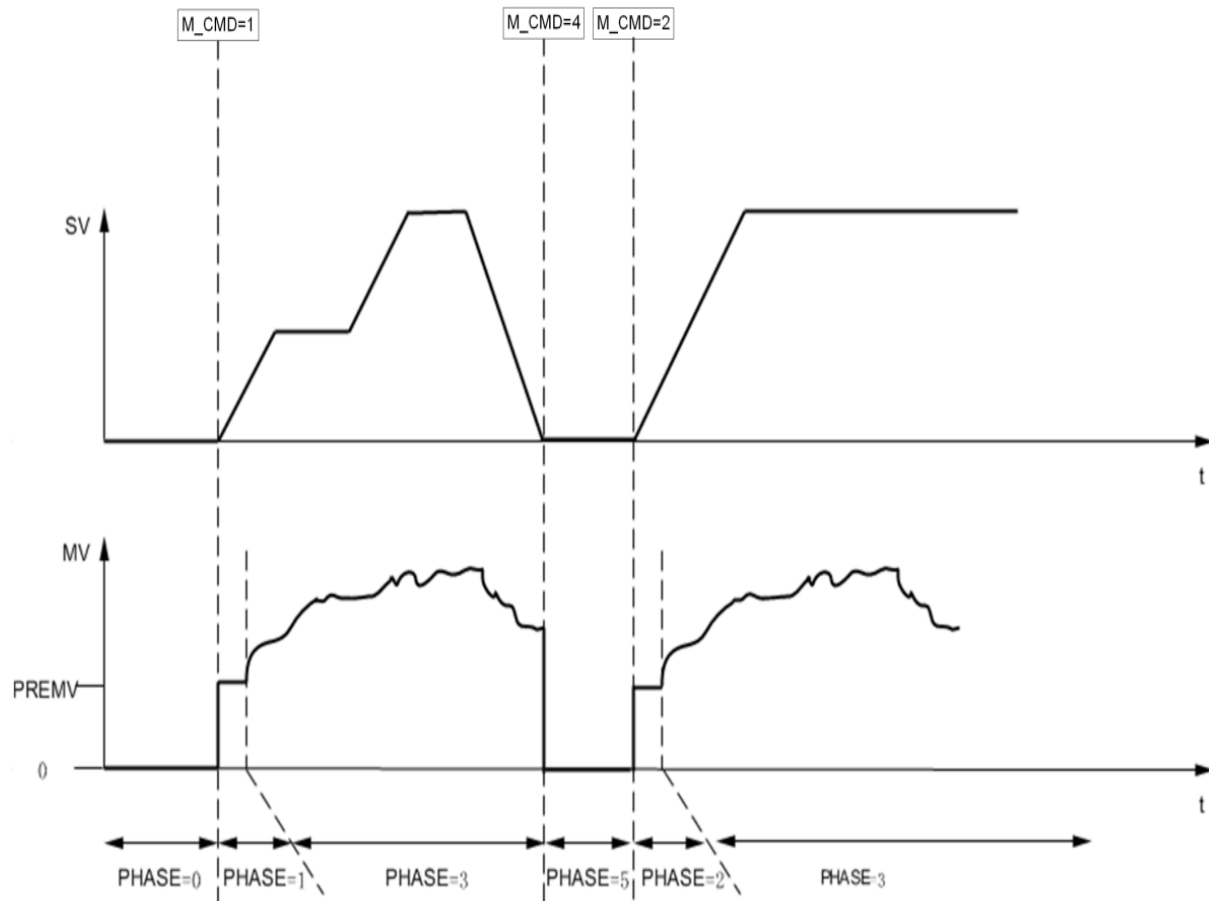


Figure 15.4 BLDSET emergency stop and restart control process

15.1.3 Flow Pre-processing and Accumulation Calculation

The BLDSET function block pre-processes the flow measurement value, and then multiplies it by various compensation coefficients to obtain the corrected flow measurement value PV, where K3 is the temperature compensation coefficient.

$$PV = K1 \cdot K2 \cdot K3 \cdot IN$$

$$PV1 = K1 \cdot IN$$

Accumulate the flow measurement value to get each cumulative amount:

$$SUM1 = \sum PV1 \text{ (not reset to zero)}$$

$$SUM = \sum PV \text{ (start to end of batch)}$$

$$SUM0 = \sum PV \text{ (not reset to zero)}$$

15.1.4 Control Step Process

The BLDSET function block performs different actions according to the current control step, and jumps the control step according to the control instruction M_CMD of the upper level BLDMST or the change of its own status.

The jump sequence of the control steps is shown in Figure 15.5.

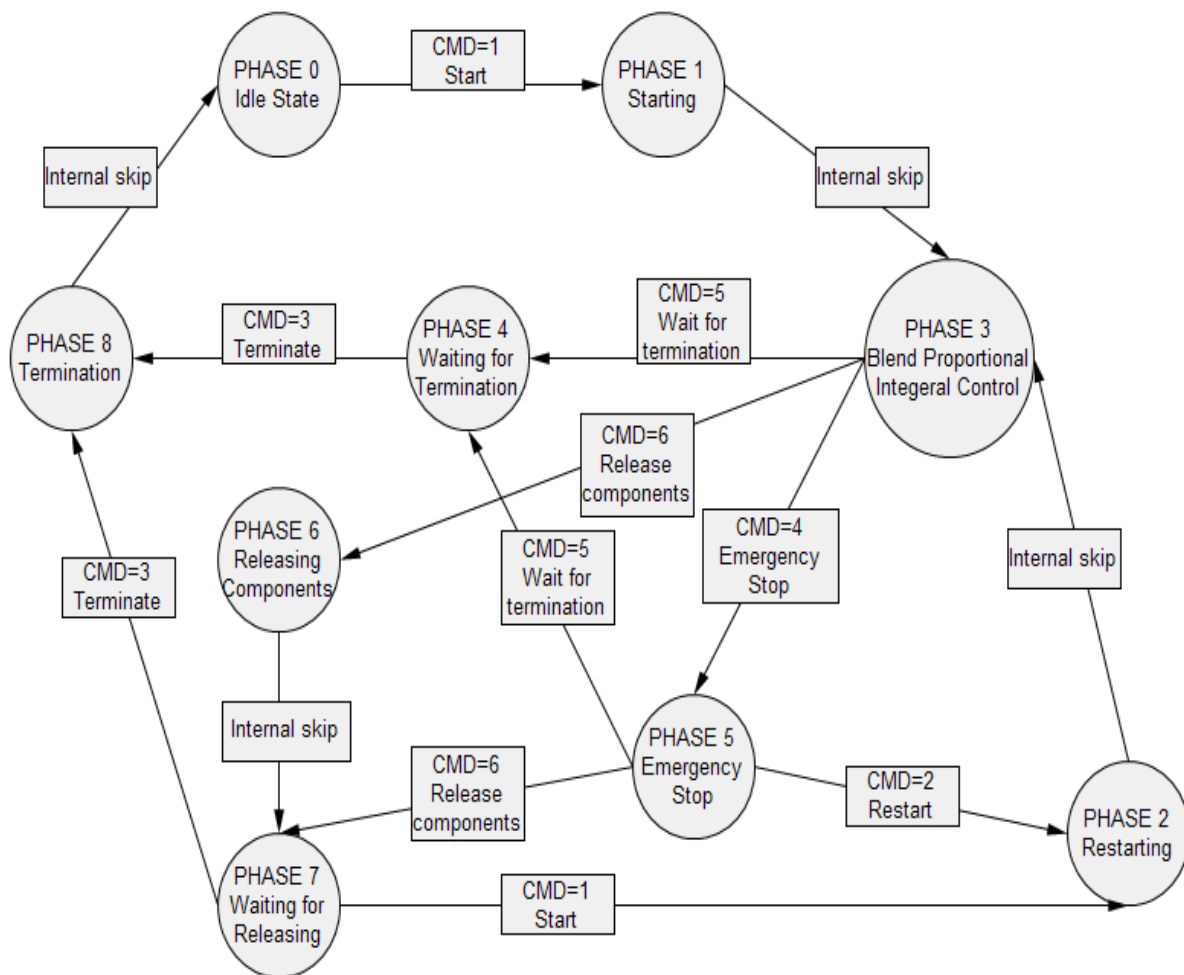


Figure 15.5 Jump sequence of the control step

The detailed operational content of each control step of BLDSET is shown in Table 15.1.

Table 15.1 The Operational Content of Each Control Step.

PHASE	Description	Acts
0	Idle State	<p>When SWAM=ON and SWSV=ON are satisfied, cascade mode is triggered: Blend control doesn't get started.</p> <p>When SWAM=ON and SWSV=OFF are satisfied, automatic mode is triggered: Conduct proportional integral control as per the flow setting value (SV) set by users. SV_O follows SV.</p> <p>When SWAM=OFF is satisfied, manual mode is triggered: MV is set manually by users; MV=MANMV; SV_O follows PV, and DV doesn't accumulate.</p>
1	Start State	<p>Valve small flow gets started(MV=PREMV)</p> <p>Initialize the value of alarm, SUM (accumulative amount) and DV (accumulative deviation), then skip to PHASE3 after two running periods.</p>
2	Restart State	Valve small flow gets started(MV=PREMV)

Table 15.1 The Operational Content of Each Control Step. (continued)

PHASE	Description	Acts
		Initialize the value of alarm and DV (accumulative deviation), then skip to PHASE3 after two running periods.
3	Blend Proportional Integral Control	<p>When SWAM=ON, SWSV=ON are satisfied, cascade mode: as per the flow setting values (CSV) sent from BLD MST, BLD MST conducts cumulative deviation blend proportional integral control as well as conducts cumulative deviation alarm. Only when BLD MST is in steady state control (PHASE=3), it transfers to automatic or manual mode. When BLD MST ends steady state control to enter batch termination prediction or emergency stop (PHASE=4、8), the mode would be forced to be cascade. If SV is bigger than CSV, then it will directly decrease to CSV while if SV is smaller than CSV, it will synchronized until CSV decreases to SV. When the superior BLD MST enters the adjustment phase due to the resetting of SVH, SV changes with CSV.</p> <p>When SWAM=ON, SWSV=OFF are satisfied, automatic mode: as per the flow setting values (SV) set by users, BLD MST conducts cumulative deviation proportional integral control.</p> <p>When SWAM=OFF is satisfied, manual mode: MV is set by users manually. SV_O follows PV, and cumulative deviation DV doesn't accumulate.</p>
4	Waiting for Termination	Close firmly the control valve and conduct cumulative deviation alarm
5	Emergency Stop	Close firmly the control valve and conduct cumulative deviation alarm
6	Component Release	MV gradually descends to 0 then the control step skips to PHASE7
7	Waiting for release	Close firmly the control valve and conduct cumulative deviation alarm
8	Termination	Close firmly the control valve and then the control step skips to PHASE 0

The control commands sent by BLD MST are shown in Table 15.2.

Table 15.2 Control step's execution content

CMD	Description	Acts
1	Start	<p>In PHASE 0, if M_PHASE=1 (blend starts) is satisfied, and after it receives this command, SWAM turns to ON means automatic mode and SWSV turns to ON means cascade mode and then the control step enters PHASE 1.</p> <p>In PHASE 0, if M_PHASE=3 (add components during blend) is satisfied, and SWAM=OFF is satisfied at the same time, the control step turns to PHASE 1.</p> <p>In PHASE 7 and M_PHASE =3 is satisfied, if this command is received, it means the deleted component has already been re-added during the blend control, SWAM turns to be OFF and control step skips to PHASE 2.</p> <p>In PHASE 7 and M_PHASE =9 is satisfied, if this command is received, it means the deleted component restarts following other components, SWAM and SWSV turn to be ON, and control step skips to PHASE 2.</p> <p>It doesn't respond to this command in other modes.</p>

Table 15.2 Control step's execution content (continued)

CMD	Description	Acts
2	Restart	In PHASE 5, if this command is received, it means the emergency stop status ends and the control step enters PHASE 2. It doesn't respond to this command in other modes.
3	Termination	In PHASE 4, if this command is received, it means blend ends and the control step skips to PHASE 8. In PHASE 7, if this command is received, it means blend ends and the control step skips to PHASE 8. It doesn't respond to this command in other modes.
4	Emergency Stop	In PHASE 3, if this command is received, it means system starts emergency stop and enter PHASE 5. It doesn't respond to this command in other modes.
5	Waiting for termination	In PHASE 3, if this command is received, it means blend ends and the control step skips to PHASE 4. In PHASE 5 if this command is received, it means blend ends and the control step skips to PHASE 4. It doesn't respond to this command in other modes.
6	Release components	In PHASE 3, after this command is received, the control step skips to PHASE 6. In PHASE 5, after this command is received, the control step skips to PHASE 7. It doesn't respond to this command in other modes.
9	Reset	In PHASE 0, 3, and 5, SUM and DV are reset (no matter whether the components are selected, 16 components are all reset), and PHASE keeps unchanged after this command is received. It doesn't respond to this command in other modes.
Others	No commands	Don't conduct any acts.

At last, the value of control step PHASE of BLDSET is updated and BLDSET will conduct the new act in the next control period.

15.1.5 Control Mode

The values of SWAM and SWSV determine the control mode of BLDSET. Under different control modes and control status, the output value of BLDSET is different. See Table 15.3 for details.

Table 15.3 Control Modes

PHASE		Cascade Mode SWAM=ON and SWSV=ON	Automatic Mode SWAM=ON and SWSV=OFF	Manual Mode SWAM=OFF
0	Idle	MV=0	MV=cumulative deviation PIAE controls the output	MV=MANMV

Table 15.3 Control Modes (continued)

PHASE		Cascade Mode SWAM=ON and SWSV=ON	Automatic Mode SWAM=ON and SWSV=OFF	Manual Mode SWAM=OFF
1	Start	MV=PREMV	-	MV=PREMV
2	Restart	MV=PREMV	-	MV=PREMV
3	Blend proportional integral control	MV=cumulative deviation PIAE controls the output	MV=cumulative deviation PIAE controls the output	MV=MANMV
4	Waiting to terminate	MV=0	-	-
5	Emergency stop	MV=0	-	-
6	Releasing components	MV gradually decreases to 0	-	-
7	Waiting to release	MV=0	-	-
8	Termination	-	-	MV=0

In the following two states, users can use BLDSET to switch among cascade state, auto state and manual state. While in other states, users cannot switch states.

- When control step is proportional integral control (PHASE=3) and superior BLD MST is steady status control (M_PHASE=3) at the same time;
- When control step is in idle condition (PHASE=0).

Control mode would be forcibly switched to cascade mode in the following situations:

- When control step is proportional integral control (PHASE=3) as well as MASTER ends steady status control and enters batch termination prediction or emergency stop (M_PHASE=4 or 8);
- When control step is proportional integral control (PHASE=3) as well as BLDSET receives command of releasing component (M_CMD=6);
- When PHASE=0 and M_PHASE=1 (Blend Starts) are satisfied, and after the start command (M_CMD=1) is received, SWAM is in ON automatic mode and SWSV is in ON cascade then control step turns to PHASE=1;
- When PHASE=7 and M_PHASE=9 (Emergency stop) are satisfied, and after the start command (M_CMD=1) is received, SWAM is in ON automatic mode and SWSV is in ON cascade then control step turns to PHASE=2;

Control mode would be forcibly switched to manual mode in the following situations:

- When PHASE=0 and M_PHASE=3 (Steady Status Control) are satisfied, and after the start command is received, SWAM and SWSV will be OFF, switch to manual mode and control step turns to PHASE=1.
- When PHASE=7 and M_PHASE=3 (Steady Status Control) are satisfied, and after the start command is received, SWAM and SWSV will be OFF, switch to manual mode and control step turns to PHASE=2.
- When PHASE=8, SWAM and SWSV will be OFF, switch to manual mode.

15.1.6 Cumulative Deviation Proportional Integral Control

BLDSET supports three modes including MAN (manual mode), AUTO (auto mode) and CAS (cascade mode). When BLDSET is in AUTO (auto mode) or CAS (cascade mode), the following formula is adopted for cumulative deviation PI (proportional integral) control.

$$\Delta MV_n = 0.125 * KS * 100 / PB * (\Delta T * E_n + \frac{\Delta T}{TI} * DV * 3600)$$

- ΔMV_n : output change value
- E_n : Deviation value ($E_n = SV - PV$) In the cascade mode, SV is the set value of BLD MST. In the automatic mode, SV is the user-set value.
- DV : Cumulative deviation $\sum (E_n * \Delta T / 3600.0)$ (unit: t or M³)
- ΔT : Scanning period (unit: s)
- TI : Integral time (unit: s)
- PB : Proportional modulus
- KS : Measuring range conversion modulus ($= \frac{MVSCH - MVSCL}{PVSCH - PVSCL}$)
- The value of SwNeg determines the action to MV. When SwNeg=ON, the action is negative; otherwise when SwNeg=OFF, the action is positive.

15.1.7 Alarm Processing

The alarm information of BLDSET includes leakage alarm, deviation alarm, and input and output error alarm which are represented by bit vectors, with ALM output pin connecting to the ALMx of BLD MST corresponds to the component, finishing the report of BLD MST's alarm information.

- Leakage alarm
When SWLK=ON is satisfied, which means leakage alarm is enabled, and BLDSET is in PHASE 5 (Emergency stop status), BLDSET starts leakage alarm check and compare the current flow cumulative value with that at the point when the emergency stop signal is received so as to get the deviation. If the deviation is beyond the setting value LKH of

leakage alarm, the alarm status is LEAK. When PHASE=0 is satisfied, alarm status would be reset. When SWLK=OFF is satisfied, leakage alarm is closed.

- Cumulative deviation alarm (DV1 or DV2)

When control step is PHASE 3, PHASE 4, PHASE 5 or PHASE 7, BLDSET supervises cumulative deviation alarm. When the cumulative deviation alarm is H alarm, the alarm status is DV1, while it is HH alarm, the alarm status is DV2.

Users can set whether to use cumulative deviation H alarm or HH alarm:

H alarm: When $|DV| > DL1$ is satisfied, the alarm status turns into DV1, while if $|DV| < DL1 - DLHYS$ is satisfied, the alarm status goes back to normal status.

HH alarm: When $|DV| > DL2$ is satisfied, the alarm status turns into DV2, while if $|DV| < DL2 - DLHYS$ is satisfied, the alarm status goes back to normal status.

DV: Cumulative deviation

DL1: H alarm point of cumulative deviation

DL2: HH alarm point of cumulative deviation

DLHYS: accumulated deviation hysteresis value

- Input error alarm (PVERR) and output error alarm (MVERR)

It executes input and output error check every minute and PVERR pin of the function block receives the error information from the input cells. MVERR pin receives the error information from the output cells. When the test displays error, the MV is set as 0 and it is reported to BLD MST.

15.1.8 Panel Parameter

BLDSET's panel is shown as figure below.

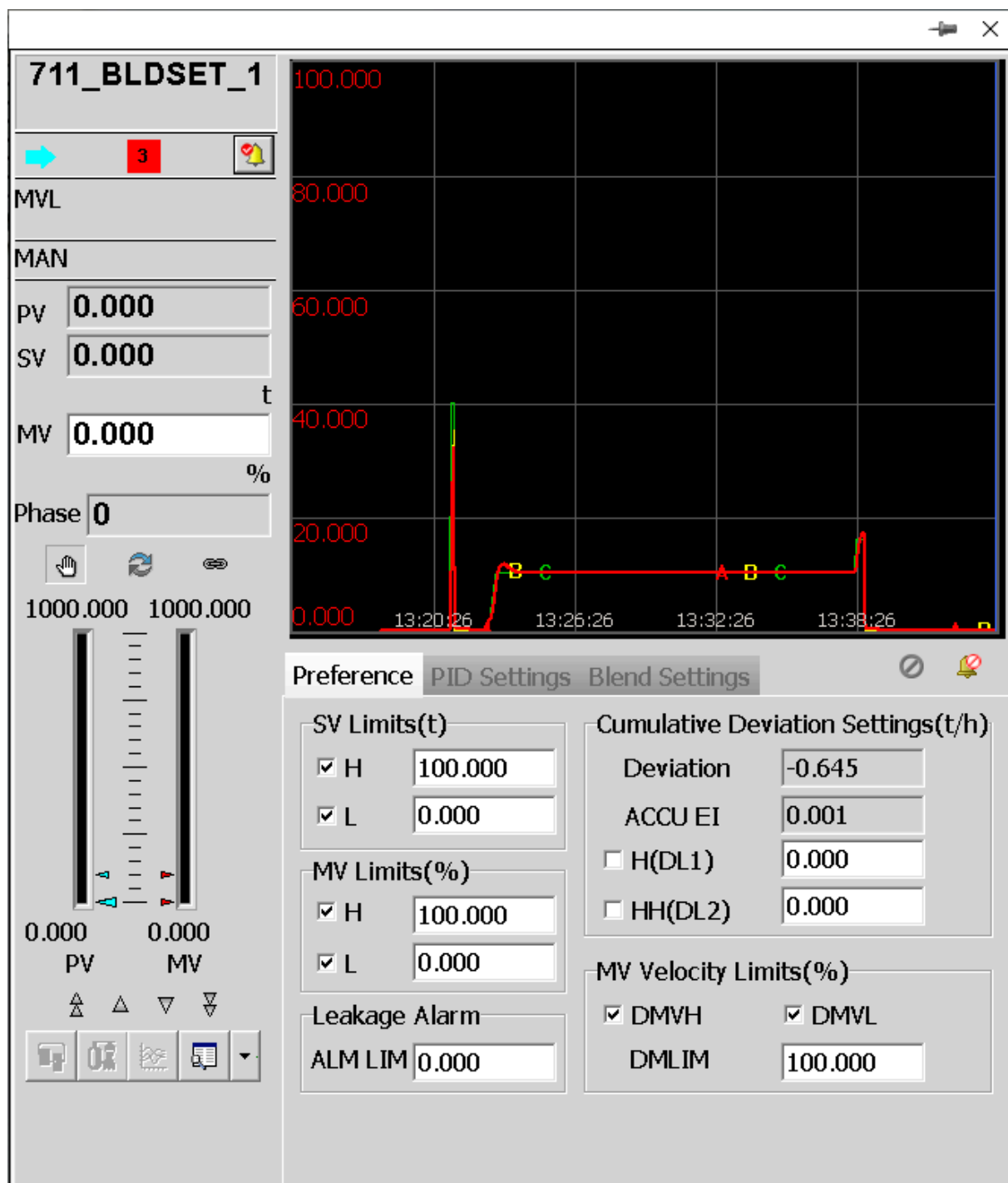
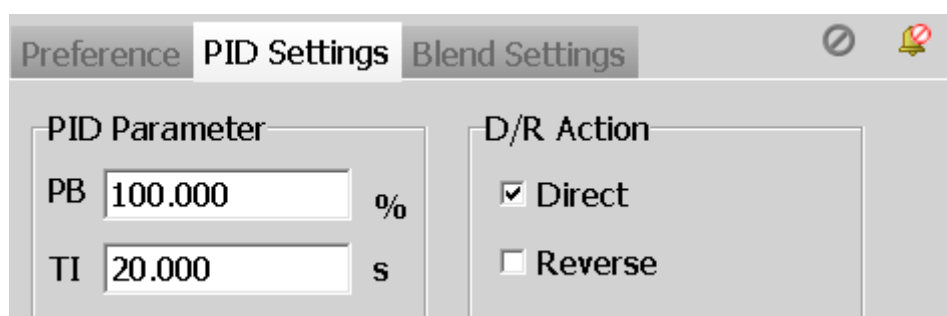


Figure 15.6 BLDSET's Panel (Preference Tab)



The screenshot shows a control panel with two main sections: PID Settings and Blend Settings. The PID Settings section has a sub-section 'Accumulate(t/h)' containing three input fields: 'T ACCU FLOW' (2.733), 'S ACCU FLOW' (2.674), and 'PRE ACCU' (2.733). Below these is a 'PRESET MV' field with the value 2.000. The Blend Settings section has a sub-section 'Compensate(t)' containing four input fields: 'RAW INPUT' (0.000), 'K1' (1.000), 'K2' (1.000), and 'K3' (1.000). The panel has tabs for 'Preference', 'PID Settings', and 'Blend Settings', with 'Blend Settings' currently selected. There are also icons for a lock and a bell in the top right corner.

Figure 15.7 BLDSET's Panel (PID Settings/Blend Settings)

Table 15.4 shows the instruction of the BLDSET's panel.

Table 15.4 BLDSET Panel Instruction

Panel's Parameter			FBD Parameter	Range	Application
Preference	SV Limits	H	SVH	[SVS-CL,SVSCH]	SV maximum (the option selected SVH valid, otherwise invalid)
		L	SVL	[SVS-CL,SVSCH]	SV minimum (the option selected SVL valid, otherwise invalid)
	MV Limits	H	MVH	[MVS-CL,MVSCH]	H value setting of loop MV (select "Alarm" enabled, or it is disabled). Note: MV limit is not affected by selection.
		L	MVL	[MVS-CL,MVSCH]	L value setting of loop MV (select "Alarm" enabled, or it is disabled). Note: MV limit is not affected by selection.
	Leakage Alarm	ALM LIM	LKH	-	-
	Cumulative Deviation Settings	Deviation	EI	-	Read-only. EI=PV - SV(select "Alarm" enabled, or it is disabled).
		ACCU EI	DV	-	-
		H(DL1)	DL1	-	-
		HH(DL2)	DL2	-	-
	MV Velocity Limit	DMVH	-	-	Selecting positive velocity alarm is enabled.
		DMVL	-	-	Selecting negative velocity alarm is enabled.
		DMVLIM	DMVLIM	-	Loop MV velocity limit SV

Table 15.4 BLDSET Panel Instruction (continued)

Panel's Parameter			FBD Parameter	Range	Application
PID Set- tings	PID	PB(%)	PB	>0	Loop proportional band parameter SV
		TI(S)	TI	>0	Loop integral time parameter SV
	D/R Ac- tion	Direct	SWPN	-	Selecting direct action is enabled.
		Re- verse	SWPN	-	Selecting reverse action is enabled.
Blend Settings	Accumu- late	T AC- CU FLOW	SUM0	-	-
		S AC- CU FLOW	SUM	-	-
		PRE ACCU	SUM1	-	-
	Compen- sate	RAW INPUT	-	-	-
		K1	K1	-	-
		K2	K2	-	-
		K3	K3	-	-
	PRESET		PREMV	-	-

15.1.9 Flag

Table 15.5 Flag list

Flag	Alarm Code	Description
D0	OOS	disable
D2	MAN	manual
D4	AUTO	auto
D5	CAS	cascade
D8	SVH_B	SV H limit
D9	SVL_B	SV L limit
D10	MVH_B	Output H Limit Alarm
D11	MVL_B	MV L Limit Alarm

Table 15.5 Flag list (continued)

Flag	Alarm Code	Description
D12	DMVH	MV positive deviation alarm
D13	DMVL	MV negative deviation alarm
D14	AOF	suppress alarm

15.2 BLDMST Function Block

The blending master control function block BLDMST manages the flow control module BLDSET for the subordinate components. BLDMST manages the blending amount of batch, blending traffic of each component, multiplying the blending ratio of each component as the set value of each component blending ratio with its own blending flow setting value (SV) to control the blending flow of each component, the management control of the batch is carried out by the accumulation of the instantaneous flow of each component.

Before using the BLDMST function block, make sure to have a software dog with a "High-performanceHMI oil blending software".

* BLDMST		
0.00	<input type="checkbox"/> PV1	CMD1 <input type="checkbox"/>
0	<input type="checkbox"/> ALM1	PHASE1 <input type="checkbox"/>
0.00	<input type="checkbox"/> PV2	SV1 <input type="checkbox"/>
0	<input type="checkbox"/> ALM2	CMD2 <input type="checkbox"/>
0.00	<input type="checkbox"/> PV3	PHASE2 <input type="checkbox"/>
0	<input type="checkbox"/> ALM3	SV2 <input type="checkbox"/>
0.00	<input type="checkbox"/> PV4	CMD3 <input type="checkbox"/>
0	<input type="checkbox"/> ALM4	PHASE3 <input type="checkbox"/>
0.00	<input type="checkbox"/> PV5	SV3 <input type="checkbox"/>
0	<input type="checkbox"/> ALM5	CMD4 <input type="checkbox"/>
0.00	<input type="checkbox"/> PV6	PHASE4 <input type="checkbox"/>
0	<input type="checkbox"/> ALM6	SV4 <input type="checkbox"/>
0.00	<input type="checkbox"/> PV7	CMD5 <input type="checkbox"/>
0	<input type="checkbox"/> ALM7	PHASE5 <input type="checkbox"/>
0.00	<input type="checkbox"/> PV8	SV5 <input type="checkbox"/>
0	<input type="checkbox"/> ALM8	CMD6 <input type="checkbox"/>
OFF	<input type="checkbox"/> EMSW	PHASE6 <input type="checkbox"/>
		SV6 <input type="checkbox"/>
		CMD7 <input type="checkbox"/>
		PHASE7 <input type="checkbox"/>
		SV7 <input type="checkbox"/>
		CMD8 <input type="checkbox"/>
		PHASE8 <input type="checkbox"/>
		SV8 <input type="checkbox"/>
p0002		2#

15.2.1 Parameter Description

Table 15.6 Parameter Description

Parameter		Type	Description
Input Pins	EMSW	BOOL	External emergency stop switch
	PV1	REAL	the measured value of component1 flow
	ALM1	USINT	the Alarm of component1
	PV2	REAL	the measured value of component2 flow
	ALM2	USINT	the Alarm of component2
	PV3	REAL	the measured value of component3 flow
	ALM3	USINT	the Alarm of component3
	PV4	REAL	the measured value of component4 flow
	ALM4	USINT	the Alarm of component 4
	PV5	REAL	the measured value of component5
	ALM5	USINT	the Alarm of component5
	PV6	REAL	the measured value of component6
	ALM6	USINT	the Alarm of component6
	PV7	REAL	the measured value of component7
	ALM7	USINT	the Alarm of component7
	PV8	REAL	the measured value of component8
	ALM8	USINT	the Alarm of component8
	PV9	REAL	the measured value of component9
	ALM9	USINT	the Alarm of component9
	PV10	REAL	the measured value of component10
	ALM10	USINT	the Alarm of component10
	PV11	REAL	the measured value of component11 flow
	ALM11	USINT	the Alarm of component11
	PV12	REAL	the measured value of component11 flow
	ALM12	USINT	the Alarm of component 12
	PV13	REAL	the measured value of component 12 flow
	ALM13	USINT	the Alarm of component 13
	PV14	REAL	the measured value of component 13 flow

Table 15.6 Parameter Description (continued)

Parameter		Type	Description
	ALM14	USINT	the Alarm of component 14
	PV15	REAL	the measured value of component 14 flow
	ALM15	USINT	the Alarm of component 15
	PV16	REAL	the measured value of component 15 flow
	ALM16	USINT	the Alarm of component 16
Output Pins	CMD1	USINT	the Control Command of component 1
	PHASE1	USINT	the current control step of component1
	SV1	REAL	the set value of component 1 flow
	CMD2	USINT	the Control Command of component 2
	PHASE2	USINT	the current control step of component2
	SV2	REAL	the set value of component2 flow
	CMD3	USINT	the Control Command of component3
	PHASE3	USINT	the current control step of component3
	SV3	REAL	the set value of component4 flow
	CMD4	USINT	the Control Command of component4
	PHASE4	USINT	the current control step of component4
	SV4	REAL	the set value of component4 flow
	CMD5	USINT	the Control Command of component4
	PHASE5	USINT	the current control step of component5
	SV5	REAL	the set value of component5 flow
	CMD6	USINT	the Control Command of component6
	PHASE6	USINT	the current control step of component6
	SV6	REAL	the set value of component6 flow
	CMD7	USINT	the Control Command of component6
	PHASE7	USINT	the current control step of component7
	SV7	REAL	the set value of component7 flow
	CMD8	USINT	the Control Command of component8
	PHASE8	USINT	the current control step of component8

Table 15.6 Parameter Description (continued)

Parameter		Type	Description
	SV8	REAL	the set value of component8 flow
	CMD9	USINT	the Control Command of component9
	PHASE9	USINT	the current control step of component9
	SV9	REAL	the set value of component9 flow
	CMD10	USINT	the Control Command of component10
	PHASE10	USINT	the current control step of component10
	SV10	REAL	the set value of component 10 flow
	CMD11	USINT	the Control Command of component11
	PHASE11	USINT	the current control step of component11
	SV11	REAL	the set value of component11 flow
	CMD12	USINT	the Control Command of component12
	PHASE12	USINT	the current control step of component12
	SV12	REAL	the set value of component12 flow
	CMD13	USINT	the Control Command of component12
	PHASE13	USINT	the current control step of component13
	SV13	REAL	the set value of component13 flow
	CMD14	USINT	the Control Command of component14
	PHASE14	USINT	the current control step of component14
	SV14	REAL	the set value of component14 flow
	CMD15	USINT	the Control Command of component15
	PHASE15	USINT	the current control step of component15
	SV15	REAL	the set value of component16 flow
	CMD16	USINT	the Control Command of component16
	PHASE16	USINT	the current control step of component16
	SV16	REAL	the set value of component16 flow
Operator Parameter	CSW1	BOOL	Switch of component1
	CSW2	BOOL	Switch of component2
	CSW3	BOOL	Switch of component3

Table 15.6 Parameter Description (continued)

Parameter	Type	Description
CSW4	BOOL	Switch of component4
CSW5	BOOL	Switch of component5
CSW6	BOOL	Switch of component6
CSW7	BOOL	Switch of component7
CSW8	BOOL	Switch of component8
CSW9	BOOL	Switch of component9
CSW10	BOOL	Switch of component10
CSW11	BOOL	Switch of component11
CSW12	BOOL	Switch of component12
CSW13	BOOL	Switch of component13
CSW14	BOOL	Switch of component14
CSW15	BOOL	Switch of component15
CSW16	BOOL	Switch of component16
CR1	REAL	Actual blend rate of component1
CR2	REAL	Actual blend rate of component2
CR3	REAL	Actual blend rate of component3
CR4	REAL	Actual blend rate of component4
CR5	REAL	Actual blend rate of component5
CR6	REAL	Actual blend rate of component6
CR7	REAL	Actual blend rate of component7
CR8	REAL	Actual blend rate of component8
CR9	REAL	Actual blend rate of component9
CR10	REAL	Actual blend rate of component10
CR11	REAL	Actual blend rate of component11
CR12	REAL	Actual blend rate of component12
CR13	REAL	Actual blend rate of component13
CR14	REAL	Actual blend rate of component14
CR15	REAL	Actual blend rate of component15

Table 15.6 Parameter Description (continued)

Parameter		Type	Description
	CR16	REAL	Actual blend rate of component16
	CMD	USINT	Control Command
	ILSW	BOOL	Switch of original flow cumulative values
	ILST	REAL	Original flow cumulative setting values
	BSET	REAL	Single batch flow setting values
	SVL	REAL	Original flow setting value in adjustment phase
	SVH	REAL	Final flow setting value in adjustment phase
	SVPR	REAL	The target flow setting value in the process of batch termination prediction
	SWAM	BOOL	Switch between manual and automatic modes, ON=automatic, OFF=manual.
Configure Parameter	SVSCH	REAL	SV high value
	SVSCL	REAL	SV low value
	SVEU	EUNIT	SV actual value unit
	SUMEU	EUNIT	Flow actual value unit
	SVDLEN	USINT	SV and PV decimal digits [0,5]
Alarm Settings	FLAG	UDINT	Flag
	AOF	BOOL	Alarm Shield
	ENALM	UDINT	Alarm Enable
Monitoring Parameter	RCR1	REAL	Actual blend rate of component1
	RCR2	REAL	Actual blend rate of component2
	RCR3	REAL	Actual blend rate of component3
	RCR4	REAL	Actual blend rate of component4
	RCR5	REAL	Actual blend rate of component5
	RCR6	REAL	Actual blend rate of component6
	RCR7	REAL	Actual blend rate of component7
	RCR8	REAL	Actual blend rate of component8
	RCR9	REAL	Actual blend rate of component9
	RCR10	REAL	Actual blend rate of component10

Table 15.6 Parameter Description (continued)

Parameter		Type	Description
	RCR11	REAL	Actual blend rate of component11
	RCR12	REAL	Actual blend rate of component12
	RCR13	REAL	Actual blend rate of component13
	RCR14	REAL	Actual blend rate of component14
	RCR15	REAL	Actual blend rate of component15
	RCR16	REAL	Actual blend rate of component16
	PHASE	USINT	the current control step of component
	SUM	REAL	Single batch accumulative flow
	PV	REAL	Overall instantaneous flow of blend batch
	SV	REAL	Overall flow setting value currently
OOS Setting	SWOOS	BOOL	OFF of this function block

15.2.2 Internal Process Procedure

Adjustment is done as per the logic shown in the figure below in the BLDMST blending process.

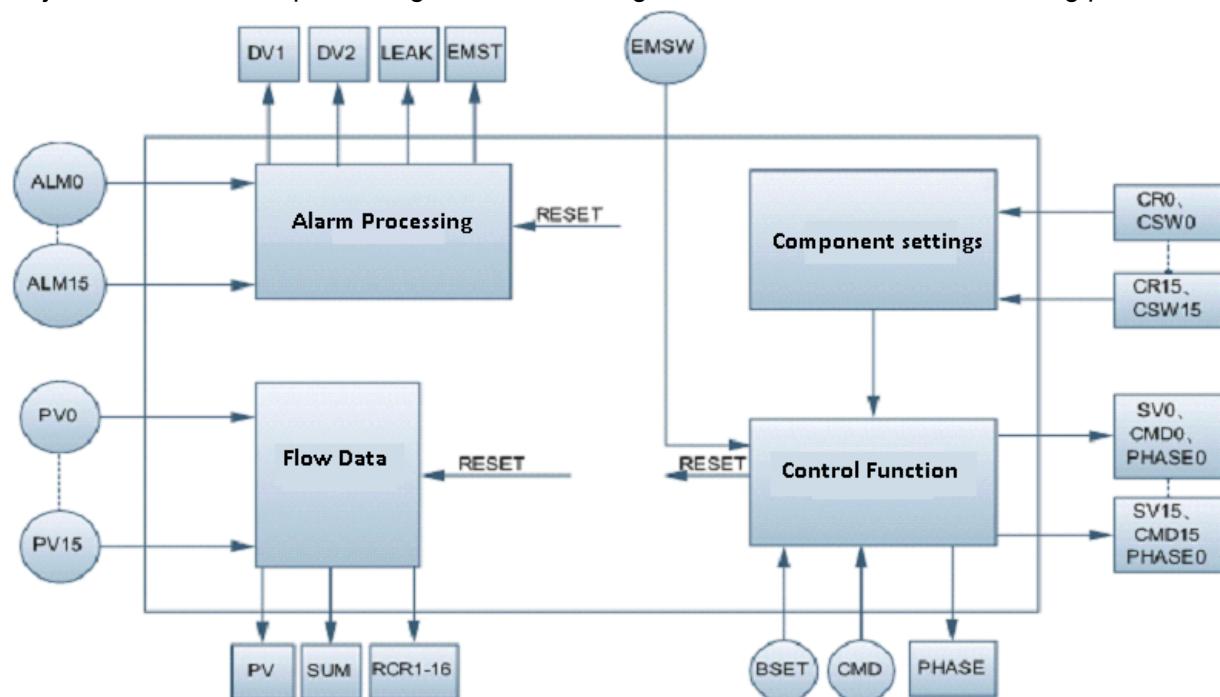


Figure 15.8 Internal logic adjustment process in BLDMST

15.2.3 Types of Blend Process

During the whole blend process, a classic blend process includes normal termination and forcible termination, as shown in Figure 15.9 and Figure 15.10.

Normal termination:

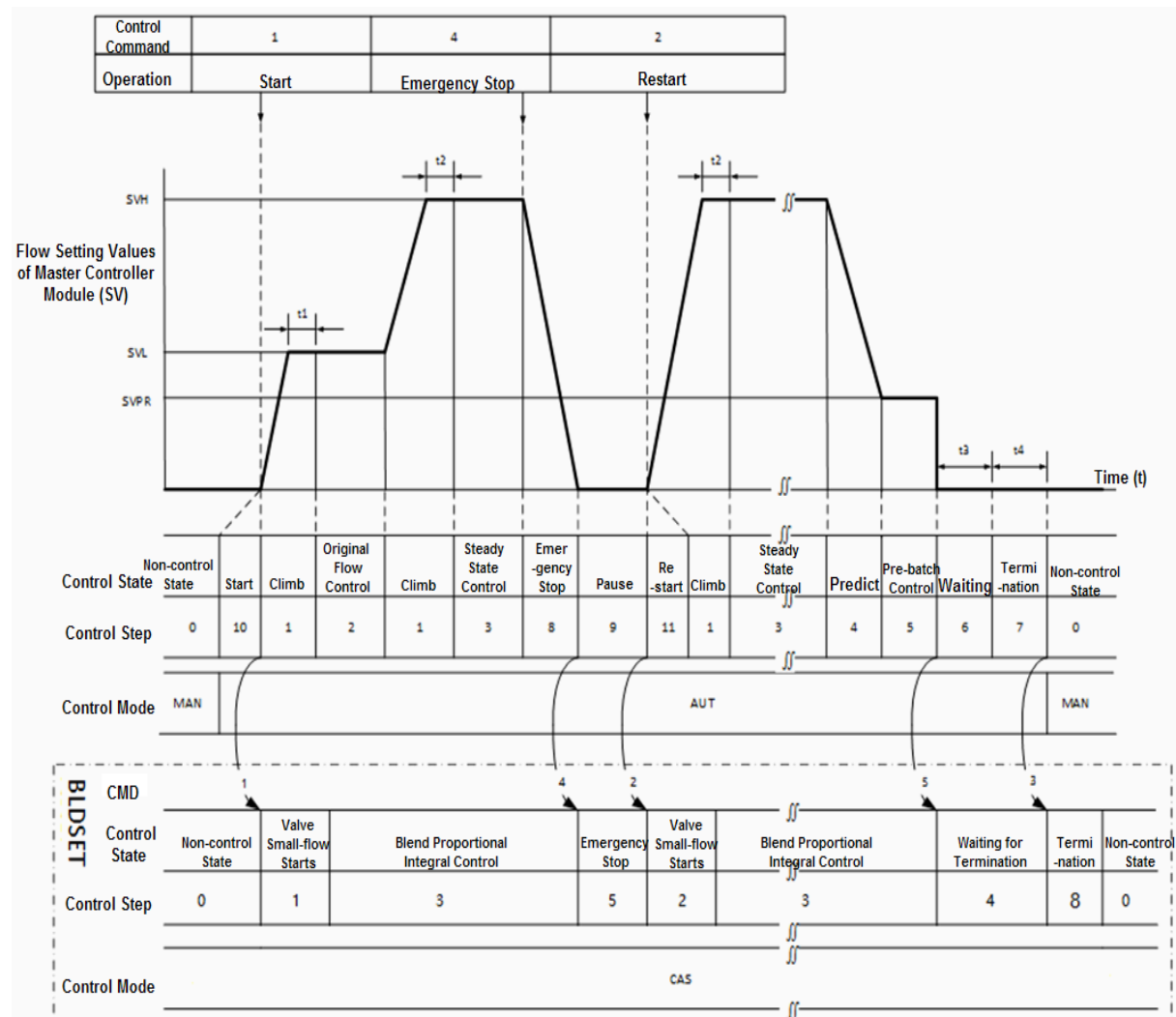


Figure 15.9 Blend Process of Normal Termination

Force termination:

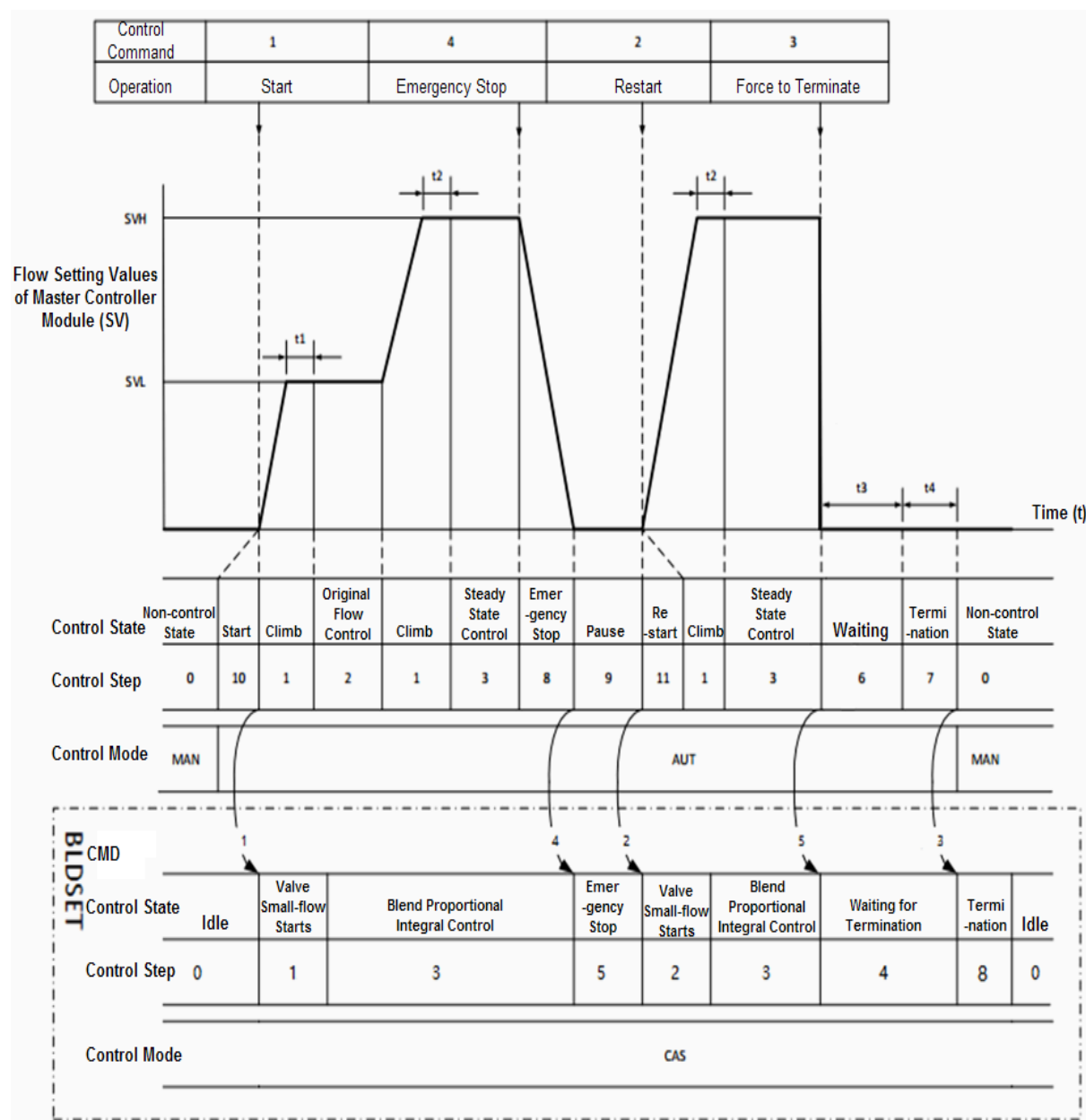


Figure 15.10 Blend Process of Forcible Termination

During the running cycle of one single function block, BLDMST executes control by the following steps:

1. BLDMST checks the alarm information of each component, calculating the total instantaneous flow and the actual blending ratio among each component.
2. Execute the corresponding actions according to the control step currently.
3. The control step PHASE of the function block is updated to a new value.

15.2.4 Flow Statistics and the Calculation of Actual Blend Rate

BLDMST gets the instantaneous flow and alarm information of all components together to be the flow of current blend batch (PV, SUM).

- BLDMST would take the sum of the instantaneous flow (PVx) of the components in the blend management (CSWx=ON) as the overall instantaneous flow value (PV). $PV = \sum PVx$ (CSWx = ON)
- BLDMST accumulates the overall instantaneous flow to get a value which is cumulative flow (SUM).

$$SUM = \sum PV$$

At the same time, BLDMST would output the actual blend rate of each component by calculating each PV values.

- $RCRx = \frac{PVx}{PV}$ (CSWx=ON)
- $RCRx = 0$ (CSWx=OFF)
- x is the parameter's serial numbers that is in the range of 1 to 16.

15.2.5 Alarm Processing

BLDMST gets the alarm information of all components together as the alarm information of the current blend batch (LEAK, DV1, DV2, PVERR, MVERR).

BLDMST collects and manages the alarm information of each BLDSET module and use it as the alarm information of itself, including cumulative deviation alarm (DV1, DV2), leakage alarm (LEAK), input module alarm (PVERR), output module alarm (MVERR). As long as one component alarms, BLDMST would set the corresponding alarm pins.

BLDMST detects the pin status of EMSW and CMD command to tell the external shutdown alarm (MVERR). When the EMSW pins' location or the received shutdown control command CMD=4, BLDMST will set EMST as ON and conduct the corresponding emergency shutdown act.

15.2.6 SV Distribution and Command Transmission

BLDMST calculates the actual blend rate (which is output from RCRx pin) of each component as per the component-selecting switch set by the CSWx. BLDMST also calculates the flow settings of SV of each component as per the blend rate CRx as well as sends control command CMD to BLDSET.

BLDMST multiplies setting SV of the overall instantaneous flow by each blend rate CRx of components to get a value to be the flow setting value SVx which would be sent to each BLDSET. BLDMST also can set control command CMDx, and set PHASEx to be the current control step. Both of them would be sent to the subordinate BLDSET module.

$$SV = SV * CRx \text{ CSWx=ON}$$

SV_x=0 CSW_x=OFF

BLDMST can manage up to 16 component flow-controlling BLDSET modules and the component-selecting switch CSW_x determines whether to conduct blend management.

15.2.7 Control Steps and Orders

BLDMST has 12 control steps as shown in Table 15.7.

Table 15.7 12 Control Steps of BLDMST

PHASE	Control Steps
0	Non-control Status
1	Adjustment Status
2	Original Flow Control
3	Steady Status Control
4	Prediction Status
5	Pre-batch Control Status
6	Waiting Status
7	Termination Status
8	Emergency Stop Status
9	Waiting Status
10	Start Status
11	Restart Status

Four control commands BLDMST is able to receive as shown in Table 15.8.

Table 15.8 Four commands BLDMST accepts

CMD	Description
1	<div>Start</div> <ul style="list-style-type: none"> In PHASE0 and SWAM=ON, if it receives this command in automatic mode, control step skips to PHASE 1 from PHASE 0. In PHASE0, if it is in manual mode, it doesn't respond to this command. It doesn't respond to this command in other modes.
2	<div>Restart</div> <ul style="list-style-type: none"> In PHASE9, the control step skips to PHASE 11 after BLDMST receives this command. It doesn't respond to this command in other modes.

Table 15.8 Four commands BLD MST accepts (continued)

CMD		Description
3	Force to terminate	<ul style="list-style-type: none"> In PHASE 1, 2, 3, 4, 5, and 9, the control step skips to PHASE 6 after BLD MST receives this command. It doesn't respond to this command in other modes.
4	Emergency stop	<ul style="list-style-type: none"> In PHASE 1, 2, 3, 4, 5, and 9, the control step skips to PHASE 8 after BLD MST receives this command. It doesn't respond to this command in other modes.
9	Reset	<ul style="list-style-type: none"> In PHASE 0, 3, and 9, SUM is reset and PHASE keeps unchanged after BLD MST receives this command. It doesn't respond to this command in other modes.
Others	No commands	Don't conduct any acts.

- PHASE 0 (controlling status: uncontrolled status)

In uncontrolled status, after operator sets control mode as AUTO, BLD MST receives the start command CMD=1 to enter PHASE 10. If users don't set components CSWx in OFF status, then the control mode won't be AUTO and neither conduct any acts to respond CMD command, remaining in PHASE 0 status.

- PHASE 1 (controlling status: adjustment status)

When blend batch starts or flow setting values (final flow setting value: SVH, or original flow setting value: SVL) update, every the waiting time (t0: one scanning period, fixed) during the "adjustment" phase, the current flow setting value (SV) would gradually change during each control period until it reaches the target value (SVL OR SVH). If SV is the target value or beyond, SV keeps equal to the target value and waits for a while (t1 or t2) to enter the next step. The time interval of SV when it is changing is set in FBD configuration (t0: interval time of climbing): 0~10000 (scanning period) and the default value is "1".

STUP is the ascent rang of SV and considered by default as changing 1% every period while STDN is the descent range of SV and considered by default as changing 2% every period.

The waiting time (t1) after SV reaches the original target flow setting value: 10 scanning periods.

The waiting time (t2) after SV reaches the final target flow setting value: 10 scanning periods.

In this phase, BLD MST can normally conduct the examination of emergency stop, examination of batch termination, advanced prediction examination of batch termination and SV distribution process.

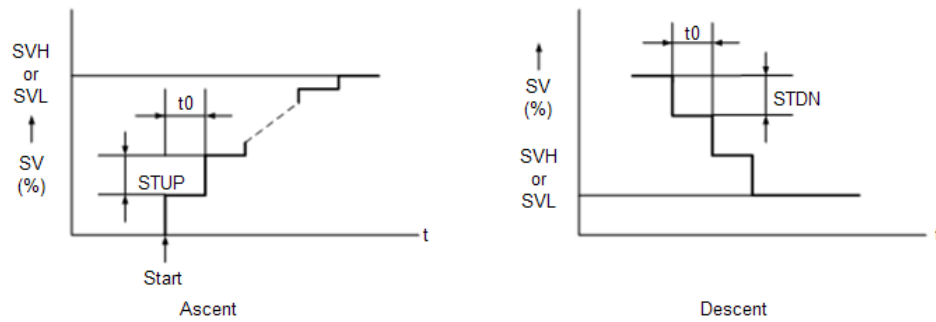


Figure 15.11 SV ascending and descending process

In Phase 1, when all the following conditions are satisfied, the original target flow control would be conducted. At this point, SVL is the target value of SV:

ILSW = ON (original target flow control command)

ILST > SUM (flow cumulative amount is less than original target amount)

When SV is on its ascensional phase to SVL, however the conditions above are not satisfied, then SV directly ascends to SVH.

When adjustment process ends, control status will skip to PHASE 2 (original flow control) or PHASE 3 (steady status control) on the condition that the current SV is SVL or SVH.

- PHASE 2 (controlling status: original flow control)

In original flow control phase, if the original flow setting value (SVL) updates, SV sets the updated SVL as the target and the control step skips to PHASE 1. When the original flow control is removed (ILSW=OFF) or flow cumulative amount (SUM) reaches the original target amount (ILST), SV would rise with SVL as target and control step would skip to PHASE 1.

In this phase, examination of emergency stop, examination of batch termination, advanced prediction examination of batch termination and SV distribution process can be conducted normally.

- PHASE 3 (controlling status: steady status control)

In this phase, flow setting value (SV) keeps to be the final flow setting value (SVH). When SVH updates, control step skips back to PHASE 1 and acts in PHASE 1 are conducted.

In this phase, examination of emergency stop, examination of batch termination, advanced prediction examination of batch termination, SV distribution process and adding and deleting component can be conducted normally.

- PHASE 4 (controlling status: prediction)

Flow setting value (SV) gradually descends by the unit of ΔS . The formula is shown below.

$$SV_n = SV_{n-1} - \Delta S$$

When $SV_n \leq SV_{PR}$ is satisfied, control step skips to PHASE 5 and BLDMST conducts $SV = SV_{PR}$ batch control. The descending process of SV is shown in the figure below.

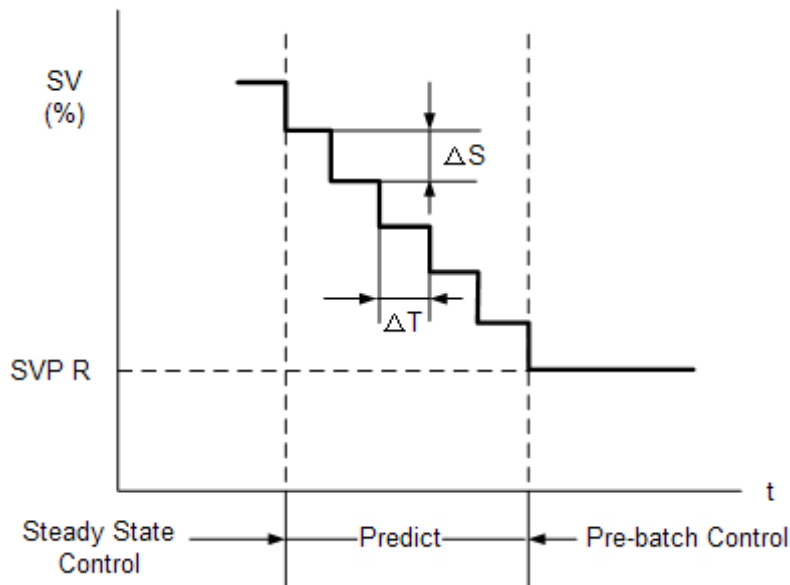


Figure 15.12 SV Descending Process

In this phase, examination of emergency stop, examination of batch termination, SV distribution process can be conducted normally.

- PHASE 5 (controlling status: pre-batch control)

In this phase, examination of emergency stop, examination of batch termination, SV distribution process can be conducted normally. SV keeps the value as the same as SVPR (Pre-batch flow setting value) and control step skips to PHASE 6 until batch is validated.

- PHASE 6 (controlling status: waiting)

When waiting for the batch termination, BLD MST outputs 0 to the SV pins of each flow-controlling module BLD SET of blend component and sends “waiting for termination” command at the same time (BSET.CMD=5). Then, BLD MST waits for a while preset as t_3 . The cumulative flow in this phase is included into this batch cumulative flow. Then, the control step skips to PHASE 7.

Waiting time in waiting phase (t_3): 10 scanning periods.

- PHASE 7 (controlling status: termination)

Wait until the period of time (t_4) preset expires after entering PHASE 7, BLD MST sends “termination” command (BSET.CMD=3) to each component BLD SET. Then, the control step skips to PHASE 0.

Waiting time in the termination phase (t_4): 10 scanning periods.

- PHASE 8 (controlling status: emergency stop)

After the examination of emergency stop is validated, close the valve gradually. SV gradually descends to 0 by the pace of ΔSE .

$$SV_n = SV_{n-1} - \Delta SE$$

When $SV \leq 0$ (do not examine PV) is satisfied, BLD MST processes as follows:

Send “emergency stop” command to each component BLDSET (BSET.CMD=4). BLD MST skips to PHASE 9.

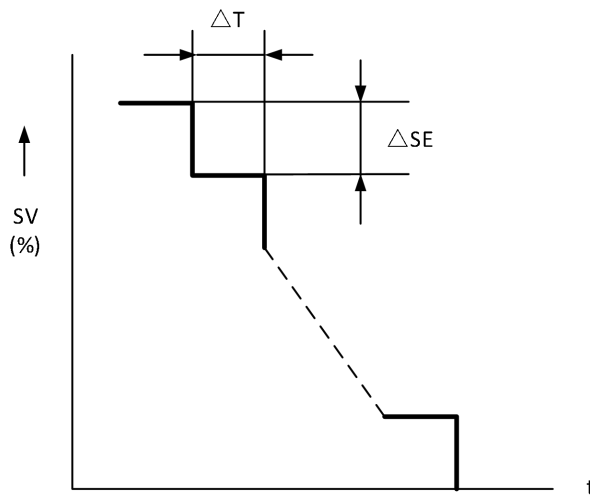


Figure 15.13 The Change of SV in Emergency Stop Phase

The pace parameter (ΔSE) in emergency stop is 1% by default. In this phase examination of batch termination and SV distribution process could be conducted.

- PHASE 9 (controlling status: waiting)
In this phase examination of batch termination and adding and deleting component could be conducted.
- PHASE 10 (controlling status: start)
BLDMST sends “start” command (CMDx=1) to each component BLDSET modules. BLD MST resets the alarm status of itself and cumulative flow SUM becomes zero. Then it enters PHASE 1.
- PHASE 11 (controlling status: restart)
BLDMST sends “restart” command (CMDx=2) to each BLDSET module of components. BLD MST resets the alarm status of itself. Then it enters PHASE 1.

Examination of Emergency Stop

When alarms of emergency stop occur or “emergency stop” command is received (EMSW=ON or CMD=4), emergency stop command should be reset firstly (EMSW=OFF or CMD=0) and then control step skips to PHASE 8 emergency stop.

Prediction Examination of Batch Termination

When blend batch is terminating, BLD MST needs gradually to decrease blend flow. Prediction Examination of Batch Termination is to predict the timing to descent flow.

When blend batch cumulative amount is reach or beyond (batch setting value-pre-batch amount-leakage predicted amount), control step skips to PHASE 4 (blend termination prediction process):

SUM≥BSET-QE-VL

VL is set as zero by default.

The formula of Pre-batch amount (QE) is shown as follows:

In the process of blend termination prediction, control valves are gradually closing. Therefore, the valve-closing time (T) could be calculated out. T includes deviation time (b), QE can be calculated out by flow setting values:

$$QE = SV * T * \frac{1}{3600} * \frac{1}{2}$$

$$T = \frac{SV}{\Delta S} * \Delta T + b$$

QE: Pre-batch amount

SV: current flow setting value

ΔS: Valve-closing range

b: deviation time, unit is second

ΔT: Controlling period, unit is second

The change of flow setting value SV during the process of blend termination advanced prediction is shown as the figure below:

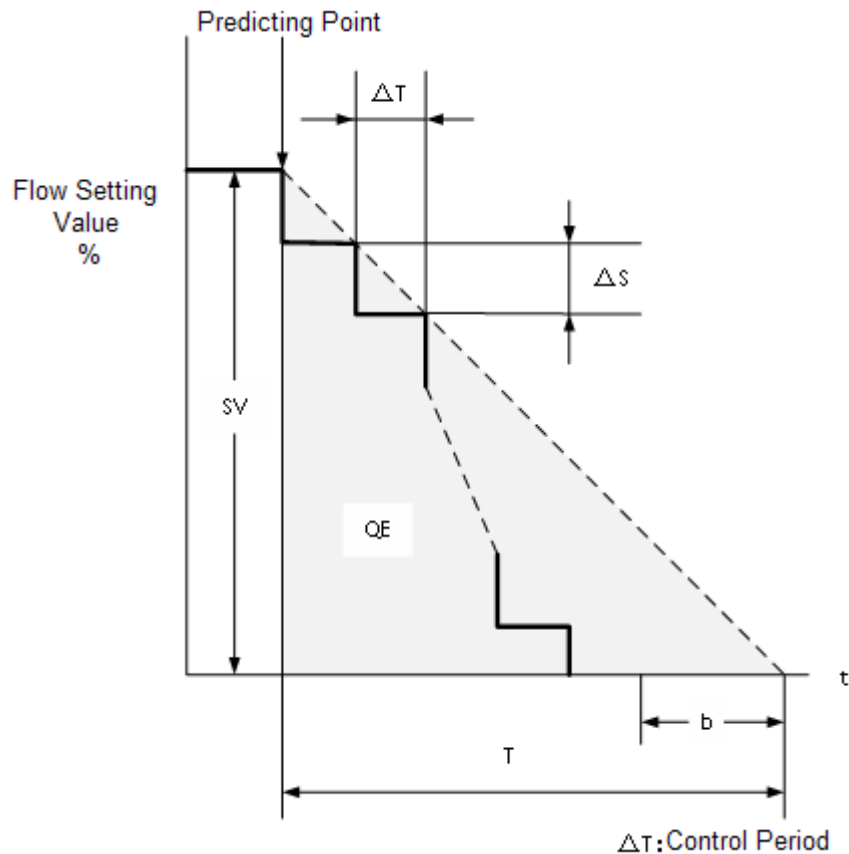


Figure 15.14 The Change of Flow Setting Value SV During the Process of Blend Termination Advanced Prediction

Valve-closing range (ΔS) is set as 1.000% by default.

Deviation time (b) is set as 30s by default.

Examination Process of Batch Termination

When the cumulative amount of BLD MST reaches (batch setting value – leakage prediction amount), the setting value (SV) of each component BLD SET is set as zero and BLD MST would send “waiting for termination” command (BSETx_O.CMD=5) to BLD SET, and then it skips to the PHASE 6 waiting for termination:

$SUM \geq BSET-VL$, and VL is set as zero by default.

15.2.8 Component Addition and Deletion

Component addition and deletion can be conducted by setting CSWx. Component addition and deletion can be divided into two situations:

- Prior to component blend control
Here the whole system has not yet started to blend control and all components (BLD SET) are staying at PHASE 0 as well as the blend master module BLD MST. To set CSWx means

selecting the component to start blend management. If not any one component is selected, the blend cannot be get started.

- During the process of component blend control

Here the whole system has been in the status of blending components. Only BLD MST is in PHASE 3 (steady status control) or PHASE 9 (waiting), and if it is detected CSW_x has changed from OFF to ON, then BLD MST will send CMD=1 (start command) to the corresponding component. On the contrary, if it is detected CSW_x has turned to OFF from ON, CMD=6 (release components) will be sent to the corresponding component. The operation of component addition and deletion can only be performed for BLD MST in the states of idle, stable control, pause waiting (PHASE=0, 3, 9) and CSW_x modification is ineffective in other status, maintaining the original value.

15.2.9 Panel Parameter

BLD MST's panel is shown as figure below.

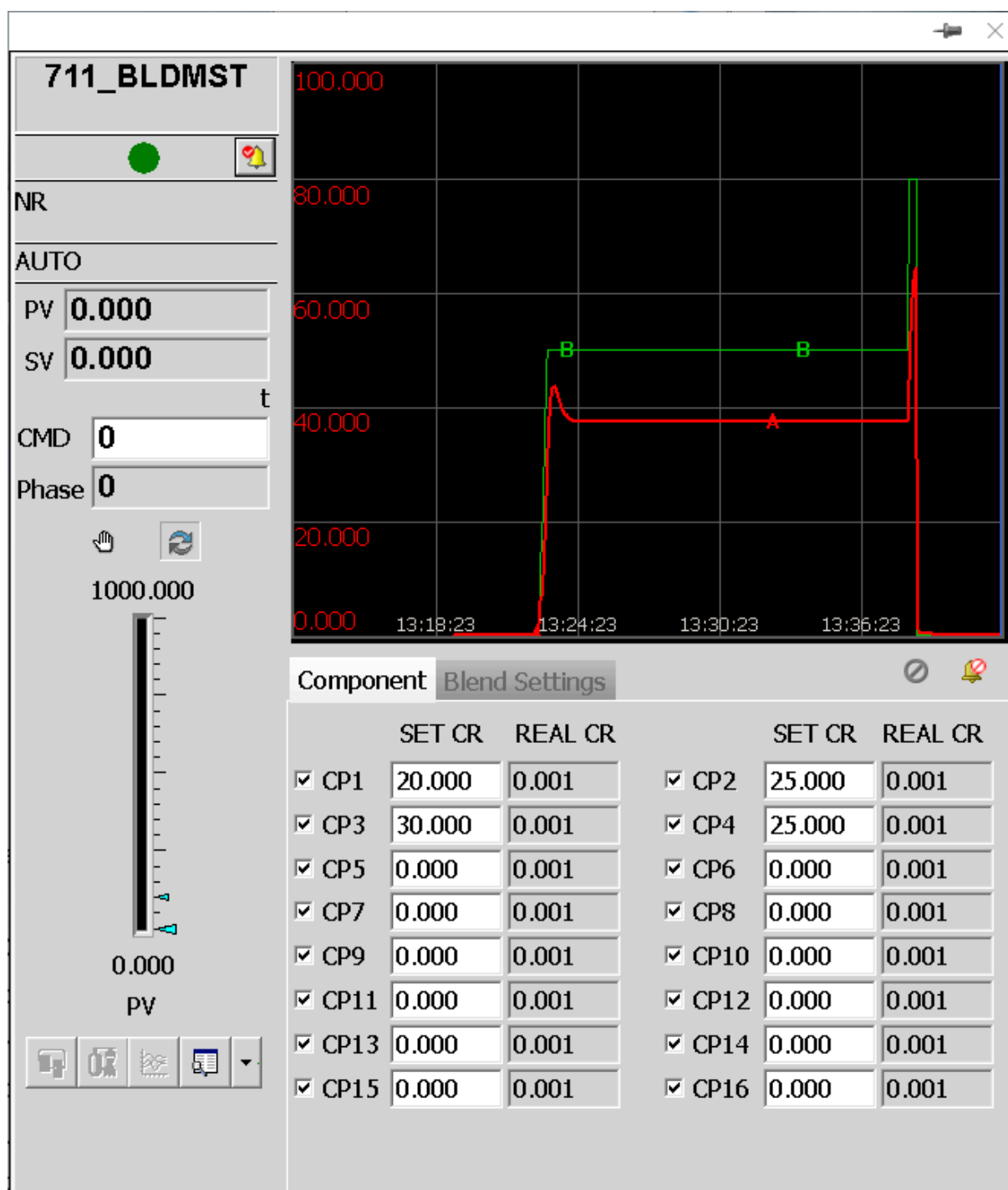


Figure 15.15 BLDMST's Panel (Preference Tab)

The screenshot shows a software interface titled "Component Blend Settings". It contains several input fields for flow rates with their respective units:

- Final Flow: 100.000 t
- Batch Aim ACCU Flow: 10.000 t/h
- Pre_Final Flow: 80.000 t
- Current Batch ACCU Flow: 10.029 t/h
- Initial Flow section (expanded):
 - ☒ Start
 - Initial Control ACCU Flow: 30.000 t/h
 - Initial Control Flow: 50.000 t

Figure 15.16 BLD MST's Panel (Blend Settings)

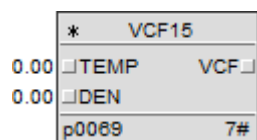
Table 15.4 shows the instruction of the BLD MST's panel.

Table 15.9 BLD MST's Panel Instruction

Panel's Parameter			FBD's Parameter
Component	SET CR	CP1-CP16	CR1-CR16
	REAL CR	CP1-CP16	RCR1-RCR16
Blend Settings	Final Flow		SVH
	Batch Aim ACCU Flow		SUM
	Pre_Final Flow		SVPR
	Current Batch ACCU Flow		PV
	Initial Flow	Start	ILSW
		Initial Control ACCU Flow	ILST
		Initial Control	SVL

15.3 Temperature Compensate 15 Function Block (VCF15)

The temperature compensation module VCF15 is a functional block for calculating the volume compensation coefficient of the corresponding 15°C. The volume compensation coefficient is calculated based on oil type, current temperature and standard density, in accordance with ASTM and API 2540 standards at 15°C. The VCF15 function block diagram is shown below.



The table below illustrates each parameter definition of VCF15.

Parameter Names		Type	Description
Input pins	OIL_TYPE	UINT	Oil product types: 0: crude oil 1: fuel oil 2: lubricating oil 3: the liquefied
	TEMP	FLOAT	Temperature of current oil products
	DEN15	FLOAT	The standard density of current oil products when they are 15°C
Output pins	VCF	FLOAT	Volume compensating coefficient by calculation

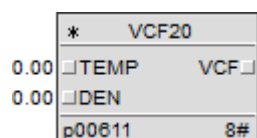
The calculation of temperature compensating coefficient has limit to the density range and temperature range of each types of oil products, such as:

- OIL_TYPE=0(Crude oil): DEN15 is in the range of [610.0, 1075.0] and in the unit of kg/m^3 .
- OIL_TYPE=1(Fuel oil): DEN15 is in the range of [653.0, 1075.0] and in the unit of kg/m^3 .
- OIL_TYPE=2(Lubricating oil): DEN15 is in the range of [800.0, 1164.0] and in the unit of kg/m^3 .
- OIL_TYPE=3(Liquefied gas): DEN15 is in the range of [351.7, 687.8] and in the unit of kg/m^3 , TEMP is in the range of [-46.0, 93.0] and in the unit of °C.

When the calculation is beyond the limited range, it will not go on. VCF directly returns to 1, meaning not going to compensate.

15.4 Temperature Compensation 20 Function Block (VCF20)

The temperature compensation module VCF20 is used to calculate a functional block of the volume compensation coefficient at 20°C. The volume compensation coefficient is calculated based on oil type, current temperature and standard density, and meets national standards GB / T1885-1998 at 20°C. The VCF20 function block diagram is shown below.



The table below illustrates each parameter definition of VCF20.

Parameter Names		Types	Description
Input pins	OIL_TYPE	UINT	Oil product types: 0: crude oil 1: fuel oil 2: lubricating oil 3: the liquefied
	TEMP	FLOAT	Temperature of current oil products.
	DEN20	FLOAT	The standard density of current oil when they are 20°C.
Output pins	VCF	FLOAT	Volume compensating coefficient by calculation.

The calculation of temperature compensating coefficient has limit to the density range and temperature range of each types of oil products, such as:

- When OIL_TYPE is 0, 1 or 2, the oil standard densities in 20°C can be transferred to those in 15°C which should conform to the standard of VCF15.
- OIL_TYPE=0(Crude oil): DEN15 is in the range of [610.0, 1075.0] and in the unit of kg/m^3 .
- OIL_TYPE=1(Fuel oil): DEN15 is in the range of [653.0, 1075.0] and in the unit of kg/m^3 .
- OIL_TYPE=2(Lubricating oil): DEN15 is in the range of [800.0, 1164.0] and in the unit of kg/m^3 .
- When OIL_TYPE=3 is met, the range of DEN20 is in [331.7, 683.6] (unit kg/m^3) and temperature range is in [-46.0, 93.0] (unit °C).

When the calculation is beyond the limited range, it will not go on. VCF directly returns to 1, meaning not going to compensate.

15.5 F_AI_ALM

This function block is used for alarm management of multiplex conditions. Through the alias of the F_AI_ALM function block, the association with the AI tag can be established. This function block dynamically adjusts the alarm enable, properties such as upper and lower limits of AI tags according to different set values.

Based on single parameter AI alarm management function block, F_AI_ALM function block is shown below.



Parameter Name		Type	Description	Whether to up-load
Input pin	IN	REAL	Input value	no

Parameter Name		Type	Description	Whether to up-load
	SWAOF	BOOL	Alarm shield	no
Output pin	ADDR_ERR	BOOL	AI address error	no
	XY_ERR	BOOL	XY setting error	no
	STA	USINT	Error Segment promptX[i] input error: XY_ - ERR=ON,STA=2+(i-2);	no
Monitoring parameter	ENHHH	BOOL	HHH alarm enable	no
	ENHH	BOOL	HH alarm enable	no
	ENH	BOOL	H alarm enable	no
	ENL	BOOL	L alarm enable	no
	ENLL	BOOL	LL alarm enable	no
	ENLLL	BOOL	LLL alarm enable	no
	ENDPV	BOOL	DPV alarm enable	no
Operating parameters	START	BOOL	start	true
	X1~ X6	REAL	X1 input~X6 input	true
	HHH1~HHH6	REAL	HHH alarm limit Y1 output~HHH alarm limit Y6 output	true
	HH1~HH6	REAL	HH alarm limit Y1 output ~ HH alarm limit Y6 output	true
	H1~H6	REAL	H alarm limit Y1 output~ H alarm limit Y6 output	true
	L1~L6	REAL	L alarm limit Y1 output~ L alarm limit Y6 output	true
	LL1~LL6	REAL	LL alarm limitY1 output~ LL alarm limit Y6output	true
	LLL1~ LLL6	REAL	LLL alarm limitY1 output~ LLL alarm limit Y6output	true
	HYS1~ HYS6	REAL	Alarm hysteresis Y1output~alarm hysteresis Y6output	true
	VEL1~ VEL6	REAL	DPV alarm limit Y1output~rate alarm limit Y6output	true
	PCT1~ PCT6	REAL	percent basisY1 output~percent basis Y6output	true
	SWEU	BOOL	ON=engineering OFF=percent	true

Parameter Name		Type	Description	Whether to up-load
	SEGUISE	USINT	Used sections	true
	SWXY	BOOL	OFF=ramp; ON=jump	true
	HHH_DEF	REAL	HHH default value	true
	HH_DEF	REAL	HH default value	true
	H_DEF	REAL	H default value	true
	L_DEF	REAL	L default value	true
	LL_DEF	REAL	LL default value	true
	LLL_DEF	REAL	LLL default value	true
	HYS_DEF	REAL	hysteresis default value	true
	VEL_DEF	REAL	DPV limit default value	true
Alias	PV	REAL	It is used to build an association of AI tags and PV section.	no

15.5.1 Function Illustration

F_AI_ALM function block establishes the association with the AI tag PV field through the alias variable PV. After establishing a relationship, F_AI_ALM can modify the AI tag alarm property configuration.

Whether to modify alarm property

The F_AI_ALM function block's START parameter value determines whether to modify the alarm properties of the associated AI tag.

- When START = ON, the function block performs the corresponding alarm modification function.
- When START = OFF, the function block does not perform alarm modification, and the associated AI tag can independently modify the alarm.
- When START is changed from ON to OFF, the associated AI tag alarm limit is the default value.

Alarm shield

The value of the ALM_AOF parameter of the F_AI_ALM function block determines whether to mask the alarm associated with the AI tag:

When ALM_AOF=ON, the associated AI tag AOF=ON, shield the alarm.

When ALM_AOF=OFF, the associated AI tag AOF=OFF, and the alarm is not shielded.

Polyline table

SEGUSE is the number of segments that can be used in the polyline table. Assuming SEGUSE=3, the input value IN is differentiated according to X1, X2, X3, X4. When SWXY=OFF, use the ramp mode, when SWXY=ON, use the step mode.

According to the input of IN, calculate the broken line table:

IN	X1	HHH1	HH1	H1	L1	LL1	LLL1	HYS1	VEL1	PCT1
	X2	HHH2	HH2	H2	L2	LL2	LLL2	HYS2	VEL2	PCT2
	X3	HHH3	HH3	H3	L3	LL3	LLL3	HYS3	VEL3	PCT3
	X4	HHH4	HH4	H4	L4	LL4	LLL4	HYS4	VEL4	PCT4
	X5	HHH5	HH5	H5	L5	LL5	LLL5	HYS5	VEL5	PCT5
	X6	HHH6	HH6	H6	L6	LL6	LLL6	HYS6	VEL6	PCT6

15.5.2 Alarm Limit Calculation

Modification rules of the actual value of AI tags by ramp mode

When SWXY = OFF, SWEU = ON, modify the alarm associated with AI tags in the rules listed in the table below.

Alarm Property	Input Value	Alarm Enable	Modification
AI.HHH	$IN \leq x1$	√	$PCT = PCT1$, $AI.HHH = PCT * (1 + HHH1/100)$
	IN between x1 and x2	√	$PCT = (IN - X1)/(X2 - X1) * (PCT2 - PCT1) + PCT1$ $AI.HHH = PCT * (1 + ((IN - X1)/(X2 - X1) * (HHH2 - HHH1) + HHH1)/100)$
	IN between x2 and x3	√	$PCT = (IN - X2)/(X3 - X2) * (PCT3 - PCT2) + PCT2$ $AI.HHH = PCT * (1 + ((IN - X2)/(X3 - X2) * (HHH3 - HHH2) + HHH2)/100)$
	IN between x3 and x4	√	$PCT = (IN - X3)/(X4 - X3) * (PCT4 - PCT3) + PCT3$ $AI.HHH = PCT * (1 + ((IN - X3)/(X4 - X3) * (HHH4 - HHH3) + HHH3)/100)$
	$IN \geq x4$	√	$PCT = PCT4$, $AI.HHH = PCT * (1 + HHH4/100)$
	-	×	Not to modify AI.HHH alarm
AI.HH	$IN \leq x1$	√	$PCT = PCT1$, $AI.HH = PCT * (1 + HH1/100)$
	IN between x1 and x2	√	$PCT = (IN - X1)/(X2 - X1) * (PCT2 - PCT1) + PCT1$ $AI.HH = PCT * (1 + ((IN - X1)/(X2 - X1) * (HH2 - HH1) + HH1)/100)$

Alarm Property	Input Value	Alarm Enable	Modification
	IN between x2 and x3	√	$PCT = (IN - X2)/(X3 - X2) * (PCT3 - PCT2) + PCT2$ $AI.HH = PCT * (1 + ((IN - X2)/(X3 - X2) * (HH3 - HH2) + HH2)/100)$
	IN between x3 and x4	√	$PCT = (IN - X3)/(X4 - X3) * (PCT4 - PCT3) + PCT3$ $AI.HH = PCT * (1 + ((IN - X3)/(X4 - X3) * (HH4 - HH3) + HH3)/100)$
	$IN \geq x4$	√	$PCT = PCT4$, $AI.HH = PCT * (1 + HH4/100)$
	-	×	Not to modify AI.HH alarm
AI.H	$IN \leq x1$	√	$PCT = PCT1$, $AI.H = PCT * (1 + H1/100)$
	IN between x1 and x2	√	$PCT = (IN - X1)/(X2 - X1) * (PCT2 - PCT1) + PCT1$ $AI.H = PCT * (1 + ((IN - X1)/(X2 - X1) * (H2 - H1) + H1)/100)$
	IN between x2 and x3	√	$PCT = (IN - X2)/(X3 - X2) * (PCT3 - PCT2) + PCT2$ $AI.H = PCT * (1 + ((IN - X2)/(X3 - X2) * (H3 - H2) + H2)/100)$
	IN between x3 and x4	√	$PCT = (IN - X3)/(X4 - X3) * (PCT4 - PCT3) + PCT3$ $AI.H = PCT * (1 + ((IN - X3)/(X4 - X3) * (H4 - H3) + H3)/100)$
	$IN \geq x4$	√	$PCT = PCT4$, $AI.H = PCT * (1 + H4/100)$
	-	×	Not to modify AI.H alarm
AI.L	$IN \leq x1$	√	$PCT = PCT1$, $AI.L = PCT * (1 + L1/100)$
	IN between x1 and x2	√	$PCT = (IN - X1)/(X2 - X1) * (PCT2 - PCT1) + PCT1$ $AI.L = PCT * (1 + ((IN - X1)/(X2 - X1) * (L2 - L1) + L1)/100)$
	IN between x2 and x3	√	$PCT = (IN - X2)/(X3 - X2) * (PCT3 - PCT2) + PCT2$ $AI.L = PCT * (1 + ((IN - X2)/(X3 - X2) * (L3 - L2) + L2)/100)$
	IN between x3 and x4	√	$PCT = (IN - X3)/(X4 - X3) * (PCT4 - PCT3) + PCT3$ $AI.L = PCT * (1 + ((IN - X3)/(X4 - X3) * (L4 - L3) + L3)/100)$
	$IN \geq x4$	√	$PCT = PCT4$, $AI.L = PCT * (1 + L4/100)$
	-	×	Not to modify AI.L alarm
AI.LL	$IN \leq x1$	√	$PCT = PCT1$, $AI.LL = PCT * (1 + LL1/100)$
	IN between x1 and x2	√	$PCT = (IN - X1)/(X2 - X1) * (PCT2 - PCT1) + PCT1$ $AI.LL = PCT * (1 + ((IN - X1)/(X2 - X1) * (LL2 - LL1) + LL1)/100)$
	IN between x2 and x3	√	$PCT = (IN - X2)/(X3 - X2) * (PCT3 - PCT2) + PCT2$ $AI.LL = PCT * (1 + ((IN - X2)/(X3 - X2) * (LL3 - LL2) + LL2)/100)$
	IN between x3 and x4	√	$PCT = (IN - X3)/(X4 - X3) * (PCT4 - PCT3) + PCT3$ $AI.LL = PCT * (1 + ((IN - X3)/(X4 - X3) * (LL4 - LL3) + LL3)/100)$
	$IN \geq x4$	√	$PCT = PCT4$, $AI.LL = PCT * (1 + LL4/100)$

Alarm Property	Input Value	Alarm Enable	Modification
	-	×	Not to modify AI.LL alarm
AI.LLL	$IN \leq x1$	✓	$PCT = PCT1, AI.LL = PCT * (1 + LLL1/100)$
	IN between x1 and x2	✓	$PCT = (IN - X1)/(X2 - X1) * (PCT2 - PCT1) + PCT1$ $AI.LLL = PCT * (1 + ((IN - X1)/(X2 - X1) * (LLL2 - LLL1))/100)$
	IN between x2 and x3	✓	$PCT = (IN - X2)/(X3 - X2) * (PCT3 - PCT2) + PCT2$ $AI.L = PCT * (1 + ((IN - X2)/(X3 - X2) * (LLL3 - LLL2) + LLL2)/100)$
	IN between x3 and x4	✓	$PCT = (IN - X3)/(X4 - X3) * (PCT4 - PCT3) + PCT3$ $AI.L = PCT * (1 + ((IN - X3)/(X4 - X3) * (LLL4 - LLL3) + LLL3)/100)$
	$IN \geq x4$	✓	$PCT = PCT4, AI.LLL = PCT * (1 + LLL4/100)$
	-	×	Not to modify AI.LLL alarm
AI.HYS	$IN \leq x1$	AI.HHH to AI.LLL any one alarm is enabled	$PCT = PCT1, AI.HYS = PCT * (0 + HYS1/100)$
	IN between x1 and x2		$PCT = (IN - X1)/(X2 - X1) * (PCT2 - PCT1) + PCT1$ $AI.HYS = PCT * (0 + ((IN - X1)/(X2 - X1) * (HYS3 - HYS2) + HYS2)/100)$
	IN between x2 and x3		$PCT = (IN - X2)/(X3 - X2) * (PCT3 - PCT2) + PCT2$ $AI.HYS = PCT * (0 + ((IN - X1)/(X2 - X1) * (HYS3 - HYS2) + HYS2)/100)$
	IN between x3 and x4		$PCT = (IN - X3)/(X4 - X3) * (PCT4 - PCT3) + PCT3$ $AI.HYS = PCT * (0 + ((IN - X3)/(X4 - X3) * (HYS4 - HYS3) + HYS3)/100)$
	$IN \geq x4$		$PCT = PCT4, AI.HYS = PCT * (0 + HYS4/100)$
	-	AI.HHH to L-LL no one is enabled	Not to modify AI.HYS
AI.DPV	$IN \leq x1$	✓	$PCT = PCT1, AI.DPV = PCT * (1 + VEL1/100)$
	IN between x1 and x2	✓	$PCT = (IN - X1)/(X2 - X1) * (PCT2 - PCT1) + PCT1$ $AI.DPV = PCT * (1 + ((IN - X1)/(X2 - X1) * (VEL2 - VEL1) + VEL1)/100)$
	IN between x2 and x3	✓	$PCT = (IN - X2)/(X3 - X2) * (PCT3 - PCT2) + PCT2$ $AI.DPV = PCT * (1 + ((IN - X1)/(X2 - X1) * (VEL3 - VEL2) + VEL2)/100)$
	IN between x3 and x4	✓	$PCT = (IN - X3)/(X4 - X3) * (PCT4 - PCT3) + PCT3$ $AI.DPV = PCT * (1 + ((IN - X3)/(X4 - X3) * (VEL4 - VEL3) + VEL3)/100)$
	$IN \geq x4$	✓	$PCT = PCT4, AI.DPV = PCT * (1 + VEL4/100)$

Alarm Property	Input Value	Alarm Enable	Modification
	-	x	Not to modify AI.DPV alarm

Modification rules of the actual value of AI tags by jump mode

When SWXY=ON and SWEU=ON, modify the alarm associated with AI tags according to the rules listed in the table below.

Alarm property	Input value	Alarm enable	Modification
AI.HHH	$IN \leq x1$, or IN between x1 and x2	√	$PCT = PCT1, AI.HHH = PCT * (1 + HHH1/100)$
	IN between x2 and x3	√	$PCT = PCT2, AI.HHH = PCT * (1 + HHH2/100)$
	IN between x3 and x4	√	$PCT = PCT3, AI.HHH = PCT * (1 + HHH3/100)$
	$IN \geq x4$	√	$PCT = PCT4, AI.HHH = PCT * (1 + HHH4/100)$
	-	x	As alarm is not enabled, not to modify AI.HHH alarm
AI.HH	$IN \leq x1$, or IN between x1 and x2	√	$PCT = PCT1, AI.HH = PCT * (1 + HH1/100)$
	IN between x2 and x3	√	$PCT = PCT2, AI.HH = PCT * (1 + HH2/100)$
	IN between x3 and x4	√	$PCT = PCT3, AI.HH = PCT * (1 + HH3/100)$
	$IN \geq x4$	√	$PCT = PCT4, AI.HH = PCT * (1 + HH4/100)$
	-	x	Not to modify AI.HH alarm
AI.H	$IN \leq x1$, or IN between x1 and x2	√	$PCT = PCT1, AI.H = PCT * (1 + H1/100)$
	IN between x2 and x3	√	$PCT = PCT2, AI.H = PCT * (1 + H2/100)$
	IN between x3 and x4	√	$PCT = PCT3, AI.H = PCT * (1 + H3/100)$
	$IN \geq x4$	√	$PCT = PCT4, AI.H = PCT * (1 + H4/100)$
	-	x	Not to modify AI.H alarm
AI.L	$IN \leq x1$, or IN between x1 and x2	√	$PCT = PCT1, AI.L = PCT * (1 + L1/100)$
	IN between x2 and x3	√	$PCT = PCT2, AI.L = PCT * (1 + L2/100)$
	IN between x3 and x4	√	$PCT = PCT3, AI.L = PCT * (1 + L3/100)$
	$IN \geq x4$	√	$PCT = PCT4, AI.L = PCT * (1 + L4/100)$
	-	x	Not to modify AI.L alarm
AI.LL	$IN \leq x1$ or IN between x1 and x2	√	$PCT = PCT1, AI.LL = PCT * (1 + LL1/100)$

Alarm property	Input value	Alarm enable	Modification
	IN between x2 and x3	√	$PCT=PCT2, AI.LL=PCT*(1+LL2/100)$
	ININ between x3 and x4	√	$PCT=PCT3, AI.H=PCT*(1+LL3/100)$
	$IN \geq x4$	√	$PCT=PCT4, AI.LL=PCT*(1+LL4/100)$
	-	×	Not to modify AI.LL alarm
AI.LLL	$IN \leq x1$ or IN between x1 and x2	√	$PCT=PCT1, AI.LLL=PCT*(1+LLL1/100)$
	IN between x2 and x3	√	$PCT=PCT2, AI.LLL=PCT*(1+LLL2/100)$
	ININ between x3 and x4	√	$PCT=PCT3, AI.H=PCT*(1+LLL3/100)$
	$IN \geq x4$	√	$PCT=PCT4, AI.LLL=PCT*(1+LLL4/100)$
	-	×	Not to modify AI.LLL alarm
AI.HYS	$IN \leq x1$ or IN between x1 and x2	AI.HHH to AI.LLL any one is enabled	$PCT=PCT1, AI.HYS=PCT*(0+HYS1/100)$
	IN between x2 and x3		$PCT=PCT2, AI.HYS=PCT*(0+HYS2/100)$
	IN between x3 and x4		$PCT=PCT3, AI.HYS=PCT*(0+HYS3/100)$
	$IN \geq x4$		$PCT=PCT4, AI.HYS=PCT*(0+HYS4/100)$
	-	From AI.HHH to AI.LLL, no one is enabled	Not to modify AI.HYS
AI.DPV	$IN \leq x1$ or IN between x1 and x2	√	$PCT=PCT1, AI.DPV=PCT*(1+VEL1/100)$
	IN between x2 and x3	√	$PCT=PCT2, AI.DPV=PCT*(1+VEL2/100)$
	IN between x3 and x4	√	$AI.DPV=PCT*(1+VEL3/100)$
	$IN \geq x4$	√	$PCT=PCT4, AI.DPV=PCT*(1+VEL4/100)$
	-	×	Not to modify AI.DPV alarm

Modification rules of Percent AI tags in ramp mode

When SWXY=OFF and SWEU=OFF, modify the alarm associated with AI tags according to the rules listed in the table below.

Alarm property	Input value	Alarm enable	Modification Illustration
AI.HHH	$IN \leq x1$	√	$PCT=PCT1, AI.HHH=PCT*(1+HHH1/100)$
	IN between x1 and x2	√	$PCT=(IN - X1)/(X2-X1)*(PCT2-PCT1)+PCT1$ $AI.HHH=PCT*(1+((IN - X1)/(X2-X1)*(HHH2-HHH1)+HHH1)/100)$

Alarm property	Input value	Alarm enable	Modification Illustration
	IN between x2 and x3	√	$PCT = (IN - X2) / (X3 - X2) * (PCT3 - PCT2) + PCT2$ $AI.HHH = PCT * (1 + ((IN - X2) / (X3 - X2) * (HHH3 - HHH2) + HHH2) / 100)$
	IN between x3 and x4	√	$PCT = (IN - X3) / (X4 - X3) * (PCT4 - PCT3) + PCT3$ $AI.HHH = PCT * (1 + ((IN - X3) / (X4 - X3) * (HHH4 - HHH3) + HHH3) / 100)$
	$IN \geq x4$	√	$PCT = PCT4, AI.HHH = PCT * (1 + HHH4 / 100)$
	-	×	Not to modify AI.HHH alarm
AI.HH	$IN \leq x1$	√	$PCT = PCT1, AI.HH = PCT * (1 + HH1 / 100)$
	IN between x1 and x2	√	$PCT = (IN - X1) / (X2 - X1) * (PCT2 - PCT1) + PCT1$ $AI.HH = PCT * (1 + ((IN - X1) / (X2 - X1) * (HH2 - HH1) + HH1) / 100)$
	IN between x2 and x3	√	$PCT = (IN - X2) / (X3 - X2) * (PCT3 - PCT2) + PCT2$ $AI.HH = PCT * (1 + ((IN - X2) / (X3 - X2) * (HH3 - HH2) + HH2) / 100)$
	IN between x3 and x4	√	$PCT = (IN - X3) / (X4 - X3) * (PCT4 - PCT3) + PCT3$ $AI.HH = PCT * (1 + ((IN - X3) / (X4 - X3) * (HH4 - HH3) + HH3) / 100)$
	$IN \geq x4$	√	$PCT = PCT4, AI.HH = PCT * (1 + HH4 / 100)$
	-	×	Not to modify AI.HH alarm
AI.H	$IN \leq x1$	√	$PCT = PCT1, AI.H = PCT * (1 + H1 / 100)$
	IN between x1 and x2	√	$PCT = (IN - X1) / (X2 - X1) * (PCT2 - PCT1) + PCT1$ $AI.H = PCT * (1 + ((IN - X1) / (X2 - X1) * (H2 - H1) + H1) / 100)$
	IN between x2 and x3	√	$PCT = (IN - X2) / (X3 - X2) * (PCT3 - PCT2) + PCT2$ $AI.H = PCT * (1 + ((IN - X2) / (X3 - X2) * (H3 - H2) + H2) / 100)$
	IN between x3 and x4	√	$PCT = (IN - X3) / (X4 - X3) * (PCT4 - PCT3) + PCT3$ $AI.H = PCT * (1 + ((IN - X3) / (X4 - X3) * (H4 - H3) + H3) / 100)$
	$IN \geq x4$	√	$PCT = PCT4, AI.H = PCT * (1 + H4 / 100)$
	-	×	Not to modify AI.H alarm
AI.L	$IN \leq x1$	√	$PCT = PCT1, AI.L = PCT * (1 + L1 / 100)$
	IN between x1 and x2	√	$PCT = (IN - X1) / (X2 - X1) * (PCT2 - PCT1) + PCT1$ $AI.L = PCT * (1 + ((IN - X1) / (X2 - X1) * (L2 - L1) + L1) / 100)$
	IN between x2 and x3	√	$PCT = (IN - X2) / (X3 - X2) * (PCT3 - PCT2) + PCT2$ $AI.L = PCT * (1 + ((IN - X2) / (X3 - X2) * (L3 - L2) + L2) / 100)$
	IN between x3 and x4	√	$PCT = (IN - X3) / (X4 - X3) * (PCT4 - PCT3) + PCT3$ $AI.L = PCT * (1 + ((IN - X3) / (X4 - X3) * (L4 - L3) + L3) / 100)$
	$IN \geq x4$	√	$PCT = PCT4, AI.L = PCT * (1 + L4 / 100)$
	-	×	Not to modify AI.L alarm
AI.LL	$IN \leq x1$	√	$PCT = PCT1, AI.LL = PCT * (1 + LL1 / 100)$

Alarm property	Input value	Alarm enable	Modification Illustration
	IN between x1 and x2	√	$PCT = (IN - X1) / (X2 - X1) * (PCT2 - PCT1) + PCT1$ $AI.LL = PCT * (1 + ((IN - X1) / (X2 - X1) * (LL2 - LL1) + LL1) / 100)$
	IN between x2 and x3	√	$PCT = (IN - X2) / (X3 - X2) * (PCT3 - PCT2) + PCT2$ $AI.L = PCT * (1 + ((IN - X2) / (X3 - X2) * (LL3 - LL2) + LL2) / 100)$
	IN between x3 and x4	√	$PCT = (IN - X3) / (X4 - X3) * (PCT4 - PCT3) + PCT3$ $AI.L = PCT * (1 + ((IN - X3) / (X4 - X3) * (LL4 - LL3) + LL3) / 100)$
	$IN \geq x4$	√	$PCT = PCT4$, $AI.LL = PCT * (1 + LL4 / 100)$
	-	×	Not to modify AI.LL alarm
AI.LLL	$IN \leq x1$	√	$PCT = PCT1$, $AI.LL = PCT * (1 + LLL1 / 100)$
	IN between x1 and x2	√	$PCT = (IN - X1) / (X2 - X1) * (PCT2 - PCT1) + PCT1$ $AI.LLL = PCT * (1 + ((IN - X1) / (X2 - X1) * (LLL2 - LLL1) + LLL1) / 100)$
	IN between x2 and x3	√	$PCT = (IN - X2) / (X3 - X2) * (PCT3 - PCT2) + PCT2$ $AI.L = PCT * (1 + ((IN - X2) / (X3 - X2) * (LLL3 - LLL2) + LLL2) / 100)$
	IN between x3 and x4	√	$PCT = (IN - X3) / (X4 - X3) * (PCT4 - PCT3) + PCT3$ $AI.L = PCT * (1 + ((IN - X3) / (X4 - X3) * (LLL4 - LLL3) + LLL3) / 100)$
	$IN \geq x4$	√	$PCT = PCT4$, $AI.LLL = PCT * (1 + LLL4 / 100)$
	-	×	Not to modify AI.LLL alarm
AI.HYS	$IN \leq x1$	AI.HHH to AI.LLL any one alarm is enabled	$PCT = PCT1$, $AI.HYS = PCT * (0 + HYS1 / 100)$
	IN between x1 and x2		$PCT = (IN - X1) / (X2 - X1) * (PCT2 - PCT1) + PCT1$ $AI.HYS = PCT * (0 + ((IN - X1) / (X2 - X1) * (HYS3 - HYS2) + HYS2) / 100)$
	IN between x2 and x3		$PCT = (IN - X2) / (X3 - X2) * (PCT3 - PCT2) + PCT2$ $AI.HYS = PCT * (0 + ((IN - X1) / (X2 - X1) * (HYS3 - HYS2) + HYS2) / 100)$
	IN between x3 and x4		$PCT = (IN - X3) / (X4 - X3) * (PCT4 - PCT3) + PCT3$ $AI.HYS = PCT * (0 + ((IN - X3) / (X4 - X3) * (HYS4 - HYS3) + HYS3) / 100)$
	$IN \geq x4$		$PCT = PCT4$, $AI.HYS = PCT * (0 + HYS4 / 100)$
	-	AI each high low limit alarm is not enabled	Not to modify AI.HYS
AI.DPV	$IN \leq x1$	√	$PCT = PCT1$, $AI.DPV = PCT * (1 + VEL1 / 100)$
	IN between x1 and x2	√	$PCT = (IN - X1) / (X2 - X1) * (PCT2 - PCT1) + PCT1$ $AI.DPV = PCT * (1 + ((IN - X1) / (X2 - X1) * (VEL2 - VEL1) + VEL1) / 100)$
	IN between x2 and x3	√	$PCT = (IN - X2) / (X3 - X2) * (PCT3 - PCT2) + PCT2$ $AI.DPV = PCT * (1 + ((IN - X1) / (X2 - X1) * (VEL3 - VEL2) + VEL2) / 100)$

Alarm property	Input value	Alarm enable	Modification Illustration
	IN between x3 and x4	√	$PCT = (IN - X3)/(X4 - X3) * (PCT4 - PCT3) + PCT3$ $AI.DPV = PCT * (1 + ((IN - X3)/(X4 - X3) * (VEL4 - VEL3) + VEL3)/100)$
	$IN \geq x4$	√	$PCT = PCT4, AI.DPV = PCT * (1 + VEL4/100)$
	-	×	Not to modify AI.DPV alarm.

Modification rules of Percent AI tags by jump mode

When SWXY=ON and SWEU=OFF, modify the alarm associated with AI tags according to the rules listed in the table below.

Alarm property	Input value	Alarm enable	Modification Illustration
AI.HHH	$IN \leq x1$, Or IN between x1 and x2	√	$PCT = PCT1, AI.HHH = PCT * (1 + HHH1/100)$
	IN between x2 and x3	√	$PCT = PCT2, AI.HHH = PCT * (1 + HHH2/100)$
	IN between x3 and x4	√	$PCT = PCT3, AI.HHH = PCT * (1 + HHH3/100)$
	$IN \geq x4$	√	$PCT = PCT4, AI.HHH = PCT * (1 + HHH4/100)$
	-	×	Not to modify AI.HHH alarm
AI.HH	$IN \leq x1$, Or IN between x1 and x2	√	$PCT = PCT1, AI.HH = PCT * (1 + HH1/100)$
	IN between x2 and x3	√	$PCT = PCT2, AI.HH = PCT * (1 + HH2/100)$
	IN between x3 and x4	√	$PCT = PCT3, AI.HH = PCT * (1 + HH3/100)$
	$IN \geq x4$	√	$PCT = PCT4, AI.HH = PCT * (1 + HH4/100)$
	-	×	Not to modify AI.HH alarm
AI.H	$IN \leq x1$, or IN between x1 and x2	√	$PCT = PCT1, AI.H = PCT * (1 + H1/100)$
	IN between x2 and x3	√	$PCT = PCT2, AI.H = PCT * (1 + H2/100)$
	IN between x3 and x4	√	$PCT = PCT3, AI.H = PCT * (1 + H3/100)$
	$IN \geq x4$	√	$PCT = PCT4, AI.H = PCT * (1 + H4/100)$
	-	×	Not to modify AI.H alarm

Alarm property	Input value	Alarm enable	Modification Illustration
AI.L	$IN \leq x1$, or IN between $x1$ and $x2$	√	$PCT = PCT1, AI.L = PCT * (1 + L1/100)$
	IN between $x2$ and $x3$	√	$PCT = PCT2, AI.L = PCT * (1 + L2/100)$
	IN between $x3$ and $x4$	√	$PCT = PCT3, AI.H = PCT * (1 + L3/100)$
	$IN \geq x4$	√	$PCT = PCT4, AI.L = PCT * (1 + L4/100)$
	-	×	Not to modify AI.L alarm
AI.LL	$IN \leq x1$, Or IN between $x1$ and $x2$	√	$PCT = PCT1, AI.LL = PCT * (1 + LL1/100)$
	IN between $x2$ and $x3$	√	$PCT = PCT2, AI.LL = PCT * (1 + LL2/100)$
	IN between $x3$ and $x4$	√	$PCT = PCT3, AI.H = PCT * (1 + LL3/100)$
	$IN \geq x4$	√	$PCT = PCT4, AI.LL = PCT * (1 + LL4/100)$
	-	×	Not to modify AI.LL alarm
AI.LLL	$IN \leq x1$, Or IN between $x1$ and $x2$	√	$PCT = PCT1, AI.LLL = PCT * (1 + LLL1/100)$
	IN between $x2$ and $x3$	√	$PCT = PCT2, AI.LLL = PCT * (1 + LLL2/100)$
	IN between $x3$ and $x4$	√	$PCT = PCT3, AI.H = PCT * (1 + LLL3/100)$
	$IN \geq x4$	√	$PCT = PCT4, AI.LLL = PCT * (1 + LLL4/100)$
	-	×	Not to modify AI.LLL alarm
AI.HYS	$IN \leq x1$, Or IN between $x1$ and $x2$	AI.HH-H~AI.L-LL any alarm enable	$PCT = PCT1, AI.HYS = PCT * (0 + HYS1/100)$
	IN between $x2$ and $x3$		$PCT = PCT2, AI.HYS = PCT * (0 + HYS2/100)$
	IN between $x3$ and $x4$		$PCT = PCT3, AI.HYS = PCT * (0 + HYS3/100)$
	$IN \geq x4$		$PCT = PCT4, AI.HYS = PCT * (0 + HYS4/100)$
	-	AI each high and low alarm are not enabled	Not to modify AI.HYS

Alarm property	Input value	Alarm enable	Modification Illustration
AI.DPV	$IN \leq x1$, Or IN between $x1$ and $x2$	√	$PCT = PCT1, AI.DPV = PCT * (1 + VEL1/100)$
	IN between $x2$ and $x3$	√	$PCT = PCT2, AI.DPV = PCT * (1 + VEL2/100)$
	IN between $x3$ and $x4$	√	$AI.DPV = PCT * (1 + VEL3/100)$
	$IN \geq x4$	√	$PCT = PCT4, AI.DPV = PCT * (1 + VEL4/100)$
	-	×	Not to modify AI.DPV alarm

15.6 M_AI_ALM

This function block is used for alarm management of multiplex conditions. Through the alias of the M_AI_ALM function block, the association with the AI tag can be established. Implement the alarm enablement of the AI tag according to the user-defined alarm distribution table real-time, and its upper and lower limits. Thus, dynamically modify the attributes of the high and low limit alarms and rate alarms of the AI tag.

Based on multi-parametric AI alarm management function block, M_AI_ALM function block as shown below.

M_AI_ALM			
* M_AI_ALM			
0.00	IN	ADDR_ERR	
0.00	IN_VEL	XY_ERR	
OFF	SWAOF	XY_V_ERR	
OFF	SHUTDOWN	STA	
p0002		1#	

Parameter Name	Type	Description	Upload
in-put pins	IN	REAL	Input value
	IN_VEL	REAL	Rate input value
	SWAOF	BOOL	Alarm shield
	SHUT-DOWN	BOOL	Shut down working condition
Out-put pins	ADDR_ERR	BOOL	AI address error
	XY_ERR	BOOL	XY setting error
	XY_V_ERR	BOOL	Rate XY setting error
	STA	USINT	error section promptX[i] input error:XY_ERR=ON,S-TA=2+(i-2)X_V[j] input error:XY_V_ERR=ON,S-

Parameter Name		Type	Description	Upload
			TA=2+(j-2)*10X[j], X_V[ji] as input error:XY_ER-R=ON、XY_V_ERR=ON,STA=i+(j-2)*10	
Monitor parameters	ENHHH	BOOL	HHH alarm enable	No
	ENHH	BOOL	HH alarm enable	No
	ENH	BOOL	H alarm enable	No
	ENL	BOOL	L alarm enable	No
	ENLL	BOOL	LL alarm enable	No
	ENLLL	BOOL	LLL alarm enable	No
	ENDPV	BOOL	rate alarm enable	No
Operation parameters	START	BOOL	start	True
	SV	REAL	alarm base value	True
	X1~X6	REAL	X1 input~X6 input	True
	Y1~Y6	REAL	Y1 input ~Y6 input	True
	SWEU	BOOL	ON=engineering value, OFF=percent value	True
	SWCND	BOOL	ON=line table	True
	SEGUSE	USINT	used sections	True
	SWXY	BOOL	OFF=ramp; ON=jump	True
	HHH_EU	REAL	HHH bias in percent	True
	HH_EU	REAL	HH bias in percent	True
	H_EU	REAL	H bias in percent	True
	L_EU	REAL	L base in percent	True
	LL_EU	REAL	LL bias in percent	True
	LLL_EU	REAL	LLL bias in percent	True
	HYS_EU	REAL	alarm hysteresis	True
	HHH_PCT	REAL	HHH bias in percent	True
	HH_PCT	REAL	HH base in percent	True
	H_PCT	REAL	H bias in percent	True
	L_PCT	REAL	L bias in percent	True
	LL_PCT	REAL	LL bias in percent	True

Parameter Name	Type	Description	Upload
LLL_PCT	REAL	LLL bias in percent	True
HYS_PCT	REAL	alarm hysteresis in percent	True
HHH_DEF	REAL	HHH default value	True
HH_DEF	REAL	HH default value	True
H_DEF	REAL	H default value	True
L_DEF	REAL	L default value	True
LL_DEF	REAL	LL default value	True
LLL_DEF	REAL	LLL default value	True
HYS_DEF	REAL	Default alarm hysteresis	True
HHH_SHTD	REAL	HHH shutdown value	True
HH_SHTD	REAL	HH shutdown value	True
H_SHTD	REAL	H shutdown value	True
L_SHTD	REAL	L shutdown value	True
LL_SHTD	REAL	LL shutdown value	True
LLL_SHTD	REAL	LLL shutdown value	True
HYS_SHTD	REAL	alarm hysteresis in shutdown	True
START_V	BOOL	rate alarm starts	True
SV_V	REAL	rate alarm base value	True
X_V1~X_V6	REAL	X1 input~X6 input	True
Y_V1~Y_V6	REAL	Y1 input~Y6 input	True
SEGUSE_V	USINT	Used section	True
SWXY_V	BOOL	OFF=ramp;ON=jump	True
V_DEF	REAL	rate default value	True
V_SHTD	REAL	rate shutdown value	True

15.6.1 High and Low Limit Alarm Management

The M_AI_ALM function block establishes the association with the AI tag PV field through the alias variable PV. After establishing a relationship, M_AI_ALM manages the upper and lower limit alarms of the AI tags as the rules below.

Whether to modify alarm property

- The START parameter value of the M_AI_ALM function block determines whether to modify the alarm attribute of the associated AI tag.
- When START=ON, the function block performs the corresponding alarm modification function.
- When START=OFF, the function block does not perform alarm modification, and the associated AI tag can independently modify the alarm.
- When START is changed from ON to OFF, the associated AI tag alarm limit is the default value.

Alarm shield

- The ALM_AOF parameter value of the M_AI_ALM function block determines whether to shield the alarm associated with the AI tag:
- When ALM_AOF=ON, the associated AI tag AOF=ON, shield the alarm.
- When ALM_AOF=OFF, the associated AI tag AOF=OFF, and the alarm is not shielded.

Base value calculation

- When SWCND=ON, according to the input of IN, a broken line table is used to calculate the reference value SV.

IN	X1	X2	X3	X4	X5	X6
SV	Y1	Y2	Y3	Y4	Y5	Y6

SEGUSE is the number of segments that can be used by the folding table, assuming SEGUSE = 3, the input value in follows x1, x2, x3, x4, when SWXY = OFF uses a ramp mode, when SWXY = ON, use step mode.

- When SWCND = OFF, the reference value SV can be manually modified.

Alarm limit calculation

The value of SHUTDOWN and SWEU determines the modification of the M_AI_ALM function block to the associated AI tag alarm property.

Alarm property	SHUTDOWN and SWEU	Alarm enable	Modification
AI.HHH	SHUTDOWN=ON	√	AI.HHH=HHH_SHTD

Alarm property	SHUTDOWN and SWEU	Alarm enable	Modification
	SHUTDOWN=OFFand SWEU=ON	√	AI.HHH=SV+HHH_EU
	SHUTDOWN=OFF,SWEU=OFF	√	AI.HHH=SV*(1+HHH_PCT/100)
	-	×	Not to modify AI.HHH alarm
AI.HH	SHUTDOWN=ON	√	AI.HH=HH_SHTD
	SHUTDOWN=OFFand SWEU=ON	√	AI.HH=SV+HH_EU
	SHUTDOWN=OFF,SWEU=OFF	√	AI.HH=SV*(1+HH_PCT/100)
	-	×	not to modify AI.HH alarm
AI.H	SHUTDOWN=ON	√	AI.H=H_SHTD
	SHUTDOWN=OFFand SWEU=ON	√	AI.H=SV+H_EU
	SHUTDOWN=OFF,SWEU=OFF	√	AI.H=SV*(1+H_PCT/100)
	-	×	not to modify AI.H alarm
AI.L	SHUTDOWN=ON	√	AI.L=L_SHTD
	SHUTDOWN=OFF and SWEU=ON	√	AI.L=SV+L_EU
	SHUTDOWN=OFF,SWEU=OFF	√	AI.L=SV*(1+L_PCT/100)
	-	×	not to modify AI.L alarm
AI.LL	SHUTDOWN=ON	√	AI.LL=LL_SHTD
	SHUTDOWN=OFFand SWEU=ON	√	AI.LL=SV+LL_EU
	SHUTDOWN=OFF,SWEU=OFF	√	AI.LL=SV*(1+LL_PCT/100)
	-	×	not to modify AI.LL alarm
AI.LLL	SHUTDOWN=ON	√	AI.LLL=LLL_SHTD
	SHUTDOWN=OFFand SWEU=ON	√	AI.LLL=SV+LLL_EU
	SHUTDOWN=OFF,SWEU=OFF	√	AI.LL=SV*(1+LLL_PCT/100)
	-	×	Not to modify AI.LLL alarm
AI.HYS	SHUTDOWN=ON	AI.HHH to AI.LLL, any one enable	AI.HYS=HYS_SHTD
	SHUTDOWN=OFFand SWEU=ON		AI.HYS=HYS_EU

Alarm property	SHUTDOWN and SWEU	Alarm enable	Modification
	SHUTDOWN=OFF,SWEU=OFF		AI.HYS=SV*HYS_PCT/100
	-	AI.HHH to AI.LLL, no one enable	Not to modify AI.HYS

15.6.2 Rate Alarm Management

The M_AI_ALM function block establishes the association with the AI tag PV field through the alias variable PV. After establishing a correlation relationship, M_AI_ALM is managed by the rate alarm of the AI tag in accordance with the rules below.

Whether to modify alarm property

- The START_V parameter value of the M_AI_ALM function block determines whether the DPV value of the associated AI tag is modified.
- When START_V = ON, the function block performs the corresponding DPV alarm modification function.
- When START_V = OFF, the function block does not perform alarm modification, and the associated AI tag can independently modify the alarm.
- When START_V is changed from ON to OFF, it is associated with AI.DPV=V_DEF.

Alarm shield

- The ALM_AOF parameter value of the M_AI_ALM function block determines whether to shield the associated AI tag rate alarm.
- When ALM_AOF = ON, the associated AI tag AOF = ON, the mask alarm.
- When ALM_AOF = OFF, the associated AI tag AOF = OFF, does not mask alarm.

Base value calculation

According to the input IN, calculate SV_V by line table.

IN	X1_V	X2_V	X3_V	X4_V	X5_V	X6_V
SV_V	Y1_V	Y2_V	Y3_V	Y4_V	Y5_V	Y6_V

SEGUSE_V is the number of segments that can be used by the folding table, assuming SEGUSE_V = 3, the input value in follows X1_V, X2_V, X3_V, X4_V, when SWXY_V = OFF uses a ramp mode, when SWXY_V = ON, use step mode.

Alarm limit calculation

The SHUTDOWN value determines the modification of the alarm attribute of the associated AI tag DPV by the M_AI_ALM function block.

SHUTDOWN	Alarm enable	Modification illustration
SHUTDOWN=ON	√	AI.DPV=V_SHTD
SHUTDOWN=OFF	√	AI.DPV=SV_V
-	×	Not to modify AI.DPV alarm.

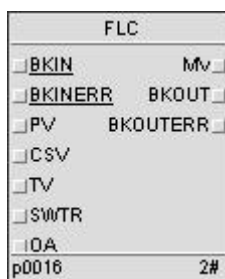
15.7 Fuzzy Control Function Block(FLC)

Function block FLC is the fuzzy controller achieved by fuzzy control algorithm. It gains outputs by fuzzy operation with error and error rate. FLC can realize single loop control, cascade control and other control functions. Its using method is similar to function block PID. As fuzzy controller is a nonlinear controller, it isn't sensitive to the change of object parameters and noise. It is used to control those objects whose character changing with load. So it has smaller overshoot, faster rise time and adjusting time.

When using FLC function block, three parameters are needed to tune: KE, KDE, KDU. The smaller the KE is, the bigger the impact of error EI on MV would be. The smaller the KDE is, the bigger the impact of error rate on MV would be. The bigger the KDU is, the bigger the impact of MV would be at the same EI and error rate.

The using method of FLC is the same to PID except the three tune parameters and tuning method, so the usage introduction of PID function block could be a reference.

The FLC is complex function block. The block performance period is 150μs.



15.7.1 Parameter Description

Table 15.10 The FLC Parameters Description

Name			Description	Upload	Properties	Application Reference
Basic Parameters	Range Settings	MVSCH	MV range high value	-	Configuration Parameter	The same as MV actual value H limit
		MVSCL	MV range low value	-	Configuration Parameter	The same as MV actual value L limit
		SVSCH	SV range high value	-	Configuration Parameter	The same as PV actual value H limit
		SVSCL	SV range low value	-	Configuration Parameter	The same as PV actual value L limit
		SVEU	SV engineer unit	-	Configuration Parameter	Set in the function block properties settings interface
		MVEU	MV engineer unit	-	Configuration Parameter	Set in the function block properties settings interface
		SVDLEN	SV decimal digits [0,5]	-	Configuration Parameter	Used for Data displayed on function block panel (Equal to 3 as default)
		MVDLEN	MV decimal digits [0,5]	-	Configuration Parameter	Used for Data displayed on function block panel (Equal to 3 as default)
	Limits	MVH	MV high limit value	TRUE	Operation parameter	Value range [MVS-CL,MVSCH]
		MVL	MV low limit value	TRUE	Operation parameter	Value range [MVS-CL,MVSCH]
		SVH	SV high limit value	TRUE	Operation parameter	Value range [SVS-CL,SVSCH]
		SVL	SV low limit value	TRUE	Operation parameter	Value range [SVS-CL,SVSCH]
		DMVLIM	MV output Rate variety limit value.	TRUE	Operation parameter	Refer part Integral Cutting

Table 15.10 The FLC Parameters Description (continued)

Name			Description	Upload	Properties	Application Reference
			Used to prevent the MV from overlarge modification in a short time.			
	Direct/Reverse Switch Settings	SWPN	Direct/Reverse action select switch. SV is not changed, the MV Increases with the increasing of PV in Direct action, and decreases with the increasing of PV in reverse action.	TRUE	Operation parameter	SWPN=OFF equal to direct action; SWPN=ON equal to reverse action
Extended Parameters	Base Input Pin Settings	BKIN	Function block feedback input	-	Input pin	Connect to BKOUT of downstream block
		BKINERR	Function block feedback status input	-	Input pin	Connect to BKOUTERR of downstream block
		PV	The measured value of loop Control object	-	Input pin	Connect to AI
		CSV	The cascade setpoint	-	Input pin	Connect to MV of upstream block
		TV	Tracking input(MV=TV when tracking status)	-	Input pin	Connect to AIRelated parameter: SWTR
		SWTR	Tracking selecting switch. MV track TV when SWTR=ON; Do not track when SWTR=OFF	-	Input pin	Use to upstream interlock condition inputRelated parameter: TV
		OA	Output compensating value. Use to feedforward control	-	Input pin	Connect feed-forward signal AI. Related parameters are OK and OB

Table 15.10 The FLC Parameters Description (continued)

Name			Description	Upload	Properties	Application Reference
	Advanced Input Pin Settings	MF	Actuator feed-back value. Use to monitoring	-	Input pin	Connect to AI
		IA	Input compensating value. Use to improve controllability of procedure with long dead zone time.	-	Input pin	Connect to AI. Refer part Input Process; Related parameter IK and IB.
		PSWAM	MAN/AUTO control for program control. The program Man control when PSWAM=OFF; program AUTO control when PSWAM=ON	-	Input pin	Connect to output of upstream block. Significance when MAN_OPT=ON
		PSWSV	The SV/CSV selecting switch for program control. Adopt SV when PSWSV=OFF; adopt CSV when PSWSV=ON	-	Input pin	Connect to output of upstream block. Significance when SV_OPT=ON
		MAN - OPT	MAN/AUTO control source select switch. If MAN_OPT=ON then MAN/AUTO select switch is controlled by the PSWAM; if MAN_OPT=OFF then MAN/AUTO select switch is controlled by SWAM	-	Input pin	Connect to output of upstream block. Related parameter PSWAM and SWAM
		SV_OPT	SV/CSV control source select switch. If it is ON then SV/CSV se-	-	Input pin	Connect to output of upstream block. Related parameter

Table 15.10 The FLC Parameters Description (continued)

Name			Description	Upload	Properties	Application Reference
			lect switch is controlled by the PSWSV; if it is OFF then SV/CSV select switch is controlled by the SWSV.			PSWSV and SWSV
		SWINC	Switch of closedown increase for MV(MV can not increase). Carry out closedown increase when SWINC=ON	-	Input pin	Connect to upstream block out. It is active when block is AUTO/CAS status.
		SWDEC	Switch of closedown decrease for MV(MV can not increase). Carry out closedown decrease when SWDEC=ON	-	Input pin	Connect to upstream block out. It is active when block is AUTO/CAS status.
		HOLD	Switch for MV hold. The MV hold when HOLD=ON	-	Input pin	Connect to upstream block out. It is active when block is AUTO/CAS status.
	Output pin	MV	Function block output value	-	Output pin	Connect to AOIf there's a float abnormal happened to the MV value, the MV will be set as the value of previous period or the lower range limit. Please refer to "Application" for details.
		BKOUT	Function block feedback value output	-	Output pin	Connect to upstream block BKINRelated parameter is BK_OPT

Table 15.10 The FLC Parameters Description (continued)

Name			Description	Upload	Properties	Application Reference
		BKOUTERR	Function block feedback status output	-	Output pin	Connect to upstream block BKINERR
		BK_OPT	Select switch for BKOUT value. If BK_OPT=ON then BKOUT track measured value else track setpoint.	-	Configuration parameter	Related parameter is BKOUT
	Blur Param Setting	KE	Error change factor	TRUE	Operation parameter	KE decreases with the increasing of the effect of EI for MV
		KDE	Error change ratio setting factor	TRUE	Operation parameter	KDE decreases with the increasing of the effect of error change ratio for MV
		KDU	Out increment setting factor	TRUE	Operation parameter	KDU increasing with the increasing of the effect of MV when the same EI and error change ratio.
	Operator Command	MODE	Work mode	-	Monitoring parameter	Refer part Transition Process of Function Block Modes
		IMODE	Stand-by work mode	-	Monitoring parameter	Refer part Transition Process of Function Block Modes
		MODE_OPT	ON=auto return, OFF=manual return (default)	-	Configuration parameter	Refer part Transition Process of Function Block Modes
		SWAM	Manual and auto switch: OFF=manual, ON=auto	-	Operation parameter	It is active for MAN_OPT=OFF
		SWSV	Suto/ cascade selection: OFF=au-	-	Operation parameter	It is active for SV_OPT=OFF

Table 15.10 The FLC Parameters Description (continued)

Name			Description	Upload	Properties	Application Reference
			to, ON=cascade			
		SWPMV	Whether to equal to pre-set MV value when switch to auto status. PMV enable switch. When SWPMV=ON, MV = PMV, MV velocity alarm, lock increase/decrease are disabled	TRUE	Operation parameter	Related parameter is PMV
		PMV	Preset MV when switching from OOS/IMAN/TR/MAN modes to AUTO or CAS mode	TRUE	Operation parameter	It is active for SWPMV=ON
	Operator Data	SV	Setpoint for loop control	TRUE	Operation parameter	Refer to Set Variable Process
		MANMV	Manual output value	-	Operation parameter	When manual mode, MV=MANMV
		EI	error	-	Monitoring parameter	Refer to Operation Process
	Input Alarm Settings	PVHH	PV HH alarm value	TRUE	Operation parameter	Refer to Input Process
		PVH	PV H alarm value	TRUE	Operation parameter	Refer to Input Process
		PVL	PV L alarm value	TRUE	Operation parameter	Refer to Input Process
		PVLL	PV LL alarm value	TRUE	Operation parameter	Refer to Input Process
		PVHYS	Measured value alarm hysteresis	TRUE	Operation parameter	Refer to Input Process
		DL	Deviation alarm set value	TRUE	Operation parameter	Refer to Operation Process

Table 15.10 The FLC Parameters Description (continued)

Name			Description	Upload	Properties	Application Reference
		DLHYS	Deviation alarm hysteresis value	TRUE	Operation parameter	Refer to Operation Process
		KSV	Deviation filter coefficient	TRUE	Operation parameter	Refer to Operation Process
		TSV	Deviation filter time constant(s)	TRUE	Operation parameter	Refer to Operation Process
		NMFLIM	Valve position negative error thresholds	TRUE	Operation parameter	Related parameter: NMF. Refer to Integral Cutting
		PMFLIM	Valve position positive error thresholds	TRUE	Operation parameter	Related parameter: PMF. Refer to Integral Cutting
		TMFHYS	Valve position error alarm hysteresis time	TRUE	Operation parameter	Refer to Integral Cutting
	Advance Calculation Settings	BYPASS	FLC bypass switch. When BYPASS=ON, bypass FLC operation. SV is directly converted to MV.	TRUE	Operation parameter	In CAS mode, if the slave loop is faulty, use BYPASS to bypass this loop.
		SWDB	Enable switch, when SWDB=ON, deadband enable	TRUE	Operation parameter	Related parameter: DB
		DB	Deadband band size	TRUE	Operation parameter	It is active when SWDB=ON
		DBHYS	Deadband band hysteresis	TRUE	Operation parameter	Refer to
		OUT_-OPT	Control output type: OFF=position type, ON=increment type	-	Configuration parameter	Related parameter: MV
	Alarm	PVHHIND	PV HH limit alarm indication	-	Monitoring parameter	Refer to Integral Cutting

Table 15.10 The FLC Parameters Description (continued)

Name			Description	Upload	Properties	Application Reference
		PVHIND	PV H limit alarm indication	-	Monitoring parameter	Refer to Integral Cutting
		PVLIND	PV L limit alarm indication	-	Monitoring parameter	Refer to Integral Cutting
		PVLLIND	PV LL limit alarm indication	-	Monitoring parameter	Refer to Integral Cutting
		MVHIND	MV H limit alarm indication	-	Monitoring parameter	Refer to Integral Cutting
		MVLIND	MV L limit alarm indication	-	Monitoring parameter	Refer to Integral Cutting
		SVHIND	SV H limit alarm indication	-	Monitoring parameter	Refer to Integral Cutting
		SVLIND	SV L limit alarm indication	-	Monitoring parameter	Refer to Integral Cutting
		PEIIND	Positive deviation alarm indication	-	Monitoring parameter	Refer to Integral Cutting
		NEIIND	Negative deviation alarm indication	-	Monitoring parameter	Refer to Integral Cutting
		DMVHIND	MV positive rate limit indication	-	Monitoring parameter	Refer to Integral Cutting
		DMVLIND	MV negative rate limit indication	-	Monitoring parameter	Refer to Integral Cutting
		NMFIND	Valve position error negative alarm indication	-	Monitoring parameter	Refer to Integral Cutting
		PMFIND	Valve position error positive alarm indication	-	Monitoring parameter	Refer to Integral Cutting
	Compensation Settings	IK	Input compensation gain	TRUE	Operation parameter	Refer to Input Process. Relat-

Table 15.10 The FLC Parameters Description (continued)

Name			Description	Upload	Properties	Application Reference
						ed parameter: IA.
		IB	Input compensation bias value	TRUE	Operation parameter	Refer to Input Process. Related parameter: IA.
		OK	Output compensation gain	TRUE	Operation parameter	Refer to Operation Process. Related parameter: OA.
	Fase/Slow/Increase/Decrease Settings	OB	Output compensation bias value	TRUE	Operation parameter	Refer to Operation Process. Related parameter: OA.
		SMV	MV manual slow increase/decrease value (%)	TRUE	Operation parameter	Set MV manual slow increase/decrease percentage in function block properties settings
		FMV	MV manual fast increase/decrease value (%)	TRUE	Operation parameter	Set MV manual fast increase/decrease percentage in function block properties settings
		SSV	SV slow increase/decrease value (%)	TRUE	Operation parameter	Set SV manual slow increase/decrease percentage in function block properties settings
		FSV	SV fast increase/decrease value (%)	TRUE	Operation parameter	Set SV manual fast increase/decrease percentage in function block properties settings
	Extended Range Settings	HORLIM	Extended range maximum percentage	-	Configuration parameter	Refer to Output Process
		LORLIM	Extended range mini-	-	Configuration parameter	Refer to Output Process

Table 15.10 The FLC Parameters Description (continued)

Name			Description	Upload	Properties	Application Reference
	SV Advance Settings		num percent-age			
		SWRAMP	SV ramp function switch. When changing set value, incline it to SV according to the set RAMP (s). OFF=SV ramp function off, ON=SV ramp function on	TRUE	Operation parameter	Related parameter: RAM-Pactive when in automatic or cascade mode
		RAMP	Ramp coefficient	TRUE	Operation parameter	Related parameter: SWRAMP
		SVTR_-OPT	SV track PV switch enable/disable: OFF=not track, ON=track. If PV> SVH/ SVL, SV= range limit. used to prevent the output MV from interference when changing the control mode.	-	Configuration parameter	Refer to Output Process
	Alarm Enabled and Suppress	AOF	Suppress module alarm, on=prohibit to	TRUE	Operation parameter	Refer to Integral Cutting
		ENALM	Alarm enable	TRUE	Alarm Parameter	Refer to Integral Cutting
		FLAG	Flag code	-	Output pin	Refer to Integral Cutting
	OOS Settings	SWOOS	Function block disable (ON=disable)	TRUE	Operation parameter	Set as ON at the first time of function block downloading
		OOSVAL	Output value in OOS status	TRUE	Operation parameter	Related parameter: OOS_-OPT=ON
		OOS_-OPT	Output value type in OOS status.	-	Configuration parameter	Refer to About

Table 15.10 The FLC Parameters Description (continued)

Name			Description	Upload	Properties	Application Reference
			when OOS_ OPT =ON, MV=OOSVAL, when OOS_ OPT =OFF, maintain the MV			

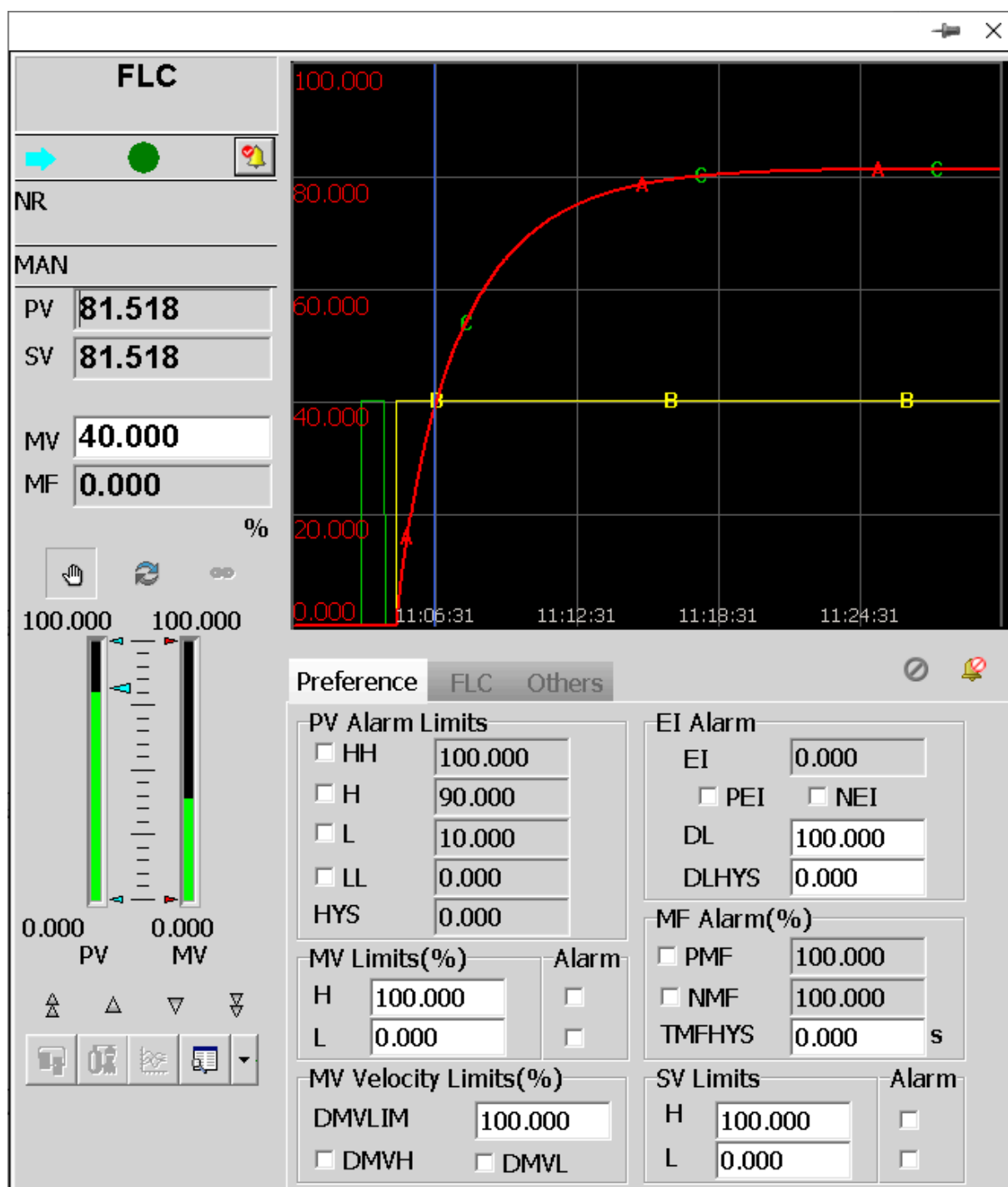
15.7.2 Application

The float abnormal of output values means that the output values are not float format, or a meaningless output value is produced in a calculation that performs a divide-by-zero operation. When float abnormal happened, the function block's output value shall conform to the following rules:

- If there's the normal value of previous period, MV outputs the value of previous period.
- If there's the abnormal value of previous period or no previous period value, MV outputs the lower range limit.

15.7.3 Panel Parameter

The "Preference" and "Other Item" parameters of FLC are the same as PID except "FLC item".



Preference **FLC** Others

FLC Parameter

KE 100.000

KDE 100.000

KDU 0.000

SV Ramp Action

☒ Disable ☐ Enable

RAMP 100.000

Deadband

☐ Enable ☒ Disable

DB 0.000

DBHYS 0.000

Control Direction

☐ Direct ☒ Reverse

FLC Action

☒ Run ☐ Bypass

Preference FLC **Others**

Input Compensation

Value 0.000

Coef. (IK) 1.000

Bias (IB) 0.000

BKOUT Track

☐ Track PV

☒ Track SV

SV Track

☒ Track

☐ Not Track

Output Compensation(%)

Value 0.000

Coef. (OK) 1.000

Bias (OB) 0.000

MAN_OPT

☒ Panel

☐ Program

SV_OPT

☐ Panel

☒ Program

EI Alarm Filter

Coef. (KSV) 1.000

Time 0.000

Track

Track Value 0.000 %

Figure 15.17 Panel Instruction of FLC

Panel Parameter Name			Function Block Parameter Name	Initial Value	Value Range	Application Instruction
Preference	PV Alarm (%)	HH	PVHH	100.000	[SVSCL,SVSCH]	Set the HH limit alarm value of loop PV. (Selecting the alarm means enable, or it is disabled.)

Panel Parameter Name			Function Block Parameter Name	Initial Value	Value Range	Application Instruction
		H	PVH	90.000	[SVSCL,SVSCH]	Set the H limit alarm value of loop PV. (Selecting the alarm means enable, or it is disbled.)
		L	PVL	10.000	[SVSCL,SVSCH]	Set the L limit alarm value of loop PV. (Selecting the alarm means enable, or it is disbled.)
		LL	PVLL	0.000	[SVSCL,SVSCH]	Set the LL limit alarm value of loop PV. (Selecting the alarm means enable, or it is disbled.)
		HYS	PVHYS	0.000	-	Alarm hysteresis value of PV
	SV Limits (%)	H	SVH	40.000	[SVSCL,SVSCH]	Set the H limit alarm value of loop SV. (Selecting the alarm means enable, or it is disbled.) Note: SV limit will not be affected by the selection.
		L	SVL	0.000	[SVSCL,SVSCH]	Set the L limit alarm value of SV. (Selecting the alarm means enable, or it is disbled.) Note: SV limit will not be affected by the selection.
	MV Limits (%)	H	MVH	100.000	[MVSCL,MVSCH]	Set the H limit alarm value of loop MV. (Selecting the alarm means enable, or it is disbled.) Note: MV limit will not be affected by the selection.
		L	MVL	0.000	[MVSCL,MVSCH]	Set the L limit alarm value of loop MV. (Selecting the alarm means enable, or it is disbled.) Note: MV limit will not be affected by the selection.
	EI Alarm (%)	EI	EI	0.000	-	Read-only. EI= SV-PV (Selecting the alarm means enable, or it is disbled.)
		DMVH (Selected)	-	-	-	Selecting positive deviation alarm means enabled.
		DMVL (Selected)	-	-	-	Selecting negative deviation alarm means enabled.
		DL	DL	100.000	± (Range H Limit – Range L Limit)	SV of Deviation alarm
		DL-HYS	DLHYS	0.000	-	SV of alarm hysteresis value

Panel Parameter Name			Function Block Parameter Name	Initial Value	Value Range	Application Instruction
	MF Alarm (%)	PMF	PMFLIM	100.000	-	Selecting positive deviation alarm means enabled.
		NMF	NMFLIM	100.000	-	Selecting negative deviation alarm means enabled.
		TMFH	TMFHYS	0.000	-	SV of lag time.
	MV Velocity Limits (%)	DMVH (Selected)	-	-	-	Selecting the positive velocity alarm means enabled.
		DMVL (Selected)	-	-	-	Selecting the negative velocity alarm means enabled.
		DMVLIM	DMVLIM	100.000	-	SV of loop MV velocity limit
FFLC	FLC Parameter	KE	KE	100.000		SV of bias adjusting factor parameter
		KDE	KDE	100.000		SV of output increment adjusting factor parameter
		KDU	KDU	0.000		SV of output increment adjusting factor parameter
	Deadband (%)	Enable (Selected)	SWDB	-		Selecting the deadband parameter means enable.
		Disable (Selected)	SWDB	√		Selecting the deadband parameter means disable.
		DB	DB	0.000		Size of deadband
		DB-HYS	DBHYS	0.000		Hysysteris value of deadband
	SV Ramp Action (%)	Enable (Selected)	SWRAMP	-		Selecting the SV ramp action means enable.
		Disable (Selected)	SWRAMP	√		Selecting the SV ramp action means disable.
		RAMP	RAMP	100.000		SV of ramp coefficient (slope) parameter

Panel Parameter Name			Function Block Parameter Name	Initial Value	Value Range	Application Instruction
	Control Direction	Direct (Selected)	SWPN	-		Selecting the direct action means enable.
		Reverse (Selected)	SWPN	√		Selecting the reverse action means enable.
	FLC Action	Run	BYPASS	√		The modification of function block panel is enabled for the function block properties dialog in debugging.
		Bypass	BYPASS	-		The modification of function block panel is disabled for the function block properties dialog in debugging.
Others	Input Compensation (%)	Value (IA)	IA	0.000	-	Read-only. It can be set in configuration or program.
		Coefficient (IK)	IK	1.000	-	Input compensation gain
		Bias (IB)	IB	0.000	-	Input compensation bias value
	Output Compensation (%)	Value (OA)	OA	0.000	-	Read-only, feedforward signal.
		Coefficient (OK)	OK	1.000	-	Output compensation gain
		Bias (DB)	DB	0.000	-	Output compensation bias value
	Error Alarm Filter Settings	Coefficient (KSV)	KSV	1.000	0~100	Bias filter coefficient
		Time (TSV)	TSV	0.000	0~1000s	Constant between errors (s)
	Feedback Output Track	Track PV	BK_OPT	-	-	Read-only. It can be set in configuration or program.
		Track SV	BK_OPT	√	-	Read-only. It can be set in configuration or program.
	SV Track	Track	SVTR_OPT	√	-	Read-only. It can be set in configuration or program.
		Not Track	SVTR_OPT	-	-	Read-only. It can be set in configuration or program.

Panel Parameter Name			Function Block Parameter Name	Initial Value	Value Range	Application Instruction
	MAN_- OPT Set- tings	Panel	MAN_OPT	√	-	Read-only. It can be set in configuration or program.
		Pro- gram	MAN_OPT	-	-	Read-only. It can be set in configuration or program.
	SV_- OPT Set- tings	Panel	SV_OPT	-	-	Read-only. It can be set in configuration or program.
		Pro- gram	SV_OPT	√	-	Read-only. It can be set in configuration or program.
	Track Value (%)		TV	0.000	-	Read-only. Track the input value (%).

15.7.4 Flag

Table 15.11 Flag list

Flag	Alarm	Instruction
D0	OOS	Disable
D1	IMAN	Initialize Manually
D2	MAN	Manual
D3	TR	Track
D4	AUTO	Auto
D5	CAS	Cascade
D8	PVHH	PV HH Limit Alarm
D9	PVLL	PV LL Limit Alarm
D10	PVH	PV H Limit Alarm
D11	PVL	PV L Limit Alarm
D12	SVH	SV H Limit Alarm
D13	SVL	SV L Limit Alarm
D14	MVH	Output H Limit Alarm
D15	MVL	Output L Limit Alarm
D16	PEI	Positive Deviation Alarm
D17	NEI	Negative Deviation Alarm

Table 15.11 Flag list (continued)

Flag	Alarm	Instruction
D18	REVSCL	Span H/L Limit Reverse or float abnormal
D19	CFGERR	Configuration Error
D22	DMVH	MV Positive Rate Limit Alarm
D23	DMVL	MV Negative Rate Limit Alarm
D25	AOF	Suppress Alarm
D27	NMF	Valve Negative Deviation Alarm
D28	PMF	Valve Positive Deviation Alarm

15.7.5 Programming Example for Application

The programming method reference part Application Example.

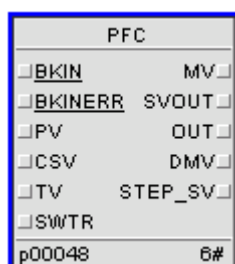
15.8 Predictive Function Control Function Block For Single Variable(PFC)

PFC is a model predictive control algorithm: Predictive Functional Control. PFC has easy algorithm, small calculating quantity, fast tracing, high precision and other characters. PFC has been successfully applied in industrial robot for fast and high precision tracing, target tracing in martial domain and other fast control systems as well as chemical batch reaction process, rolling and other relatively slow rate control systems. It has also been successfully applied in PVC polymeric reaction, PH control, chloridizing PVC and other producing processes.

PFC uses the first-order pure lag model to control the first-order pure lag object with fitting high order asymptotic stable objects to first-order pure lag objects. PFC has PID in it. It could combine process object with PID to make a whole, and define it a predictive control generalized object.

Regulating PID parameters to make generalized objects first-order pure lag objects.

The PFC is complex function block. The block performance period is 150μs.



15.8.1 Parameter Description

Table 15.12 The FLC Parameters Description

Name			Description	Upload	Properties	Application Reference
Basic Parameters	Range Settings	MVSCH	MV range high value	-	Configuration Parameter	The same as MV actual value H limit
		MVSCL	MV range low value	-	Configuration Parameter	The same as MV actual value L limit
		SVSCH	SV range high value	-	Configuration Parameter	The same as PV actual value H limit
		SVSCL	SV range low value	-	Configuration Parameter	The same as PV actual value L limit
		SVEU	SV engineer unit	-	Configuration Parameter	Set in the function block properties settings interface
		MVEU	MV engineer unit	-	Configuration Parameter	Set in the function block properties settings interface
		SVDLEN	SV decimal digits [0,5]	-	Configuration Parameter	Used for Data displayed on function block panel (Equal to 3 as default)
		MVDLEN	MV decimal digits [0,5]	-	Configuration Parameter	Used for Data displayed on function block panel (Equal to 3 as default)
	Limits	MVH	MV high limit value	TRUE	Operation parameter	Value range [MVS-CL,MVSCH]
		MVL	MV low limit value	TRUE	Operation parameter	Value range [MVS-CL,MVSCH]
		SVH	SV high limit value	TRUE	Operation parameter	Value range [SVS-CL,SVSCH]
		SVL	SV low limit value	TRUE	Operation parameter	Value range [SVS-CL,SVSCH]
		DMVLIM	MV output Rate variety limit value.	TRUE	Operation parameter	Refer part Integral Cutting

Table 15.12 The FLC Parameters Description (continued)

Name			Description	Upload	Properties	Application Reference
			Used to prevent the MV from overlarge modification in a short time.			
	Direct/Reverse Switch Settings	SWPN	Direct/Reverse action select switch. SV is not changed, the MV Increases with the increasing of PV in Direct action, and decreases with the increasing of PV in reverse action.	TRUE	Operation parameter	SWPN=OFF equal to direct action; SWPN=ON equal to reverse action
Extended Parameters	Base Input Pin Settings	BKIN	Function block feedback input	-	Input pin	Connect to BKOUT of downstream block
		BKINERR	Function block feedback status input	-	Input pin	Connect to BKOUTERR of downstream block
		PV	The measured value of loop Control object	-	Input pin	Connect to AI
		CSV	The cascade setpoint	-	Input pin	Connect to MV of upstream block
		TV	Tracking input(MV=TV when tracking status)	-	Input pin	Connect to AIRelated parameter: SWTR
		SWTR	Tracking selecting switch. MV track TV when SWTR=ON; Do not track when SWTR=OFF	-	Input pin	Use to upstream interlock condition inputRelated parameter: TV
		OA	Output compensating value. Use to feedforward control	-	Input pin	Connect feedforward signal AI. Related parameters are OK and OB

Table 15.12 The FLC Parameters Description (continued)

Name			Description	Upload	Properties	Application Reference
	Advanced Input Pin Settings	MF	Actuator feed-back value. Use to monitoring	-	Input pin	Connect to AI
		IA	Input compensating value. Use to improve controllability of procedure with long dead zone time.	-	Input pin	Connect to AI. Refer part Input Process; Related parameter IK and IB.
		PSWAM	MAN/AUTO control for program control. The program Man control when PSWAM=OFF; program AUTO control when PSWAM=ON	-	Input pin	Connect to output of upstream block. Significance when MAN_OPT=ON
		PSWSV	The SV/CSV selecting switch for program control. Adopt SV when PSWSV=OFF; adopt CSV when PSWSV=ON	-	Input pin	Connect to output of upstream block. Significance when SV_OPT=ON
		MAN - OPT	MAN/AUTO control source select switch. If MAN_OPT=ON then MAN/AUTO select switch is controlled by the PSWAM; if MAN_OPT=OFF then MAN/AUTO select switch is controlled by SWAM	-	Input pin	Connect to output of upstream block. Related parameter PSWAM and SWAM
		SV_OPT	SV/CSV control source select switch. If it is ON then SV/CSV se-	-	Input pin	Connect to output of upstream block. Related parameter

Table 15.12 The FLC Parameters Description (continued)

Name			Description	Upload	Properties	Application Reference
			lect switch is controlled by the PSWSV; if it is OFF then SV/CSV select switch is controlled by the SWSV.			PSWSV and SWSV
		SWINC	Switch of closedown increase for MV(MV can not increase). Carry out closedown increase when SWINC=ON	-	Input pin	Connect to upstream block out. It is active when block is AUTO/CAS status.
		SWDEC	Switch of closedown decrease for MV(MV can not increase). Carry out closedown decrease when SWDEC=ON	-	Input pin	Connect to upstream block out. It is active when block is AUTO/CAS status.
		HOLD	Switch for MV hold. The MV hold when HOLD=ON	-	Input pin	Connect to upstream block out. It is active when block is AUTO/CAS status.
	Output pin	MV	Function block output value	-	Output pin	Connect to AOIf there's a float abnormal happened to the MV value, the MV will be set as the value of previous period or the lower range limit. Please refer to "Application" for details.
		BKOUT	Function block feedback value output	-	Output pin	Connect to upstream block BKINRelated parameter is BK_OPT

Table 15.12 The FLC Parameters Description (continued)

Name			Description	Upload	Properties	Application Reference
		BKOUTERR	Function block feedback status output	-	Output pin	Connect to upstream block BKINERR
		BK_OPT	Select switch for BKOUT value. If BK_OPT=ON then BKOUT track measured value else track setpoint.	-	Configuration parameter	Related parameter is BKOUT
	Blur Param Setting	KE	Error change factor	TRUE	Operation parameter	KE decreases with the increasing of the effect of EI for MV
		KDE	Error change ratio setting factor	TRUE	Operation parameter	KDE decreases with the increasing of the effect of error change ratio for MV
		KDU	Out increment setting factor	TRUE	Operation parameter	KDU increasing with the increasing of the effect of MV when the same EI and error change ratio.
	Operator Command	MODE	Work mode	-	Monitoring parameter	Refer part Transition Process of Function Block Modes
		IMODE	Stand-by work mode	-	Monitoring parameter	Refer part Transition Process of Function Block Modes
		MODE_OPT	ON=auto return, OFF=manual return (default)	-	Configuration parameter	Refer part Transition Process of Function Block Modes
		SWAM	Manual and auto switch: OFF=manual, ON=auto	-	Operation parameter	It is active for MAN_OPT=OFF
		SWSV	Suto/ cascade selection: OFF=au-	-	Operation parameter	It is active for SV_OPT=OFF

Table 15.12 The FLC Parameters Description (continued)

Name			Description	Upload	Properties	Application Reference
			to, ON=cascade			
		SWPMV	Whether to equal to pre-set MV value when switch to auto status. PMV enable switch. When SWPMV=ON, MV = PMV, MV velocity alarm, lock increase/decrease are disabled	TRUE	Operation parameter	Related parameter is PMV
		PMV	Preset MV when switching from OOS/IMAN/TR/MAN modes to AUTO or CAS mode	TRUE	Operation parameter	It is active for SWPMV=ON
	Operator Data	SV	Setpoint for loop control	TRUE	Operation parameter	Refer to Set Variable Process
		MANMV	Manual output value	-	Operation parameter	When manual mode, MV=MANMV
		EI	error	-	Monitoring parameter	Refer to Operation Process
	Input Alarm Settings	PVHH	PV HH alarm value	TRUE	Operation parameter	Refer to Input Process
		PVH	PV H alarm value	TRUE	Operation parameter	Refer to Input Process
		PVL	PV L alarm value	TRUE	Operation parameter	Refer to Input Process
		PVLL	PV LL alarm value	TRUE	Operation parameter	Refer to Input Process
		PVHYS	Measured value alarm hysteresis	TRUE	Operation parameter	Refer to Input Process
		DL	Deviation alarm set value	TRUE	Operation parameter	Refer to Operation Process

Table 15.12 The FLC Parameters Description (continued)

Name			Description	Upload	Properties	Application Reference
		DLHYS	Deviation alarm hysteresis value	TRUE	Operation parameter	Refer to Operation Process
		KSV	Deviation filter coefficient	TRUE	Operation parameter	Refer to Operation Process
		TSV	Deviation filter time constant(s)	TRUE	Operation parameter	Refer to Operation Process
		NMFLIM	Valve position negative error thresholds	TRUE	Operation parameter	Related parameter: NMF. Refer to Integral Cutting
		PMFLIM	Valve position positive error thresholds	TRUE	Operation parameter	Related parameter: PMF. Refer to Integral Cutting
		TMFHYS	Valve position error alarm hysteresis time	TRUE	Operation parameter	Refer to Integral Cutting
	Advance Calculation Settings	BYPASS	FLC bypass switch. When BYPASS=ON, bypass FLC operation. SV is directly converted to MV.	TRUE	Operation parameter	In CAS mode, if the slave loop is faulty, use BYPASS to bypass this loop.
		SWDB	Enable switch, when SWDB=ON, deadband enable	TRUE	Operation parameter	Related parameter: DB
		DB	Deadband band size	TRUE	Operation parameter	It is active when SWDB=ON
		DBHYS	Deadband band hysteresis	TRUE	Operation parameter	Refer to
		OUT_-OPT	Control output type: OFF=position type, ON=increment type	-	Configuration parameter	Related parameter: MV
	Alarm	PVHHIND	PV HH limit alarm indication	-	Monitoring parameter	Refer to Integral Cutting

Table 15.12 The FLC Parameters Description (continued)

Name			Description	Upload	Properties	Application Reference
		PVHIND	PV H limit alarm indication	-	Monitoring parameter	Refer to Integral Cutting
		PVLIND	PV L limit alarm indication	-	Monitoring parameter	Refer to Integral Cutting
		PVLLIND	PV LL limit alarm indication	-	Monitoring parameter	Refer to Integral Cutting
		MVHIND	MV H limit alarm indication	-	Monitoring parameter	Refer to Integral Cutting
		MVLIND	MV L limit alarm indication	-	Monitoring parameter	Refer to Integral Cutting
		SVHIND	SV H limit alarm indication	-	Monitoring parameter	Refer to Integral Cutting
		SVLIND	SV L limit alarm indication	-	Monitoring parameter	Refer to Integral Cutting
		PEIIND	Positive deviation alarm indication	-	Monitoring parameter	Refer to Integral Cutting
		NEIIND	Negative deviation alarm indication	-	Monitoring parameter	Refer to Integral Cutting
		DMVHIND	MV positive rate limit indication	-	Monitoring parameter	Refer to Integral Cutting
		DMVLIND	MV negative rate limit indication	-	Monitoring parameter	Refer to Integral Cutting
		NMFIND	Valve position error negative alarm indication	-	Monitoring parameter	Refer to Integral Cutting
		PMFIND	Valve position error positive alarm indication	-	Monitoring parameter	Refer to Integral Cutting
	Compensation Settings	IK	Input compensation gain	TRUE	Operation parameter	Refer to Input Process. Relat-

Table 15.12 The FLC Parameters Description (continued)

Name			Description	Upload	Properties	Application Reference
						ed parameter: IA.
		IB	Input compensation bias value	TRUE	Operation parameter	Refer to Input Process. Related parameter: IA.
		OK	Output compensation gain	TRUE	Operation parameter	Refer to Operation Process. Related parameter: OA.
	Fase/Slow/Increase/Decrease Settings	OB	Output compensation bias value	TRUE	Operation parameter	Refer to Operation Process. Related parameter: OA.
		SMV	MV manual slow increase/decrease value (%)	TRUE	Operation parameter	Set MV manual slow increase/decrease percentage in function block properties settings
		FMV	MV manual fast increase/decrease value (%)	TRUE	Operation parameter	Set MV manual fast increase/decrease percentage in function block properties settings
		SSV	SV slow increase/decrease value (%)	TRUE	Operation parameter	Set SV manual slow increase/decrease percentage in function block properties settings
		FSV	SV fast increase/decrease value (%)	TRUE	Operation parameter	Set SV manual fast increase/decrease percentage in function block properties settings
	Extended Range Settings	HORLIM	Extended range maximum percentage	-	Configuration parameter	Refer to Output Process
		LORLIM	Extended range mini-	-	Configuration parameter	Refer to Output Process

Table 15.12 The FLC Parameters Description (continued)

Name			Description	Upload	Properties	Application Reference
	SV Advance Settings		num percent-age			
		SWRAMP	SV ramp function switch. When changing set value, incline it to SV according to the set RAMP (s). OFF=SV ramp function off, ON=SV ramp function on	TRUE	Operation parameter	Related parameter: RAM-Pactive when in automatic or cascade mode
		RAMP	Ramp coefficient	TRUE	Operation parameter	Related parameter: SWRAMP
		SVTR_-OPT	SV track PV switch enable/disable: OFF=not track, ON=track. If PV> SVH/ SVL, SV= range limit. used to prevent the output MV from interference when changing the control mode.	-	Configuration parameter	Refer to Output Process
	Alarm Enabled and Suppress	AOF	Suppress module alarm, on=prohibit to	TRUE	Operation parameter	Refer to Integral Cutting
		ENALM	Alarm enable	TRUE	Alarm Parameter	Refer to Integral Cutting
		FLAG	Flag code	-	Output pin	Refer to Integral Cutting
	OOS Settings	SWOOS	Function block disable (ON=disable)	TRUE	Operation parameter	Set as ON at the first time of function block downloading
		OOSVAL	Output value in OOS status	TRUE	Operation parameter	Related parameter: OOS_-OPT=ON
		OOS_-OPT	Output value type in OOS status.	-	Configuration parameter	Refer to About

Table 15.12 The FLC Parameters Description (continued)

Name			Description	Upload	Properties	Application Reference
			when OOS_ OPT =ON, MV=OOSVAL, when OOS_ OPT =OFF, maintain the MV			

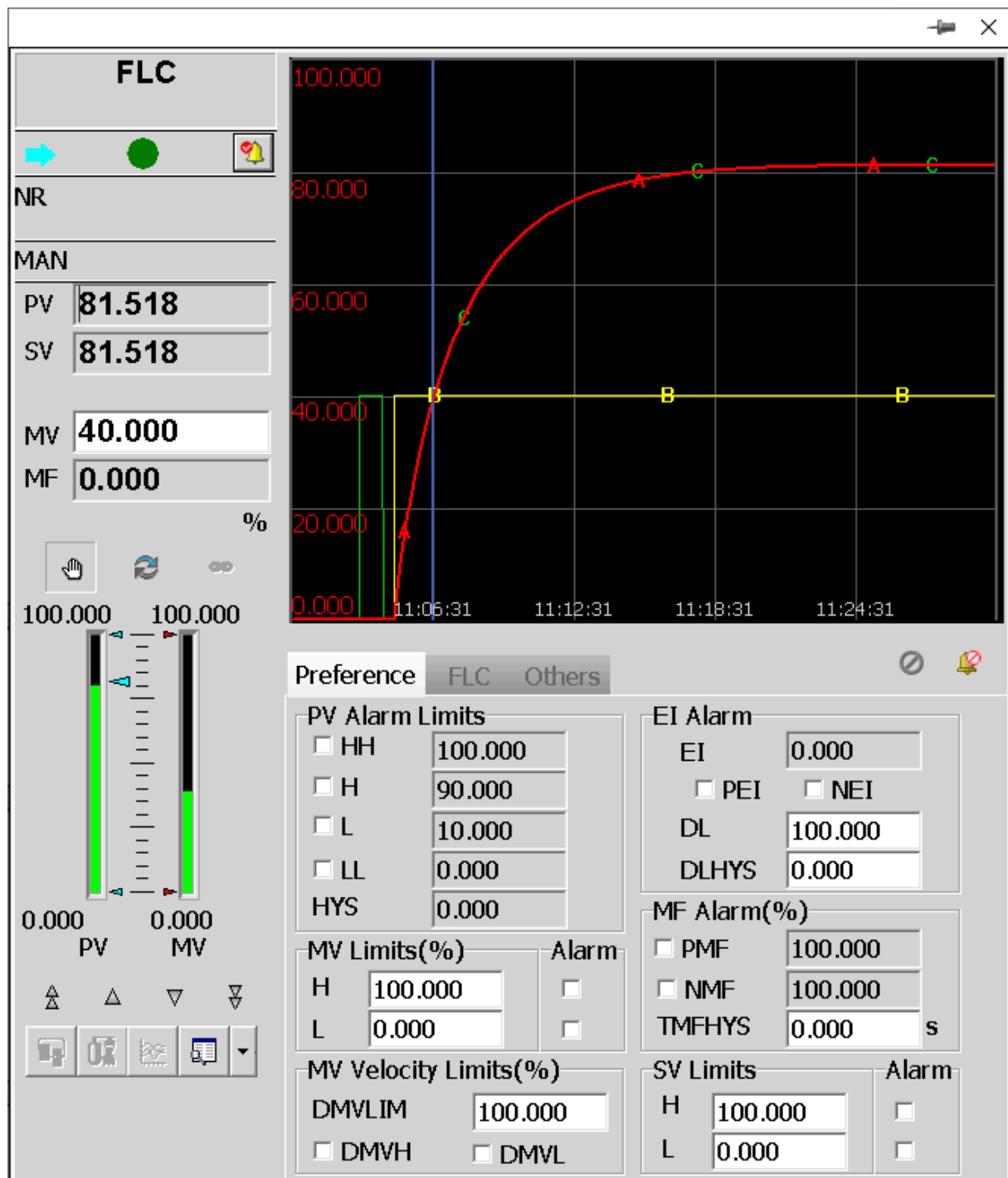
15.8.2 Application

The float abnormal of output values means that the output values are not float format, or a meaningless output value is produced in a calculation that performs a divide-by-zero operation. When float abnormal happened, the function block's output value shall conform to the following rules:

- If there's the normal value of previous period, MV outputs the value of previous period.
- If there's the abnormal value of previous period or no previous period value, MV outputs the lower range limit.

15.8.3 Panel Parameter

The "Preference" and "Other Item" parameters of FLC are the same as PID except "FLC item".



Preference **FLC** Others

FLC Parameter

KE 100.000

KDE 100.000

KDU 0.000

SV Ramp Action

☒ Disable ☐ Enable

RAMP 100.000

Deadband

☐ Enable ☒ Disable

DB 0.000

DBHYS 0.000

Control Direction

☐ Direct ☒ Reverse

FLC Action

☒ Run ☐ Bypass

Preference FLC **Others**

Input Compensation

Value 0.000

Coef. (IK) 1.000

Bias (IB) 0.000

BKOUT Track

☐ Track PV

☒ Track SV

SV Track

☒ Track

☐ Not Track

Output Compensation(%)

Value 0.000

Coef. (OK) 1.000

Bias (OB) 0.000

MAN_OPT

☒ Panel

☐ Program

SV_OPT

☐ Panel

☒ Program

EI Alarm Filter

Coef. (KSV) 1.000

Time 0.000

Track

Track Value 0.000 %

Figure 15.18 Panel Instruction of FLC

Panel Parameter Name			Function Block Parameter Name	Initial Value	Value Range	Application Instruction
Preference	PV Alarm (%)	HH	PVHH	100.000	[SVSCL,SVSCH]	Set the HH limit alarm value of loop PV. (Selecting the alarm means enable, or it is disabled.)

Panel Parameter Name			Function Block Parameter Name	Initial Value	Value Range	Application Instruction
		H	PVH	90.000	[SVSCL,SVSCH]	Set the H limit alarm value of loop PV. (Selecting the alarm means enable, or it is disabled.)
		L	PVL	10.000	[SVSCL,SVSCH]	Set the L limit alarm value of loop PV. (Selecting the alarm means enable, or it is disabled.)
		LL	PVLL	0.000	[SVSCL,SVSCH]	Set the LL limit alarm value of loop PV. (Selecting the alarm means enable, or it is disabled.)
		HYS	PVHYS	0.000	-	Alarm hysteresis value of PV
	SV Limits (%)	H	SVH	40.000	[SVSCL,SVSCH]	Set the H limit alarm value of loop SV. (Selecting the alarm means enable, or it is disabled.) Note: SV limit will not be affected by the selection.
		L	SVL	0.000	[SVSCL,SVSCH]	Set the L limit alarm value of SV. (Selecting the alarm means enable, or it is disabled.) Note: SV limit will not be affected by the selection.
	MV Limits (%)	H	MVH	100.000	[MVSCL,MVSCH]	Set the H limit alarm value of loop MV. (Selecting the alarm means enable, or it is disabled.) Note: MV limit will not be affected by the selection.
		L	MVL	0.000	[MVSCL,MVSCH]	Set the L limit alarm value of loop MV. (Selecting the alarm means enable, or it is disabled.) Note: MV limit will not be affected by the selection.
	EI Alarm (%)	EI	EI	0.000	-	Read-only. EI= SV-PV (Selecting the alarm means enable, or it is disabled.)
		DMVH (Selected)	-	-	-	Selecting positive deviation alarm means enabled.
		DMVL (Selected)	-	-	-	Selecting negative deviation alarm means enabled.
		DL	DL	100.000	\pm (Range H Limit – Range L Limit)	SV of Deviation alarm
		DL-HYS	DLHYS	0.000	-	SV of alarm hysteresis value

Panel Parameter Name			Function Block Parameter Name	Initial Value	Value Range	Application Instruction
	MF Alarm (%)	PMF	PMFLIM	100.000	-	Selecting positive deviation alarm means enabled.
		NMF	NMFLIM	100.000	-	Selecting negative deviation alarm means enabled.
		TMFH	TMFHYS	0.000	-	SV of lag time.
	MV Velocity Limits (%)	DMVH (Selected)	-	-	-	Selecting the positive velocity alarm means enabled.
		DMVL (Selected)	-	-	-	Selecting the negative velocity alarm means enabled.
		DMVLIM	DMVLIM	100.000	-	SV of loop MV velocity limit
FFLC	FLC Parameter	KE	KE	100.000		SV of bias adjusting factor parameter
		KDE	KDE	100.000		SV of output increment adjusting factor parameter
		KDU	KDU	0.000		SV of output increment adjusting factor parameter
	Deadband (%)	Enable (Selected)	SWDB	-		Selecting the deadband parameter means enable.
		Disable (Selected)	SWDB	√		Selecting the deadband parameter means disable.
		DB	DB	0.000		Size of deadband
		DB-HYS	DBHYS	0.000		Hysysteris value of deadband
	SV Ramp Action (%)	Enable (Selected)	SWRAMP	-		Selecting the SV ramp action means enable.
		Disable (Selected)	SWRAMP	√		Selecting the SV ramp action means disable.
		RAMP	RAMP	100.000		SV of ramp coefficient (slope) parameter

Panel Parameter Name			Function Block Parameter Name	Initial Value	Value Range	Application Instruction
	Control Direction	Direct (Selected)	SWPN	-		Selecting the direct action means enable.
		Reverse (Selected)	SWPN	√		Selecting the reverse action means enable.
	FLC Action	Run	BYPASS	√		The modification of function block panel is enabled for the function block properties dialog in debugging.
		Bypass	BYPASS	-		The modification of function block panel is disabled for the function block properties dialog in debugging.
Others	Input Compensation (%)	Value (IA)	IA	0.000	-	Read-only. It can be set in configuration or program.
		Coefficient (IK)	IK	1.000	-	Input compensation gain
		Bias (IB)	IB	0.000	-	Input compensation bias value
	Output Compensation (%)	Value (OA)	OA	0.000	-	Read-only, feedforward signal.
		Coefficient (OK)	OK	1.000	-	Output compensation gain
		Bias (DB)	DB	0.000	-	Output compensation bias value
	Error Alarm Filter Settings	Coefficient (KSV)	KSV	1.000	0~100	Bias filter coefficient
		Time (TSV)	TSV	0.000	0~1000s	Constant between errors (s)
	Feedback Output Track	Track PV	BK_OPT	-	-	Read-only. It can be set in configuration or program.
		Track SV	BK_OPT	√	-	Read-only. It can be set in configuration or program.
	SV Track	Track	SVTR_OPT	√	-	Read-only. It can be set in configuration or program.
		Not Track	SVTR_OPT	-	-	Read-only. It can be set in configuration or program.

Panel Parameter Name			Function Block Parameter Name	Initial Value	Value Range	Application Instruction
	MAN_- OPT Set- tings	Panel	MAN_OPT	√	-	Read-only. It can be set in configuration or program.
		Pro- gram	MAN_OPT	-	-	Read-only. It can be set in configuration or program.
	SV_- OPT Set- tings	Panel	SV_OPT	-	-	Read-only. It can be set in configuration or program.
		Pro- gram	SV_OPT	√	-	Read-only. It can be set in configuration or program.
	Track Value (%)		TV	0.000	-	Read-only. Track the input value (%).

15.8.4 Flag

Table 15.13 Flag list

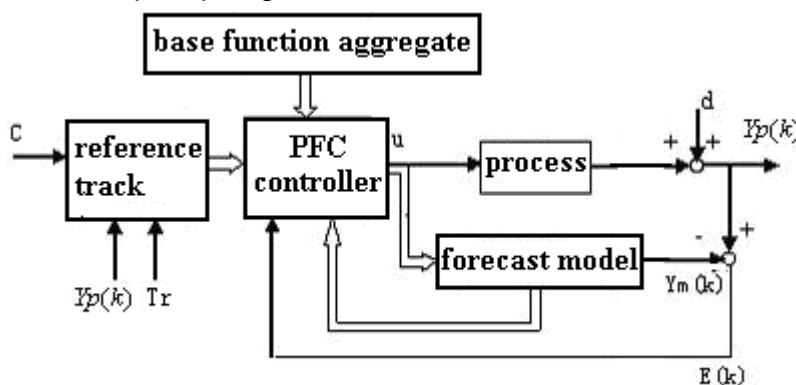
Flag	Alarm	Instruction
D0	OOS	Disable
D1	IMAN	Initialize Manually
D2	MAN	Manual
D3	TR	Track
D4	AUTO	Auto
D5	CAS	Cascade
D8	PVHH	PV HH Limit Alarm
D9	PVLL	PV LL Limit Alarm
D10	PVH	PV H Limit Alarm
D11	PVL	PV L Limit Alarm
D12	SVH	SV H Limit Alarm
D13	SVL	SV L Limit Alarm
D14	MVH	Output H Limit Alarm
D15	MVL	Output L Limit Alarm
D16	PEI	Positive Deviation Alarm
D17	NEI	Negative Deviation Alarm

Table 15.13 Flag list (continued)

Flag	Alarm	Instruction
D18	REVSCL	Span H/L Limit Reverse or float abnormal
D19	CFGERR	Configuration Error
D22	DMVH	MV Positive Rate Limit Alarm
D23	DMVL	MV Negative Rate Limit Alarm
D25	AOF	Suppress Alarm
D27	NMF	Valve Negative Deviation Alarm
D28	PMF	Valve Positive Deviation Alarm

15.8.5 Prediction Control Algorithm

The basic principle figure of Predictive Functional Control is shown as follows:

**Figure 15.19 Principle Figure of Predictive Functional Control**

C is the setpoint value. $Y_p(k)$ is the output of process. T_r is the time constant of referenced track. u is the output of PFC. d is the disturbance in the process.

The final goal of Predictive Functional Control is to make the output of process object $Y_p(k)$ to follow the referencing track (Referencing track is the output curve that has been defined in advance, commonly a first order exponential curve) and gradually reach the set point value C . Through contracting predictive model to simulate the features of actual inputs and outputs of process objects, and calculate the intending outputs of the predictive model based on historical information and intending inputs. So as long as PFC control output U to make the predictive model to put out alonging referencing curve, that is equal to that the output curve of process object alonging referencing curve. As predictive model is not strictly the same as actual process objects, use the discrepancy between output of predictive model and actual object as a feedforward compensation through the predictor to proofread the output of process to decrease the model mismatch problem caused by disturbance, noise and so on.

15.8.6 Method of Place in Service

Predictive control output

1. Select OUT_OPT=ON. Then MV=OUT.
2. BKIN and BKINERR link to feedback value of down stream function block
3. Manipulating set MV to step change, and observe change curve of object.
4. Capture gain, time constant and pure lag time of first-order pure lag object by step curve.
Then write these parameters to KM, TM and TDED. If the object is in reverse characteristic then set KM to negative.
5. The MAN switch to AUTO and change SV

Setpoint value control output

1. Select OUT_OPT=OFF. Then MV=SVOUT.
2. BKIN and BKINERR link to feedback value of down stream function block
3. This mode are used to cascade control. The PFC is outer loop and the PID is inner loop.
STEP_SV be used to inner loop setpoint.
4. First set inner loop to AUTO. Then change SV to step change and adjust PB_PID, TI_PID, TD_PID, and adjust step response of object to border first-order pure lag curve.
5. Capture gain, time constant and pure lag time of first-order pure lag object by step curve.
Then write these parameters to KM, TM and TDED
6. Set the CSV of inner loop and then put outer loop to AUTO. Wait some times, then slow let go STEP_SVH and STEP_SVL, achieve the PFC-PID cascade control.

15.9 PID Self-tune Function Block (PID_TUN)

Function block PID_TUN is to achieve PID parameters self-tuning function. After using relay identification method to approximate the object to first-order pure lag, tune parameters through the standard ZN method, CHR method and Lambda method.

The using method of PID_TUN is the same to PID except the PID parameters self-tuning function, so the usage introduction of PID function block could be a reference.

The PID_TUN algorithm is the same as the PID function block. The block performance period is 150μs.

PID_TUN	
<input type="checkbox"/> BKIN	MV
<input type="checkbox"/> BKINERR	BKOUT
<input type="checkbox"/> PV	BKOUTERR
<input type="checkbox"/> CSV	
<input type="checkbox"/> TV	
<input type="checkbox"/> SWTR	
<input type="checkbox"/> OA	
p00010	19#

15.9.1 Parameter Description

Table 15.14 PID_TUN Function Block Parameter Instrument

Name			Description	Upload	Properties	Application Reference
Basic Parameters	Range Settings	MVSCH	MV high scale	-	Configuration parameter	The same as MV actual value H limit
		MVSCL	MV low scale	-	Configuration parameter	The same as MV actual value L limit
		SVSCH	SV high scale	-	Configuration parameter	The same as PV actual value H limit
		SVSCL	SV low scale	-	Configuration parameter	The same as PV actual value L limit
		SVEU	SV engineer unit	-	Configuration parameter	Set in the function block properties settings interface
		MVEU	MV engineer unit	-	Configuration parameter	Set in the function block properties settings interface
		SVDLEN	SV decimal digits [0,5]	-	Configuration parameter	Used for Data displayed on function block panel (Equal to 3 as default)
		MVDLEN	MV decimal digits [0,5]	-	Configuration parameter	Used for Data displayed on function block panel (Equal to 3 as default)
	Limits	MVH	MV high limit value	TRUE	Operation parameter	Value range [MVSCL,MVSCH]
		MVL	MV low limit value	TRUE	Operation parameter	Value range [MVSCL,MVSCH]
		SVH	SV high limit value	TRUE	Operation parameter	Value range [SVSCL,SVSCH]

Table 15.14 PID_TUN Function Block Parameter Instrument (continued)

Name			Description	Upload	Properties	Application Reference
		SVL	SV low limit value	TRUE	Operation parameter	Value range [SVS-CL,SVSCH]
		DMVLIM	MV output Rate variety limit value. Used to prevent the MV from over-large modification in a short time.	TRUE	Operation parameter	Refer to Integral Cutting
	Direct/Reverse Switch Settings	SWPN	Direct/Reverse action select switch. SV is not changed, the MV Increases with the increasing of PV in Direct action, and decreases with the increasing of PV in reverse action.	TRUE	Operation parameter	direct action with SWPN = OFF and reverse action with SWPN = ON
Extended Parameters	Base Input Pin Settings	BKIN	Function block feedback input	-	Input pin	Connect to BKOUT of downstream block
		BKIN-ERR	Function block feedback status input	-	Input pin	Connect to BKOUTERR of downstream block
		PV	The measured value of loop Control object	-	Input pin	Connect to AI
		CSV	The cascade set-point	-	Input pin	Connect to MV of upstream block
		TV	Tracking input(MV=TV when tracking status)	-	Input pin	Connect to AIRelated parameter: SWTR
		SWTR	Tracking selecting switch.MV track TV	-	Input pin	Use to upstream interlock condition input Related parameter: TV

Table 15.14 PID_TUN Function Block Parameter Instrument (continued)

Name			Description	Upload	Properties	Application Reference
			when SWTR=ON; Do not track when SWTR=OFF			
		OA	Output compensating value. Use to feedforward control	-	Input pin	Connect feedforward signal AI. Related parameters are OK and OB
	Advanced Input Pin Settings	PVERR	ON=PV Fault	-	Input pin	Connect to AI.ERR
		SVERR	ON=SV fault	-	Input pin	Connect to upstream block output
		TVERR	ON=TV fault	-	Input pin	Connect to AI.ERR
		OAERR	ON=OA fault	-	Input pin	Connect to upstream block output
		MF	Actuator feedback value. Use to monitoring	-	Input pin	Connect to AI
		IA	Input compensation value. Use to improve controllability of procedure with long dead zone time.	-	Input pin	Connect to AI. Refer part Input Process; Related parameter IK and IB.
		PSWAM	MAN/AUTO switch for program control. The program Man control when PSWAM=OFF; program AUTO control when PSWAM=ON	-	Input pin	Connect to output of upstream block. Significance when MAN_OPT=ON
		PSWSV	The SV/CSV selecting switch for program control. Adopt SV when	-	Input pin	Connect to output of upstream block. Significance when SV_OPT=ON

Table 15.14 PID_TUN Function Block Parameter Instrument (continued)

Name			Description	Upload	Properties	Application Reference
			PSWSV=OFF; adopt CSV when PSWSV=ON			
		MAN_ OPT	MAN/AU- TO control source se- lect switch. If MAN_OP- T=ON then MAN/AUTO select switch is controlled by the PSWAM; if MAN_OP- T=OFF then MAN/AUTO select switch is controlled by SWAM	-	Input pin	Connect to output of up- stream block.Related para- meter PSWAM and SWAM
		SV_OPT	SV/CSV control source select switch. If it is ON then SV/CSV se- lect switch is controlled by the PSWSV; if it is OFF then SV/CSV se- lect switch is controlled by the SWSV.	-	Input pin	Connect to output of up- stream block.Related para- meter PSWSV and SWSV
		SWINC	Switch of closedown increase for MV(MV can not in- crease). Carry out close- down in- crease when SWINC=ON	-	Input pin	Connect to upstream block out. It is active when block is AUTO/CAS status.
		RRL	Anti-integral windup in- put, used for control over- shoot	-	Input Pin	Connect to measuring point AI,related parameters: BKIN. Refer to Operation Process

Table 15.14 PID_TUN Function Block Parameter Instrument (continued)

Name		Description	Upload	Properties	Application Reference	
		SWDEC	Switch of closedown decrease for MV(MV can not increase). Carry out close-down decrease when SWDEC=ON	-	Input pin	Connect to upstream block out. It is active when block is AUTO/CAS status.
		HOLD	Switch for MV hold. The MV hold when HOLD=ON	-	Input pin	Connect to upstream block out. It is active when block is AUTO/CAS status.
	Output pin	MV	Function block output value	-	Output pin	Connect to AO
		BKOUT	Function block feedback value output	-	Output pin	Connect to upstream block BKINRelated parameter is BK_OPT
		BKOUTERR	Function block feedback status output	-	Output pin	Connect to upstream block BKINERR
		BK_OPT	Select switch for BKOUT value. If BK_OPT=ON then BKOUT track measured value else track setpoint.	-	Configuration parameter	Related parameter is BKOUT
	PID Param Settings	PB	Proportion band size	TRUE	Operation parameter	Refer to PID Parameter Tune
		TI	Integral time (s)	TRUE	Operation parameter	Refer to PID Parameter Tune
		TD	Derivative time (s)	TRUE	Operation Parameter	When TD=0, suppress derivation action, Refer to PID Parameter Tune
		KD	Derivative filter coefficient	TRUE	Operation parameter	-

Table 15.14 PID_TUN Function Block Parameter Instrument (continued)

Name			Description	Upload	Properties	Application Reference
	Self-tune Settings	K	Object static gain	TRUE	Monitoring parameter	-
		T	Object time constant	TRUE	Monitoring parameter	-
		L	Object hysteresis time	TRUE	Monitoring parameter	-
		STC	When STC=ON into auto-setting model	TRUE	Operation parameter	-
		UPDATE	If auto-update after setting finish	TRUE	Operation parameter	-
		OS	Setting method	TRUE	Operation parameter	-
		MA	Jump step-per value	TRUE	Operation parameter	-
		NB	Noise belt	TRUE	Operation parameter	-
		PBC	PB setting value	TRUE	Monitoring parameter	-
		TIC	TI setting value	TRUE	Monitoring parameter	-
		TDC	TD setting value	TRUE	Monitoring parameter	-
		STC_-MODE	Setting status	-	Monitoring parameter	-
		TUN_-TYPE	PID run model selecting	-	Operation parameter	TUN_TYPE=0, PID control; TUN_TYPE=1, PI control; TUN_TYPE=2, P control.
	Operator Command	MODE	Work mode	-	Monitoring parameter	Refer to Transition Process of Function Block Modes
		IMODE	Stand-by work mode	-	Monitoring parameter	Refer to Transition Process of Function Block Modes
		MODE_-OPT	ON=auto return, OFF=manual return (default)	-	Configuration parameter	Refer to Transition Process of Function Block Modes
		SWAM	Manual and auto switch:	-	Operation parameter	It is active for MAN_OPT=OFF

Table 15.14 PID_TUN Function Block Parameter Instrument (continued)

Name		Description	Upload	Properties	Application Reference
			OFF=manual, ON=auto		
		SWSV	Suto/ cascade selection: OFF=auto, ON=cascade	-	Operation parameter It is active for SV_OPT=OFF
		SWPMV	Whether to equal to preset MV value when switch to auto status. PMV enable switch. When SWPMV=ON, MV = PMV, MV velocity alarm, lock increase/decrease are disabled	TRUE	Operation parameter Related parameter is PMV
		PMV	Preset MV when switching from OOS/IMAN/TR/MAN modes to AUTO or CAS mode	TRUE	Operation parameter It is active for SWPMV=ON
	Operator Data	SV	Setpoint for loop control	TRUE	Operation parameter Refer to Set Variable Process
		MANMV	Manual output value	-	Operation parameter When manual mode, MV=MANMV
		EI	Deviation	-	Monitoring parameter Refer to Set Variable Process
	Input Alarm Settings	PVHH	PV HH alarm value	TRUE	Operation parameter Refer to Input Process
		PVH	PV H alarm value	TRUE	Operation parameter Refer to Input Process
		PVL	PV L alarm value	TRUE	Operation parameter Refer to Input Process
		PVLL	PV LL alarm value	TRUE	Operation parameter Refer to Input Process

Table 15.14 PID_TUN Function Block Parameter Instrument (continued)

Name			Description	Upload	Properties	Application Reference
		PVHYS	Measured value alarm hysteresis	TRUE	Operation parameter	Refer to Input Process
		DL	Deviation alarm set value	TRUE	Operation parameter	Refer to Operation Process
		DLHYS	Deviation alarm hys-ter-sis value	TRUE	Operation parameter	Refer to Operation Process
		KSV	Deviation filter coefficient	TRUE	Operation parameter	Refer to Operation Process
		TSV	Deviation fil-ter time constant(s)	TRUE	Operation parameter	Refer to Operation Process
		NMFLIM	Valve posi-tion negative error thresh-olds	TRUE	Operation parameter	Related parameter: NMF. Refer to Integral Cutting
		PMFLIM	Valve posi-tion positive error thresh-olds	TRUE	Operation parameter	Related parameter: PMF. Refer to Integral Cutting
		TMFHYS	Valve po-sition error alarm hys-teresis time	TRUE	Operation parameter	Refer to Integral Cutting
	Advance Calculation Set-tings	BYPASS	Bypass PID operation, when BY-PASS=ON, excise PID calculation, switch SV to MV directly for output	TRUE	Operation parameter	When cascade adjusting, used to excise inner loop when it fails
		STOPP	Proportion supress switch, when STOP-P=ON, stop integral ac-tion	TRUE	Operation Parameter	-
		STOPI	Integral supress switch, when	TRUE	Operation Parameter	-

Table 15.14 PID_TUN Function Block Parameter Instrument (continued)

Name		Description	Upload	Properties	Application Reference
		STOPI=ON, stop integral action			
	SWDB	Enable switch, when SWD- B=ON, deadband enable	TRUE	Operation parameter	Related parameter: DB
	DB	Deadband band size	TRUE	Operation parameter	It is active when SWD- B=ON
	DBHYS	Deadband band hys- teresis	TRUE	Operation parameter	Refer to Operation Process
	GW	Non-linear gain range non-linear gain range	TRUE	Operation Parameter	Refer to Operation Process
	KN	Non-linear gain coeffi- cient [0,1.0]	TRUE	Operation Parameter	Refer to Operation Process
	NGN_- OPT	Non-linear gain selec- tion switch, switch the relation be- tween error and output change val- ue to nonlin- ear. used for control when proportional gain needs nonlinear change. OFF=Error square root function, ON=Gap ac- tion function	-	Configura- tion param- eter	Related parameters: GW, PB and KN When NGN_- OPT = ON; GW and PB when NGN_OPT = OFF
	EA	Integral ex- cise coeffi- cient. when EI > EA, ex- cise coeffi- cient, when EI < EA, ex- cising coef- ficient is dis- abled, used for prevent	TRUE	Operation parameter	Related parameter: DK

Table 15.14 PID_TUN Function Block Parameter Instrument (continued)

Name			Description	Upload	Properties	Application Reference
			MV change from over-large			
		DK	Proportion modified value when integral excising	TRUE	Operation Parameter	Related parameter: EAPlease refer to Transition Process of Function Block Modes ^{Note5}
		OUT_-OPT	Control output type: OFF=position type, ON=increment type	-	Configuration parameter	Related parameter: MV
		PID_-OPT	Select switch for PID control algorithm	-	Configuration parameter	PID_OPT = 0 then execute standard PID;PID_OPT = 1 then execute D_PI;PID_-OPT = 2 then execute PD_I
	Alarm	PVH-HIND	PVHH alarm indication	-	Monitoring parameter	Refer to Integral Cutting
		PVHIND	PV H Limit alarm indication	-	Monitoring parameter	Refer to Integral Cutting
		PVLIND	PV L limit alarm indication	-	Monitoring parameter	Refer to Integral Cutting
		PVL-LIND	PV LL limit alarm indication	-	Monitoring parameter	Refer to Integral Cutting
		MVHIND	MV H limit alarm indication	-	Monitoring parameter	Refer to Integral Cutting
		MVLIND	MV L limit alarm indication	-	Monitoring parameter	Refer to Integral Cutting
		SVHIND	SV H limit alarm indication	-	Monitoring parameter	Refer to Integral Cutting
		SVLIND	SV L limit alarm indication	-	Monitoring parameter	Refer to Integral Cutting
		PEIIND	Positive deviation alarm indication	-	Monitoring parameter	Refer to Integral Cutting

Table 15.14 PID_TUN Function Block Parameter Instrument (continued)

Name			Description	Upload	Properties	Application Reference
		NEIIND	Negative deviation alarm indication	-	Monitoring parameter	Refer to Integral Cutting
		DMVHIND	MV positive rate limit indication	-	Monitoring parameter	Refer to Integral Cutting
		DMVLIND	MV negative rate limit indication	-	Monitoring parameter	Refer to Integral Cutting
		NMFIND	Valve position error negative alarm indication	-	Monitoring parameter	Refer to Integral Cutting
		PMFIND	Valve position error positive alarm indication	-	Monitoring parameter	Refer to Integral Cutting
	Compensation Settings	IK	Input compensation gain	TRUE	Operation parameter	Refer to Input Process
		IB	Input compensation bias value	TRUE	Operation parameter	Refer to Input Process
		OK	Output compensation gain	TRUE	Operation parameter	Refer to Operation Process
		OB	Output compensation bias value	TRUE	Operation parameter	Refer to Operation Process
	Fase/Slow/Increase/Decrease Settings	SMV	MV manual slow increase/decrease value (%)	TRUE	Operation parameter	Set MV manual slow increase/decrease percentage in function block properties settings
		FMV	MV manual fast increase/decrease value (%)	TRUE	Operation parameter	Set MV manual fast increase/decrease percentage in function block properties settings
		SSV	SV slow increase/decrease value (%)	TRUE	Operation parameter	Set SV manual slow increase/decrease percentage in function block properties settings

Table 15.14 PID_TUN Function Block Parameter Instrument (continued)

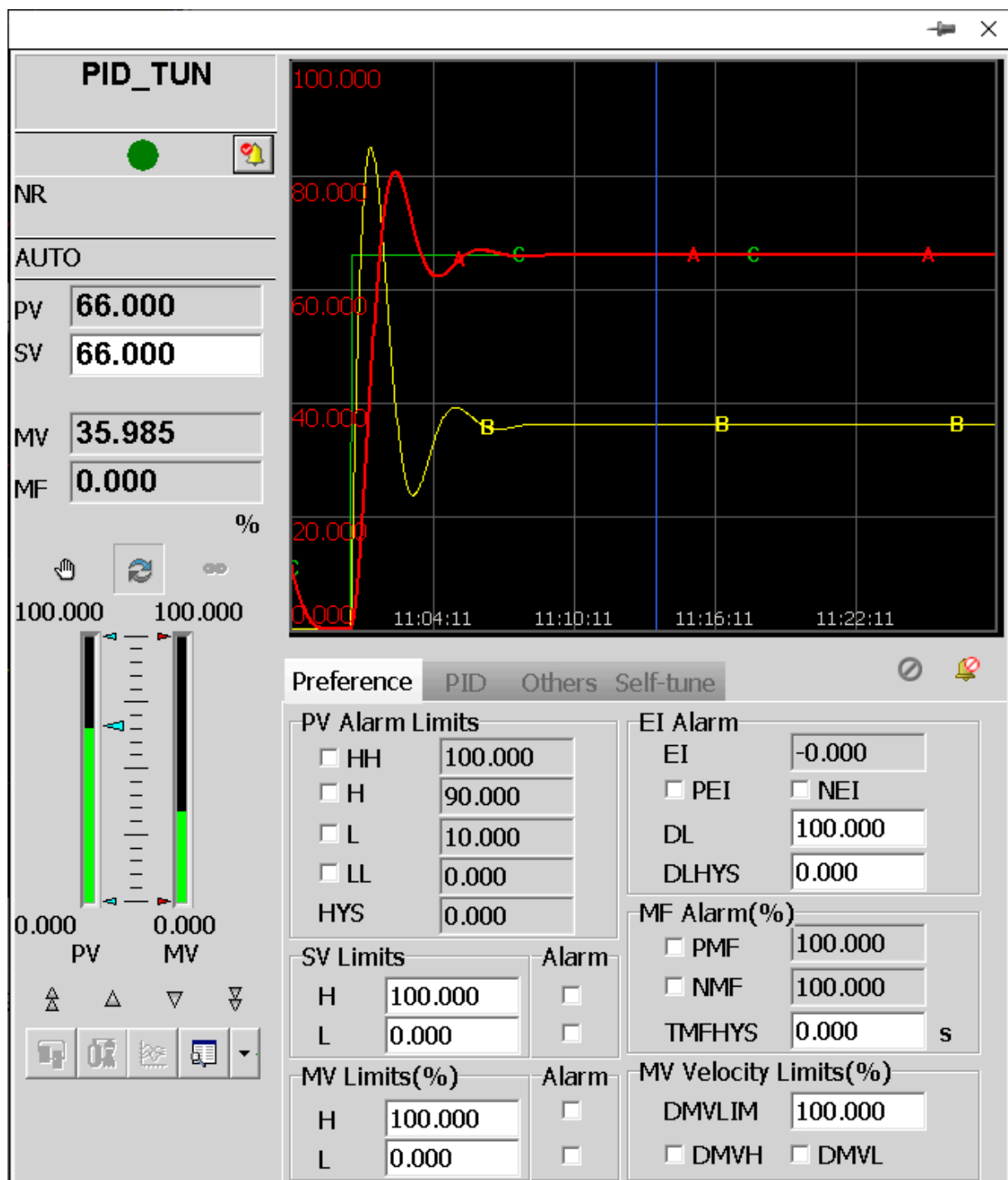
Name			Description	Upload	Properties	Application Reference
	Ex- tended Range Settings	FSV	SV fast in- crease/de- crease value (%)	TRUE	Operation parameter	Set SV manual fast in- crease/decrease percent- age in function block prop- erties settings
		HORLIM	Extended range max- imum per- centage	-	Configura- tion paramete- r	Refer to Output Process
		LORLIM	Extended range min- imum per- centage	-	Configura- tion paramete- r	Refer to Output Process
	SV Ad- vance Settings	SWRAMP	SV ramp function switch. When changing set value, incline it to SV accord- ing to the set RAMP (s). OF- F=SV ramp function off, ON=SV ramp func- tion on	TRUE	Operation parameter	Related parameter: RAM- Pactive when in automatic or cascade mode
		RAMP	Ramp coeffi- cient	TRUE	Operation parameter	Related parameter: SWRAMP
		SVTR_ OPT	SV track PV switch enable/dis- able: OF- F=not track, ON=track. If PV> SVH/ SVL, SV= range limit. used to pre- vent the out- put MV from interfer- ence when changing the control mode.	-	Configura- tion paramete- r	SV=range limit when PV exceeds SVH and SVL. It is used to prevent the in- terference generated with the MV output when control mode is modified. Refer to Set Variable Process
	Alarm Enabled and Sup- press	AOF	Suppress module alarm, on=prohibit to	TRUE	Operation parameter	Refer to Integral Cutting

Table 15.14 PID_TUN Function Block Parameter Instrument (continued)

Name			Description	Upload	Properties	Application Reference
		ENALM	Alarm enable	TRUE	Alarm parameter	Refer to Integral Cutting
		FLAG	Flag code	-	Output pin	Refer to Integral Cutting
	OOS Settings	SWOOS	Function block disable (ON=disable)	TRUE	Operation parameter	Set as ON at the first time of function block downloading
		OOSVAL	Output value in OOS status	TRUE	Operation parameter	Related parameter: OOS_OPT=ON
		OOS_OPT	Output value type in OOS status. when OOS_OPT=ON, MV=OOSVAL, when OOS_OPT=OFF, maintain the MV	-	Configuration parameter	Refer to OOS

15.9.2 Panel Parameter

The PID_TUN function block face plate parameters same as the PID function block except “self-tuning” page parameters.



Preference	PID	Others	Self-tune
PID Parameter PB <input type="text" value="100.000"/> % TI <input type="text" value="20.000"/> s TD <input type="text" value="0.000"/> s			
Non-linear Gain <input type="checkbox"/> Gap Action <input checked="" type="checkbox"/> Square Root GW <input type="text" value="0.000"/> KN <input type="text" value="1.000"/>		D/R Action <input type="checkbox"/> Direct <input checked="" type="checkbox"/> Reverse Proportional <input checked="" type="checkbox"/> Run <input type="checkbox"/> Stop	
Incomplete Diff Coef. KD <input type="text" value="10.000"/> s		Integral Separation EA <input type="text" value="0.000"/> DK <input type="text" value="0.000"/>	
Deadband <input type="checkbox"/> Enable <input checked="" type="checkbox"/> Disable DB <input type="text" value="0.000"/> DBHYS <input type="text" value="0.000"/>		SV Ramp Action <input type="checkbox"/> Enable <input checked="" type="checkbox"/> Disable RAMP <input type="text" value="100.000"/>	
		Integral Action <input checked="" type="checkbox"/> Run <input type="checkbox"/> Stop PID Action <input checked="" type="checkbox"/> Run <input type="checkbox"/> Bypass	

Preference	PID	Others	Self-tune
Input Compensation IA <input type="text" value="0.000"/> IK <input type="text" value="1.000"/> IB <input type="text" value="0.000"/>		Feedback Output Track SV Track <input type="checkbox"/> PV <input checked="" type="checkbox"/> SV <input checked="" type="checkbox"/> Track <input type="checkbox"/> Not Track	
Output Compensation(%) OA <input type="text" value="0.000"/> OK <input type="text" value="1.000"/> OB <input type="text" value="0.000"/>		SV_TRACK <input checked="" type="checkbox"/> Panel <input type="checkbox"/> Program <input type="checkbox"/> Panel <input checked="" type="checkbox"/> Program	
EI Alarm Filter KSV <input type="text" value="1.000"/> TSV <input type="text" value="0.000"/> s		TR <input type="text" value="0.000"/> %	

The “self-tune” page parameters shown as follow.

Preference PID Others **Self-tune**

Tuning Mode Option
☒ Mode 0 ☐ Mode 3
☐ Mode 1 ☐ Mode 4
☐ Mode 2 ☐ Mode 5

Parameter Update
☐ Auto Update
☒ Manual Update

Tuning Process
☐ Stabilizing Waiting
☐ Relay Oscillation
☐ Tuning Failure

Tuning Parameter
 NB
 MA

Mode Option
☐ Tuning Mode
☒ Control Mode

Tuning Objective
☐ P
☐ PI
☒ PID

PID Tuned Parameter

PBC	<input type="text" value="100.000"/>	%	K	<input type="text" value="1.000"/>
TIC	<input type="text" value="1.000"/>	s	T	<input type="text" value="1.000"/>
TDC	<input type="text" value="1.000"/>	s	L	<input type="text" value="1.000"/>

Table 15.15 Panel parameter of PID_TUN

Panel Parameter Name			Function Block Parameter Name	Initial Value	Value Range	Application Instruction
Preference	PV Alarm (%)	HH	PVHH	100.000	[SVSCL,SVSCH]	Set the HH limit alarm value of loop PV. (Selecting the alarm means enable, or it is disabled.)
		H	PVH	90.000	[SVSCL,SVSCH]	Set the H limit alarm value of loop PV. (Selecting the alarm means enable, or it is disabled.)
		L	PVL	10.000	[SVSCL,SVSCH]	Set the L limit alarm value of loop PV. (Selecting the alarm means enable, or it is disabled.)
		LL	PVLL	0.000	[SVSCL,SVSCH]	Set the LL limit alarm value of loop PV. (Selecting the alarm means enable, or it is disabled.)
		HYS	PVHYS	0.000	-	Alarm hysteresis value of PV
	SV Limits (%)	H	SVH	40.000	[SVSCL,SVSCH]	Set the H limit alarm value of loop SV. (Selecting the alarm means enable, or it is disabled.) Note: SV limit will not be affected by the selection.
		L	SVL	0.000	[SVSCL,SVSCH]	Set the L limit alarm value of loop SV. (Selecting the alarm

Table 15.15 Panel parameter of PID_TUN (continued)

Panel Parameter Name			Function Block Parameter Name	Initial Value	Value Range	Application Instruction
	MV Limits (%)					means enable, or it is disabled.) Note: SV limit will not be affected by the selection.
		H	MVH	100.000	[MVS-CL,MVSCH]	Set the H limit alarm value of loop MV. (Selecting the alarm means enable, or it is disabled.) Note: MV limit will not be affected by the selection.
		L	MVL	0.000	[MVS-CL,MVSCH]	Set the L limit alarm value of loop MV. (Selecting the alarm means enable, or it is disabled.) Note: MV limit will not be affected by the selection.
	EI Alarm (%)	EI	EI	0.000	-	Read-only. EI= SV-PV(Selecting the alarm means enable, or it is disabled.)
		PEI (Selected)	-	-	-	Selecting positive deviation alarm means enabled.
		NEI (Selected)	-	-	-	Selecting negative deviation alarm means enabled.
		DL	DL	100.000	± (Range H Limit – Range L Limit)	SV of Deviation alarm
		DL-HYS	DLHYS	0.000	-	Hysteresis value of bias alarm
	MF Alarm (%)	PMF	PMFLIM	100.000	-	Selecting positive deviation alarm means enabled.
		NMF	NMFLIM	100.000	-	Selecting negative deviation alarm means enabled.
		TMFHYS (s)	TMFHYS	0.000	-	SV of lag time
	MV Velocity Limits (%)	DMVH (Selected)	-	-	-	Selecting the positive velocity alarm means enabled.
		DMVL (Selected)	-	-	-	Selecting the negative velocity alarm means enabled.
		DMVLIM	DMVLIM	100.000	-	SV of loop MV velocity limit

Table 15.15 Panel parameter of PID_TUN (continued)

Panel Parameter Name			Function Block Parameter Name	Initial Value	Value Range	Application Instruction
PID	PID	PB(%)	PB	100.000	≥ 0	SV of loop proportional parameter
		TI(S)	TI	20.000	≥ 0	SV of loop integral time parameter
		TD(S)	TD	0.000	≥ 0	SV of loop differential time parameter
	Incomplete Differential Coefficient	KD(S)	KD	10.000	≥ 0	Incomplete differential filter coefficient
	Dead-band (%)	Enable (Selected)	SWDB	-	-	Selecting the deadband parameter means enabled.
		Disable (Selected)	SWDB	√	-	Selecting the deadband parameter means disabled.
		DB	DB	0.000	-	Size of deadband
		DB-HYS	DBHYS	0.000	[0,DB]	Hysteresis value of deadband
	Non-linear Gain (%)	Gap Action (Selected)	NGN_OPT	-	-	Read-only, non-linear gain selection switch, ON= gap action
		Square Root (Selected)	NGN_OPT	√	-	Read-only, non-linear gain selection switch, OFF=square root
		GW	GW	0.000	-	Action range of non-linear gain
		KN	KN	1.000	[0,1.0]	Non-linear gain coefficient
	Integral Separation (%)	EA	EA	0.000	-	SV of range parameter
		DK	DK	0.000	-	Integral cutting coefficient. When EI>EA, cut the integral; when EI<EA, integral cutting is disabled.
	SV Ramp	Enable	SWRAMP	-	-	Selecting the SV ramp action means enable.

Table 15.15 Panel parameter of PID_TUN (continued)

Panel Parameter Name			Function Block Parameter Name	Initial Value	Value Range	Application Instruction
	Action (%)	(Selected)				
		Disable (Selected)	SWRAMP	√	-	Selecting the SV ramp action means disable.
		RAMP	RAMP	100.000	-	SV of coefficient parameter
	Control Direction	Direct (Selected)	SWPN	-	-	Selecting the direct action means enable.
		Reverse (Selected)	SWPN	√	-	Selecting the reverse action means enable.
	Proportional	Run (Selected)	STOPP	√	-	Selecting proportional action means enabled.
		Stop	STOPP	-	-	Selecting proportional action means disabled.
	Integral Action	Run	STOPI	√	-	Selecting integral action means enabled.
		Stop	STOPI	-	-	Selecting integral action means disabled.
	PID Action	Run	BYPASS	√	-	The modification of function block panel is enabled for the function block properties dialog in debugging.
		Bypass	BYPASS	-	-	The modification of function block panel is disabled for the function block properties dialog in debugging.
Others	Input Compensation (%)	IA	IA	0.000	-	Read-only. It can be set in configuration or program.
		IK	IK	1.000	-	Input compensation gain
		IB	IB	0.000	-	Bias value of input compensation
	Output Compensation (%)	OA	OA	0.000	-	Read-only, feedforward signal
		OK	OK	1.000	-	Output compensation gain

Table 15.15 Panel parameter of PID_TUN (continued)

Panel Parameter Name			Function Block Parameter Name	Initial Value	Value Range	Application Instruction
		DB	DB	0.000	-	Bias value of output compensation
	Set EI alarm filter	KSV	KSV	1.000	0~100	Bias filter coefficient
		TSV	TSV	0.000	0~1000s	Constant between errors (s)
	Feed-back Output Track	PV	BK_OPT	-	-	Read-only. It can be set in configuration or program.
		SV	BK_OPT	√	-	Read-only. It can be set in configuration or program.
	SV Track	Track	SVTR_OPT	√	-	Read-only. It can be set in configuration or program.
		Not Track	SVTR_OPT	-	-	Read-only. It can be set in configuration or program.
	MAN_OPT Settings	Panel	MAN_OPT	√	-	Read-only. It can be set in configuration or program.
		Program	MAN_OPT	-	-	Read-only. It can be set in configuration or program.
	SV_OPT Settings	Panel	SV_OPT	-	-	Read-only. It can be set in configuration or program.
		Program	SV_OPT	√	-	Read-only. It can be set in configuration or program.
	TV (%)		TV	0.000	-	Read-only. Track the input value (%).
Self-tune	Tuning Mode Option	Mode 0	MODE	√	-	Read-only. It can be set in configuration or program.
		Mode 1	MODE	-	-	Read-only. It can be set in configuration or program.
		Mode 2	MODE	-	-	Read-only. It can be set in configuration or program.
		Mode 3	MODE	-	-	Read-only. It can be set in configuration or program.
		Mode 4	MODE	-	-	Read-only. It can be set in configuration or program.
		Mode 5	MODE	-	-	Read-only. It can be set in configuration or program.

Table 15.15 Panel parameter of PID_TUN (continued)

Panel Parameter Name			Function Block Parameter Name	Initial Value	Value Range	Application Instruction
	Tuning Parameter Settings	NB	NB	1.000	-	Read-only. It can be set in configuration or program.
		MA	MA	10.000	-	Read-only. It can be set in configuration or program.
	Parameter Update	Auto Update	UPDATE	-	-	Read-only. It can be set in configuration or program.
		Manual Update	UPDATE	√	-	Read-only. It can be set in configuration or program.
	Tuning Process	Stabilizing Waiting	STC_-MODE	-	-	Read-only. It can be set in configuration or program.
		Relay Oscillation	STC_-MODE	-	-	Read-only. It can be set in configuration or program.
		Tuning Failure	STC_-MODE	-	-	Read-only. It can be set in configuration or program.
	Mode Option	Tuning Mode	STC	-	-	Read-only. It can be set in configuration or program.
		Control Mode	STC	√	-	Read-only. It can be set in configuration or program.
	Tuning Objective	P	TUN TYPE=2	-	-	Read-only. It can be set in configuration or program.
		PI	TUN TYPE=1	-	-	Read-only. It can be set in configuration or program.
		PID	TUN TYPE=0	√	-	Read-only. It can be set in configuration or program.
	PID Tuned Parameter	PBC (%)	PBC	100.000	-	Read-only. It can be set in configuration or program.
		TIC (s)	TIC	1.000	-	Read-only. It can be set in configuration or program.
		TDC (s)	TDC	1.000	-	Read-only. It can be set in configuration or program.

Table 15.15 Panel parameter of PID_TUN (continued)

Panel Parameter Name			Function Block Parameter Name	Initial Value	Value Range	Application Instruction
		K	K	1.000	-	Read-only. It can be set in configuration or program.
		T (s)	T	1.000	-	Read-only. It can be set in configuration or program.
		L(s)	L	1.000	-	Read-only. It can be set in configuration or program.

15.9.3 PID Parameters Self-Tuning

- Start Self-tuning

In no mode can self-tuning mode been entered in except in manual, automatic and cascade modes. Make STC = ON to enter in self-tuning mode. MA ,that is, the amplitude of relay oscillation must be set before starting self-tuning.

- Tuning Process

1. After entering into self-tuning mode, switch loop to manual and keep the current output value unchanged. Note that automated and cascade button can not be manipulated at this time, otherwise tuning would be failed to. A certain period of time should be waited for stability.
2. After reaching stability, calculate the mean of the current object and noise band;
3. Do relay oscillation;
4. End the relay oscillation, and calculate PID parameters according to settings;
5. Complete tuning.

15.9.4 Flag

Table 15.16 Flag list

Flag	Alarm	Instruction
D0	OOS	Disable
D1	IMAN	Initialize Manually
D2	MAN	Manual
D3	TR	Track
D4	AUTO	Auto
D5	CAS	Cascade

Table 15.16 Flag list (continued)

Flag	Alarm	Instruction
D8	PVHH	PV HH Limit Alarm
D9	PVLL	PV LL Limit Alarm
D10	PVH	PV H Limit Alarm
D11	PVL	PV L Limit Alarm
D12	SVH	SV H Limit Alarm
D13	SVL	SV L Limit Alarm
D14	MVH	Output H Limit Alarm
D15	MVL	Output L Limit Alarm
D16	PEI	Positive Deviation Alarm
D17	NEI	Negative Deviation Alarm
D18	REVSCL	Span H/L Limit Reverse
D19	CFGERR	Configuration Error
D20	TVERR	Trace Value Fault
D21	OAERR	Output Compensation Value Fault
D22	DMVH	MV Positive Rate Limit Alarm
D23	DMVL	MV Negative Rate Limit Alarm
D25	AOF	Suppress Alarm
D27	NMF	Valve Negative Deviation Alarm
D28	PMF	Valve Positive Deviation Alarm
D29	PVERR	PV Fault
D30	SVERR	SV Fault

15.9.5 Programming Example For Apply

The programming method refer to Application Example.

15.10 SMITH Predictor Function Block (SMITH)

Industrial process objects usually have pure lag. Pure lag part would make it difficult to control the process, resulting in decreased in quality control, and even cause system instability. It is difficult

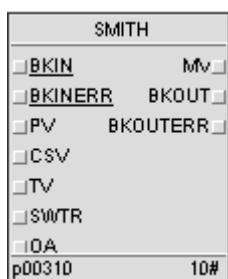
to obtain good control effect using conventional PID in pure lag systems. In order to achieve effective control for pure lag systems, the pure delay compensation control method could be used. SMITH predictor is the most commonly used method in industry.

SMITH contains SMITH predictor and PI controller, which could be applied to pure lag objects control. The control effect is badly affected by the stability of the lag character of objects.

The control effect would be well when the lag character is stable, otherwise the effect would deteriorate.

The using method of SMITH is the same to PID except the internal controls, tuning parameters and tuning method. so the usage introduction of PID function block can be a reference.

The SMITH is complex function block. The block performance period is 150 μ s.



15.10.1 Parameter Description

Table 15.17 SMITH Function Block Parameter Instruction

Name		Description	Upload	Properties	Application reference	
Basic Parameters	Range Settings	MVSCH	MV high scale	-	Configuration parameter	The same as MV actual value H limit
		MVSCL	MV low scale	-	Configuration parameter	The same as MV actual value L limit
		SVSCH	SV high scale	-	Configuration parameter	The same as PV actual value H limit
		SVSCL	SV low scale	-	Configuration parameter	The same as PV actual value L limit
		SVEU	SV engineer unit	-	Configuration parameter	Set in the function block properties settings interface
		MVEU	MV engineer unit	-	Configuration parameter	Set in the function block properties settings interface

Table 15.17 SMITH Function Block Parameter Instruction (continued)

Name			Description	Upload	Properties	Application reference
		SVDLEN	SV decimal digits [0,5]	-	Configuration parameter	Used for Data displayed on function block panel (Equal to 3 as default)
		MVDLEN	MV decimal digits [0,5]	-	Configuration parameter	Used for Data displayed on function block panel (Equal to 3 as default)
	Limits	MVH	MV high limit value	TRUE	Operation parameter	Value range [MVS-CL,MVSCH]
		MVL	MV low limit value	TRUE	Operation parameter	Value range [MVS-CL,MVSCH]
		SVH	SV high limit value	TRUE	Operation parameter	Value range [SVS-CL,SVSCH]
		SVL	SV low limit value	TRUE	Operation parameter	Value range [SVS-CL,SVSCH]
		DMVLIM	MV output Rate variety limit value. Used to prevent the MV from overlarge modification in a short time.	TRUE	Operation parameter	Refer to Integral Cutting
	Direct/Reverse Switch Settings	SWPN	Direct/Reverse action select switch. SV is not changed, the MV Increases with the increasing of PV in Direct action, and decreases with the increasing of PV in reverse action.	TRUE	Operation parameter	SWPN=OFF equal to direct action; SWPN=ON equal to reverse action
Extended Parameters	Base Input Pin Settings	BKIN	Function block feedback input	-	Input pin	Connect to BKOUT of downstream block
		BKIN-ERR	Function block feedback status input	-	Input pin	Connect to BKOUTERR of downstream block
		PV	The measured value of loop Control object	-	Input pin	Connect to AI
		CSV	The cascade setpoint	-	Input pin	Connect to MV of upstream block

Table 15.17 SMITH Function Block Parameter Instruction (continued)

Name			Description	Upload	Properties	Application reference
		TV	Tracking input(MV=TV when tracking status)	-	Input pin	Connect to AIRelated parameter: SWTR
		SWTR	Tracking selecting switch.MV track TV when SWTR=ON; Do not track when SWTR=OFF	-	Input pin	Use to upstream interlock condition input Related parameter: TV
		OA	Output compensating value. Use to feedforward control	-	Input pin	Connect feedforward signal AI. Related parameters are OK and OB
	Advanced Input Pin Settings	MF	Actuator feedback value. Use to monitoring	-	Input pin	Connect to AI
		IA	Input compensating value. Use to improve controllability of procedure with long dead zone time.	-	Input pin	Connect to AI. Refer to "Input Process"; Related parameter IK and IB.
		PSWAM	MAN/AUTO switch for program control. The program Man control when PSWAM=OFF; program AUTO control when PSWAM=ON	-	Input pin	Connect to output of upstream block.Significance when MAN_OPT=ON
		PSWSV	The SV/CSV selecting switch for program control. Adopt SV when PSWSV=OFF; adopt CSV when PSWSV=ON	-	Input pin	Connect to output of upstream block.Significance when SV_OPT=ON

Table 15.17 SMITH Function Block Parameter Instruction (continued)

Name			Description	Upload	Properties	Application reference
		MAN_- OPT	MAN/AUTO control source select switch. If MAN_OP-T=ON then MAN/AUTO select switch is controlled by the PSWAM; if MAN_OP-T=OFF then MAN/AUTO select switch is controlled by SWAM	-	Input pin	Connect to output of upstream block. Related parameter PSWAM and SWAM
		SV_- OPT	SV/CSV control source select switch. If it is ON then SV/CSV select switch is controlled by the PSWSV; if it is OFF then SV/CSV select switch is controlled by the SWSV.	-	Input pin	Connect to output of upstream block. Related parameter PSWSV and SWSV
		SWINC	Switch of closedown increase for MV(MV can not increase). Carry out closedown increase when SWINC=ON	-	Input pin	Connect to upstream block out. It is active when block is AUTO/CAS status.
		SWDEC	Switch of closedown decrease for MV(MV can not increase). Carry out closedown decrease when SWDEC=ON	-	Input pin	Connect to upstream block out. It is active when block is AUTO/CAS status.
		HOLD	Switch for MV hold. The MV hold when HOLD=ON	-	Input pin	Connect to upstream block out. It is active when block is AUTO/CAS status.
	Output Pin	MV	Function block output value	-	Output pin	Connect to AOIf there's a float abnormal happened to the MV, the MV will be set as the value of previ-

Table 15.17 SMITH Function Block Parameter Instruction (continued)

Name			Description	Upload	Properties	Application reference
						ous period or the low limit.Please refer to "Application" for details.
		BKOUT	Function block feedback value output	-	Output pin	Connect to upstream block BKIN Related parameter is BK_OPT
		BKOUTERR	Function block feedback status output	-	Output pin	Connect to upstream block BKINERR
		BK_-OPT	Select switch for BKOUT value. If BK_-OPT=ON then BKOUT track measured value else track setpoint.	-	Configuration parameter	Related parameter is BKOUT
	SMITH-Param Settings	T	Setting parameter. T can be regarded as the time constant of closed-loop	TRUE	Operation parameter	when T decreases, the response speed of system becomes faster, but the stability reduces. When T increases, the response speed of system becomes slower, while the stability increases
		L	Model parameter. Object time constant	TRUE	Operation parameter	-
		D	Model parameter. Object pure hysteresis time constant	TRUE	Operation parameter	-
		K	Model parameter. Object gain	TRUE	Operation parameter	-
	Operator Command	MODE	Work mode	-	Monitoring parameter	Refer to Transition Process of Function Block Modes
		IMODE	Stand-by work mode	-	Monitoring parameter	Refer to Transition Process of Function Block Modes
MOD-E_OPT		ON=auto return, OFF>manual return (default)	-	Configuration parameter	Refer to Transition Process of Function Block Modes	

Table 15.17 SMITH Function Block Parameter Instruction (continued)

Name			Description	Upload	Properties	Application reference
		SWAM	Manual and auto switch: OFF=manual, ON=auto	-	Operation parameter	It is active for MAN_OP-T=OFF
		SWSV	Auto/ cascade selection: OFF=auto, ON=cascade	-	Operation parameter	It is active for SV_OP-T=OFF
		SWP-MV	Whether to equal to preset MV value when switch to auto status. PMV enable switch. When SWPMV=ON, MV = PMV, MV velocity alarm, lock increase/decrease are disabled	TRUE	Operation parameter	Related parameter is PMV
		PMV	Preset MV when switching from OOS/ IMAN/TR/MAN modes to AUTO or CAS mode	TRUE	Operation parameter	It is active for SWP-MV=ON
	Operator Data	SV	Setpoint for loop control	TRUE	Operation parameter	Refer to Set Variable Process
		MAN-MV	Manual output value	-	Operation parameter	When manual mode, MV=MANMV
		EI	error	-	Monitoring parameter	Refer to Operation Process
	Input Alarm Settings	PVHH	PV HH alarm value	TRUE	Operation parameter	Refer to Input Process
		PVH	PV H alarm value	TRUE	Operation parameter	Refer to Input Process
		PVL	PV L alarm value	TRUE	Operation parameter	Refer to Input Process
		PVLL	PV LL alarm value	TRUE	Operation parameter	Refer to Input Process

Table 15.17 SMITH Function Block Parameter Instruction (continued)

Name			Description	Upload	Properties	Application reference
		PVHYS	Measured value alarm hysteresis	TRUE	Operation parameter	Refer to Input Process
		DL	Deviation alarm set value	TRUE	Operation parameter	Refer to Operation Process
		DLHYS	Deviation alarm hysteresis value	TRUE	Operation parameter	Refer to Operation Process
		KSV	Deviation filter coefficient	TRUE	Operation parameter	Refer to Operation Process
		TSV	Deviation filter time constant(s)	TRUE	Operation parameter	Refer to Operation Process
		NM-FLIM	Valve position negative error thresholds	TRUE	Operation parameter	Related parameter: NMF. Refer to Integral Cutting
		PM-FLIM	Valve position positive error thresholds	TRUE	Operation parameter	Related parameter: PMF. Refer to Integral Cutting
		TMFHYS	Valve position error alarm hysteresis time	TRUE	Operation parameter	Refer to Integral Cutting
	Advance Calculation Settings	BY-PASS	Bypass PID operation, when BY-PASS=ON, excise PID calculation, switch SV to MV directly for output	TRUE	Operation parameter	When cascade adjusting, used to excise inner loop when it fails
		SWDB	Enable switch, when SWD-B=ON, deadband enable	TRUE	Operation parameter	Related parameter: DB
		DB	Deadband band size	TRUE	Operation parameter	It is active when SWD-B=ON
		DBHYS	Deadband band hysteresis	TRUE	Operation parameter	Refer to Operation Process
		OUT- OPT	Control output type: OFF=position type,	-	Configuration parameter	Related parameter: MV

Table 15.17 SMITH Function Block Parameter Instruction (continued)

Name			Description	Upload	Properties	Application reference
	Alarm		ON=increment type			
		PVH-HIND	PVHH alarm indication	-	Monitoring parameter	Refer to Integral Cutting
		PVHIND	PV H Limit alarm indication	-	Monitoring parameter	Refer to Integral Cutting
		PVLIND	PV L limit alarm indication	-	Monitoring parameter	Refer to Integral Cutting
		PVL-LIND	PV LL limit alarm indication	-	Monitoring parameter	Refer to Integral Cutting
		MVHIND	MV H limit alarm indication	-	Monitoring parameter	Refer to Integral Cutting
		MVLIND	MV L limit alarm indication	-	Monitoring parameter	Refer to Integral Cutting
		SVHIND	SV H limit alarm indication	-	Monitoring parameter	Refer to Integral Cutting
		SVLIND	SV L limit alarm indication	-	Monitoring parameter	Refer to Integral Cutting
		PEIIND	Positive deviation alarm indication	-	Monitoring parameter	Refer to Integral Cutting
		NEIIND	Negative deviation alarm indication	-	Monitoring parameter	Refer to Integral Cutting
		DMVHIND	MV positive rate limit indication	-	Monitoring parameter	Refer to Integral Cutting
		DMVLIND	MV negative rate limit indication	-	Monitoring parameter	Refer to Integral Cutting
		NM-FIND	Valve position error negative alarm indication	-	Monitoring parameter	Refer to Integral Cutting

Table 15.17 SMITH Function Block Parameter Instruction (continued)

Name			Description	Upload	Properties	Application reference
		PM-FIND	Valve position error positive alarm indication	-	Monitoring parameter	Refer to Integral Cutting
	Compensation Settings	IK	Input compensation gain	TRUE	Operation parameter	Refer to Input Process
		IB	Input compensation bias value	TRUE	Operation parameter	Refer to Integral Cutting
		OK	Output compensation gain	TRUE	Operation parameter	Refer to Operation Process
		OB	Output compensation bias value	TRUE	Operation parameter	Refer to Operation Process
	Fase/Slow/Increase/Decrease Settings	SMV	MV manual fast increase/decrease value (%)	TRUE	Operation parameter	Set MV manual fast increase/decrease percentage in function block properties settings
		FMV	SV slow increase/decrease value (%)	TRUE	Operation parameter	Set SV manual slow increase/decrease percentage in function block properties settings
		SSV	SV fast increase/decrease value (%)	TRUE	Operation parameter	Set SV manual fast increase/decrease percentage in function block properties settings
		FSV	MV manual fast increase/decrease value (%)	TRUE	Operation parameter	Set MV manual fast increase/decrease percentage in function block properties settings
	Extended Range Settings	HOR-LIM	Extended range maximum percentage	-	Configuration parameter	Refer to Output Process
		LOR-LIM	Extended range minimum percentage	-	Configuration parameter	Refer to Output Process
	SV Advance Settings	SWRAMP	SV ramp function switch. When changing set value, incline it to SV according to the set RAMP	TRUE	Operation parameter	Related parameter: RAMP active when in automatic or cascade mode

Table 15.17 SMITH Function Block Parameter Instruction (continued)

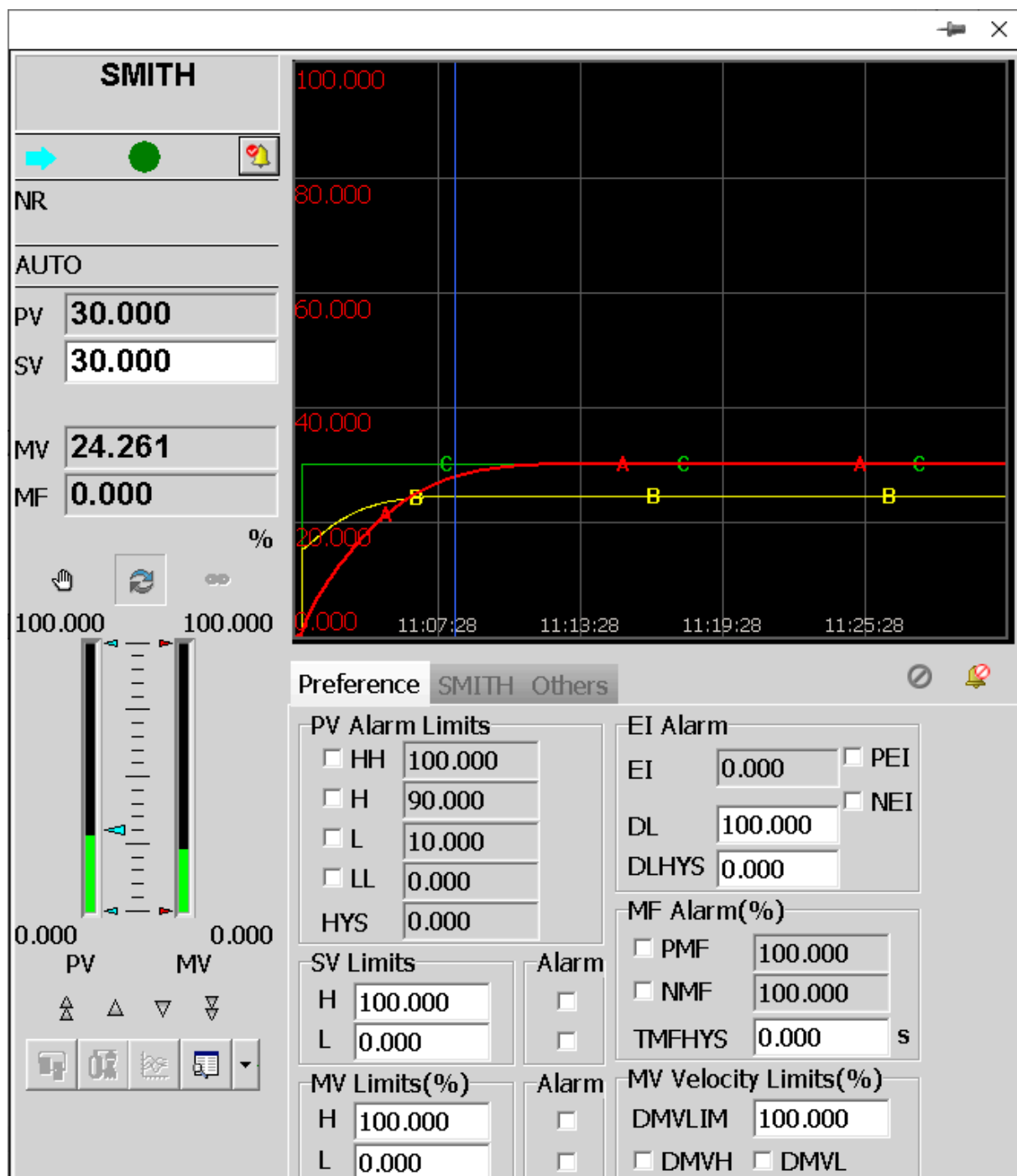
Name			Description	Upload	Properties	Application reference
			(s). OFF=SV ramp function off, ON=SV ramp function on			
		RAMP	Ramp coefficient	TRUE	Operation parameter	Related parameter: SWRAMP
		SVTR_ OPT	SV track PV switch enable/disable: OFF=not track, ON=track. If PV> SVH/ SVL, SV= range limit. used to prevent the output MV from interference when changing the control mode.	-	Configuration parameter	SV=range limit when PV exceeds SVH and SVL, to prevent the interference generated with the MV output when control mode is modified. Refer to Set Variable Process
	Alarm Enabled and Suppress	AOF	Suppress module alarm, on=prohibit to	TRUE	Operation parameter	Refer to Integral Cutting
		ENALM	Alarm enable	TRUE	Alarm parameter	Refer to Integral Cutting
		FLAG	Flag code	-	Output pin	Refer to Integral Cutting
	OOS Settings	SWOOS	Function block disable (ON=disable)	TRUE	Operation parameter	Set as ON at the first time of function block downloading
		OOS-VAL	Output value in OOS status	TRUE	Operation parameter	Related parameter: OOS_OPT=ON
		OOS_ OPT	Output value type in OOS status. when OOS_ OPT =ON, MV=OOSVAL, when OOS_ OPT =OFF, maintain the MV	-	Configuration parameter	Refer to About

15.10.2 Application

The float abnormal of output values means that the output values are not float format, or a meaningless output value is produced in a calculation that performs a divide-by-zero operation. When float abnormal happened, the function block's output value shall conform to the following rules:

- If there's the normal value of previous period, MV outputs the value of previous period.
- If there's the abnormal value of previous period or no previous period value, MV outputs the lower range limit.

15.10.3 Panel Parameter



The SMITH function block face plate parameters same as the PID function block except "SMITH" page parameters. The "SMITH" page parameters shown as follow.

Preference **SMITH** Others

Model Parameter

K

L s

D s

Control Direction

☐ Direct

☒ Reverse

SMITH Action

☒ Run

☐ Bypass

Deadband

☐ Enable ☒ Disable

DB

DBHYS

SV Ramp Action

☐ Enable ☒ Disable

RAMP

Tuning Parameter

T

Preference **SMITH** Others

Input Compensation(%)

IA

IK

IB

Feedback Output Track

☐ PV

☒ SV

SV Track

☒ Track

☐ Not Track

Output Compensation(%)

OA

OK

OB

MAN_OPT

☒ Panel

☐ Program

SV_OPT

☐ Panel

☒ Program

EI Alarm Filter Settings

KSV

TSV s

TR %

Table 15.18 Panel parameter instruction of SMITH

Panel Parameter Name			Function Block Parameter Name	Initial Value	Value Range	Application Instruction
Preference	PV Alarm (%)	HH	PVHH	100.000	[SVS-CL,SVSCH]	Set the HH limit alarm value of loop PV. (Selecting the alarm means enable, or it is disabled.)

Table 15.18 Panel parameter instruction of SMITH (continued)

Panel Parameter Name			Function Block Parameter Name	Initial Value	Value Range	Application Instruction
		H	PVH	90.000	[SVS-CL,SVSCH]	Set the H limit alarm value of loop PV. (Selecting the alarm means enable, or it is disbled.)
		L	PVL	10.000	[SVS-CL,SVSCH]	Set the L limit alarm value of loop PV. (Selecting the alarm means enable, or it is disbled.)
		LL	PVLL	0.000	[SVS-CL,SVSCH]	Set the LL limit alarm value of loop PV. (Selecting the alarm means enable, or it is disbled.)
		HYS	PVHYS	0.000	-	ALARM HYSTERESIS VALUE OF PV
	SV Limits (%)	H	SVH	40.000	[SVS-CL,SVSCH]	Set the H limit alarm value of loop SV. (Selecting the alarm means enable, or it is disbled.) Note: SV limit will not be affected by the selection.
		L	SVL	0.000	[SVS-CL,SVSCH]	Set the L limit alarm value of loop SV. (Selecting the alarm means enable, or it is disbled.) Note: SV limit will not be affected by the selection.
	MV Limits (%)	H	MVH	100.000	[MVS-CL,MVSCH]	Set the H limit alarm value of loop MV. (Selecting the alarm means enable, or it is disbled.) Note: MV limit will not be affected by the selection.
		L	MVL	0.000	[MVS-CL,MVSCH]	Set the L limit alarm value of loop MV. (Selecting the alarm means enable, or it is disbled.) Note: MV limit will not be affected by the selection.
	EI Alarm (%)	EI	EI	0.000	-	Read-only. EI= SV-PV(Selecting the alarm means enable, or it is disbled.)
		PEI (Selected)	-	-	-	Selecting positive deviation alarm means enabled.
		NEI (Selected)	-	-	-	Selecting negative deviation alarm means enabled.
		DL	DL	100.000	± (Range H Limit – Range L Limit)	SV of Deviation alarm
		DLHYS	DLHYS	0.000	-	Hysteresis value of bias alarm

Table 15.18 Panel parameter instruction of SMITH (continued)

Panel Parameter Name			Function Block Parameter Name	Initial Value	Value Range	Application Instruction
	MF Alarm (%)	PMF	PMFLIM	100.000	-	Selecting positive deviation alarm means enabled.
		NMF	NMFLIM	100.000	-	Selecting negative deviation alarm means enabled.
		TMFHYS	TMFHYS	0.000	-	SV of lag time
	MV Velocity Limits (%)	DMVH (Selected)	-	-	-	Selecting the positive velocity alarm means enabled.
		DMVL (Selected)	-	-	-	Selecting the negative velocity alarm means enabled.
		DMVLIM	DMVLIM	100.000	-	SV of loop MV velocity limit
SMITH	Model Parameter	K	K	1.000	-	Read-only. It can be set in configuration or program.
		L	L	100.000	-	Read-only. It can be set in configuration or program.
		D	D	0.000	-	Read-only. It can be set in configuration or program.
	Dead-band (%)	Enable (Selected)	SWDB	-	-	Read-only. It can be set in configuration or program.
		Disable (Selected)	SWDB	√	-	Read-only. It can be set in configuration or program.
		DB	DB	0.000	-	Read-only. It can be set in configuration or program.
		DBHYS	DBHYS	0.000	-	Read-only. It can be set in configuration or program.
	Tuning Parameter	T	T	200	-	Read-only. It can be set in configuration or program.
	SV Ramp Action	Enable (Selected)	SWRAMP	-	-	Read-only. It can be set in configuration or program.
		Disable (Selected)	SWRAMP	√	-	Read-only. It can be set in configuration or program.
		RAMP	RAMP	100.000	-	Read-only. It can be set in configuration or program.
	Control Direction	Direct (Selected)	SWPN	-	-	Read-only. It can be set in configuration or program.

Table 15.18 Panel parameter instruction of SMITH (continued)

Panel Parameter Name			Function Block Parameter Name	Initial Value	Value Range	Application Instruction
	SMITH Action	Reverse	SWPN	√	-	Read-only. It can be set in configuration or program.
		Run (Selected)	BYPASS	√	-	Read-only. It can be set in configuration or program.
		Bypass (Selected)	BYPASS	-	-	Read-only. It can be set in configuration or program.
Others	Input Compensation (%)	IA	IA	0.000	-	Read-only. It can be set in configuration or program.
		IK	IK	1.000	-	Input compensation gain
		IB	IB	0.000	-	Input compensation bias value
	Output Compensation (%)	OA	OA	0.000	-	Read-only, feedforward signal
		OK	OK	1.000	-	Output compensation gain
		DB	DB	0.000	-	Output compensation bias value
	Bias Alarm Filter Settings	KSV	KSV	1.000	0~100	Bias filter coefficient
		TSV	TSV	0.000	0~1000s	Constant between errors (s)
	Feedback Output Track	PV	BK_OPT	-	-	Read-only. It can be set in configuration or program.
		SV	BK_OPT	√	-	Read-only. It can be set in configuration or program.
	SV Track	Track	SVTR_-OPT	√	-	Read-only. It can be set in configuration or program.
		Not Track	SVTR_-OPT	-	-	Read-only. It can be set in configuration or program.
	MAN_-OPT Settings	Panel	MAN_OPT	√	-	Read-only. It can be set in configuration or program.
		Program	MAN_OPT	-	-	Read-only. It can be set in configuration or program.
	SV_-OPT Settings	Panel	SV_OPT	-	-	Read-only. It can be set in configuration or program.
		Program	SV_OPT	√	-	Read-only. It can be set in configuration or program.
	TV (%)		TV	0.000	-	Read-only. Track the input value (%).

15.10.4 Flag

Table 15.19 Flag list

Flag	Alarm	Instruction
D0	OOS	Disable
D1	IMAN	Initialize Manually
D2	MAN	Manual
D3	TR	Track
D4	AUTO	Auto
D5	CAS	Cascade
D8	PVHH	PV HH Limit Alarm
D9	PVLL	PV LL Limit Alarm
D10	PVH	PV H Limit Alarm
D11	PVL	PV L Limit Alarm
D12	SVH	SV H Limit Alarm
D13	SVL	SV L Limit Alarm
D14	MVH	Output H Limit Alarm
D15	MVL	Output L Limit Alarm
D16	PEI	Positive Deviation Alarm
D17	NEI	Negative Deviation Alarm
D18	REVSCL	Span H/L Limit Reverse or float abnormal
D19	CFGERR	Configuration Error
D22	DMVH	MV Positive Rate Limit Alarm
D23	DMVL	MV Negative Rate Limit Alarm
D25	AOF	Suppress Alarm
D27	NMF	Valve Negative Deviation Alarm
D28	PMF	Valve Positive Deviation Alarm

15.10.5 Programming Example For Apply

The programming method refer to Application Example.

15.10.6 Matters Need Attention

The processes are looked as first-order lag objects in this controller, that is

$$G(s) = \frac{K}{Ls + 1} e^{-Ds}$$

K is the object gain, L is the time constant for the object, D is the pure lag time of the object.

Model parameters K, L, D should be set in function blocks when in application. The more accurate the model parameters are, the better the control effect would be. Intending control effect may be not reached without accurate model parameters.

Controller need to tune parameter T, which can be regarded as the time constant of closed-loop systems. Therefore, when T decreases, the response speed of system becomes faster, but the stability reduces. When T increases, the response speed of system becomes slower, while the stability increases.

15.11 Branches Balance Control of Oil Furnace Function Block (BALANCE8)

Function block (BALANCE) balance controls 8 branches at most. Tube-type heating furnace is the most common heating furnace in production of oil refining & chemical industry, which costs about 10% of the equipment investment. It is used to heat the oil in the furnace to the required temperature and then go on with fractional distillation, cracking and reactions in the next process equipment. Because of the large amount of oil to be heated, it is usually divided into multiple branches in heating furnace. As the combustion in the furnace chamber is uneven and the heat transfer characteristics of each branch tube is different, outlet temperature of each branch is also different, which has a great effect on the level operation of the downstream atmospheric tower. Therefore, the Crude Oil Unit Furnace outlet temperature balance is an important control target aim, which is of great importance to production safety and reducing energy consumption. The BALANCE8 is complex function block. The block performance period is 2000μs.

BALANCE8	
<input type="checkbox"/> FTTL	FPSET1 <input type="checkbox"/>
<input type="checkbox"/> FTTLSET	FPSET2 <input type="checkbox"/>
<input type="checkbox"/> FPASS1	FPSET3 <input type="checkbox"/>
<input type="checkbox"/> FPASS2	FPSET4 <input type="checkbox"/>
<input type="checkbox"/> FPASS3	FPSET5 <input type="checkbox"/>
<input type="checkbox"/> FPASS4	FPSET6 <input type="checkbox"/>
<input type="checkbox"/> FPASS5	FPSET7 <input type="checkbox"/>
<input type="checkbox"/> FPASS6	FPSET8 <input type="checkbox"/>
<input type="checkbox"/> FPASS7	BKOUT <input type="checkbox"/>
<input type="checkbox"/> FPASS8	BKOUTERR <input type="checkbox"/>
<input type="checkbox"/> TPASS1	
<input type="checkbox"/> TPASS2	
<input type="checkbox"/> TPASS3	
<input type="checkbox"/> TPASS4	
<input type="checkbox"/> TPASS5	
<input type="checkbox"/> TPASS6	
<input type="checkbox"/> TPASS7	
<input type="checkbox"/> TPASS8	
<input type="checkbox"/> TCS1	
<input type="checkbox"/> TCS2	
<input type="checkbox"/> TCS3	
<input type="checkbox"/> TCS4	
<input type="checkbox"/> TCS5	
<input type="checkbox"/> TCS6	
<input type="checkbox"/> TCS7	
<input type="checkbox"/> TCS8	
<input type="checkbox"/> BKIN1	
<input type="checkbox"/> BKIN2	
<input type="checkbox"/> BKIN3	
<input type="checkbox"/> BKIN4	
<input type="checkbox"/> BKIN5	
<input type="checkbox"/> BKIN6	
<input type="checkbox"/> BKIN7	
<input type="checkbox"/> BKIN8	
<input type="checkbox"/> BKINERR1	
<input type="checkbox"/> BKINERR2	
<input type="checkbox"/> BKINERR3	
<input type="checkbox"/> BKINERR4	
<input type="checkbox"/> BKINERR5	
<input type="checkbox"/> BKINERR6	
<input type="checkbox"/> BKINERR7	
<input type="checkbox"/> BKINERR8	
<input type="checkbox"/> FTTLERR	
<input type="checkbox"/> TPSERR1	
<input type="checkbox"/> TPSERR2	
<input type="checkbox"/> TPSERR3	
<input type="checkbox"/> TPSERR4	
<input type="checkbox"/> TPSERR5	
<input type="checkbox"/> TPSERR6	
<input type="checkbox"/> TPSERR7	
<input type="checkbox"/> TPSERR8	
<input type="checkbox"/> TCSERR1	
<input type="checkbox"/> TCSERR2	
<input type="checkbox"/> TCSERR3	
<input type="checkbox"/> TCSERR4	
<input type="checkbox"/> TCSERR5	
<input type="checkbox"/> TCSERR6	
<input type="checkbox"/> TCSERR7	
<input type="checkbox"/> TCSERR8	
p0001	1#

15.11.1 Parameter Description

Table 15.20 Parameter instruction list

Name	Type	Description	Panel Operation Authority	Default	Upload Parameter	Extend Parameter	Confirm Panel Operation
Input Parameter							
FTTL	REAL	Header pipe flow	0/ Non-configurable	0.0	No	True	No
FT-TLSET	REAL	Set Header pipe flow	0/ Non-configurable	0.0	No	True	No
FPASS1	REAL	Branch flow PV 1	0/ Non-configurable	0.0	No	True	No
FPASS2	REAL	Branch flow PV 2	0/ Non-configurable	0.0	No	True	No
FPASS3	REAL	Branch flow PV 3	0/ Non-configurable	0.0	No	True	No
FPASS4	REAL	Branch flow PV 4	0/ Non-configurable	0.0	No	True	No
FPASS5	REAL	Branch flow PV 5	0/ Non-configurable	0.0	No	True	No
FPASS6	REAL	Branch flow PV 6	0/ Non-configurable	0.0	No	True	No
FPASS7	REAL	Branch flow PV 7	0/ Non-configurable	0.0	No	True	No
FPASS8	REAL	Branch flow PV 8	0/ Non-configurable	0.0	No	True	No
TPASS1	REAL	Branch temperature 1	0/ Non-configurable	0.0	No	True	No
TPASS2	REAL	Branch temperature 2	0/ Non-configurable	0.0	No	True	No
TPASS3	REAL	Branch temperature 3	0/ Non-configurable	0.0	No	True	No
TPASS4	REAL	Branch temperature 4	0/ Non-configurable	0.0	No	True	No
TPASS5	REAL	Branch temperature 5	0/ Non-configurable	0.0	No	True	No
TPASS6	REAL	Branch temperature 6	0/ Non-configurable	0.0	No	True	No

Table 15.20 Parameter instruction list (continued)

Name	Type	Description	Panel Operation Authority	Default	Upload Parameter	Extend Parameter	Confirm Panel Operation
TPASS7	REAL	Branch temperature 7	0/ Non-configurable	0.0	No	True	No
TPASS8	REAL	Branch temperature 8	0/ Non-configurable	0.0	No	True	No
TCS1	REAL	Temperature in furnace 1	0/ Non-configurable	0.0	No	True	No
TCS2	REAL	Temperature in furnace 2	0/ Non-configurable	0.0	No	True	No
TCS3	REAL	Temperature in furnace 3	0/ Non-configurable	0.0	No	True	No
TCS4	REAL	Temperature in furnace 4	0/ Non-configurable	0.0	No	True	No
TCS5	REAL	Temperature in furnace 5	0/ Non-configurable	0.0	No	True	No
TCS6	REAL	Temperature in furnace 6	0/ Non-configurable	0.0	No	True	No
TCS7	REAL	Temperature in furnace 7	0/ Non-configurable	0.0	No	True	No
TCS8	REAL	Temperature in furnace 8	0/ Non-configurable	0.0	No	True	No
BKIN1	REAL	Feedback of branch flow SV 1	0/ Non-configurable	0.0	No	True	No
BKIN2	REAL	Feedback of branch flow SV 2	0/ Non-configurable	0.0	No	True	No
BKIN3	REAL	Feedback of branch flow SV 3	0/ Non-configurable	0.0	No	True	No
BKIN4	REAL	Feedback of branch flow SV 4	0/ Non-configurable	0.0	No	True	No
BKIN5	REAL	Feedback of branch flow SV 5	0/ Non-configurable	0.0	No	True	No
BKIN6	REAL	Feedback of branch flow SV 6	0/ Non-configurable	0.0	No	True	No

Table 15.20 Parameter instruction list (continued)

Name	Type	Description	Panel Operation Authority	Default	Upload Parameter	Extend Parameter	Confirm Panel Operation
BKIN7	REAL	Feedback of branch flow SV 7	0/ Non-configurable	0.0	No	True	No
BKIN8	REAL	Feedback of branch flow SV 8	0/ Non-configurable	0.0	No	True	No
BKIN-ERR1	BOOL	Status feedback of branch flow SV 1	0/ Non-configurable	OFF	No	True	No
BKIN-ERR2	BOOL	Status feedback of branch flow SV 2	0/ Non-configurable	OFF	No	True	No
BKIN-ERR3	BOOL	Status feedback of branch flow SV 3	0/ Non-configurable	OFF	No	True	No
BKIN-ERR4	BOOL	Status feedback of branch flow SV 4	0/ Non-configurable	OFF	No	True	No
BKIN-ERR5	BOOL	Status feedback of branch flow SV 5	0/ Non-configurable	OFF	No	True	No
BKIN-ERR6	BOOL	Status feedback of branch flow SV 6	0/ Non-configurable	OFF	No	True	No
BKIN-ERR7	BOOL	Status feedback of branch flow SV 7	0/ Non-configurable	OFF	No	True	No
BKIN-ERR8	BOOL	Status feedback of branch flow SV 8	0/ Non-configurable	OFF	No	True	No
FT-TLERR	BOOL	Header pipe flow fault	0/ Non-configurable	OFF	No	True	No
TPSERR1	BOOL	Branch temperature 1 fault	0/ Non-configurable	OFF	No	True	No

Table 15.20 Parameter instruction list (continued)

Name	Type	Description	Panel Operation Authority	Default	Upload Parameter	Extend Parameter	Confirm Panel Operation
TPSERR2	BOOL	Branch temperature 2 fault	0/ Non-configurable	OFF	No	True	No
TPSERR3	BOOL	Branch temperature 3 fault	0/ Non-configurable	OFF	No	True	No
TPSERR4	BOOL	Branch temperature 4 fault	0/ Non-configurable	OFF	No	True	No
TPSERR5	BOOL	Branch temperature 5 fault	0/ Non-configurable	OFF	No	True	No
TPSERR6	BOOL	Branch temperature 6 fault	0/ Non-configurable	OFF	No	True	No
TPSERR7	BOOL	Branch temperature 7 fault	0/ Non-configurable	OFF	No	True	No
TPSERR8	BOOL	Branch temperature 8 fault	0/ Non-configurable	OFF	No	True	No
TCSERR1	BOOL	Temperature in furnace 1 fault	0/ Non-configurable	OFF	No	True	No
TCSERR2	BOOL	Temperature in furnace 2 fault	0/ Non-configurable	OFF	No	True	No
TCSERR3	BOOL	Temperature in furnace 3 fault	0/ Non-configurable	OFF	No	True	No
TCSERR4	BOOL	Temperature in furnace 4 fault	0/ Non-configurable	OFF	No	True	No
TCSERR5	BOOL	Temperature in furnace 5 fault	0/ Non-configurable	OFF	No	True	No
TCSERR6	BOOL	Temperature in furnace 6 fault	0/ Non-configurable	OFF	No	True	No
TCSERR7	BOOL	Temperature in furnace 7 fault	0/ Non-configurable	OFF	No	True	No

Table 15.20 Parameter instruction list (continued)

Name	Type	Description	Panel Operation Authority	Default	Upload Parameter	Extend Parameter	Confirm Panel Operation
TCSERR8	BOOL	Temperature in furnace 8 fault	0/ Non-configurable	OFF	No	True	No
Output Parameter							
FPSET1	REAL	Feedback of branch flow SV 1	0/ Non-configurable	0.0	No	True	No
FPSET2	REAL	Feedback of branch flow SV 2	0/ Non-configurable	0.0	No	True	No
FPSET3	REAL	Feedback of branch flow SV 3	0/ Non-configurable	0.0	No	True	No
FPSET4	REAL	Feedback of branch flow SV 4	0/ Non-configurable	0.0	No	True	No
FPSET5	REAL	Feedback of branch flow SV 5	0/ Non-configurable	0.0	No	True	No
FPSET6	REAL	Feedback of branch flow SV 6	0/ Non-configurable	0.0	No	True	No
FPSET7	REAL	Feedback of branch flow SV 7	0/ Non-configurable	0.0	No	True	No
FPSET8	REAL	Feedback of branch flow SV 8	0/ Non-configurable	0.0	No	True	No
BKOUT	REAL	BKOUT	0/ Non-configurable	0.0	No	True	No
BKOUTERRBOOL		BKOUTERR	0/ Non-configurable	OFF	No	True	No
Monitoring Parameter							
FMAX-ER21	REAL	Maximum flow error of 2-branch balance 1	0/ Non-configurable	100.0	No	True	No
TMAX-ER21	REAL	Maximum flow error of 2-branch balance 1	0/ Non-configurable	100.0	No	True	No

Table 15.20 Parameter instruction list (continued)

Name	Type	Description	Panel Operation Authority	Default	Upload Parameter	Extend Parameter	Confirm Panel Operation
FMAX-ER22	REAL	Maximum flow error of 2-branch balance 2	0/ Non-configurable	100.0	No	True	No
TMAX-ER22	REAL	Maximum temperature error of 2-branch balance 2	0/ Non-configurable	100.0	No	True	No
FMAX-ER41	REAL	Maximum flow error of 4-branch balance 1	0/ Non-configurable	100.0	No	True	No
TMAX-ER41	REAL	Maximum temperature error of 4-branch balance 1	0/ Non-configurable	100.0	No	True	No
FMAX-ER23	REAL	Maximum temperature error of 2-branch balance 3	0/ Non-configurable	100.0	No	True	No
TMAX-ER23	REAL	Maximum temperature error of 2-branch balance 3	0/ Non-configurable	100.0	No	True	No
FMAX-ER24	REAL	Maximum flow error of 2-branch balance 4	0/ Non-configurable	100.0	No	True	No
TMAX-ER24	REAL	Maximum temperature error of 2-branch balance 4	0/ Non-configurable	100.0	No	True	No
FMAX-ER42	REAL	Maximum flow error of 4-branch balance 2	0/ Non-configurable	100.0	No	True	No
TMAX-ER42	REAL	Maximum flow error of 4-branch balance 2	0/ Non-configurable	100.0	No	True	No

Table 15.20 Parameter instruction list (continued)

Name	Type	Description	Panel Operation Authority	Default	Upload Parameter	Extend Parameter	Confirm Panel Operation
FMAX-ER8	REAL	Maximum flow error of 8-branch balance	0/ Non-configurable	100.0	No	True	No
TMAX-ER8	REAL	Maximum temperature error of 8-branch balance	0/ Non-configurable	100.0	No	True	No
MODE	USINT	Current work mode	0/ Non-configurable	0	No	True	No
IMODE	USINT	Standby work mode	0/ Non-configurable	0	No	True	No
RUN_S-TAT	UDINT	Branch running status	0/ Non-configurable	0	No	True	No
PERMIT	USINT	Whether output can manually set Bit0	0/ Non-configurable	0	No	True	No
FLAG	UDINT	Flag	0/ Non-configurable	0	No	True	No
MODE_-SV	REAL	Actual SV value of model method branch	0/ Non-configurable	0.0	No	True	No
SWOOS	BOOL	Select OOS status	5/ Configurable	OFF	True	True	True
SWSV	BOOL	Cascade select switch: OFF= non-cascade, ON= cascade	5/ Configurable	OFF	True	True	True
SWAM	BOOL	Select auto/manual	5/ Configurable	OFF	True	True	True
SW21	BOOL	2-branch balance 1 switch	5/ Configurable	OFF	True	True	True
SW22	BOOL	2-branch balance 2 switch	5/ Configurable	OFF	True	True	True
SW41	BOOL	4-branch balance 1 switch	5/ Configurable	OFF	True	True	True
SW23	BOOL	2-branch balance 3 switch	5/ Configurable	OFF	True	True	True

Table 15.20 Parameter instruction list (continued)

Name	Type	Description	Panel Operation Authority	Default	Upload Parameter	Extend Parameter	Confirm Panel Operation
SW24	BOOL	2-branch balance 4 switch	5/ Configurable	OFF	True	True	True
SW42	BOOL	4-branch balance 2 switch	5/ Configurable	OFF	True	True	True
SW6	BOOL	6-branch balance switch	5/ Configurable	OFF	True	True	True
SW8	BOOL	8-branch balance switch	5/ Configurable	OFF	True	True	True
SW-MODE	USINT	Select control method, 0= differential method, 1= model method, 2= average method	5/ Configurable	0	True	True	True
AOF	BOOL	Module alarm shield	5/ Configurable	OFF	True	True	True
SWFAIL	BOOL	Troubleshooting mode, OFF: only influence fault branch ON: all branches exit switch	5/ Configurable	OFF	True	True	True
SWFF	BOOL	Enable feed forward	5/ Configurable	OFF	True	True	True
SWDEBUG	BOOL	Debug mode	5/ Configurable	OFF	True	True	True
SWA-MEND	BOOL	Average method, OFF= output non-balance, ON= - output balance	5/ Configurable	OFF	True	True	True
SWPN	BOOL	Positive and negative action, ON= negative action	5/ Configurable	OFF	True	True	True
Operation Parameter							
FPSETH1	REAL	Feedback output high	5/ Configurable	100.0	True	True	No

Table 15.20 Parameter instruction list (continued)

Name	Type	Description	Panel Operation Authority	Default	Upload Parameter	Extend Parameter	Confirm Panel Operation
		limit of branch flow SV 1					
FPSETL1	REAL	Feedback output low limit of branch flow SV 1	5/ Configurable	0.0	True	True	No
FPSETVL1	REAL	Feedback rate limit of branch flow SV 1	5/ Configurable	100.0	True	True	No
FPSETH2	REAL	Feedback output high limit of branch flow SV 2	5/ Configurable	100.0	True	True	No
FPSETL2	REAL	Feedback output low limit of branch flow SV 2	5/ Configurable	0.0	True	True	No
FPSETVL2	REAL	Feedback rate limit of branch flow SV 2	5/ Configurable	100.0	True	True	No
FPSETH3	REAL	Feedback output high limit of branch flow SV 3	5/ Configurable	100.0	True	True	No
FPSETL3	REAL	Feedback output low limit of branch flow SV 3	5/ Configurable	0.0	True	True	No
FPSETVL3	REAL	Feedback rate limit of branch flow SV 3	5/ Configurable	100.0	True	True	No
FPSETH4	REAL	Feedback output high limit of branch flow SV 4	5/ Configurable	100.0	True	True	No
FPSETL4	REAL	Feedback output low limit of branch flow SV 4	5/ Configurable	0.0	True	True	No
FPSETVL4	REAL	Feedback rate limit of	5/ Configurable	100.0	True	True	No

Table 15.20 Parameter instruction list (continued)

Name	Type	Description	Panel Operation Authority	Default	Upload Parameter	Extend Parameter	Confirm Panel Operation
		branch flow SV 4					
FPSETH5	REAL	Feedback output high limit of branch flow SV 5	5/ Configurable	100.0	True	True	No
FPSETL5	REAL	Feedback rate low limit of branch flow SV 5	5/ Configurable	0.0	True	True	No
FPSETVL5	REAL	Feedback rate limit of branch flow SV 5	5/ Configurable	100.0	True	True	No
FPSETH6	REAL	Feedback output high limit of branch flow SV 6	5/ Configurable	100.0	True	True	No
FPSETL6	REAL	Feedback output low limit of branch flow SV 6	5/ Configurable	0.0	True	True	No
FPSETVL6	REAL	Feedback rate limit of branch flow SV 6	5/ Configurable	100.0	True	True	No
FPSETH7	REAL	Feedback output high limit of branch flow SV 7	5/ Configurable	100.0	True	True	No
FPSETL7	REAL	Feedback output low limit of branch flow SV 7	5/ Configurable	0.0	True	True	No
FPSETVL7	REAL	Feedback rate limit of branch flow SV 7	5/ Configurable	100.0	True	True	No
FPSETH8	REAL	Feedback output high limit of branch flow SV 8	5/ Configurable	100.0	True	True	No
FPSETL8	REAL	Feedback output low	5/ Configurable	0.0	True	True	No

Table 15.20 Parameter instruction list (continued)

Name	Type	Description	Panel Operation Authority	Default	Upload Parameter	Extend Parameter	Confirm Panel Operation
		limit of branch flow SV 8					
FPSETVL8	REAL	Feedback rate limit of branch flow SV 8	5/ Configurable	100.0	True	True	No
K211	REAL	2-branch balance 1 coefficient 1	5/ Configurable	100.0	True	True	No
K212	REAL	2-branch balance 1 coefficient 2	5/ Configurable	0.5	True	True	No
K213	REAL	2-branch balance 1 coefficient 3	5/ Configurable	20	True	True	No
K221	REAL	2-branch balance 2 coefficient 1	5/ Configurable	100.0	True	True	No
K222	REAL	2-branch balance 2 coefficient 2	5/ Configurable	0.5	True	True	No
K223	REAL	2-branch balance 2 coefficient 3	5/ Configurable	20	True	True	No
K411	REAL	2-branch balance 1 coefficient 1	5/ Configurable	100.0	True	True	No
K412	REAL	2-branch balance 1 coefficient 2	5/ Configurable	0.5	True	True	No
K413	REAL	2-branch balance 1 coefficient 3	5/ Configurable	20	True	True	No
K231	REAL	2-branch balance 3 coefficient 1	5/ Configurable	100.0	True	True	No
K232	REAL	2-branch balance 3 coefficient 2	5/ Configurable	0.5	True	True	No
K233	REAL	2-branch balance 3 coefficient 3	5/ Configurable	20	True	True	No

Table 15.20 Parameter instruction list (continued)

Name	Type	Description	Panel Operation Authority	Default	Upload Parameter	Extend Parameter	Confirm Panel Operation
K241	REAL	2-branch balance 4 coefficient 1	5/ Configurable	100.0	True	True	No
K242	REAL	2-branch balance 4 coefficient 2	5/ Configurable	0.5	True	True	No
K243	REAL	2-branch balance 4 coefficient 3	5/ Configurable	20	True	True	No
K421	REAL	4-branch balance 2 coefficient 1	5/ Configurable	100.0	True	True	No
K422	REAL	2-branch balance 2 coefficient 2	5/ Configurable	0.5	True	True	No
K423	REAL	2-branch balance 2 coefficient 3	5/ Configurable	20	True	True	No
K81	REAL	8-branch balance coefficient 1	5/ Configurable	100.0	True	True	No
K82	REAL	8-branch balance coefficient 2	5/ Configurable	0.5	True	True	No
K83	REAL	8-branch balance coefficient 3	5/ Configurable	20	True	True	No
FERLMT21	REAL	Flow deviation limit of 2-branch balance 1	5/ Configurable	100.0	True	True	No
TERLMT21	REAL	Flow deviation limit of 2-branch balance 1	5/ Configurable	100.0	True	True	No
FERLMT22	REAL	Flow deviation limit of 2-branch balance 2	5/ Configurable	100.0	True	True	No
TERLMT22	REAL	Flow deviation limit of 2-branch balance 2	5/ Configurable	100.0	True	True	No

Table 15.20 Parameter instruction list (continued)

Name	Type	Description	Panel Operation Authority	Default	Upload Parameter	Extend Parameter	Confirm Panel Operation
FERLMT41	REAL	Flow deviation limit of 4-branch balance 1	5/ Configurable	100.0	True	True	No
TERLMT41	REAL	Flow deviation limit of 4-branch balance 1	5/ Configurable	100.0	True	True	No
FERLMT23	REAL	Flow deviation limit of 2-branch balance 3	5/ Configurable	100.0	True	True	No
TERLMT23	REAL	Flow deviation limit of 2-branch balance 3	5/ Configurable	100.0	True	True	No
FERLMT24	REAL	Flow deviation limit of 2-branch balance 4	5/ Configurable	100.0	True	True	No
TERLMT24	REAL	Flow deviation limit of 2-branch balance 4	5/ Configurable	100.0	True	True	No
FERLMT42	REAL	Flow deviation limit of 4-branch balance 2	5/ Configurable	100.0	True	True	No
TERLMT42	REAL	Flow deviation limit of 4-branch balance 2	5/ Configurable	100.0	True	True	No
FERLMT8	REAL	Flow deviation limit of 8-branch balance	5/ Configurable	100.0	True	True	No
TERLMT8	REAL	Flow deviation limit of 8-branch balance	5/ Configurable	100.0	True	True	No
HLMT21	REAL	Output high limit of 2-branch balance 1	5/ Configurable	100.0	True	True	No

Table 15.20 Parameter instruction list (continued)

Name	Type	Description	Panel Operation Authority	Default	Upload Parameter	Extend Parameter	Confirm Panel Operation
LLMT21	REAL	Output low limit of 2-branch balance 1	5/ Configurable	-100.0	True	True	No
HLMT22	REAL	Output high limit of 2-branch balance 2	5/ Configurable	100.0	True	True	No
LLMT22	REAL	Output low limit of 2-branch balance 2	5/ Configurable	-100.0	True	True	No
HLMT41	REAL	Output high limit of 4-branch balance 1	5/ Configurable	100.0	True	True	No
LLMT41	REAL	Output low limit of 4-branch balance 1	5/ Configurable	-100.0	True	True	No
HLMT23	REAL	Output high limit of 2-branch balance 3	5/ Configurable	100.0	True	True	No
LLMT23	REAL	Output low limit of 2-branch balance 3	5/ Configurable	-100.0	True	True	No
HLMT24	REAL	Output high limit of 2-branch balance 4	5/ Configurable	100.0	True	True	No
LLMT24	REAL	Output low limit of 2-branch balance 4	5/ Configurable	-100.0	True	True	No
HLMT42	REAL	Output high limit of 4-branch balance 2	5/ Configurable	100.0	True	True	No
LLMT42	REAL	Output low limit of 4-branch balance 2	5/ Configurable	-100.0	True	True	No

Table 15.20 Parameter instruction list (continued)

Name	Type	Description	Panel Operation Authority	Default	Upload Parameter	Extend Parameter	Confirm Panel Operation
HLMT8	REAL	Output high limit of 8-branch balance	5/ Configurable	100.0	True	True	No
LLMT8	REAL	Output low limit of 8-branch balance	5/ Configurable	-100.0	True	True	No
PB_-AVE1	REAL	Average method proportion parameter of branch 1	5/ Configurable	100.0	True	True	No
TI_AVE1	REAL	Average method integral parameter of branch 1	5/ Configurable	20.0	True	True	No
TD_-AVE1	REAL	Average method differential parameter of branch 1	5/ Configurable	0.0	True	True	No
PB_-AVE2	REAL	Average method proportion parameter of branch 2	5/ Configurable	100.0	True	True	No
TI_AVE2	REAL	Average method integral parameter of branch 2	5/ Configurable	20.0	True	True	No
TD_-AVE2	REAL	Average method differential parameter of branch 2	5/ Configurable	0.0	True	True	No
PB_-AVE3	REAL	Average method proportion parameter of branch 3	5/ Configurable	100.0	True	True	No
TI_AVE3	REAL	Average method integral parameter of branch 3	5/ Configurable	20.0	True	True	No

Table 15.20 Parameter instruction list (continued)

Name	Type	Description	Panel Operation Authority	Default	Upload Parameter	Extend Parameter	Confirm Panel Operation
		ter of branch 3					
TD_AVE3	REAL	Average method differential parameter of branch 3	5/ Configurable	0.0	True	True	No
PB_AVE4	REAL	Average method proportion parameter of branch 4	5/ Configurable	100.0	True	True	No
TI_AVE4	REAL	Average method integral parameter of branch 4	5/ Configurable	20.0	True	True	No
TD_AVE4	REAL	Average method differential parameter of branch 4	5/ Configurable	0.0	True	True	No
PB_AVE5	REAL	Average method proportion parameter of branch 5	5/ Configurable	100.0	True	True	No
TI_AVE5	REAL	Average method integral parameter of branch 5	5/ Configurable	20.0	True	True	No
TD_AVE5	REAL	Average method differential parameter of branch 5	5/ Configurable	0.0	True	True	No
PB_AVE6	REAL	Average method proportion parameter of branch 6	5/ Configurable	100.0	True	True	No
TI_AVE6	REAL	Average method integral parameter of branch 6	5/ Configurable	20.0	True	True	No

Table 15.20 Parameter instruction list (continued)

Name	Type	Description	Panel Operation Authority	Default	Upload Parameter	Extend Parameter	Confirm Panel Operation
TD_-AVE6	REAL	Average method differential parameter of branch 6	5/ Configurable	0.0	True	True	No
PB_-AVE7	REAL	Average method proportion parameter of branch 7	5/ Configurable	100.0	True	True	No
TI_AVE7	REAL	Average method integral parameter of branch 7	5/ Configurable	20.0	True	True	No
TD_-AVE7	REAL	Average method differential parameter of branch 7	5/ Configurable	0.0	True	True	No
PB_-AVE8	REAL	Average method proportion parameter of branch 8	5/ Configurable	100.0	True	True	No
TI_AVE8	REAL	Average method integral parameter of branch 8	5/ Configurable	20.0	True	True	No
TD_-AVE8	REAL	Average method differential parameter of branch 8	5/ Configurable	0.0	True	True	No
PB_FF1	REAL	Feed forward proportion parameter of branch 1	5/ Configurable	100.0	True	True	No
TI_FF1	REAL	Feed forward integral parameter of branch 1	5/ Configurable	20.0	True	True	No
TD_FF1	REAL	Feed forward differential parameter of branch 1	5/ Configurable	0.0	True	True	No

Table 15.20 Parameter instruction list (continued)

Name	Type	Description	Panel Operation Authority	Default	Upload Parameter	Extend Parameter	Confirm Panel Operation
PB_FF2	REAL	Feed forward proportion parameter of branch 2	5/ Configurable	100.0	True	True	No
TI_FF2	REAL	Feed forward integral parameter of branch 2	5/ Configurable	20.0	True	True	No
TD_FF2	REAL	Feed forward differential parameter of branch 2	5/ Configurable	0.0	True	True	No
PB_FF3	REAL	Feed forward proportion parameter of branch 3	5/ Configurable	100.0	True	True	No
TI_FF3	REAL	Feed forward integral parameter of branch 3	5/ Configurable	20.0	True	True	No
TD_FF3	REAL	Feed forward differential parameter of branch 3	5/ Configurable	0.0	True	True	No
PB_FF4	REAL	Feed forward proportion parameter of branch 4	5/ Configurable	100.0	True	True	No
TI_FF4	REAL	Feed forward integral parameter of branch 4	5/ Configurable	20.0	True	True	No
TD_FF4	REAL	Feed forward differential parameter of branch 4	5/ Configurable	0.0	True	True	No
PB_FF5	REAL	Feed forward proportion parameter of branch 5	5/ Configurable	100.0	True	True	No
TI_FF5	REAL	Feed forward integral parameter of branch 5	5/ Configurable	20.0	True	True	No

Table 15.20 Parameter instruction list (continued)

Name	Type	Description	Panel Operation Authority	Default	Upload Parameter	Extend Parameter	Confirm Panel Operation
TD_FF5	REAL	Feed forward differential parameter of branch 5	5/ Configurable	0.0	True	True	No
PB_FF6	REAL	Feed forward proportion parameter of branch 6	5/ Configurable	100.0	True	True	No
TI_FF6	REAL	Feed forward integral parameter of branch 6	5/ Configurable	20.0	True	True	No
TD_FF6	REAL	Feed forward differential parameter of branch 6	5/ Configurable	0.0	True	True	No
PB_FF7	REAL	Feed forward proportion parameter of branch 7	5/ Configurable	100.0	True	True	No
TI_FF7	REAL	Feed forward integral parameter of branch 7	5/ Configurable	20.0	True	True	No
TD_FF7	REAL	Feed forward differential parameter of branch 7	5/ Configurable	0.0	True	True	No
PB_FF8	REAL	Feed forward proportion parameter of branch 8	5/ Configurable	100.0	True	True	No
TI_FF8	REAL	Feed forward integral parameter of branch 8	5/ Configurable	20.0	True	True	No
TD_FF8	REAL	Feed forward differential parameter of branch 8	5/ Configurable	0.0	True	True	No
TPS_DB	REAL	Temperature dead zone	5/ Configurable	0.0	True	True	No

Table 15.20 Parameter instruction list (continued)

Name	Type	Description	Panel Operation Authority	Default	Upload Parameter	Extend Parameter	Confirm Panel Operation
KPM1	REAL	Model coefficient K of branch 1	5/ Configurable	1.0	True	True	No
TPM1	REAL	Model coefficient T of branch 1	5/ Configurable	10.0	True	True	No
LPM1	REAL	Model coefficient L of branch 1	5/ Configurable	2.0	True	True	No
KPM2	REAL	Model coefficient K of branch 2	5/ Configurable	1.0	True	True	No
TPM2	REAL	Model coefficient T of branch 2	5/ Configurable	10.0	True	True	No
LPM2	REAL	Model coefficient L of branch 2	5/ Configurable	2.0	True	True	No
KPM3	REAL	Model coefficient K of branch 3	5/ Configurable	1.0	True	True	No
TPM3	REAL	Model coefficient T of branch 3	5/ Configurable	10.0	True	True	No
LPM3	REAL	Model coefficient L of branch 3	5/ Configurable	2.0	True	True	No
KPM4	REAL	Model coefficient K of branch 4	5/ Configurable	1.0	True	True	No
TPM4	REAL	Model coefficient T of branch 4	5/ Configurable	10.0	True	True	No
LPM4	REAL	Model coefficient L of branch 4	5/ Configurable	2.0	True	True	No
KPM5	REAL	Model coefficient K of branch 5	5/ Configurable	1.0	True	True	No
TPM5	REAL	Model coefficient T of branch 5	5/ Configurable	10.0	True	True	No

Table 15.20 Parameter instruction list (continued)

Name	Type	Description	Panel Operation Authority	Default	Upload Parameter	Extend Parameter	Confirm Panel Operation
LPM5	REAL	Model coefficient L of branch 5	5/ Configurable	2.0	True	True	No
KPM6	REAL	Model coefficient K of branch 6	5/ Configurable	1.0	True	True	No
TPM6	REAL	Model coefficient T of branch 6	5/ Configurable	10.0	True	True	No
LPM6	REAL	Model coefficient L of branch 6	5/ Configurable	2.0	True	True	No
KPM7	REAL	Model coefficient K of branch 7	5/ Configurable	1.0	True	True	No
TPM7	REAL	Model coefficient T of branch 7	5/ Configurable	10.0	True	True	No
LPM7	REAL	Model coefficient L of branch 7	5/ Configurable	2.0	True	True	No
KPM8	REAL	Model coefficient K of branch 8	5/ Configurable	1.0	True	True	No
TPM8	REAL	Model coefficient T of branch 8	5/ Configurable	10.0	True	True	No
LPM8	REAL	Model coefficient L of branch 8	5/ Configurable	2.0	True	True	No
PSTEP	REAL	Estimated steps	5/ Configurable	20	True	No	No
TC	UINT	Sampling cycle	5/ Configurable	1.0	True	No	No
LAMD	REAL	adjust parameter by reference of contrail dynamic response velocity [0,1]	5/ Configurable	0.779	True	No	No
Alarm Parameter							

Table 15.20 Parameter instruction list (continued)

Name	Type	Description	Panel Operation Authority	Default	Upload Parameter	Extend Parameter	Confirm Panel Operation
ENALM	UDINT	Alarm Enable	5/ Configurable	0	True	True	No
Configuration Parameter							
FT-TLSCH	REAL	High limit of header pipe flow	0/ Non-configurable	100.0	No	No	No
FTTLS-CL	REAL	Low limit of header pipe flow	0/ Non-configurable	0.0	No	No	No
FPSCH	REAL	High limit of branch flow PV	0/ Non-configurable	100.0	No	No	No
FPSCL	REAL	Low limit of branch flow PV	0/ Non-configurable	0.0	No	No	No
TPSCH	REAL	Branch temperature high limit	0/ Non-configurable	100.0	No	No	No
TPSCL	REAL	Branch temperature low limit	0/ Non-configurable	0.0	No	No	No
TCSSCH	REAL	Temperature in furnace high limit	0/ Non-configurable	100.0	No	No	No
TCSSCL	REAL	Temperature in furnace low limit	0/ Non-configurable	0.0	No	No	No
FTTLEU	EU-TYPE	Unit of header pipe flow	0/ Non-configurable	0	No	No	No
FPEU	EU-TYPE	Unit of branch flow PV	0/ Non-configurable	0	No	No	No
TPEU	EU-TYPE	Branch temperature unit	0/ Non-configurable	0	No	No	No
TCSEU	EU-TYPE	Temperature in furnace unit	0/ Non-configurable	0	No	No	No
FFTLLEN	USINT	Header pipe flow decimal digits [0,5]	0/ Non-configurable	3	No	True	No

Table 15.20 Parameter instruction list (continued)

Name	Type	Description	Panel Operation Authority	Default	Upload Parameter	Extend Parameter	Confirm Panel Operation
FPDLEN	USINT	Branch flow PV decimal digits [0,5]	0/ Non-configurable	3	No	True	No
TPDLEN	USINT	Branch temperature decimal digits [0,5]	0/ Non-configurable	3	No	True	No
TCSDLEN	USINT	Temperature in furnace decimal digits [0,5]	0/ Non-configurable	3	No	True	No
RUN_MODE	USINT	2-branch, 4-branch, 6-branch, 8-branch	0/ Non-configurable	0	No	No	No
MODE_OPT	BOOL	ON= auto back, OFF= manual back	0/ Non-configurable	OFF	No	No	No

15.11.2 Application Illustration


The float abnormal of output values means that the output values are not float format, or a meaningless output value is produced in a calculation that performs a divide-by-zero operation. When float abnormal happened, the function block is processed according to the following rules:

- Output values
 - If there's the normal value of previous period, FPSET outputs the value of previous period.
 - If there's the abnormal value of previous period or no previous period value, FPSET outputs the lower range limit.
- The 10th bit of flag is 1.

15.11.3 Panel Parameter

The function block panel include: branch temperature alarm page, furnace tube surface temperature alarm page, input rate alarm page etc. branch model coefficient page shown as follow.

BALANCE8



NR

MAN

Branch Temperature

Branch1	40.000	Branch2	40.000
Branch3	40.000	Branch4	40.000
Branch5	40.000	Branch6	40.000
Branch7	40.000	Branch8	40.000

Branch Flow Output

Branch1	70.000	Branch2	25.000
Branch3	0.000	Branch4	90.000
Branch5	0.000	Branch6	4.000
Branch7	3.000	Branch8	8.000

Header Pipe Flow

20.000

Set Header Pipe Flow

95.000

Branch Running Status

Preference Branch EI Flow Output Limit Differential Method Parameter

2-b Balance 1 Switching

2-b Balance 2 Switching

2-b Balance 3 Switching

2-b Balance 4 Switching

4-b Balance 1 Switching

4-b Balance 2

6-b Balance

8-b Balance

Non-debug mode

Temperature Deviation Dead Zone:

0.000

Temperature in Tube

Branch1	80.000	Branch2	80.000
Branch3	80.000	Branch4	80.000
Branch5	80.000	Branch6	80.000
Branch7	80.000	Branch8	80.000

Branch Flow Value

Branch1	5.000	Branch2	5.000
Branch3	5.000	Branch4	9.000
Branch5	5.000	Branch6	0.000
Branch7	0.000	Branch8	0.000

Balance Mode

☒ 2-b Balance

☐ 4-b Balance

☐ 6-b Balance

☐ 8-b Balance

Control Mode

☒ Differential

☐ Model

☐ Average

Positive/Negative

☒ Positive

☐ Negative

Troubleshooting

☒ Only Influence Fault Branch

☐ All Branches Exit Switching

Restore Fault

☐ Auto Back

☒ Manual Back

BALANCE8



NR

MAN

Branch Temperature

Branch1	40.000	Branch2	40.000
Branch3	40.000	Branch4	40.000
Branch5	40.000	Branch6	40.000
Branch7	40.000	Branch8	40.000

Branch Flow Output

Branch1	70.000	Branch2	25.000
Branch3	0.000	Branch4	90.000
Branch5	0.000	Branch6	4.000
Branch7	3.000	Branch8	8.000

Header Pipe Flow

20.000

Set Header Pipe Flow

95.000

Branch Running Status

Preference Branch EI Flow Output Limit Differential Method Parameter

2-b Balance 1

Flow EI Limit

100.000

Max Deviation

0.000

Temperature EI Limit

100.000

Max Deviation

0.000

2-b Balance 2

Flow EI Limit

100.000

Max Deviation

-4.000

Temperature EI Limit

100.000

Max Deviation

0.000

2-b Balance 3

Flow EI Limit

100.000

Max Deviation

5.000

Temperature EI Limit

100.000

Max Deviation

0.000

2-b Balance 4

Flow EI Limit

100.000

Max Deviation

0.000

Temperature EI Limit

100.000

Max Deviation

0.000

4-branch Balance 1

Flow EI Limit

100.000

Max Deviation

100.000

Temperature EI Limit

100.000

Max Deviation

100.000

4-branch Balance 2

Flow EI Limit

100.000

Max Deviation

100.000

Temperature EI Limit

100.000

Max Deviation

100.000

8(6)-b Balance

Flow EI Limit

100.000

Max Deviation

100.000

Temperature EI Limit

100.000

Max Deviation

100.000

BALANCE8

NR

MAN

Branch Temperature

Branch1	40.000	Branch2	40.000
Branch3	40.000	Branch4	40.000
Branch5	40.000	Branch6	40.000
Branch7	40.000	Branch8	40.000

Branch Flow Output

Branch1	70.000	Branch2	25.000
Branch3	0.000	Branch4	90.000
Branch5	0.000	Branch6	4.000
Branch7	3.000	Branch8	8.000

Header Pipe Flow

20.000

Set Header Pipe Flow

95.000

Branch Running Status

Preference Branch EI Flow Output Limit Differential Method Parameter

H

Branch1	100.000
Branch2	100.000
Branch3	100.000
Branch4	100.000
Branch5	100.000
Branch6	100.000
Branch7	100.000
Branch8	100.000

Velocity Limit

Branch1	100.000
Branch2	100.000
Branch3	100.000
Branch4	100.000
Branch5	100.000
Branch6	100.000
Branch7	100.000
Branch8	100.000

L

Branch1	0.000
Branch2	0.000
Branch3	0.000
Branch4	0.000
Branch5	0.000
Branch6	0.000
Branch7	0.000
Branch8	0.000

BALANCE8

NR

MAN

Branch Temperature

Branch1	40.000	Branch2	40.000
Branch3	40.000	Branch4	40.000
Branch5	40.000	Branch6	40.000
Branch7	40.000	Branch8	40.000

Branch Flow Output

Branch1	70.000	Branch2	25.000
Branch3	0.000	Branch4	90.000
Branch5	0.000	Branch6	4.000
Branch7	3.000	Branch8	8.000

Header Pipe Flow

20.000

Set Header Pipe Flow

95.000

Branch Running Status

Preference Branch EI Flow Output Limit Differential Method Parameter

2-b Balance 1

Output H Limit	100.000
Output L Limit	-100.000
K1	100.00
K2	0.50
K3	20.0

2-b Balance 2

Output H Limit	100.000
Output L Limit	-100.000
K1	100.00
K2	0.50
K3	20.0

2-b Balance 3

Output H Limit	100.000
Output L Limit	-100.000
K1	100.00
K2	0.50
K3	20.0

2-b Balance 4

Output H Limit	100.000
Output L Limit	-100.000
K1	100.00
K2	0.50
K3	20.0

4-b Balance 1

Output H Limit	100.000
Output L Limit	-100.000
K1	100.00
K2	0.50
K3	20.0

4-b Balance 2

Output H Limit	100.000
Output L Limit	-100.000
K1	100.00
K2	0.50
K3	20.0

8(6)-b Balance

Output H Limit	100.000
Output L Limit	-100.000
K1	100.00
K2	0.50
K3	20.0

BALANCE8

NR

MAN

Branch Temperature

Branch1	40.000	Branch2	40.000
Branch3	40.000	Branch4	40.000
Branch5	40.000	Branch6	40.000
Branch7	40.000	Branch8	40.000

Branch Flow Output

Branch1	70.000	Branch2	25.000
Branch3	0.000	Branch4	90.000
Branch5	0.000	Branch6	4.000
Branch7	3.000	Branch8	8.000

Header Pipe Flow

Set Header Pipe Flow

Branch Running Status

Differential Method Parameter

Branch Model Parameter

Average Parameter

K

Branch1	1.00
Branch2	1.00
Branch3	1.00
Branch4	1.00
Branch5	1.00
Branch6	1.00
Branch7	1.00
Branch8	1.00

T(s)

Branch1	10.0
Branch2	10.0
Branch3	10.0
Branch4	10.0
Branch5	10.0
Branch6	10.0
Branch7	10.0
Branch8	10.0

L(s)

Branch1	2.0
Branch2	2.0
Branch3	2.0
Branch4	2.0
Branch5	2.0
Branch6	2.0
Branch7	2.0
Branch8	2.0

Estimated Parameter Settings

Estimated Steps

Sampling Cycle

Debug Parameter

BALANCE8

NR

MAN

Branch Temperature

Branch1	40.000	Branch2	40.000
Branch3	40.000	Branch4	40.000
Branch5	40.000	Branch6	40.000
Branch7	40.000	Branch8	40.000

Branch Flow Output

Branch1	70.000	Branch2	25.000
Branch3	0.000	Branch4	90.000
Branch5	0.000	Branch6	4.000
Branch7	3.000	Branch8	8.000

Header Pipe Flow

Set Header Pipe Flow

Branch Running Status

Branch Model Parameter

Average Parameter

Feed Forward Parameter

P(%)

Branch1	100.00
Branch2	100.00
Branch3	100.00
Branch4	100.00
Branch5	100.00
Branch6	100.00
Branch7	100.00
Branch8	100.00

I(s)

Branch1	20.0
Branch2	20.0
Branch3	20.0
Branch4	20.0
Branch5	20.0
Branch6	20.0
Branch7	20.0
Branch8	20.0

D(s)

Branch1	0.0
Branch2	0.0
Branch3	0.0
Branch4	0.0
Branch5	0.0
Branch6	0.0
Branch7	0.0
Branch8	0.0

Output Balance

☒ Not Balance

☐ Balance

BALANCE8

NR

MAN

Branch Temperature

Branch1	40.000	Branch2	40.000
Branch3	40.000	Branch4	40.000
Branch5	40.000	Branch6	40.000
Branch7	40.000	Branch8	40.000

Branch Flow Output

Branch1	70.000	Branch2	25.000
Branch3	0.000	Branch4	90.000
Branch5	0.000	Branch6	
Branch7	3.000	Branch8	8.000

Header Pipe Flow: 20.000

Set Header Pipe Flow: 95.000

Branch Running Status

Branch Model Parameter

P(%)

Branch1	100.00
Branch2	100.00
Branch3	100.00
Branch4	100.00
Branch5	100.00
Branch6	100.00
Branch7	100.00
Branch8	100.00

I(s)

Branch1	20.0
Branch2	20.0
Branch3	20.0
Branch4	20.0
Branch5	20.0
Branch6	20.0
Branch7	20.0
Branch8	20.0

D(s)

Branch1	0.0
Branch2	0.0
Branch3	0.0
Branch4	0.0
Branch5	0.0
Branch6	0.0
Branch7	0.0
Branch8	0.0

Feed Forward Parameter

Feedforward Enable

☒ Disable

☐ Enable

Table 15.21 Panel parameter instruction of BALANCE8

Panel Parameter		Function Block Parameter	Initial Value	Range	Application
Major panel	Branch temperature, branches 1~8	TPASS1 ~ 8	0.0	[TPSCL,TPSCH]	Branch temperature is overlimit, shown as red.
	Branch flow output, branches 1~8	FPSET1 ~ 8	0.0	[FTTLSCL, FT-TLSCH]	If branch BKINERR= ON, the frame is red.
	Header pipe flow	FTTL	0.000	[FTTLSCL, FT-TLSCH]	If header pipe flow PV has fault, the frame is red.
	Set header pipe flow	FTTLSET	0.000	[FTTLSCL, FT-TLSCH]	Read-only, can be set in configuration or program.
Preference	Temperature deviation dead zone	TPS_DB	0.0		-
	Temperature in furnace, branches 1~8	TCS1 ~ 8	0.0		If the temperature fault is ON, the frame is red. Fault parameter corresponding to TCS1 is TCSERR1, others are in the same way.
	Branch flow PV, branches 1~8	FPASS1 ~ FPASS8	0.000	[FPSCL,FPSCH]	-

Table 15.21 Panel parameter instruction of BALANCE8 (continued)

Panel Parameter			Function Block Parameter	Initial Value	Range	Application
	Balance mode		RUN_-MODE	0	-	-
	Control mode		SWMODE	0	-	-
	Positive and negative action		SWPN	OFF	-	-
	Troubleshooting		SWFAIL	OFF	-	-
	Restore fault		MODE_-OPT	OFF	-	-
Branch EI	2-branch balance 1	Flow deviation limit	FERLMT21	100.000	[FPSCL,FPSCH]	Parameter SV of flow deviation limit
		Maximum deviation	FMAX-ER21	0.000	[FPSCL,FPSCH]	Read-only, can be set in configuration or program.
		Temperature deviation limit	TERLMT21	100.000	[TPSCL,TPSCH]	Parameter SV of temperature deviation limit
		Maximum deviation	TMAX-ER21	0.000	[TPSCL,TPSCH]	Read-only, can be set in configuration or program.
	2-branch balance 2	Flow deviation limit	FERLMT22	100.000	[FPSCL,FPSCH]	Parameter SV of flow deviation limit
		Maximum deviation	FMAX-ER22	0.000	[FPSCL,FPSCH]	Read-only, can be set in configuration or program.
		Temperature deviation limit	TERLMT22	100.000	[TPSCL,TPSCH]	Parameter SV of temperature deviation limit
		Maximum	TMAX-ER22	0.000	[TPSCL,TPSCH]	Read-only, can be set in configuration or program.

Table 15.21 Panel parameter instruction of BALANCE8 (continued)

Panel Parameter			Function Block Parameter	Initial Value	Range	Application
	2-branch balance 3	deviation				
		Flow deviation limit	FERLMT23	100.000	[FPSCL,FPSCH]	Parameter SV of flow deviation limit
		Maximum deviation	FMAX-ER23	0.000	[FPSCL,FPSCH]	Read-only, can be set in configuration or program.
		Temperature deviation limit	TERLMT23	100.000	[TPSCL,TPSCH]	Parameter SV of temperature deviation limit
		Maximum deviation	TMAX-ER23	0.000	[TPSCL,TPSCH]	Read-only, can be set in configuration or program.
	2-branch balance 4	Flow deviation limit	FERLMT24	100.000	[FPSCL,FPSCH]	Parameter SV of flow deviation limit
		Maximum deviation	FMAX-ER24	0.000	[FPSCL,FPSCH]	Read-only, can be set in configuration or program.
		Temperature deviation limit	TERLMT24	100.000	[TPSCL,TPSCH]	Parameter SV of temperature deviation limit
		Maximum deviation	TMAX-ER24	0.000	[TPSCL,TPSCH]	Read-only, can be set in configuration or program.
	4-branch balance 1	Flow deviation limit	FERLMT41	100.000	[FPSCL,FPSCH]	Parameter SV of flow deviation limit
		Maximum deviation	FMAX-ER41	0.000	[FPSCL,FPSCH]	Read-only, can be set in configuration or program.

Table 15.21 Panel parameter instruction of BALANCE8 (continued)

Panel Parameter			Function Block Parameter	Initial Value	Range	Application
		Temperature deviation limit	TERLMT41	100.000	[TPSCL,TPSCH]	Parameter SV of temperature deviation limit
		Maximum deviation	TMAX-ER41	0.000	[TPSCL,TPSCH]	Read-only, can be set in configuration or program.
	4-branch balance 2	Flow deviation limit	FERLMT42	100.000	[FPSCL,FPSCH]	Parameter SV of flow deviation limit
		Maximum deviation	FMAX-ER42	0.000	[FPSCL,FPSCH]	Read-only, can be set in configuration or program.
		Temperature deviation limit	TERLMT42	100.000	[TPSCL,TPSCH]	Parameter SV of temperature deviation limit
		Maximum deviation	TMAX-ER42	0.000	[TPSCL,TPSCH]	Read-only, can be set in configuration or program.
	8-branch balance/ 6-branch balance	Flow deviation limit	FERLMT8	100.000	[FPSCL,FPSCH]	Parameter SV of flow deviation limit
		Maximum deviation	FMAXER8	0.000	[FPSCL,FPSCH]	Read-only, can be set in configuration or program.
		Temperature deviation limit	TERLMT8	100.000	[TPSCL,TPSCH]	Parameter SV of temperature deviation limit
		Maximum deviation	TMAXER8	0.000	[TPSCL,TPSCH]	Read-only, can be set in configuration or program.

Table 15.21 Panel parameter instruction of BALANCE8 (continued)

Panel Parameter			Function Block Parameter	Initial Value	Range	Application
Flow output limit	High limit	Branches 1~8	FPSETL1 ~ 8	100.0	-	-
	Low limit	Branches 1~8	FPSETL1 ~ 8	0.0	-	-
	Rate limit	Branches 1~8	FPSETVL1 ~ 8	100.0	-	-
Differential method coefficient	2-branch balance 1~4	Output high limit	HLMT21 ~ HLMT24	100.0	-	-
		Output low limit	LLMT21 ~ LLMT24	-100.0	-	-
		K1	K211 ~ K241	100.0	-	-
		K2	K212 ~ K242	0.5	-	-
		K3	K213 ~ K243	20.0	-	-
	4-branch balance 1~2	Output high limit	HLMT41 ~ HLMT42	100.0	-	-
		Output low limit	LLMT41 ~ LLMT42	-100.0	-	-
		K1	K411 ~ K421	100.0	-	-
		K2	K412 ~ K422	0.5	-	-
		K3	K413 ~ K423	20.0	-	-
	2-branch balance	Output high limit	HLMT8	100.0	-	-
		Output low limit	LLMT8	-100.0	-	-
		K1	K81	100.0	-	-
		K2	K82	0.5	-	-

Table 15.21 Panel parameter instruction of BALANCE8 (continued)

Panel Parameter			Function Block Parameter	Initial Value	Range	Application
		K3	K83	20.0	-	-
Branch model coefficient	K	Branch 1~ branch 8	KPM1 ~ KPM8	1.0	-	-
	T	Branch 1~ branch 8	TPM1 ~ TPM8	10.0	-	-
	L	Branch 1~ branch 8	LPM1 ~ LPM8	2.0	-	-
	Estimated parameter settings	Estimated steps	PSTEP	20	-	-
		Sampling cycle	TC	1.0	-	-
		Adjusting parameter	LAMD	0.779		
Average method parameter	P(%)	Branch 1~ branch 8	PB_ - AVE1 ~ PB_AVE8	100.0	-	-
	I(s)	Branch 1~ branch 8	TI_ - AVE1 ~ TI_ - AVE8	20.0	-	-
	D(s)	Branch 1~ branch 8	TD_ - AVE1 ~ TD_ - AVE8	0.0	-	-
	Output balance		SWA-MEND	OFF	-	OFF= output non-balance ON= output balance
Feed-forward parameter	P(%)	Branch 1~ branch 8	PB_FF1 ~ PB_FF8	100.0	-	-
	I(s)	Branch 1~ branch 8	TI_F- F1 ~ TI_ - FF8	20.0	-	-

Table 15.21 Panel parameter instruction of BALANCE8 (continued)

Panel Parameter			Function Block Parameter	Initial Value	Range	Application
	D(s)	Branch 1~branch 8	TD_F-F1~TD_FF8	0.0	-	-
	Output balance		SWFF	OFF	-	OFF= output non-balance ON= output balance

15.11.4 Function Block Flag Code

Table 15.22 Flag list

Flag	Alarm	Instruction
D0	OOS	Disable
D1	IMAN	Initialize Manually
D2	MAN	Manual
D4	AUTO	Auto
D5	CAS	Cascade
D6	FF	Feed Forward Status
D8	AOF	Suppress Alarm
D16	REVSCL	Float Abnormal

15.11.5 HMI Parameters

Table 15.23 HMI parameter list

Parameter	Instruction	Properties
FLAG	Flag	Read-only, default reference parameter of the function block
OOS	Function block forbidden mark	Read/write
AOF	Module alarm shield	Read/write
IMAN	IMAN status	Read-only
AUTO	Automatic status	Read/write
CAS	Cascade status	Read/write

15.11.6 Define branch running status (RUN_STAT)

Bit Offset	Instruction
D0	2-branch in operation
D1	4-branch in operation
D2	6-branch in operation
D3	8-branch in operation
D4	Temperature difference between branch 1 and branch 2
D5	Flow difference between branch 1 and branch 2
D6	Temperature difference between branch 3 and branch 4
D7	Flow difference between branch 3 and branch 4
D8	Temperature difference between branch 5 and branch 6
D9	Flow difference between branch 5 and branch 6
D10	Temperature difference between branch 7 and branch 8
D11	Flow difference between branch 7 and branch 8
D12	Temperature difference of branches 1~4
D13	Flow difference of branches 1~ 4
D14	Temperature difference of branches 5~ 8
D15	Flow difference of branches 5~ 8
D16	Temperature difference of branches 1~6
D17	Flow difference of branches 1~6
D18	Temperature difference of branches 1~8
D19	Flow difference of branches 1~8

15.11.7 Define Branch Mode (RUN_MODE)

RUN_MODE= 0, branch 1and branch 2 perform balance operation. RUN_MODE= 1, branches 1~4 perform balance operation. RUN_MODE= 2, branches 1~6 perform balance operation. RUN_MODE= 3, branches 1~8 perform balance operation.
Perform balance operation according to branches in operation currently.

15.11.8 Switch Mode

OOS

useless.

IMAN

trace change of downstream block.

- When RUN_MODE= 0, if all BKINERR= ON for branch 1 and branch 2, enter into IMAN status.
- When RUN_MODE= 1, if all BKINERR= ON for branches 1~4, enter into IMAN status.
- When RUN_MODE= 2, if all BKINERR= ON for branches 1~6, enter into IMAN status.
- When RUN_MODE= 3, if all BKINERR= ON for branches 1~ 8, enter into IMAN status.
 - If MODE_OPT= auto back, SWAM and SWSV keep the same.
 - If MODE_OPT= manual back, SWAM= OFF, SWSV= OFF.

MAN (manual):

- If MODE_OPT= auto back
- If SWFAIL= OFF
 - SWAM=ON

When RUN_MODE= 0, if a BKINERR || TPS_ERR=ON or all TPS_ERR= ON for branch 1 and branch 2, enter into MAN status, not perform balance control.

When RUN_MODE= 1, if 3 BKINERR || TPS_ERR= ON or all TPS_ERR= ON for branches 1~4, enter into MAN status.

When RUN_MODE= 2, if 5 BKINERR || TPS_ERR= ON or all TPS_ERR= ON for branches 1~6, enter into MAN status.

When RUN_MODE= 3, if 7 BKINERR || TPS_ERR= ON or all TPS_ERR= ON for branches 1~8, enter into MAN status.
 - SWAM= OFF

When RUN_MODE= 0, if at least 1 BKINERR= OFF for branch 1 and branch 2, enter into MAN status.

When RUN_MODE= 1, if at least 1 BKINERR= OFF for branches 1~4, enter into MAN status.

When RUN_MODE= 2, if at least 1 BKINERR= OFF for branches 1~6, enter into MAN status.

When RUN_MODE= 3, if at least 1 BKINERR= OFF for branches 1~ 8, enter into MAN status.
- If SWFAIL= ON

- SWAM= ON
If a channel temperature measurement has fault or BKINERR= ON, enter into MAN status, not perform balance control.
- SWAM= OFF
When RUN_MODE= 0, if at least 1 BKINERR= OFF for branch 1 and branch 2, enter into MAN status.
When RUN_MODE= 1, if at least 1 BKINERR= OFF for branches 1~4, enter into MAN status.
When RUN_MODE= 2, if at least 1 BKINERR= OFF for branches 1~6, enter into MAN status.
When RUN_MODE= 3, if at least 1 BKINERR= OFF for branches 1~ 8, enter into MAN status.
In manual status, not modify SWAM and SWSV values automatically.
- If MODE_OPT= auto back
In manual status, SWAM= OFF , SWSV= OFF.
When SWAM turn from ON to OFF, none branch will switch. In non-debugging mode, none branch will perform balance control.
In debugging mode, single branch can be switched in manual mode.

AUTO (automatic)

- SWAM= ON, SWSV= OFF
 - If SWFAIL= OFF
When RUN_MODE= 0
If no BKINERR || TPS_ERR=ON for branch 1 and branch 2, enter into AUTO mode, and perform 2-branch balance control.
When RUN_MODE= 1
If 2 BKINERR || TPS_ERR=ON for branches 1~4, enter into AUTO mode, perform balance control for 2 branches. If one MON BKINERR || TPS_ERR=ON for branches 1~4, enter into AUTO mode, perform balance control for 3 branches. If no BKINERR || TPS_ERR=ON, perform 4-branch balance control.
When RUN_MODE= 2
If 4 BKINERR || TPS_ERR=ON for branches 1~ 6, enter into AUTO mode, perform balance control for 2 branches. If 3 MON BKINERR || TPS_ERR=ON for branches 1~6, enter into AUTO mode, perform balance control for 3 branches. If 2 BKINERR || TPS_ERR=ON for branches 1~6, enter into AUTO mode, perform balance control for 4 branches. If 1 BKINERR || TPS_ERR=ON for branches 1~6, enter into AUTO mode,

perform balance control for 5 branches. If no BKINERR || TPS_ERR=ON for branches 1~6, enter into AUTO mode, perform 6-branch balance control.

When RUN_MODE= 3

If 6 BKINERR || TPS_ERR=ON for branches 1~8, enter into AUTO mode, perform balance control for 2 branches. If 5 MON BKINERR || TPS_ERR=ON for branches 1~8, enter into AUTO mode, perform balance control for 3 branches. If 4 BKINERR || TPS_ERR=ON for branches 1~8, enter into AUTO mode, perform balance control for 4 branches. If 3 BKINERR || TPS_ERR=ON for branches 1~8, enter into AUTO mode, perform balance control for 5 branches. If 2 BKINERR || TPS_ERR=ON for branches 1~8, enter into AUTO mode, perform balance control for 6 branches. If 1 BKINERR || TPS_ERR=ON for branches 1~8, enter into AUTO mode, perform balance control for 7 branches. If no BKINERR || TPS_ERR=ON for branches 1~8, enter into AUTO mode, perform 8-branch balance control.

- If SWFAIL= ON
 - a channel temperature measurement has fault or BKINERR= ON, enter into MAN status, not perform balance control.
- SWAM= ON, SWSV= ON
 - If SWFAIL= OFF
 - When RUN_MODE= 0
 - If no BKINERR || TPS_ERR=ON for branch 1 and branch 2, enter into AUTO mode, and perform 2-branch balance control.
 - When RUN_MODE= 1
 - If 2 BKINERR || TPS_ERR=ON for branches 1~4, enter into AUTO mode, perform balance control for 2 branches. If one MON BKINERR || TPS_ERR=ON for branches 1~4, enter into AUTO mode, perform balance control for 3 branches. If no BKINERR || TPS_ERR=ON, perform 4-branch balance control.
 - When RUN_MODE= 2
 - If 4 BKINERR || TPS_ERR=ON for branches 1~6, enter into AUTO mode, perform balance control for 2 branches. If 3 MON BKINERR || TPS_ERR=ON for branches 1~6, enter into AUTO mode, perform balance control for 3 branches. If 2 BKINERR || TPS_ERR=ON for branches 1~6, enter into AUTO mode, perform balance control for 4 branches. If 1 BKINERR || TPS_ERR=ON for branches 1~6, enter into AUTO mode, perform balance control for 5 branches. If no BKINERR || TPS_ERR=ON for branches 1~6, enter into AUTO mode, perform 6-branch balance control.
 - When RUN_MODE= 3
 - If 6 BKINERR || TPS_ERR=ON for branches 1~8, enter into AUTO mode, perform balance control for 2 branches. If 5 MON BKINERR || TPS_ERR=ON for branches 1~8, enter into AUTO mode, perform balance control for 3 branches. If 4 BKINERR ||

TPS_ERR=ON for branches 1~8, enter into AUTO mode, perform balance control for 4 branches. If 3 BKINERR || TPS_ERR=ON for branches 1~8, enter into AUTO mode, perform balance control for 5 branches. If 2 BKINERR || TPS_ERR=ON for branches 1~8, enter into AUTO mode, perform balance control for 6 branches. If 1 BKINERR || TPS_ERR=ON for branches 1~8, enter into AUTO mode, perform balance control for 7 branches. If no BKINERR || TPS_ERR=ON for branches 1~8, enter into AUTO mode, perform 8-branch balance control.

- If SWFAIL= ON
a channel temperature measurement has fault or BKINERR= ON, enter into MAN status, not perform balance control.
- If MODE_OPT= manual back
SWSV= OFF.
- If MODE_OPT= auto back
not modify SWSV value automatically.

CAS: cascade

Compare header pipe flow and set flow, assign operation results to output values according to each branch flow.

When RUN_MODE= 0, if any loop BKINERR= ON for branch 1 and branch 2, or exit cascade status if branch temperature PV has fault, enter into MAN status.

- If SWFAIL=OFF:

When RUN_MODE= 1, if any loop BKINERR= ON for branches 1~4, or exit cascade status if branch temperature PV has fault, enter into AUTO status.

When RUN_MODE= 2, if any loop BKINERR= ON for branches 1~6, or exit cascade status if branch temperature PV has fault, enter into AUTO status.

When RUN_MODE= 3, if any loop BKINERR= ON for branches 1~8, or exit cascade status if branch temperature PV has fault, enter into AUTO status.
- If SWFAIL=ON:

When RUN_MODE= 1, if any loop BKINERR= ON for branches 1~4, or exit cascade status if branch temperature PV has fault, enter into MAN status.

When RUN_MODE= 2, if any loop BKINERR= ON for branches 1~6, or exit cascade status if branch temperature PV has fault, enter into MAN status.

When RUN_MODE= 3, if any loop BKINERR= ON for branches 1~8, or exit cascade status if branch temperature PV has fault, enter into MAN status.

FF: feed forward

When feed forward, control temperature in furnace. If temperature in furnace has fault, cut the feed forward of that channel. Feed forward applies present PD control algorithm of proportion differential.

15.11.9 Algorithm

Differential method

In differential method, 2 branches form a pair, 4 branches form a group and 8 branches form a set.

- 2-branch balance

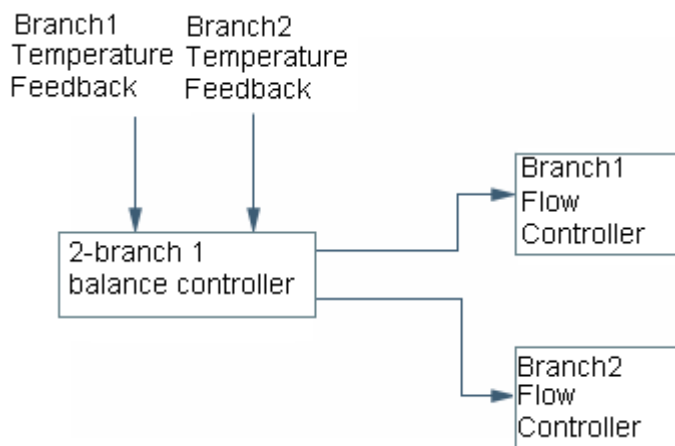


Figure 15.20 Schematic diagram 1

2-branch balance controls branch flow by PD controller. To PD controller, temperature feedback of branch 1 is the set value (SV), temperature feedback of branch 2 is process value (PV), and $EI = PV - SV$.

2-branch output 1 = $BKIN1 + PD \text{ controller output}$,

2-branch output 2 = $BKIN2 - PD \text{ controller output}$.

If temperature feedback of branch 1 is greater than that of branch 2, then EI is less than 0. Accordingly PD controller output is also less than 0, so that 2- branch output 1 will decrease and 2- branch output 2 will increase. Thus two branches will finally reach balance. And vice versa.

- 4- branch balance

4-branch balance controls branch flow by PD controller based on two 2-branch balances.

To 4-branch balance controller, $SV = (\text{temperature feedback of branch 1} + \text{temperature feedback of branch 2})/2$, $PV = (\text{temperature feedback of branch 3} + \text{temperature feedback of branch 4})/2$, and $EI = PV - SV$.

4-branch balance output = PD controller output.

2-branch balance 1 output 1 = BKIN1 + 2-branch 1 PD controller output + 4-branch balance output *K212,

2-branch balance 1 output 2 = BKIN2 - 2-branch 1 PD controller output + 4-branch balance output *(1-K212),

2-branch balance 2 output 1 = BKIN3 + 2-branch 2 PD controller output - 4-branch balance output *K222,

2-branch balance 2 output 2 = BKIN4 - 2-branch 2 PD controller output - 4-branch balance output *(1-K222).

If (temperature feedback of branch 1 + temperature feedback of branch 2) > (temperature feedback of branch 3 + temperature feedback of branch 4), then 4-branch output < 0.

Thereby, 2-branch output 1 and 2 decrease, and 2-branch output 3 and 4 increase.

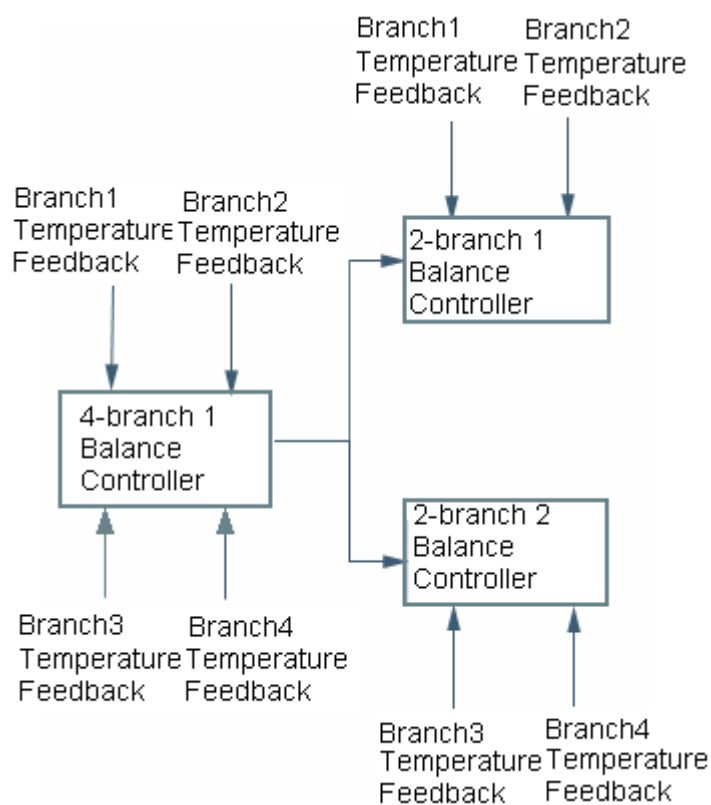


Figure 15.21 Schematic diagram 2

If any of the 4 branches has fault, enter into 3-branch balance.

For example, branch 1 fault

Balance controller takes branch 2 temperature feedback as SV, takes (branch 3 temperature feedback + branch 4 temperature feedback) / 2 as PV, deviation = PV - SV.

4-branch balance output = PD controller output.

2-branch balance 1 output 1 = BKIN1

2-branch balance 1 Output 2 = BKIN2 - 2-branch 1 PD controller output + 4-branch balance output.

2-branch balance 2 Output 1= BKIN3+ 2-branch 2PD controller output- 4-branch balance output* K222.

2-branch balance 2 Output 2= BKIN4- 2-branch 2PD controller output- 4-branch balance output* (1- K222).

If any 2 of the 4 branches have fault, enter into 2-branch balance mode.

- 6-branch balance

6-branch balance applies PD controller to perform 6-branch flow balance control. 6-branch balance controller takes (branch 1 temperature feedback+ branch 2 temperature feedback + branch 3 temperature feedback+ branch 4 temperature feedback)/ 4 as SV, takes (branch 5 temperature feedback+ branch 6 temperature feedback)/ 2 as PV, deviation= PV- SV.

6-branch balance output= PD controller output.

2-branch balance 1 output 1

= BKIN1+ 2-branch 1PD controller output+ 4-branch balance 1 output* K212+ 8-branch balance output* K412,

2-branch balance 1 Output 2

= BKIN2- 2-branch 1PD controller output+ 4-branch balance 1 output* (1-K212)+ 8-branch balance output* K412,

2-branch balance 2 output 1

= BKIN3+ 2-branch 2PD controller output- 4-branch balance 1 output* K222+ 8-branch balance output* (1-K412),

2-branch balance 2 Output 2

= BKIN4- 2-branch 2PD controller output- 4-branch balance 1 output* (1- K222)+ 8-branch balance output* (1-K412),

2-branch balance 3 output 1

= BKIN5+ 2-branch 3PD controller output+ 4-branch balance 2 output* K232 8-branch balance output* K422,

2-branch balance 3 Output 2

= BKIN6- 2-branch 3PD controller output+ 4-branch balance 2 output* (1-K232)- 8-branch balance output* K422,

If (branch 1 temperature feedback+ branch 2 temperature feedback+ branch 3 temperature feedback+ branch 4 temperature feedback)/4 > (branch 5 temperature feedback+ branch 6 temperature feedback)/ 2, 6-branch balance output will be less than 0, and 2-branch output 1, 2-branch output2, 2-branch output 3 and 2-branch output 4 will be decreased, while 2-branch output 5 and 2-branch output 6 will be added.

- 8-branch balance

8-branch balance controls branch flow by PD controller. To 8-branch balance controller, SV = (temperature feedback of branch 1 + temperature feedback of branch 2 + temperature feedback of branch 3 + temperature feedback of branch 4)/4, PV = (temperature feedback

of branch 5 + temperature feedback of branch 6 + temperature feedback of branch 7 + temperature feedback of branch 8)/4, and $EI = PV - SV$.

8-branch balance output = PD controller output.

2-branch balance 1 output 1 = $BKIN1 + 2\text{-branch 1 PD controller output} + 4\text{-branch balance 1 output} / 2 + 8\text{-branch balance output} / 4$,

2-branch balance 1 output 2 = $BKIN2 - 2\text{-branch 1 PD controller output} + 4\text{-branch balance 1 output} / 2 + 8\text{-branch balance output} / 4$,

2-branch balance 2 output 1 = $BKIN3 + 2\text{-branch 2 PD controller output} - 4\text{-branch balance 1 output} / 2 + 8\text{-branch balance output} / 4$,

2-branch balance 2 output 2 = $BKIN4 - 2\text{-branch 2 PD controller output} - 4\text{-branch balance 1 output} / 2 + 8\text{-branch balance output} / 4$,

2-branch balance 3 output 1 = $BKIN5 + 2\text{-branch 3 PD controller output} + 4\text{-branch balance 2 output} / 2 - 8\text{-branch balance output} / 4$,

2-branch balance 3 output 2 = $BKIN6 - 2\text{-branch 3 PD controller output} + 4\text{-branch balance 2 output} / 2 - 8\text{-branch balance output} / 4$,

2-branch balance 4 output 1 = $BKIN7 + 2\text{-branch 4 PD controller output} - 4\text{-branch balance 2 output} / 2 - 8\text{-branch balance output} / 4$,

2-branch balance 4 output 2 = $BKIN8 - 2\text{-branch 4 PD controller output} - 4\text{-branch balance 2 output} / 2 - 8\text{-branch balance output} / 4$,

If (temperature feedback of branch 1 + temperature feedback of branch 2 + temperature feedback of branch 3 + temperature feedback of branch 4) > (temperature feedback of branch 5 + temperature feedback of branch 6 + temperature feedback of branch 7 +

temperature feedback of branch 8), then 8-branch output < 0 . Thereby, 2-branch output 1, 2, 3 and 4 decrease, and 2-branch output 5, 6, 7 and 8 increase.

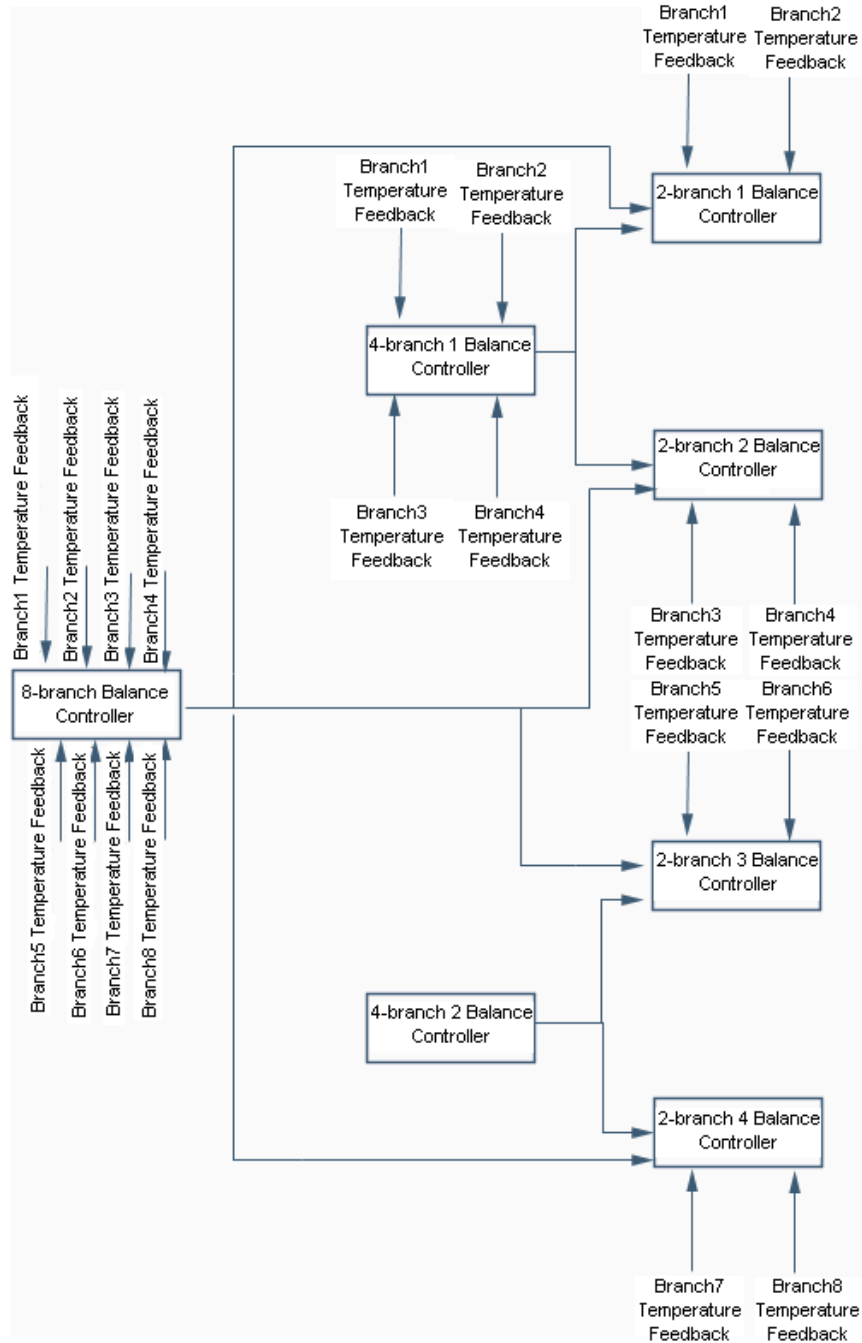


Figure 15.22 Schematic diagram 3

Model method

- If 8-branch balance, 4-branch balance 1 and 2 are all switched

$$SV = \frac{\sum_{i=1}^8 \text{branch flow process value } i * \text{branch temperature } i * ki}{\sum_{i=1}^8 \text{branch flow process value } i * ki}$$

- Model controller

Each branch is approximated as first-order pure time lag by model controller and the object model is as follows.

$$G_p(s) = \frac{K_e^{-Ls}}{1+T_s s}$$

Average Method

- 2-branch balance

SV= (branch 1 temperature feedback+ branch 2 temperature feedback)/ 2.

MV1= PID (SV- branch 1 temperature feedback).

MV2= PID (SV- branch 2 temperature feedback).

When branch 1 temperature feedback is larger than branch 2 temperature feedback, if SV is less than branch 1 temperature feedback, branch 1 output is decreased, if SV is larger than branch 2 temperature feedback, branch 2 output will be added, vice versa.

- 4-branch balance

SV= (branch 1 temperature feedback+ branch 2 temperature feedback +branch 3 temperature feedback+ branch 4 temperature feedback)/ 4.

MV1= PID (SV- branch 1 temperature feedback).

MV2= PID (SV- branch 2 temperature feedback).

MV3= PID (SV- branch 3 temperature feedback).

MV4= PID (SV- branch 4 temperature feedback).

- 6-branch balance

SV= (branch 1 temperature feedback+ branch 2 temperature feedback+ branch 3 temperature feedback+ branch 4 temperature feedback+ branch 5 temperature feedback+ branch 6 temperature feedback)/ 6.

MV1= PID (SV- branch 1 temperature feedback).

MV2= PID (SV- branch 2 temperature feedback).

MV3= PID (SV- branch 3 temperature feedback).

MV4 = PID (SV- branch 4 temperature feedback).

MV5= PID (SV- branch 5 temperature feedback).

MV6= PID (SV- branch 6 temperature feedback).

- 8-branch balance

$SV = (\text{branch 1 temperature feedback} + \text{branch 2 temperature feedback} + \text{branch 3 temperature feedback} + \text{branch 4 temperature feedback} + \text{branch 5 temperature feedback} + \text{branch 6 temperature feedback} + \text{branch 7 temperature feedback} + \text{branch 8 temperature feedback}) / 8$.

$MV1 = \text{PID}(SV - \text{branch 1 temperature feedback})$.

$MV2 = \text{PID}(SV - \text{branch 2 temperature feedback})$.

$MV3 = \text{PID}(SV - \text{branch 3 temperature feedback})$.

$MV4 = \text{PID}(SV - \text{branch 4 temperature feedback})$.

$MV5 = \text{PID}(SV - \text{branch 5 temperature feedback})$.

$MV6 = \text{PID}(SV - \text{branch 6 temperature feedback})$.

$MV7 = \text{PID}(SV - \text{branch 5 temperature feedback})$.

$MV8 = \text{PID}(SV - \text{branch 6 temperature feedback})$.

- Output balance process
 - $SWAMEND = \text{OFF}$, output non-balance
 - $FPSET1 = MV1$
 - ...
 - $FPSET8 = MV8$
 Different PID parameters set by each branch will lead to change of branch flow SV feedback sum.
 - $SWAMEND = \text{OFF}$, output balance
 - Adjust the output to keep the branch flow SV feedback sum as the same. Take all 8-branch balance switching as an example:
 - $AVE = (MV1 + \dots + MV8) / 8 - (BKIN1 + \dots + BKIN8) / 8$
 - $FPSET1 = (MV1 - AVE)$
 - ...
 - $FPSET8 = (MV8 - AVE)$

Alarm

- Output of each balance controller must be between its high limit and low limit in differential method.
- Output of each branch set value must be between its high limit and low limit, and it is limited by its velocity limit.

15.11.10 Keep Difference (Only Valid for Differential Method)

When branch 1 and branch 2 flows have difference, if branch 1 flow is larger, in 2-branch balance, branch 1 flow cannot be added, while branch 2 flow cannot be decreased. Vice versa.

When branch 1 and branch 2 temperatures have difference, in positive action, if branch 1 temperature is higher, in 2-branch balance, branch 1 temperature cannot be decreased, while branch 2 temperature cannot be added, vice versa.

When both temperatures and flows of branch 1 and branch 2 have differences, if actions for branch are opposite, output according to balance operation.

Other branches are similar.

15.11.11 Dead Zone

Differential method:

If temperature deviation is in TPS_DB, not perform operation.

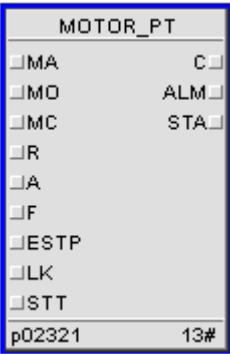
Model method, average method:

Difference of branch temperature and all branch temperature average is in TPS_DB, the branch output keeps.

15.12 One Driver Common Motor Control Function Block(MOTOR_PT)

Function block MOTOR_PT is used for one driver common motor control.

The MOTOR_PT is complex function block. The block performance period is 150μs.



15.12.1 Parameter Instruction

Table 15.24 The MOTOR_PT Parameters Instruction

Name			Description	Upload	Properties	Application
Basic Para- meters	Input Pin	MA	Status Switch for the Group/Stand-alone Device se- lection. If MA=OFF then motor device status is stand-	-	Input pin	Connect to upstream block output

Table 15.24 The MOTOR_PT Parameters Instruction (continued)

Name		Description		Upload	Properties	Application
			alone control else it is group control			
		MO	Startup Operation with Group Control Device	-	Input pin	Connect to upstream block output
		MC	Stop Operation with Group Control Device. Active with up jumping signal.	-	Input pin	Connect to upstream block output
		R	Ready. It must be R=ON when start and running.	-	Input pin	Connect to upstream block output
		A	Running feed-back. If the running time over TM and A=OFF then ALM=ON	-	Input pin	Connect to DI.Related parameter is TM and TM1.
		F	Device Fault	-	Input pin	Connect to DI
		ESTP	Emergency stop	-	Input pin	Connect to upstream block output
		LK	Technology Interlock. Set LK=ON before start-up.	-	Input pin	Connect to upstream block output
		STT	Start Enabled. Set STT=ON before start-up.	-	Input pin	Connect to upstream block output
	Output Pin	C	Device Driver. When no device stop alarm, R=ON, SLK or LK is ON, STT=ON, if STR or MO occur up-jump then C=ON.	-	Output pin	Connect to DO. If R=OFF, or ALM=ON, or SLK anf LK is OFF all then C=OFF
		ALM	Alarm Output. If R_ALM or A_ALM or F is ON then ALM=ON	-	Output pin	-
		STA	Indication of Device Status	-	Output pin	Data type:UNIT
		FLAG	Flag code	-	Output pin	
	Operation Parameter	STR	Startup Operation with Stand-alone Devic	TRUE	Operation parameter	auto-reset per-cycle

Table 15.24 The MOTOR_PT Parameters Instruction (continued)

Name		Description	Upload	Properties	Application	
		STP	Stop Operation with Stand-alone Device. Active with up-jumping	TRUE	Operation parameter	auto-reset per-cycle
		CLR	Alarm Reset	TRUE	Operation parameter	auto-reset per-cycle
		SLK	Release from Technology Interlock	TRUE	Operation parameter	If CSLK=ON then SLK=OFF
		TM	Feedback Time of Response	TRUE	Operation parameter	If running time over TM and A=OFF, then ALM=ON
		CSLK	If CSLK=ON then SLK=OFF	TRUE	Operation parameter	-
		SHSLK	Hide or Show SLK faceplate	TRUE	Operation parameter	-
		TM1	Eliminating Time of Response	TRUE	Operation parameter	When R=ON, if drive signal disappear and running feedback signal Do not disappear after TM1 then output A_ALM
		SWOOS	Function block is OOS Status when SWOOS=ON	TRUE	Operation parameter	-
		AOF	Alarm shield	TRUE	Operation parameter	-
		MSLK	Operate SLK manually,	TRUE	Operation parameter	-
	Super- vision Para- meter	R_- ALM	Alarm Output of Ready Lose. If A=ON and R down jump then R_ALM=ON; if CLR=ON then R_-ALM=OFF	-	Monitor- ingpara- meter	-
		A_- ALM	Alarm Output of Running. If C=ON and A Do not return inside TM then A_-ALM=ON; If R=ON and C=OFF and A=ON inside TM1 then A_ALM = ON. If CLR=ON then A_ALM=OFF	-	Monitoring parameter	-
		STO	Startup Enable Status. If STT and R	-	Monitoring parameter	-

Table 15.24 The MOTOR_PT Parameters Instruction (continued)

Name			Description	Upload	Properties	Application
			all is ON then allow STO =ON, else STO=OFF			
		LKO	Stop Status for Technology Interlock. If LK and SLK is all OFF then LKO=ON; if LK or SLK is ON then LKO = OFF	-	Monitoringparameter	-
		FO	Stop Status for Safe Interlock. If F=ON then FO=ON; if F=OFF then FO hold; if CLR=ON then clear this alarm.	-	Monitoringparameter	the FO=ON when safe interlock stop status.

Bit definition of STA is as follows

Bit	Parameter	Description
0	R	Ready. If R=ON then this bit is 1; if R=OFF then this bit is 0.
1	A	Running. If A=ON then this bit is 1; if A=OFF then this bit is 0.
2	ALM	Run alarm output. If ALM=ON then this bit is 1; if ALM=OFF then this bit is 0.

15.12.2 Function Block Panel Parameters

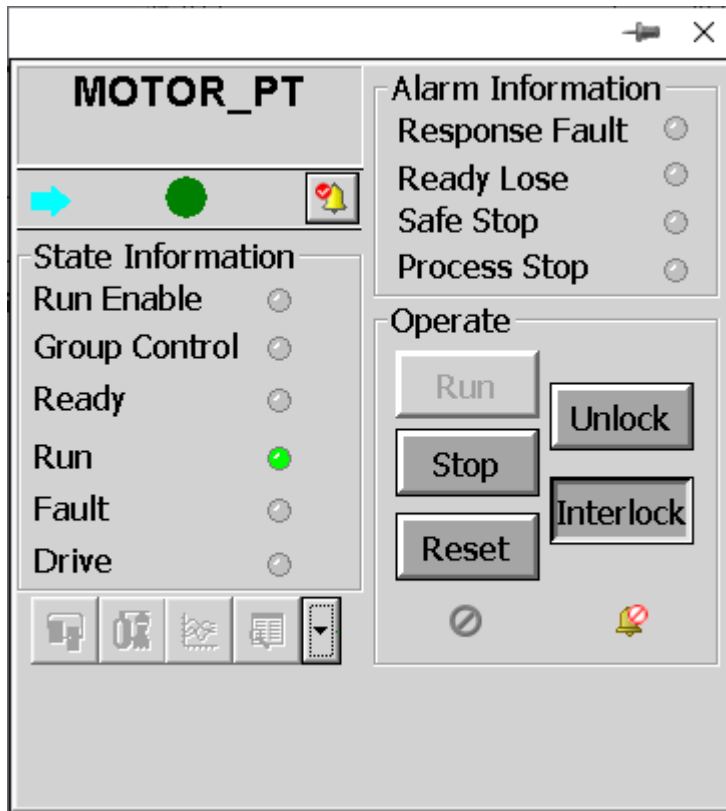


Table 15.25 Panel parameter instruction of MOTOR_PT

Panel Parameter Name		Function Block Parameter Name	Initial Value	Value Range	Application Instruction
Status Information	Run Enable	STO	-		Lights on when STT=ON
	Group Control	MA	-		Lights on when MA=ON
	Ready	R	-		Lights on when R=ON
	Run	A	-		Lights on when A=ON
	Fault	F	-		Lights on when F=ON
	Drive	C	-		Lights on when C=ON
Alarm Information	Response Fault	A_ALM	-		Lights on when A_ALM=ON
	Ready Lose	R_ALM	-		Lights on when R_ALM=ON
	Safe Stop	FO	-		Lights on when FO=ON
	Process Stop	LKO	-		Lights on when LKO=ON
Operate	Run	STR	-		Start the single machine (STR=ON)
	Stop	STP	-		Stop the single machine (STP=ON)
	Reset	CLR	-		Alarm reset

Table 15.25 Panel parameter instruction of MOTOR_PT (continued)

Panel Parameter Name		Function Block Parameter Name	Initial Value	Value Range	Application Instruction
	Unlock	SLK	-		Unlock the technical interlock (SLK=ON)
	Interlock	LK	√		Technical interlock (LK=ON)

15.12.3 Flag

Table 15.26 Flag list

Flag	Alarm	Description
D0	OOS	Disable
D1	MA	Switch between Group Control/Stand-alone Device
D2	MO	Start Group Control Device
D3	MC	Stop Group Control Device
D4	R	Ready
D5	A	Running
D6	F	Device Fault
D7	ESTP	Emergency Stop
D8	LK	Interlock
D9	STT	Start Enabled
D10	C	Device Driver
D11	ALM	Fault Alarm
D12	STR	Start Stand-alone Device
D13	STP	Stop Stand-alone Device
D14	CLR	Alarm Reset
D15	SLK	Release from Interlock
D16	CSLK	Condition of SLK. If CSLK=ON, then SLK=OFF
D17	SHSLK	Hide or Show SLK faceplate
D18	R_ALM	Alarm Output of Ready Lose
D19	A_ALM	Alarm Output of Running
D20	STO	Startup Enable Status

Table 15.26 Flag list (continued)

Flag	Alarm	Description
D21	LKO	Stop Status for Interlock
D22	FO	Run Fault (ON=Fault)
D30	AOF	Suppress Alarm

15.12.4 Logic Time Sequencing

Table 15.27 Start-up / stop / alarm logicsequencine list

Device control Mode		Control Element	Device Drive Ststus
Group con- trol(MA=ON)	Start-up	R=ON, STT=ON, LK=ON, MO up-jump	C=ON
	stop	ALM=ON or ESTP=ON or MC up-jump	C=OFF
Stand-alone con- trol(MA=OFF)	Start-up	R=ON, STT=ON, LK=ON, STR up-jump	C=ON
	stop	ALM=ON or ESTP=ON or STP up-jump	C=OFF
Alarm status (ALM=ON)		F=ON or R=OFF or A=OFF	C=OFF

15.13 Positive/Negative Rotating Motor Control Function Block (MOTOR_FM)

Function block MOTOR_FM is used for positive/negative rotating motor control.

The MOTOR_FM is complex function block. The block performance period is 150μs.

MOTOR_FM	
<input type="checkbox"/> GROUP	DF <input type="checkbox"/>
<input type="checkbox"/> G_DF	DR <input type="checkbox"/>
<input type="checkbox"/> G_DR	ALM <input type="checkbox"/>
<input type="checkbox"/> G_DC	STA <input type="checkbox"/>
<input type="checkbox"/> R	
<input type="checkbox"/> FRN	
<input type="checkbox"/> RRN	
<input type="checkbox"/> SQF	
<input type="checkbox"/> SQR	
<input type="checkbox"/> ESTP	
<input type="checkbox"/> F	
<input type="checkbox"/> LOCK	
p0013	3#

15.13.1 Parameter Description

Table 15.28 The MOTOR_FM Parameters Instruction

Name			Description	Upload	Properties	Application Reference
Basic Parameters	Input Pin	GROUP	Status Switch for the Group/Stand-alone Device	-	Input pin	Connect to upstream block output
		G_DF	Positive Startup Operation with Group Control Device	-	Input pin	Connect to upstream block output
		G_DR	Reverse Startup Operation with Group Control Device	-	Input pin	Connect to upstream block output
		G_DC	Stop Operation with Group Control Device	-	Input pin	Connect to upstream block output
		R	Ready. Set R=ON when start-up and running.	-	Input pin	Connect to upstream block output
		FRN	Positive run feedback. After start-up, if not feedback inside TM1 then ALM=ON	-	Input pin	Connect to DI
		RRN	Reverse run feedback. After start-up, if not feedback inside TM1 then ALM=ON	-	Input pin	Connect to DI
		SQF	Positive Limit feedback	-	Input pin	Connect to DI
		SQR	Reverse Limit feedback	-	Input pin	Connect to DI
		ESTP	Emergency stop	-	Input pin	Connect to upstream block output
		F	Device Fault	-	Input pin	Connect to DI
		LOCK	Technical interlock. Set LOCK=ON before startup.	-	Input pin	Connect to upstream block output
	Output Pin	DF	Positive Drive with Device. if M_STP=OFF and DR=OFF and SQF=OFF and R=ON and SLK(or LOCK)=ON then DF=ON when stand-alone/group	-	Output pin	M_STP=ON condition: ALM=ON or ESTP=ON or M_DC =ON (stand-alone/group control mode)

Table 15.28 The MOTOR_FM Parameters Instruction (continued)

Name			Description	Upload	Properties	Application Reference
			control device forward signal up-jump			
		DR	Reverse Drive with Device. if M_STP=OFF and DR=OFF and SQF=OFF and R=ON and SLK(or LOCK)=ON then DF=ON when stand-alone/group control device reverse signal up-jump	-	Output pin	
		ALM	Alarm Output. If R_ALM or A_ALM or S_ALM or F is ON then ALM=ON	-	Output pin	-
		STA	Indication of Device Status	-	Output pin	-
		FLAG	Flag code	-	Output pin	-
	Operation Parameter	M_DF	Positive Startup Operation with Stand-alone Device	TRUE	Operation parameter	M_DF, M_DR, M_DC, CLR are reset as OFF after keeping ON for a period.
		M_DR	Reverse Startup Operation with Stand-alone Device	TRUE	Operation parameter	
		M_DC	Stop Operation with Stand-alone Device	TRUE	Operation parameter	
		CLR	Alarm Reset	TRUE	Operation parameter	
		SLK	Release from Technology Interlock. If CSLK=ON then SLK=OFF.	TRUE	Operation parameter	-
		TM1	Feedback Time of Response. Unit: s	TRUE	Operation parameter	After startup, if not have running feedback then output ALM alarm.
		TM2	Feedback Time of Position Limit. Unit: s	TRUE	Operation parameter	If not have limit feedback after run TM2 then ALM=ON
		CSLK	If CSLK=ON, then SLK=OFF	TRUE	Operation parameter	-

Table 15.28 The MOTOR_FM Parameters Instruction (continued)

Name			Description	Upload	Properties	Application Reference
		SHSLK	Hide or Show SLK panel.	TRUE	Operation parameter	-
		TM3	Eliminating Time of Response	TRUE	Operation parameter	After R=ON and drive signal disappear and delay TM3, if run signal not do disappear then A_ ALM=ON
		SWOOS	If SWOOS=ON then block is OOS mode	TRUE	Operation parameter	-
		AOF	Alarm shield	TRUE	Operation parameter	-
		MSLK	Operate SLK Manually	TRUE	Operation parameter	-
		UNSQ	Position Limitation Banned	TRUE	Operation Parameter	ON= not limited OFF= limited
	Supervision Parameter	R_ALM	Alarm Output of Ready Lose.	-	Monitoring parameter	If ready signal down-jump then R_ALM = ON. If CLR=ON then reset R_ALM.
		A_ALM	Running lose Alarm	-	Monitoring parameter	A_ALM=ON when alarm
		S_ALM	Position Limit lose Alarm	-	Monitoring parameter	S_ALM=ON when alarm

Bit definition of STA is as follows

Bit	parameters	description
0	R	Ready. If R=ON, this bit is 1. And if R=OFF, the bit is 0.
1	FRN, RRN	If only one of them is ON, the bit is 1. Otherwise, it is 0.
2	RRN, FRN, SQF, SQR	When RRN, FRN and SQR are all OFF and SQF is ON, the bit is 1. Otherwise, it is 0. When UNSQ=0, this bit will always be 0.
3	RRN, FRN, SQF, SQR	When RRN, FRN and SQF are all OFF and SQR is ON, the bit is 1. Otherwise, it is 0. When UNSQ=0, this bit will always be 0.
4	ALM	Running alarm output. If ALM=ON, this bit is 1 and other bits are all 0. If ALM=OFF, this bit is 0.

Note:

- If feedback signal of positive run isn't received (FRN=OFF) within time TM1 after positive drive with device is delivered, running lose alarm will be generated. When R=ON, if positive drive signal disappears and feedback signal of positive run does not disappear (FRN=ON) after time TM3, running lose alarm will be generated too. So does the reverse case. When alarm reset CLR=ON, alarm will be reset.
- When positive drive is delivered and positive feedback is received, if positive limit SQF does not turn OFF within time TM2, position limit lose alarm will be generated. So does the reverse case. When alarm reset CLR=ON, alarm will be reset.
- When UNSQ=ON, this function will work without position limit. That is to say, the input of SQF and SQR will be invalid, the alarm of S_ALM will not be generated.

15.13.2 Panel Parameter



Table 15.29 Panel parameter instruction of MOTOR_FM

Panel Parameter Name		Function Block Parameter Name	Initial Value	Value Range	Application Instruction
Status Information	Combined	GROUP	-	[ON,OFF]	Lights on when GROUP=ON
	Ready	R	-	[ON,OFF]	Lights on when R=ON
	Positive	FRN	-	[ON,OFF]	Lights on when FRN=ON

Table 15.29 Panel parameter instruction of MOTOR_FM (continued)

Panel Parameter Name		Function Block Parameter Name	Initial Value	Value Range	Application Instruction
	Positive	DF	-	[ON,OFF]	Lights on when DF=ON
	Positive	SQF	-	[ON,OFF]	Lights on when SQF=ON When the UNSQ=ON and SQF=ON, this indicator will not be lighted.
	Reverse	RRN		[ON,OFF]	Lights on when RRN=ON
	Reverse	DR		[ON,OFF]	Lights on when DR=ON
	Invert	SQR	-	[ON,OFF]	Lights on when SQR=ON When the UNSQ=ON and SQR=ON, this indicator will not be lighted.
	Limit Forbidden	UNSQ	OFF	[ON,OFF]	Lights on When UNSQ=ON. Not lights on when UNSQ=OFF.
Alarm Information	Response	A_ALM	-	[ON,OFF]	Lights on when A_ALM=ON
	Ready	R_ALM	-	[ON,OFF]	Lights on when R_ALM=ON
	Limit Fault	S_ALM	-	[ON,OFF]	Lights on when S_ALM=ON
Operate	Direct	M_DF	-	[ON,OFF]	Start the single machine directly
	Reverse	M_DR	-	[ON,OFF]	Start the single machine reversely
	Stop	M_DC	-	[ON,OFF]	Stop the single machine
	Unlock	SLK	-	[ON,OFF]	Unlock the technical interlock
	Interlock	LOCK	√	[ON,OFF]	Interlock
	Reset	CLR	-	[ON,OFF]	Alarm the

15.13.3 Flag

Table 15.30 Flag list

Flag	Alarm	Description
D0	OOS	Disable
D1	GROUP	Group control
D2	G_DF	Positive Startup Operation with Group Control Device
D3	G_DR	Reverse Startup Operation with Group Control Device
D4	G_DC	Stop Operation with Group Control Device

Table 15.30 Flag list (continued)

Flag	Alarm	Description
D5	R	Ready
D6	FRN	Positive run
D7	RRN	Reverse Reverse
D8	SQF	Positive limit feedbackWhen UNSQ=ON, SQF=0
D9	SQR	Reverse limit feedbackWhen UNSQ=ON, SQF=0
D10	ESTP	Emergency stop
D11	F	Device fault
D12	LOCK	Interlock
D13	DF	Drive forward
D14	DR	Drive reversely
D15	ALM	Fault Alarm
D16	M_DF	Positive Startup Operation with Stand-alone Device
D17	M_DR	Reverse Startup Operation with Stand-alone Device
D18	M_DC	Stop Operation with Stand-alone Device
D19	CLR	Alarm Reset
D20	SLK	Release from Technology Interlock
D21	CSLK	Conditions of SLK
D22	SHSLK	Hide or Show SLK panel.
D23	R_ALM	Ready loss alarm output
D24	A_ALM	Running alarm output
D25	S_ALM	Position limit loss alarm
D30	AOF	Suppress Alarm

15.13.4 Logic Time Sequencing

Table 15.31 Start/Shutdown /Alarm Control Logic Instruction

Device Control Mode		Control Element	Device Drive Sttus
Group control status:GROUP=ON	Positive startup	R=ON and LOCK=ON and G_DF up-jump	DF=ON

Table 15.31 Start/Shutdown /Alarm Control Logic Instruction (continued)

Device Control Mode		Control Element	Device Drive Status
Stand-alone control status:GROUP=OFF	Reverse startup	R=ON and LOCK=ON and G_DR up-jump	DR=ON
	stop	ALM=ON or ESTP=ON or G_DC up-jump or SQF/SQR=ON	DF=OFF, DR=OFF
	Positive startup	R=ON and LOCK=ON and M_DF up-jump	DF=ON
	Reverse startup	R=ON and LOCK=ON and M_DR up-jump	DR=ON
	stop	ALM=ON or ESTP=ON or M_DC up-jump or SQF/SQR=ON	DF=OFF, DR=OFF
Alarm status(ALM=ON)		R_ALM or A_ALM or M_ALM or F is ON	DF=OFF, DR=OFF

**TIP:**

When UNSQ=ON, SQF and SQR will not influence the output.

15.13.5 Application Example

To achieve the switch control of field valve as shown in Figure 15.23, and can be operated in flow chart.

Dual-DI (Spacing) Dual-DI (Running) Dual-DO (Driver) Valve motor driven valve refers to device to achieve valve performer switch control via direct/reverse motor driver. Valve switch status is shown by dual-DI feedbacks. When valve control is applied, on DO and off driver should keep output, and stop DO output when reached spacing. It is often used for limited direct/reverse motor control, such as winding motor, motor driven door and flashboard valve.

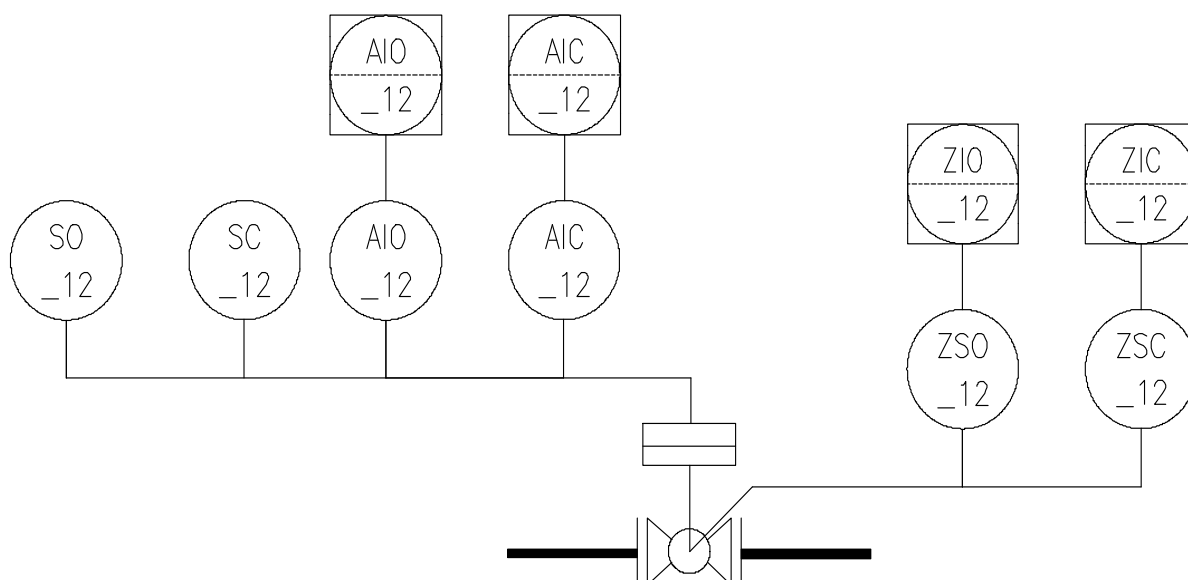


Figure 15.23 Dual-DI (Spacing) Dual-DI (Running) Dual-DO (Driver) Valve Diagram

Its program is shown below, which applied MOTOR_FM and the upper computer can control DO via function block tag.

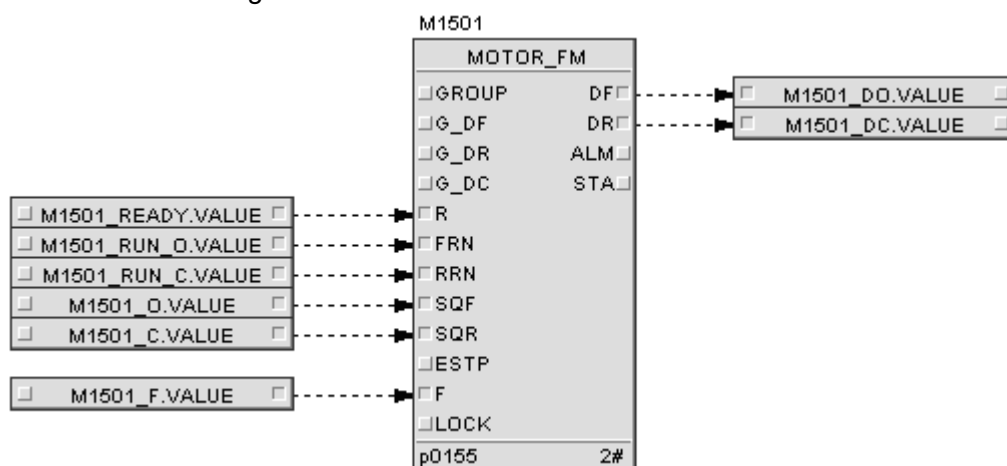


Figure 15.24 Valve Program of Dual-DI (Spacing) Dual-DI (Running) Dual-DO (Driver)

Function block and example instructions are shown below.

Table 15.32 Dual Block and Example Instructions

No.	Example	Type	Instruction	Remarks
001	M1501_READY	DI Input	Ready Signal	
002	M1501_RUN_O	DI Input	Direct Running Signal	
003	M1501_RUN_C	DI Input	Reverse Running Signal	
004	M1501_O	DI Input	Direct Spacing Signal	

Table 15.32 Dual Block and Example Instructions (continued)

No.	Example	Type	Instruction	Remarks
005	M1501_C	DI Input	Reverse Spacing Signal	
006	M1501_F	DI Input	Device Fault Signal	
007	M1501_DO	DO Output	Device Direct Driver	
008	M1501_DC	DO Output	Device Reverse Driver	
009	M1501	Function Block Tag	Motor Control Function Block Tag	Supervision Tag

Table 15.33 MOTOR_FM

No.	Function Block Pin	Description	Corresponding Tag Type	Remarks
Input Parameter				
001	R	Ready	DI Input	M1501_READY
002	FRN	Direct Running	DI Input	M1501_RUN_O
003	RRN	Reverse Running	DI Input	M1501_RUN_C
004	SQF	Direct Spacing	DI Input	M1501_O
005	SQR	Reverse Running	DI Input	M1501_C
006	F	Device Fault	DI Input	M1501_F
007	G_DF	Group Control Device Start Operation Directly	Custom BOOL	Direct Rotation Automatically
008	G_DR	Group Control Device Start Operation Reverse	Custom BOOL	Reverse Rotation Automatically
009	G_DC	Group Control Device Close Down	Custom BOOL	Stop Automatically
010	GROUP	Group Control/ Single Machine Device Status Switch	Custom BOOL	Manula/Auto Selection
011	ESTP	Emergency Shutdown	Custom BOOL	When input ON, force to stop.
012	LOCK	Interlock Condition	Custom BOOL	When interlock is applied, LOCK input is OFF, interlock stops.
Output Parameter				
001	DF	Device Direct Driver	DO Output	M1501_DO
002	DR	Device Reverse Driver	DO Output	M1501_DC

Table 15.33 MOTOR_FM (continued)

No.	Function Block Pin	Description	Corresponding Tag Type	Remarks
003	ALM	Alarm Output	Custom BOOL	Ready lost or running alarm or spacing alarm or fault=ON.
004	STA	Device Status Indication	Custom UINT	1: Ready 2, 3: Running 4, 5: Direct Spacing 8, 9: ReverseSpacing 16:Fault

Parameter settings of MOTOR_FM:

- When the operation parameter SHSLK in basic parameter is OFF, the interlock button on flow chart device panel turns grey, when it is ON, the interlock button can be operated.
- When the operation parameter CSLK in basic parameter is ON, interlock is started automatically.

Alarm Settings

- When the operation parameter TM1 in basic parameter is set as 3s, it means that there is no DI running feedback in the 3s after outputting DO driver, alarm generates (supervision parameter A_ALM and output parameter ALM is ON), driver output is canceled (the time is adjustable).
- When the operation parameter TM2 in basic parameter is set as 30s, it means that there is no spacing running feedback in the 30s after outputting DO driver, alarm space is limited (supervision parameter S_ALM and output parameter ALM is ON), driver output is canceled (the time is adjustable).
- When the operation parameter TM3 in basic parameter is set as 3s, it means that there is DI running feedback in the 3s after canceling DO driver, alarm generates (supervision parameter A_ALM and output parameter ALM is ON), driver output is canceled (the time is adjustable).

Example diagram of control panel is shown below.

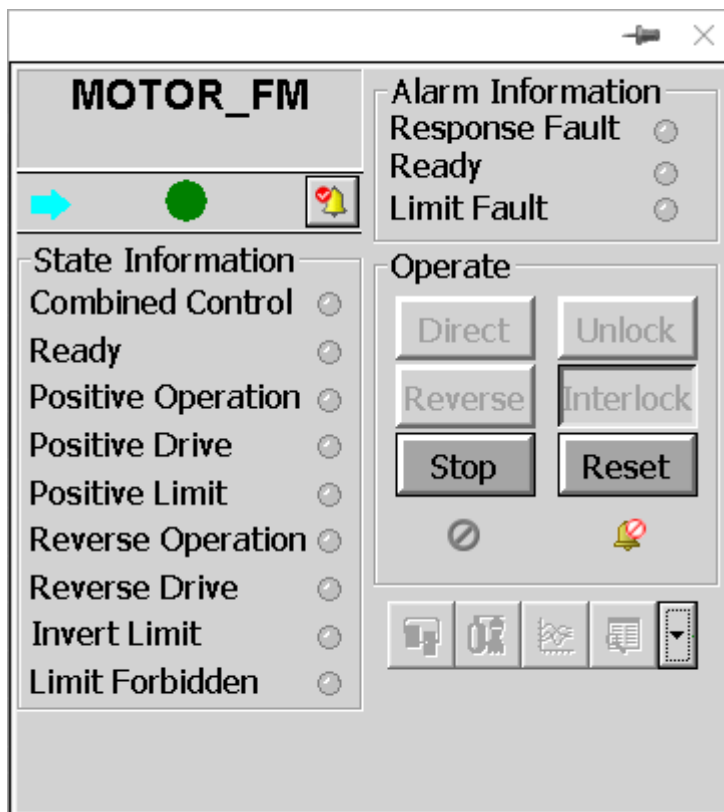
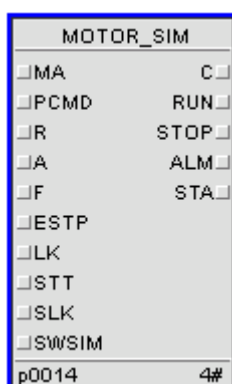


Figure 15.25 Valve Instrument Panel of Dual-DI (Spacing) Dual-DI (Running) Dual-DO (Driver)

15.14 One Driver Common Motor Control Function Block With Simulation Function (MOTOR_SIM)

Function block MOTOR_SIM is used for one driver common motor control. The function block can do simulation run.

The MOTOR_SIM is complex function block. The block performance period is 150μs.



15.14.1 Parameter Description

Table 15.34 The MOTOR_SIM Parameters Instruction

Name			Description	Upload	Properties	Application Reference
Basic Parameters	Operation Parameter	TM	Feedback Time of Response (s)	TRUE	Operation parameter	If running time over TM and A=OFF, then ALM=ON
		TM1	Eliminating Time of Response (s)	TRUE	Operation parameter	When R=ON, if drive signal disappear and running feedback signal Do not disappear after TM1 then output A_ALM
	Mode Settings	SAFE_-OPT	Safe mode selection switch. If SAFE_OPT=OFF, then running fault hold and output does not reset after startup output take place running fault; if SAFE_OPT=ON then running fault hold and output reset after startup output take place running fault, can set CLR or set simulation to remove running fault.	TRUE	Operation parameter	-
		AUTO-CLR	Running fault clear select switch. If AUTOCLR=OFF then clear after acknowledgement else auto clear.	TRUE	Operation parameter	-
		SWOUT	Mode select switch. SWOUT=OFF is one drive mode. SWOUT=ON is two drive mode.	-	Configuration parameter	One drive mode: C=ON is output and C=OFF is stop out; Two drive mode: RUN=ON is output and STOP=ON is stop out.inhibition RUN and STOP is ON at the same time.

Table 15.34 The MOTOR_SIM Parameters Instruction (continued)

Name			Description	Upload	Properties	Application Reference
Extended Parameter	Input Pin		The output plus which width is TPW when two drive mode.			
		TPW	Pulse width time (s)	-	Configuration parameter	Relate parameter: RUN and STOP
		MA	Status Switch for the Group/ Stand-alone Device selection. If MA=OFF then motor device status is stand-alone control else it is group control	-	Input pin	Connect to upstream block output
		PCMD	Group control device start/stop operation. (OFF=stop, ON=startup)	-	Input pin	Connect to upstream block output
		R	Ready. It must be R=ON when start and running.	-	Input pin	Connect to upstream block output
		A	Running feedback. If the running time over TM and A=OFF then ALM=ON	-	Input pin	Connect to DI. Related parameter is TM and TM1.
		F	Device Fault	-	Input pin	Connect to DI
		ESTP	Emergency stop	-	Input pin	Connect to upstream block output
		LK	Technology Interlock. Set LK=ON before start-up.	-	Input pin	Connect to upstream block output

Table 15.34 The MOTOR_SIM Parameters Instruction (continued)

Name			Description	Upload	Properties	Application Reference
		STT	Start Enabled. Set STT=ON before start-up.	-	Input pin	Connect to upstream block output
		SLK	Release from Technology Interlock (OFF=not release, ON=release)	TRUE	Input pin	Connect to upstream block output
	Simulation	SWSIM	Simulation switch. SWSIM=OFF is not simulation mode ; SWSIM=ON is simulation mode.	-	Input pin	-
		SWDO	When simulation, if SW-DO=OFF then block output to DO;if SW-DO=ON then block Do not output to DO	-	Configuration parameter	-
	Output Pin	C	Device Driver. When no device stop alarm, R=ON, SLK or LK is ON, STT=ON, if STR or MO occur up-jump then C=ON.	-	Output pin	Connect to DO. If R=OFF, or ALM=ON, or SLK and LK is OFF all then C=OFF
		RUN	Pulse output with two drive mode. The output pulse width is TPW.	-	Output pin	Connect to DO
		STOP	The device drive stop-when two	-	Output pin	For two drive mode, must manual stop again

Table 15.34 The MOTOR_SIM Parameters Instruction (continued)

Name			Description	Upload	Properties	Application Reference
			drive mode. The output pulse width is TPW.			when stop pulse width output.
		ALM	Alarm Output. If R_-ALM or A_-ALM or F is ON then ALM=ON	-	Output pin	-
		STA	Indication of Device Status	-	Output pin	Data type:UNIT
	Alarm Enabled and Suppress	FLAG	Flag code	-	Output pin	-
		AOF	Alarm shield	TRUE	Operation parameter	-
	Status	R_ALM	Alarm Output of Ready Lose. If A=ON and R down jump then R_-ALM=ON; if CLR=ON then R_-ALM=OFF	-	Monitoring parameter	-
		A_ALM	Alarm Output of Running. If C=ON and A Do not return inside TM then A_-ALM=ON; If R=ON and C=OFF and A=ON inside TM1 then A_-ALM = ON. If CLR=ON then A_-ALM=OFF	-	Monitoring parameter	-
		STO	Startup Enable Status. If STT and R all is ON then allow STO	-	Monitoring parameter	-

Table 15.34 The MOTOR_SIM Parameters Instruction (continued)

Name			Description	Upload	Properties	Application Reference
			=ON, else STO=OFF			
		LKO	Stop Status for Technology Interlock. If LK and SLK is all OFF then LKO=ON; if LK or SLK is ON then LKO = OFF	-	Monitoring parameter	-
		FO	Stop Status for Safe Interlock. If F=ON then FO=ON; if F=OFF then FO hold; if CLR=ON then clear this alarm.	-	Monitoring parameter	the FO=ON when safe interlock stop status.
	Operation Parameter	MSTR	One device startup operation	-	Operation parameter	-
		MSTP	One device stop operation.	-	Operation parameter	-
		CLR	Alarm reset	TRUE	Operation parameter	-
	OOS Settings	SWOOS	Function block is OOS Status when SWOOS=ON	TRUE	Operation parameter	-

Definition of STA is as follows:

If R signal is not received then show STA=5. It isn't affected by simulation;

If R signal is received but exist equipment failure at one time then show STA=3. It isn't affected by simulation;

If R signal is received and have not equipment failure signal input but exist running fault then show STA=4. when simulation have not this item;

When R signal is received and no equipment failure input and no running fault, if have running feedback then STA=1 else STA=2. when simulation result rest with operation command.

15.14.2 Flag

Flag	Monitor Value	Description
D0	Enable (SWOOS)	OOS Status (OOS_B)
D1	Enable (MA)	Switch between Group Control/Stand-alone Device (MA_B)
D2	Disable	Start/Stop Group Control Device (PCMD_B)
D3	—	—
D4	Disable	Ready (R_B)
D5	Disable	Run (A_B)
D6	Disable	Device Fault (F_B)
D7	Disable	Emergency Stop (ESTP_B)
D8	Disable	Interlock (LK_B)
D9	Enable (STT)	Start Enabled (STT_B)
D10	Disable	Device Driver (C_B)
D11	Disable	Alarm Output (ALM_B)
D12	Enable (MSTR)	Stand-alone Device Startup (MSTR_B)
D13	Enable (MSTP)	Stand-alone Device Stop (MSTP_B)
D14	Enable (CLR)	Alarm Reset (CLR_B)
D15	Enable (SLK)	Release from Interlock (SLK_B)
D16	-	-
D17	-	-
D18	Disable	Alarm Output of Ready Lose (R_ALM_B)
D19	Disable	Running Fault (A_ALM_B)
D20	Disable	Startup Enable Status (STO_B)
D21	Disable	Stop for Interlock (LKO_B)
D22	Disable	Interlock Stop Alarm (FO_B)
D23	Enable (SWSIM)	Simulation Switch (SWSIM_B)
D24~D29	—	—
D30	Enable (AOF)	Module Alarm Shield

15.14.3 Logic Time Sequencing

Table 15.35 start-up / stop / drive/alarm logic sequencing list

Device Control Mode		Control Element	Device Drive Status
Group control(MA=ON)	startup	R=ON, STT=ON, LK=ON, PCMD=ON	Out is ON
	stop	ALM=ON or ESTP=ON or PCMD=OFF	Out is OFF
Stand-alone control(MA=OFF)	startup	R=ON, STT=ON, LK=ON, MSTR up-jump	Out is ON
	stop	ALM=ON or ESTP=ON or MSTP up-jump	Out is OFF
Output mode	One drive	SWOUT=OFF	C
	Two drive	SWOUT=ON	RUN and STOP
Alarm status (ALM=ON)		F=ON or R=OFF or A=OFF	C=OFF

15.15 Valve Control Function Block With Simulation Function (DIO21V_SIM)

DIO-21V function block enables control and interlock protect to dual DI feedback/single DO output equipment by last level sequence control command or operator operating. Monitoring can use user-defined panel mode.

The function block can simulation running. The function block direction for use respect to direction of DIO-21V. Valve control function block with simulation

The DIO21V_SIM is complex function block. The block performance period is 150μs.

DIO21V_SIM	
<input type="checkbox"/> OPNSTA	DO <input type="checkbox"/>
<input type="checkbox"/> CLSSTA	ALM <input type="checkbox"/>
<input type="checkbox"/> PCMD	STA <input type="checkbox"/>
<input type="checkbox"/> EMOPN	
<input type="checkbox"/> EMCLS	
<input type="checkbox"/> OPNPRM	
<input type="checkbox"/> CLSPRM	
<input type="checkbox"/> SWAM	
<input type="checkbox"/> SWSIM	
p0015	5#

15.15.1 Parameter Description

Table 15.36 The DIO21V_SIM Parameters Instruction

Name			Description	Upload	Properties	Application Reference
Basic Parameters	Mode Settings	TOC	Device Run time (Unit: s) If the device run time greater then TOC value and not feedback, then output OPFL=ON	TRUE	Operation parameter	-
		OPFLACK	Whether to Confirm Running Fault. (ON=True).It is valid to MAN/AUTO command and invalid to interlock command.	TRUE	Operation parameter	-
		AUTO-CLR	Whether to Eliminate running Failure Auto(ON=Auto).When AUTO-CLR=ON and OPFL=ON, if recover status feedback then OPFL=OFF.When AUTOCLR=OFF and OPFL=ON, then OPFL=OFF after recover status feedback and acknowledgement.	TRUE	Operation parameter	-
		IGNO-RALM	Input Command Shield Alarm (OFF=NO)	TRUE	Operation parameter	-
		IGNORS-TA	Whether to Output Command Ignore Feedback.If the value is ON then currently output Do not judge feedback status; if the value is OFF then currently output judge feedback status.	TRUE	Operation parameter	If the value is ON then DO is not affected by OPFL else DO is affected by OPFL
		SAFE_-OPT	Output Safety Mode Selection(OFF=Not Reset Output, ON=Reset Output)	TRUE	Operation parameter	-
Extended Parameters	Input Pin	OPNSTA	Open Status Feedback	-	Input pin	Connect to DI

Table 15.36 The DIO21V_SIM Parameters Instruction (continued)

Name			Description	Upload	Properties	Application Reference
		CLSSTA	Close Status Feed-back	-	Input pin	Connect to DI
		PCMD	Command Input(ON=Open OFF=Close)	-	Input pin	Connect to upstream block.
		EMOPN	Interlock Open Command	-	Input pin	Connect to upstream block. When EMOPN=ON, it will be shown in the process alarm
		EMCLS	Interlock Close Command	-	Input pin	Connect to upstream block. When EMCLS=ON, it will be shown in the process alarm.
		OPNPRM	Open Permission Signal	TRUE	Input pin	Connect to upstream block.
		CLSPRM	Close Permission Signal	TRUE	Input pin	Connect to upstream block.
		SWAM	Manual-automatic Switch (ON=Auto OFF=Manual)	-	Input pin	Connect to upstream block.
	Simulation	SWSIM	Simulation switch. If SWSIM=OFF then the valve function block not have simulation and DO output normal; if SWSIM=ON then valve function block have simulation function and block calculation value do not output to DO.	-	Input pin	Connect to upstream block.
		SWDO	DO output select switch.(OFF=output, ON=not output)	TRUE	Operation parameter	-
	Output Pin	DO	Output	-	Output pin	Connect to DO
		ALM	alarm	-	Output pin	-
		STA	Indication of Device Status.	-	Output pin	-

Table 15.36 The DIO21V_SIM Parameters Instruction (continued)

Name			Description	Upload	Properties	Application Reference
	Enabled and Suppress		STA=1: FAIL=OFF, OPFL=OFF, OPNSTA=ON; STA=2: FAIL=OFF, OPFL=OFF, CLSSTA=ON; STA=3: FAIL=ON; STA=4: FAIL=OFF, OPFL=ON			
		AOF	Module Alarm shield	TRUE	Operation parameter	-
		ENALM	Alarm Enabled	TRUE	Operation parameter	-
	Status	FLAG	Flag code	-	Output pin	-
		FAIL	Device Fault. If OPNSTA=ON and CLSSTA=ON then FAIL=ON	-	Monitoring parameter	-
		OPFL	Running Fault (ON=Fault).	-	Monitoring parameter	If OPFL=ON then new command input ineffectiveness; if OPFL=OFF then new command input effective
		STAOPN	Device Running Status Indication(ON=Open)	-	Monitoring parameter	-
		STACLS	Device Stop Status Indication(ON=Close)	-	Monitoring parameter	-
		MODE	Function Block Mode(Observe) ^{Note 1}	-	Monitoring parameter	-
		OPN-FLAG	Open Command Output Process(Observe)	-	Monitoring parameter	-
		CLSFLAG	Close Command Output Process(Observe)	-	Monitoring parameter	-
	OOS Settings	SWOOS	Function block is OOS Status when SWOOS=ON	TRUE	Operation parameter	-

Table 15.36 The DIO21V_SIM Parameters Instruction (continued)

Name			Description	Upload	Properties	Application Reference
	Operation Parameter	MCMD	Manual Command (ON=Open OF-F=Close)	-	Operation parameter	-
		MACK	Manual Confirm	-	Operation parameter	-

Note1:

The function block mode and precedence level: OOS>Interlock>Man/Auto

- OOS(MODE=1)
When SWOOS=ON, function block is in OOS status and does not respond to command output. The output maintains.
- Interlock(interlock open/interlock stop, MODE=4)
When function block is not in OOS status, and input interlock open or interlock close command, function block turns to interlock mode. Interlock command input adopts positive transmission check.
When both interlock open, interlock close commands are inputted, the system does not respond to interlock command.
When interlock open command is inputted first and interlock close command is inputted in effective time of interlock open command, execute interlock open command first and then interlock close command after interlock open command is over.
When interlock close command is inputted first and interlock open command is inputted in effective time of interlock close command, execute interlock close command first and then interlock open command after interlock close command is over.
The validity of interlock command is restricted by open/close enable (OPNPRM, CLSPRM), device fault FAIL and running fault OPFL. Running fault limit can be shielded by OPFLACK, FAIL and OPFL limit can be shielded by IGNORALM.
- Man/auto (Man: MODE=5; Auto: MODE=6)
When function block is not in all statuses above, it is in manual /auto selection mode.
Automatic status output instruction is decided by PCMD and manual status output instruction is by MCMD.
Man/auto command input adopts positive transmission check.
If interlock open EMOPN is continuously ON, then manual close and auto close command disables.

If interlock close EMCLS is continuously ON, then manual open and auto open command disables.

The validity of man/auto command is restricted by open/close enable (OPNPRM, CLSPRM), device fault FAIL and running fault OPFL. Running fault limit can be shielded by OPFLACK. FAIL and OPFL limit can be shielded by IGNORAM.

15.15.2 Flag

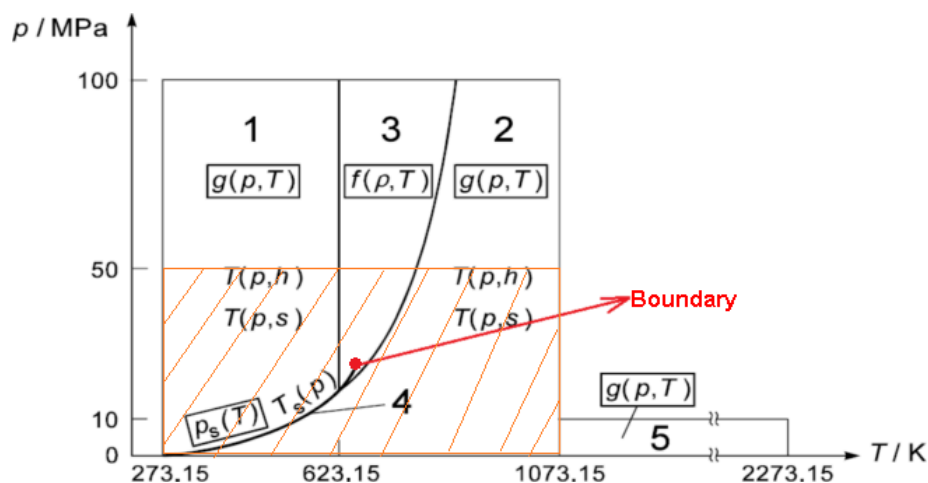
Table 15.37 Flag list

Flag	Alarm	Description
D0	OOS	Disable
D3	EMOPN	Interlock Open
D4	EMCLS	Interlock Close
D5	MAN	Manual
D6	AUTO	Auto
D9	OPFL	Running Fault
D10	FAIL	Feedback Fault
D11	STAOPN	Devices All Open
D12	STACLS	Devices All Closed
D14	OPNPRO	Open Instruction Output Process
D15	CLSPRO	Close Instruction Output Process
D18	AOF	Suppress Alarm

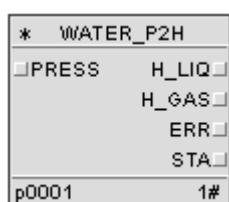
15.16 WATER_P2H(Computing Specific Enthalpy with Saturated Pressure)

FBD of water and steam is used to accomplish the thermodynamic properties process of water and steam in the shadow of following figure. The process range of the thermodynamic properties is:

- $0\text{ .degree.C} \leq \text{Temperature} \leq 800\text{ .degree.C}$
- $0.000611213\text{MPa} \leq \text{Absolute Pressure} \leq 50\text{MPa}$



The FBD of WATER_P2H is used to compute the specify enthalpy with the input saturated pressure. And the FBD of WATER_P2H is shown as following figure.



15.16.1 Parameter Instruction

Parameter		Instruction
Input Pin	PRESS	Input pressure(In:MPa).
Output Pin	H_LIQ	Output saturated water specific enthalpy (In:kJ/kg)
	H_GAS	Output moist steam specific enthalpy (In:kJ/kg)
	ERR	Module Alarm."ON" means error, and "OFF" means normal.
	STA	Alarm Status, for detail refer to "Alarm Status".

15.16.2 Alarm Status

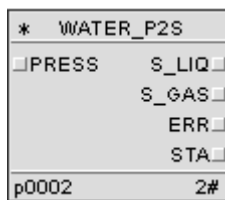
Flag	Instruction
D0	The input pressure is out of the low limit.
D1	The input pressure is out of the high limit.
D2	The input temperature is out of the low limit.
D3	The input temperature is out of the high limit.
D4	The mode is error.

Flag	Instruction
D5	The calculation is error.
D6	Specific entropy is error.
D7	Specific entropy is error.
D8	The input is not match with the mode.

15.17 WATER_P2S(Computing Specific Entropy with Saturated Pressure)

The FBD of WATER_P2S is used to compute the specify entropy with the input saturated pressure. The compute of WATER_P2S is worked according the figure in "WATER_P2H(Computing Specific Enthalpy with Saturated Pressure)".

And the FBD of WATER_P2S is shown as following figure.



Parameter		Instruction
Input Pin	PRESS	Input pressure (In: MPa)
Output Pin	S_LIQ	Output saturated water specific entropy (In:kJ/(kg*.degree.C))
	S_GAS	Output moist steam specific entropy (In:kJ/(kg*.degree.C))
	ERR	Module Alarm."ON" means error, and "OFF" means normal.
	STA	Alarm Status, for detail refer to "Alarm Status".

15.18 WATER_P2T(Computing Saturated Temperature with Saturated Pressure)

The FBD of WATER_P2T is used to compute saturated temperature with the input saturated pressure. The compute of WATER_P2T is worked according the figure in "WATER_P2H(Computing Specific Enthalpy with Saturated Pressure)".

And the FBD of WATER_P2T is shown as following figure.

* WATER_P2T	
PRESS	TMPRT
	ERR
	STA
p0001	1#

Parameter		Instruction
Input Pin	PRESS	Input pressure(In:MPa).
Output Pin	TMPRT	Output windup temperature (In: .degree.C)
	ERR	Module Alarm."ON" means error, and "OFF" means normal.
	STA	Alarm Status, for detail refer to "Alarm Status".

15.19 WATER_P2V(Computing Specify Volume with Saturated Pressure)

The FBD of WATER_P2V is used to compute specify volume with the input saturated pressure.

The compute of WATER_P2V is worked according the figure in "WATER_P2H(Computing Specific Enthalpy with Saturated Pressure)".

And the FBD of WATER_P2V is shown as following figure.

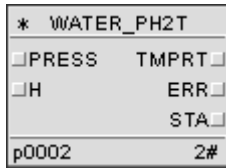
* WATER_P2V	
PRESS	M_LIQ
	M_GAS
	V_LIQ
	V_GAS
	ERR
	STA
p0001	1#

Parameter		Instruction
Input Pin	PRESS	Input pressure (In: MPa)
Output Pin	M_LIQ	Output saturated water density (In:kg/m3)
	M_GAS	Output moist steam density (In:kg/m3)
	V_LIQ	Output saturated water specific volume (In:m3/kg)
	V_GAS	Output moist steam specific volume (In:m3/kg)
	ERR	Module Alarm."ON" means error, and "OFF" means normal.
	STA	Alarm Status, for detail refer to "Alarm Status".

15.20 WATER_PH2T(Computing Temperature with Pressure and Specific Enthalpy)

The FBD of WATER_PH2T is used to compute temperature with the input pressure and specific enthalpy. The compute of WATER_PH2T is worked according the figure in "WATER_P2H(Computing Specific Enthalpy with Saturated Pressure)".

And the FBD of WATER_PH2T is shown as following figure.

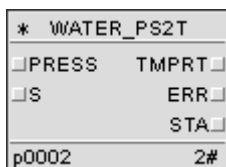


Parameter		Instruction
Input Pin	PRESS	Input pressure (In: MPa)
	H	Input specific enthalpy (In: kJ/kg)
Output Pin	TMPRT	Output temperature (In: .degree.C)
	ERR	Module Alarm."ON" means error, and "OFF" means normal.
	STA	Alarm Status, for detail refer to "Alarm Status".
Configuration Parameter	MODE	Mode selection [0,2],0: water area,1: gas area,2: automatic judgment

15.21 WATER_PS2T(Computing Temperature with Pressure and Specific Entropy)

The FBD of WATER_PS2T is used to compute temperature with the input pressure and specific enthalpy. The compute of WATER_PS2T is worked according the figure in "WATER_P2H(Computing Specific Enthalpy with Saturated Pressure)".

And the FBD of WATER_PS2T is shown as following figure.



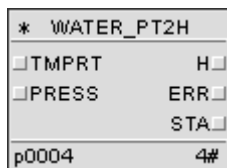
Parameter		Instruction
Input Pin	PRESS	Input pressure (In: MPa)
	S	Input specific entropy (In: kJ/(kg*.degree.C))
Output Pin	TMPRT	Output temperature (In: .degree.C)
	ERR	Module Alarm."ON" means error, and "OFF" means normal.
	STA	Alarm Status, for detail refer to "Alarm Status".

Parameter		Instruction
Configuration Parameter	MODE	Mode selection. 0: water area 1: gas area 2: critical area

15.22 WATER_PT2H(Computing Specific Enthalpy with Pressure and Temperature)

The FBD of WATER_PT2H is used to compute specific enthalpy with the input pressure and Temperature. The compute of WATER_PT2H is worked according the figure in "WATER_P2H(Computing Specific Enthalpy with Saturated Pressure)".

And the FBD of WATER_PT2H is shown as following figure.



Parameter		Instruction
Input Pin	TMPRT	Input temperature (In: .degree.C)
	PRESS	Input pressure (In: MPa)
Output Pin	H	Output specific enthalpy (In:kJ/kg)
	ERR	Module Alarm. "ON" means error, and "OFF" means normal.
	STA	Alarm Status, for detail refer to "Alarm Status".
Configuration Parameter	MODE	Mode selection. 0: water area 1: gas area 2: critical area 3:automatic judgment 4:gas area or critical area

15.23 WATER_PT2S(Computing Specific Entropy with Pressure and Temperature)

The FBD of WATER_PT2S is used to compute temperature with the input pressure and specific enthalpy. The compute of WATER_PT2S is worked according the figure in "WATER_P2H(Computing Specific Enthalpy with Saturated Pressure)".

And the FBD of WATER_PT2S is shown as following figure.

* WATER_PT2S	
<input type="checkbox"/> TMPRT	S <input type="checkbox"/>
<input type="checkbox"/> PRESS	ERR <input type="checkbox"/>
	STA <input type="checkbox"/>
p0001	1#

Parameter		Instruction
Input Pin	TMPRT	Input temperature (In: .degree.C)
	PRESS	Input pressure (In: MPa)
Output Pin	S	Output specific entropy (In:kJ/(kg*.degree.C))
	ERR	Module Alarm. "ON" means error, and "OFF" means normal.
	STA	Alarm Status, for detail refer to "Alarm Status".
Configuration Parameter	MODE	Mode selection. 0: water area 1: gas area 2: critical area 3:automatic judgment 4:gas area or critical area

15.24 WATER_PT2V(Computing Specific Volume with Pressure and Temperature)

The FBD of WATER_PT2V is used to compute Specific Volume with the input pressure and temperature. The compute of WATER_PT2V is worked according the figure in "WATER_P2H(Computing Specific Enthalpy with Saturated Pressure)".

And the FBD of WATER_PT2V is shown as following figure.

* WATER_PT2V	
<input type="checkbox"/> TMPRT	M <input type="checkbox"/>
<input type="checkbox"/> PRESS	V <input type="checkbox"/>
	ERR <input type="checkbox"/>
	STA <input type="checkbox"/>
p0002	2#

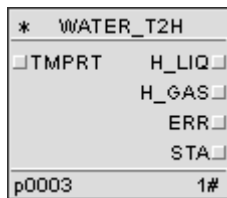
Parameter		Instruction
Input Pin	TMPRT	Input temperature (In: .degree.C)
	PRESS	Input pressure (In: MPa)
Output Pin	M	Output density (In: kg/m3)
	V	Output specific volume (In:m3/kg)
	ERR	Module Alarm.

Parameter		Instruction
		"ON" means error, and "OFF" means normal.
	STA	Alarm Status, for detail refer to "Alarm Status".
Configuration Parameter	MODE	Mode selection. 0: water area 1: gas area 2: critical area 3: automatic judgment 4: gas area or critical area

15.25 WATER_T2H(Computing Specific Enthalpy with Saturated Temperature)

The FBD of WATER_T2H is used to compute specific enthalpy with the input saturated temperature. The compute of WATER_T2H is worked according the figure in "WATER_P2H(Computing Specific Enthalpy with Saturated Pressure)".

And the FBD of WATER_T2H is shown as following figure.



Parameter		Instruction
Input Pin	TMPRT	Input temperature (In: .degree.C)
Output Pin	H_LIQ	Output saturated water specific enthalpy (In:kJ/kg)
	H_GAS	Output moist steam specific enthalpy (In: kJ/kg)
	ERR	Module Alarm. "ON" means error, and "OFF" means normal.
	STA	Alarm Status, for detail refer to "Alarm Status".

15.26 WATER_T2P(Computing Specific Pressure with Saturated Temperature)

The FBD of WATER_T2P is used to compute temperature with the input pressure and specific enthalpy. The compute of WATER_T2P is worked according the figure in "WATER_P2H(Computing Specific Enthalpy with Saturated Pressure)".

And the FBD of WATER_T2P is shown as following figure.

* WATER_T2P	
<input type="checkbox"/> TMPRT	<input type="checkbox"/> PRESS
	<input type="checkbox"/> ERR
	<input type="checkbox"/> STA
p0001	2#

Parameter		Instruction
Input Pin	TMPRT	Input temperature (In: .degree.C)
Output Pin	PRESS	Input pressure(In:MPa).
	ERR	Module Alarm."ON" means error, and "OFF" means normal.
	STA	Alarm Status, for detail refer to "Alarm Status".

15.27 WATER_T2S(Computing Specific Entropy with Saturated Temperature)

The FBD of WATER_ T2S is used to compute temperature with the input pressure and specific enthalpy. The compute of WATER_ T2S is worked according the figure in "WATER_P2H(Computing Specific Enthalpy with Saturated Pressure)".

And the FBD of WATER_ T2S is shown as following figure.

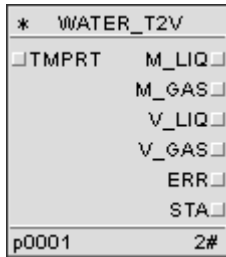
* WATER_T2S	
<input type="checkbox"/> TMPRT	<input type="checkbox"/> S_LIQ
	<input type="checkbox"/> S_GAS
	<input type="checkbox"/> ERR
	<input type="checkbox"/> STA
p0002	1#

Parameter		Instruction
Input Pin	TMPRT	Input temperature (In: .degree.C)
Output Pin	S_LIQ	Output saturated water specific entropy (In:kJ/(kg*.degree.C))
	S_GAS	Output moist steam specific entropy (In:kJ/(kg*.degree.C))
	ERR	Module Alarm. "ON" means error, and "OFF" means normal.
	STA	Alarm Status, for detail refer to "Alarm Status".

15.28 WATER_T2V(Computing Specific Volume with Saturated Temperature)

The FBD of WATER_ T2V is used to compute Specific Volume with the input Saturated Temperature. The compute of WATER_ T2V is worked according the figure in "WATER_P2H(Computing Specific Enthalpy with Saturated Pressure)".

And the FBD of WATER_ T2V is shown as following figure.

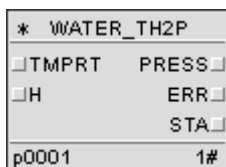


Parameter		Instruction
Input Pin	TMPRT	Output windup temperature (In: .degree.C)
Output Pin	M_LIQ	Output saturated water density (In:kg/m3)
	M_GAS	Output moist steam density (In:kg/m3)
	V_LIQ	Output saturated water specific volume (In:m3/kg)
	V_GAS	Output moist steam specific volume (In:m3/kg)
	ERR	Module Alarm. "ON" means error, and "OFF" means normal.
	STA	Alarm Status, for detail refer to "Alarm Status".

15.29 WATER_TH2P(Computing Pressure with Temperature and Specific Enthalpy)

The FBD of WATER_ TH2P is used to compute Pressure with the input Temperature and Specific Enthalpy. The compute of WATER_ TH2P is worked according the figure in "WATER_P2H(Computing Specific Enthalpy with Saturated Pressure)".

And the FBD of WATER_ TH2P is shown as following figure.



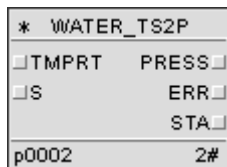
Parameter		Instruction
Input Pin	TMPRT	Output windup temperature (In: .degree.C)
	H	Input specific enthalpy (In: kJ/kg)
Output Pin	PRESS	Input pressure (In: MPa)

Parameter		Instruction
	ERR	Module Alarm. "ON" means error, and "OFF" means normal.
	STA	Alarm Status, for detail refer to "Alarm Status".
Configuration Parameter	MODE	Mode selection. 0: water area 1: gas area 2: critical area 3:automatic judgment 4.gas area or critical area

15.30 WATER_TS2P(Computing Pressure with Temperature and Specific Entropy)

The FBD of WATER_ TS2P is used to compute Pressure with the input Temperature and Specific Entropy. The compute of WATER_ TS2P is worked according the figure in "WATER_P2H(Computing Specific Enthalpy with Saturated Pressure)".

And the FBD of WATER_ TS2P is shown as following figure.



Parameter		Instruction
Input Pin	TMPRT	Output windup temperature (In: .degree.C)
	S	Input specific entropy (In: kJ/(kg*.degree.C))
Output Pin	PRESS	Input pressure (In: MPa)
	ERR	Module Alarm. "ON" means error, and "OFF" means normal.
	STA	Alarm Status, for detail refer to "Alarm Status".
Configuration Parameter	MODE	Mode selection. 0: water area 1: gas area 2: critical area 3:automatic judgment 4.gas area or critical area

16 FF Standard Function Block Library

16.1 Foundation Overview

Foundation Fieldbus (FF) is a fieldbus for process control developed by Fieldbus Foundation. FF provides the Function Block (FB) for user layer as basic unit for control engineer to perform control application. FB is a software logic process unit taking data structure as the core, to execute an independent and completed control function, and provides diagnosis and alarm functions. Function block of field device consists of FF standard function block and customized function block of manufacturer.

This system provides mapping function block for each FF standard function block. For example, mapping function blocks FFAI, FFPID, FFAO are provided to correspond to FF standard function blocks AI, PID, AO separately. For customized function block of manufacturer, FFCUSTOM is provided for unified mapping.

Mapping function block represents the FF field device function block in DCS, by which to achieve real-time monitoring, control scheme configuration, alarm collection and real-time control can be achieved in this system. Mapping function block connecting standard function block can achieve mixed control.

16.1.1 Modes

Supported and Permitted Modes

All blocks have a mode parameter, which consists of Target Mode, Actual mode, Permit Mode, Normal Mode.

- **MODE_TRG**
It is user-defined and should be an option of MODE_PER. Only one target mode can be set at one time.
- **MODE_ACT**
The actual mode is worked out by FF function block combining target mode, input parameter status and other parameter (such as track switch), etc.
- **MODE_PER**
It is user-defined and should be mode for the function block type permitted by FF protocol. Several modes can be set once. IMAN and LO cannot be options of Permitted Mode.
- **MODE_NR**
It is user-defined and should be an option of MODE_PER. Its main function is indication and has no influence for execution result of function block.

Mode Definition

FF standard protocol provides 8 modes, which sorted by priority are OOS > IMAN > LO > MAN > AUTO > CAS > RCAS > ROUT.

- OOS
Function block is out of service.
- IMAN
When the downstream function block is not in CAS mode or not use the output parameter of upstream function block to calculate output, the upstream function block enters IMAN mode.
- LO
For control function block like FFPID, when SWTR = ON, and the function block cannot meet higher priority condition, it enters LO mode, and the output is track input value. For output function block FFAO, when the target mode is CAS, and the input value from upstream function block cannot meet the condition to enter CAS mode, output hold or failsafe value.
- MAN
Function block output is set by operator.
- AUTO
Activate function block control algorithm. SV of operator is used to calculated output value.
- CAS
Activate function block control algorithm. Calculate output value via CSV (FF parameter CAS_IN) set by upstream block. It connects BKOUT (FF parameter BKCAL_OUT) with upstream function block and achieve non-reference switch o between modes.
- RCAS
Activate function block control algorithm. Like CAS, while using RSVI (FF parameter RCAS_IN) to calculate output value. It connects RSVO (FF parameter RCAS_OUT) with upstream block to achieve non-reference switch between modes.
- ROUT
Like MAN, while it is given by outer program via ROI (FF parameter ROUT_IN), but not by operator manually. It connects ROO (FF parameter ROUT_OUT) with upstream block to achieve non-reference switch between modes.

16.1.2 I/O Block Channel Setting

Function blocks of input and output include FFAI, FFAO, FFDI, FFDO, FFMAI, FFMAO, FFMDI, FFMDO, etc. They work with transducer blocks to achieve input and output of field signal.

Single-input/output blocks, such as FFAI, FFAO, FFDI, FFDO, can associate with transducer block via CHANNEL.

Multi-input/output blocks, such as FFMAI, FFMAO, FFMDI, FFMDO, perform multi-channel mode settings via CHANNEL. There are 2 methods, associate by fixed sequence, or each channel perform single channel setting separately.

The number, serial number and measuring type of transducer block are different for different device. Thus, one FFAI block has different channel values for different transducer block of device. Please refer to the device user manual for details. The channel value is valid transducer block serial number of device, the type of transducer block corresponding to channel value should be same with the block type. FFAI block cannot associate with a transducer block of Discrete. If the channel is set illegally, the device will generates alarm or not receive write-in of illegal value.

16.1.3 Failsafe Function

Only function blocks of output, i.e. FFAO, FFDO, FFMAO, FFMDO, support failsafe function. Time counting will be started once the device function block detects fault. When the accumulated time reaches FST_TIME, output function block activates failsafe function and enters LO mode, keep output value or output FST_VAL, to achieve protection for field when fault occurs. Conditions trigger starting fault time accumulation including communication failure, status of cascade input pin is GoodCascade_Initiate Fault Status, and power down restart. User can set "Fault Status to Value" and "Use Fault Status Value on restart" of IO_OPTS, MO_OPTS to use the output fault value of block when failsafe function is activated.

16.1.4 Process Alarm

Function block alarms include enabled alarm and disabled alarm.

Suppress Disabled Alarm

User cannot eliminate the alarm via alarm enable. It includes:

- ERR
ERR will be generated when the mapping function block detects that the fault of AM712 has accumulated to 8s, or corresponding device lost, or configuration mismatched. When the alarm generates, the mapping function block will stop updating data of device function block.
- FF_ALARM
When BLOCK_ERR is not 0, FF_ALARM is generated.

Suppress Enabled Alarm

1. Generated by Mapping Function Block

Enable the mapping function block alarm via ENALM_EX. If FF function block has limit for parameter, the mapping function block will generate H/L Limit Alarm based on the limit information, for example, the H/L Limit Alarm of FFPID.

2. Generated by Device Function Block

Enable the device function block alarm via ENALM. Device function block define the algorithm according to FF, and generates process alarm with alarm enabled parameter. The process alarm types of device function block include HH limit alarm, H limit alarm, L limit alarm, LL limit alarm, positive bias alarm, negative bias alarm, discrete alarm, etc., i.e. ENALM enables the alarm of field bus layer.

Enable the mapping function block alarm via ENALM_EX, i.e. when the device function block generates H limit alarm, and send to controller, if ENALM_EX suppress H limit alarm, the mapping function block will not generate H limit alarm, i.e. ENALM_EX enable alarm of DCS layer.

16.1.5 Extend Pin

Each mapping function block supports 4 extend pins, P01 and P02 of REAL and P03, P04 of USINT. Extend pin corresponds to the pin parameter of extend parameter/custom parameter in FF device function block, and set as input or output pin. Except that, FF mapping function block has no extend parameter and custom parameter.

In extend pin setting interface, user can build mapping relationship between extend pin and FF custom parameter via selecting FF custom parameter.

Only when FF extend pin connects DCS function block, the mapping function block can update data. When mapping function block connects or does not connect FF pin, the operations for FF device function block can be performed normally, while mapping function block cannot update date.

16.1.6 Function Block Options

IO_OPTS

Table 16.1 IO_OPTS parameter instruction

Bit	Meaning	FFAI	FFDI	FFAO	FFDO
0	Invert	-	Optional	-	Optional
1	SP- PV Track in MAN	-	-	Optional	Optional
2	Reserved	-	-	-	-

Table 16.1 IO_OPTS parameter instruction (continued)

Bit	Meaning	FFAI	FFDI	FFAO	FFDO
3	SP- PV Track in LO	-	-	Optional	Optional
4	SP Track Retained Target	-	-	Optional	Optional
5	Increase to Close	-	-	Optional	-
6	Fault Status to Value0=Hold, 1=Preset Value	-	-	Optional	Optional
7	Use FSTATUS_VAL (_D) Value on Restart	-	-	Optional	Optional
8	Target to MAN If Fault Status Activated	-	-	Optional	Optional
9	Use PV for BKCAL_OUT	-	-	Optional	Optional
10	Low Cutoff	Optional	-	-	-
11	Reserved	-	-	-	-
12	Units Conversion	Optional	-	-	-
13~15	Reserved	-	-	-	-

STATUS_OPTS

Table 16.2 STATUS_OPTS parameter instruction

Bit	Meaning	FFAI	FFDI	FFAO	FFDO	FFCTLSL	FFPID
0	IFS if BAD IN	-	-	-	-	Optional	Optional
1	IFS if BAD CAS_IN	-	-	-	-	-	Optional
2	Use Uncertain as Good	-	-	-	-	Optional	Optional
3	Propagate Fault Forward	Optional	Optional	-	-	-	-
4	Propagate Fault Back- ward	-	-	Optional	Optional	-	-
5	Target to Manual if BAD IN	-	-	-	-	-	Optional
6	Uncertain if Limited	Optional	-	-	-	-	-
7	BAD if Limited	Optional	-	-	-	-	-

Table 16.2 STATUS_OPTS parameter instruction (continued)

Bit	Meaning	FFAI	FFDI	FFAO	FFDO	FFCTL	FFPID
8	Uncertain if Man mode	Optional	Optional	-	-	-	-
9	Target to next permitted mode if BAD CAS_IN	-	-	-	-	-	Optional
10	Target to Man if BAD TRK_IN_D	-	-	-	-	-	Optional
11	IFS if BAD TRK_IN_D	-	-	-	-	-	Optional
12~15	Reserved	-	-	-	-	-	-

CONTROL_OPTS

Table 16.3 CONTROL_OPTS parameter instruction

Bit	Meaning	FFPID
0	Bypass Enable	Optional
1	SP-PV Track in Ma	Optional
2	SP-PV Track in ROut	Optional
3	SP-PV Track in LO or IMan	Optional
4	SP Track retained target	Optional
5	Direct Acting	Optional
6	Track if Bad TRK_IN_D	Optional
7	Track Enable	Optional
8	Track in Manual	Optional
9	Use PV for BKCAL_OUT	Optional
10	Act on IR	-
11	Use BKCAL_OUT with IN_1	-
12	Obey SP limits if Cas or RCas	Optional
13	No OUT limits in Manual	Optional
14~15	Reserved	-

16.2 Status Process

Pin of FF function block consists of value and status. FF protocol defines the status specification, please refer to it for details.

When pins of two function blocks connect, the value and status of pin will be sent from upstream block to downstream block as a whole. The status transition of parameter is only valid for input and output pins. Parameter with status of FF device function block consists of value and _STA.

The status parameter of mapping function block consists of value, _STA and _ERR.

In FFBDBuilder, function block has 2 connection methods:

1. Connect/Not Connect FF Mapping Function Block

Connect the 2 FF pins to achieve transition between value and status, and keep the status process function of FF function block.

Calculate _ERR via _STA.

2. Connect FF Mapping Function Block and DCS Function Block.

- FF Input Pin

Achieve the value transition from DCS pin to FF input pin via the connection.

Calculate _STA via _ERR.

- FF Output Pin

Achieve the value transition from FF output pin to DCS pin via the connection.

Calculate _ERR via _STA.

16.2.1 Pin Status Instruction

Table 16.4 Pin Status Instruction of Mapping Function Block

ERR>STA		STA>ERR
FFAI		
OUT	-	When in status of GoodNC or GoodC, ERR = OFF, otherwise ERR=ON.
FFPID		
BKIN	ERR = OFF, STA = GoodC_NS;ERR = ON, STA = GoodC_NI	When STA is GoodC_NonSpecific, ERR = OFF, otherwise ERR=ON.
CSV	ERR = OFF, STA = GoodC_NS;ERR = ON, STA = Bad	When in status of GoodNC or GoodC, ERR = OFF, otherwise ERR=ON.
IN	ERR = OFF, STA = GoodC_NS;ERR = ON, STA = Bad	When in status of GoodNC or GoodC, ERR = OFF, otherwise ERR=ON.
FF_VAL	ERR = OFF, STA = GoodC_NS;ERR = ON, STA = Bad	When in status of GoodNC or GoodC, ERR = OFF, otherwise ERR=ON.
SWTR	ERR = OFF, STA = GoodC_NS;ERR = ON, STA = Bad	When in status of GoodNC or GoodC, ERR = OFF, otherwise ERR=ON.

Table 16.4 Pin Status Instruction of Mapping Function Block (continued)

ERR>STA		STA>ERR
TV	ERR = OFF, STA = GoodC_NS;ERR = ON, STA = Bad	When in status of GoodNC or GoodC, ERR = OFF, otherwise ERR=ON.
RSVI	ERR = OFF, STA = GoodC_NS;ERR = ON, STA = Bad	When in status of GoodNC or GoodC, ERR = OFF, otherwise ERR=ON.
BKOUT	-	When STA is GoodC_NonSpecific, ERR = OFF, otherwise ERR=ON.
MV	-	When in status of GoodNC or GoodC, ERR = OFF, otherwise ERR=ON.
FFAO		
CSV	ERR = OFF, STA = GoodC_NS;ERR = ON, STA = Bad	When in status of GoodNC or GoodC, ERR = OFF, otherwise ERR=ON.
OUT	-	When in status of GoodNC or GoodC, ERR = OFF, otherwise ERR=ON.
BKOUT	-	When STA is GoodC_NonSpecific, ERR = OFF, otherwise ERR=ON.
FFDI		
OUT	-	When in status of GoodNC or GoodC, ERR = OFF, otherwise ERR=ON.
FFDO		
CSV	ERR = OFF, STA = GoodC_NS;ERR = ON, STA = Bad	When in status of GoodNC or GoodC, ERR = OFF, otherwise ERR=ON.
OUT	-	When in status of GoodNC or GoodC, ERR = OFF, otherwise ERR=ON.
BKOUT	-	When STA is GoodC_NonSpecific, ERR = OFF, otherwise ERR=ON.
FFMAI		
OUT1~8	-	When in status of GoodNC or GoodC, ERR = OFF, otherwise ERR=ON.
FFMAO		
IN1~8	ERR = OFF, STA = GoodC_NS;ERR = ON, STA = Bad	When in status of GoodNC or GoodC, ERR = OFF, otherwise ERR=ON.
FFMDI		
OUT1~8	-	When in status of GoodNC or GoodC, ERR = OFF, otherwise ERR=ON.
FFMDO		

Table 16.4 Pin Status Instruction of Mapping Function Block (continued)

ERR>STA		STA>ERR
IN1~8	ERR = OFF, STA = GoodC_NS;ERR = ON, STA = Bad	When in status of GoodNC or GoodC, ERR = OFF, otherwise ERR=ON.
FFISEL		
IN1~4	ERR = OFF, STA = GoodC_NS;ERR = ON, STA = Bad	When in status of GoodNC or GoodC, ERR = OFF, otherwise ERR=ON.
DIS1~4	ERR = OFF, STA = GoodC_NS;ERR = ON, STA = Bad	When in status of GoodNC or GoodC, ERR = OFF, otherwise ERR=ON.
OP_SEL	ERR = OFF, STA = GoodC_NS;ERR = ON, STA = Bad	When in status of GoodNC or GoodC, ERR = OFF, otherwise ERR=ON.
OUT	-	When in status of GoodNC or GoodC, ERR = OFF, otherwise ERR=ON.
SEL	-	When in status of GoodNC or GoodC, ERR = OFF, otherwise ERR=ON.
FFCTLSEL		
IN1~3	ERR = OFF, STA = GoodC_NS;ERR = ON, STA = Bad	When in status of GoodNC or GoodC, ERR = OFF, otherwise ERR=ON.
BKIN	RR = OFF, STA = GoodC_NS;ERR = ON, STA = Bad	When STA is GoodC_NonSpecific, ERR = OFF, otherwise ERR=ON.
BKOUT1~3	-	When STA is GoodC_NonSpecific or GoodC_NotSelect, ERR = OFF, otherwise ERR=ON.
OUT	-	When in status of GoodNC or GoodC, ERR = OFF, otherwise ERR=ON.
FFARTHM		
IN	ERR = OFF, STA = GoodC_NS;ERR = ON, STA = Bad	When in status of GoodNC or GoodC, ERR = OFF, otherwise ERR=ON.
IN1~3	ERR = OFF, STA = GoodC_NS;ERR = ON, STA = Bad	When in status of GoodNC or GoodC, ERR = OFF, otherwise ERR=ON.
IN_L	ERR = OFF, STA = GoodC_NS;ERR = ON, STA = Bad	When in status of GoodNC or GoodC, ERR = OFF, otherwise ERR=ON.
OUT	-	When in status of GoodNC or GoodC, ERR = OFF, otherwise ERR=ON.
FFINT		
IN1~2	ERR = OFF, STA = GoodC_NS;ERR = ON, STA = Bad	When in status of GoodNC or GoodC, ERR = OFF, otherwise ERR=ON.
RIN	ERR = OFF, STA = GoodC_NS;ERR = ON, STA = Bad	When in status of GoodNC or GoodC, ERR = OFF, otherwise ERR=ON.

Table 16.4 Pin Status Instruction of Mapping Function Block (continued)

ERR>STA		STA>ERR
REV1~2	ERR = OFF, STA = GoodC_NS;ERR = ON, STA = Bad	When in status of GoodNC or GoodC, ERR = OFF, otherwise ERR=ON.
OUT	-	When in status of GoodNC or GoodC, ERR = OFF, otherwise ERR=ON.
PTRP	-	When in status of GoodNC or GoodC, ERR = OFF, otherwise ERR=ON.
TRIP	-	When in status of GoodNC or GoodC, ERR = OFF, otherwise ERR=ON.
FFSGCR		
IN1~2	ERR = OFF, STA = GoodC_NS;ERR = ON, STA = Bad	When in status of GoodNC or GoodC, ERR = OFF, otherwise ERR=ON.
OUT1~2	-	When in status of GoodNC or GoodC, ERR = OFF, otherwise ERR=ON.
FFSPLIT		
BKIN1~2	ERR = OFF, STA = GoodC_NS;ERR = ON, STA = Bad	When STA is GoodC_NonSpecific, ERR = OFF, otherwise ERR=ON.
CSV	ERR = OFF, STA = GoodC_NS;ERR = ON, STA = Bad	When in status of GoodNC or GoodC, ERR = OFF, otherwise ERR=ON.
BKOUT	-	When STA is GoodC_NonSpecific, ERR = OFF, otherwise ERR=ON.
MV1~2	-	When in status of GoodNC or GoodC, ERR = OFF, otherwise ERR=ON.

16.2.2 Notice of FF and DCS Blocks

- Different Result with only FF connection.

For single loop, the upstream PID is FF device function block, AO function block is DCS block. If fault of AO occurs, the BKINERR of upstream FFPID block connected is ON, the BKIN_STA value of FFPID is GoodC_NI. FFPID enters IMAN.

If AO function block is FF device function block, when fault (communication fault with field) of AO occurs, _STA of BKIN is Bad_NoCommuWithLUV. FFPID enters IMAN, while the BKIN status of FFPID will be different in 2 configurations.

For others, because the process of FF block is different with DCS block, for the same program, applying FF block or DCS block will generate different results.

- Sub-status Information Loss

For example, when FFPID calculates IN_STA via IN_ERR, information loss will occur. IN_ERR is provided by AI block of DCS, i.e. ERR pin of AI. Conditions when ERR=ON include communication failure, AI block fault, AI channel fault. Sub-status cannot be confirmed via ERR = ON. Thus, when IN_ERR=ON, set _STA as Bad_NonSpecific, the sub-status information has a loss.

- Limit Information Loss

Because the write status cannot get the limit information of input, the sending _STA will not contain limit information. If FFPID connects AO, and its BKIN loses limit information, the anti-integral windup function of FFPID will be influenced. For example, when the downstream AO reaches maximum output, and FFPID does not reach limit, because there is no limit information feedback to FFPID via BKIN, thus the integral will continue accumulation till the limit of FFPID, and FFPID enters the windup area of a range (AO limit, FFPID limit).

16.3 FFAI

16.3.1 Overview

FFAI block represents the field device function block AI, by which DCS can monitor and control the field device AI.

16.3.2 Parameter Description

Table 16.5 FFAI Parameter Description

Parameter Name		Description	Upload	Property	FF Parameter Name	Application Instruction
Basic Parameters						
Signal Convert Setting	PV_FTIME	Filter Time Constant	TRUE	Operation Parameter	PV_FTIME	Not filter when it is 0.
	CHANNEL	Channel	TRUE	Configuration Parameter	CHANNEL	Associate transducer block in the same type of device.
	IO_OPTS	IO options. It can be viewed and configured by clicking "Settings" button.	TRUE	Configuration Parameter	IO_OPTS	Enable functions of low cutoff and units conversion.
	L_TYPE	Signal conversion type. It can be viewed and con-	TRUE	Configuration Parameter	L_TYPE	Set the signal conversion method.

Table 16.5 FFAI Parameter Description (continued)

Parameter Name		Description	Upload	Property	FF Parameter Name	Application In-struction
		figured by clicking “Settings” button.				
	STA_-OPTS	Status options. It can be viewed and configured by clicking “Settings” button.	TRUE	Configura-tion Para-meter	STATUS_-OPTS	Process when pa-rameter status is il-legal.
	SWUNCTN	Uncertain Status Switch (OFF=Use uncertain as bad; ON=Use uncer-tain as good)	TRUE	Configura-tion Para-meter	SWUNCTN	The default value is OFF. When FFAI.OUT status is Uncertain, OUTERR will be set to ON or OFF based on the value of this parameter.
Scale Set-ting	OUT_-SCH	Output Scale H Limit	TRUE	Configura-tion Para-meter	OUT_SCALE	Work for OUT and PV.
	OUT_-S-CL	Output Scale H Limit	TRUE	Configura-tion Para-meter	OUT_SCALE	
	OUT_-EU	Output Unit	TRUE	Configura-tion Para-meter	OUT_SCALE	
	OUT_-DLEN	Output Decimal Digits	TRUE	Configura-tion Para-meter	OUT_SCALE	
	XD_-SCH	Field Signal Scale H Limit	TRUE	Configura-tion Para-meter	XD_SCALE	Set the H/L limits as same as range of corresponding transducer block, and the unit as same as trans-ducer block. The unit type should be supported by transducer block. Otherwise, the function block will be in OOS mode.
	XD_-S-CL	Field Signal Scale H Limit	TRUE	Configura-tion Para-meter	XD_SCALE	
	XD_EU	Field Signal Unit	TRUE	Configura-tion Para-meter	XD_SCALE	
	XD_-DLEN	Field Signal Deci-mal Digits	TRUE	Configura-tion Para-meter	XD_SCALE	
Extended Parameters						
Output Pin	OUT	Output Value	-	Output Pin	OUT	-
	OUT_-ERR	Output Quality	-	Output Pin	-	-

Table 16.5 FFAI Parameter Description (continued)

Parameter Name	Description	Upload	Property	FF Parameter Name	Application Instruction
	When OUT_ER-R=ON, generate OUTERR alarm that lasts for at least 2 seconds.				
	OUT_S-TA	-	Output Pin	OUT	-
Alarm Indication	BLCK_ERR	-	Monitoring Parameter	BLOCK_ERR	-
	H	-	Monitoring Parameter	HI_ALM	ON when the alarm occurs. Alarm is generated by device.
	HH	-	Monitoring Parameter	HI_HI_ALM	
	L	-	Monitoring Parameter	LO_ALM	
	LL	-	Monitoring Parameter	LO_LO_ALM	
	FLAG	-	Monitoring Parameter	-	-
Real Status	FLD_VAL	-	Monitoring Parameter	FIELD_VAL	Detected value of hardware channel, percentage.
	FLD_S-TA	-	Monitoring Parameter	FIELD_VAL	-
	PV	-	Monitoring Parameter	PV	Process value of hardware channel, engineering value.
	PV_STA	-	Monitoring Parameter	PV	-
	ST_REV	-	Monitoring Parameter	ST_REV	When static parameter changes, the static revision will be incremented.

Table 16.5 FFAI Parameter Description (continued)

Parameter Name		Description	Upload	Property	FF Parameter Name	Application Instruction
Operate Command	MOD-E_ACT	Actual mode, it can be viewed by clicking "Settings" button.	-	Monitoring Parameter	MODE_BLK	Actual mode of running function block.
	MANOUT	Manual Operate Output Value	TRUE	Operation Parameter	-	In OOS and MAN modes, change MANOUT can change output value directly.
	MOD-E_TRG	Target mode. It can be viewed and configured by clicking "Settings" button.	TRUE	Operation Parameter	MODE_BLK	Target mode should be one of the permit modes.
	MOD-E_PRM	Permit mode. It can be viewed and configured by clicking "Settings" button.	TRUE	Operation Parameter	MODE_BLK	Permit Mode
	MOD-E_NR	Normal mode. It can be viewed and configured by clicking "Settings" button.	TRUE	Operation Parameter	MODE_BLK	Normal mode provides guidance and has no influence for control algorithm.
Alarm Management	AOF	Suppress Module Alarm	TRUE	Operation Parameter	-	-
	ACK_OPT	Automatically Acknowledged Alarm Options	TRUE	Operation Parameter	ACK_OPTION	-
	ENALM	Enable Fieldbus Alarm in Device	TRUE	Operation Parameter	ALARM_SUM	Suppress/ Enable alarm in device.
	ENALM_EX	Enable alarm in controller, it can be viewed and configured by clicking "Settings" button.	TRUE	Operation Parameter	-	Suppress/ Enable Controller Alarm
Signal Convert Setting	LOW_CUT	Low Cutoff Value	TRUE	Operation Parameter	LOW_CUT	Actual Value
Alarm Limits Setting	ALM_HYS	Alarm Hysteresis	TRUE	Operation Parameter	ALARM_HYS	Unit: Percentage
	HH_LIM	HH Alarm Limit	TRUE	Operation Parameter	HI_HI_LIM	H Limit Alarm of OUT

Table 16.5 FFAI Parameter Description (continued)

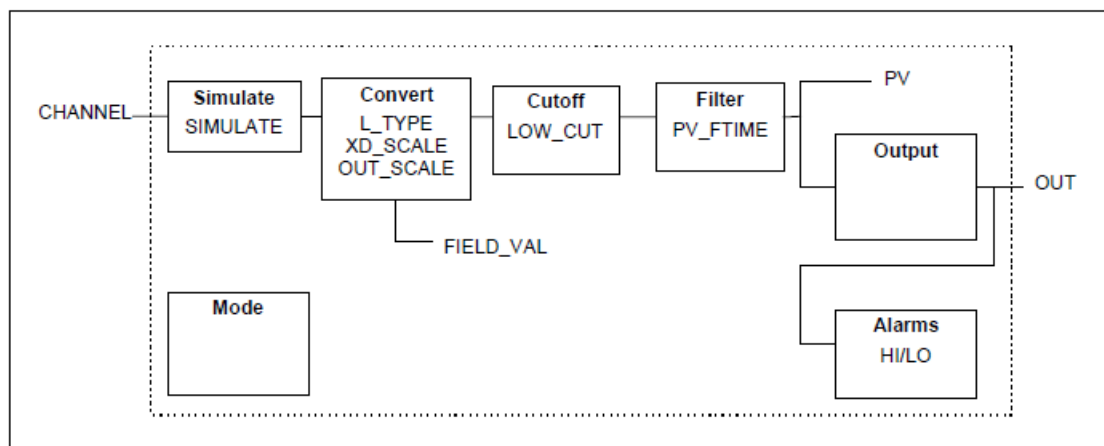
Parameter Name		Description	Upload	Property	FF Parameter Name	Application Instruction
	H_LIM	H Alarm Limit	TRUE	Operation Parameter	HI_LIM	
	L_LIM	L Alarm Limit	TRUE	Operation Parameter	LO_LIM	
	LL_LIM	LL Alarm Limit	TRUE	Operation Parameter	LO_LO_LIM	
Extend Pin	P01	Extend Pin1	-	Extend Pin	Extend pin of actual configuration associated device function block	-
	P01_S-TA	Extend Pin1 status, it can be viewed by clicking "Settings" button.	-	Extend Pin	Extend pin status of actual configuration associated device function block	-
	P02	Extend Pin2	-	Extend Pin	Extend pin of actual configuration associated device function block	-
	P02_S-TA	Extend Pin2 status, it can be viewed by clicking "Settings" button.	-	Extend Pin	Extend pin status of actual configuration associated device function block	-
	P03	Extend Pin3	-	Extend Pin	Extend pin of actual configuration associated device function block	-
	P03_S-TA	Extend Pin3 status, it can be viewed by clicking "Settings" button.	-	Extend Pin	Extend pin status of actual configuration associated device function block	-
	P04	Extend Pin4	-	Extend Pin	Extend pin of actual configuration associated device function block	-
	P04_S-TA	Extend Pin4 status, it can be viewed by click-	-	Extend Pin	Extend pin status of actual configu-	-

Table 16.5 FFAI Parameter Description (continued)

Parameter Name	Description	Upload	Property	FF Parameter Name	Application Instruction
	ing “Settings” button.			ration associated device function block	
Simulation Function	SWSIM	Simulation switch	-	Extend Pin	-
	SIM_VAL	Simulate raw input values	-	Extend Pin	-
	SIM_STA	Simulate the original inout value status	-	Extend Pin	-

16.3.3 Instruction Details

Schematic of AI

**Figure 16.1 Schematic of AI**

Algorithm

- Transducer Block Association
Through setting the parameter CHANNEL of FFAI to associate transducer block corresponding to device, define physical transducer and get field signal.

If CHANNEL value is set illegal, device function block will not receive, and the parameter CHANNEL of device function block will keep the original value. For example, if channel value is not device transducer block number, the transducer block corresponding to channel value is not AI type.

- Scale Setting

- XD_SCALE

XD_SCH and XD_SCL are applied to the value the channel to produce the FIELD_VAL in percent. Thus, the limits of range should be same with transducer block. Otherwise, difference between output value and actual value will be generated.

The XD_EU unit must be same with the corresponding transducer block. Otherwise, the function block will be in OOS mode.

XD_DLEN is applied when function block getting channel value from transducer block. It will influence the later control precision.

- OUT_SCALE

OUT_SCH and OUT_SCL determine the conversion from FIELD_VAL to output. PV and OUT always have identical scaling.

OUT_EU is normally set as the unit of transducer measuring signal.

OUT_DLEN will only work for display but has no influence for control precision.

- Signal Conversion

$FIELD_VAL = 100 * (\text{channel value} - \text{Scale H Limit}) / (\text{Scale H Limit} - \text{Scale H Limit})$. The scale is XD scale.

1. Set L_TYPE as no conversion

PV = channel value.

Set L_TYPE as linear conversion

$PV = (FIELD_VAL/100) * (\text{Scale H Limit} - \text{Scale H Limit}) + \text{Scale H Limit}$ (The scale is OUT scale).

2. Set L_TYPE as linear conversion

$PV = \sqrt{(FIELD_VAL/100) * (\text{Scale H Limit} - \text{Scale H Limit}) + \text{Scale H Limit}}$ (The scale is OUT scale).

- Low Cutoff

If IO_OPTS selects Low Cutoff, the Low Cutoff will be performed. When input signal is less than Low Cutoff Value, AI value is 0% of scale, and equal to Scale H Limit.

Low Cutoff Value is Actual Value.

- Filter

The first order hysteresis filter performed by input AI signal can prevent from high/low frequency interference, eliminate serious random interference and interference of large input jump caused by unsteady field transducer.

Filter time is PV_FTIME, when PV_FTIME = 0, no filter.

- **Supported Mode**
OOS, MAN and AUTO.
- **Alarm Types**
The function block can perform alarm process, including HH, H, L, LL, for OUT, each can has hysteresis.
- **Panel**
Input tag name in supervision to pop up the operation panel of FF block, the device panel displays OUT trend.
- **Other**
FFAI does not support the setting of simulation function block and parameter alarm priority. Simulation function block can be set via FFBuilder.

Simulation Description

Under the simulation controller, when the SWSIM is equal to ON, system enters the simulation status. When SWSIM is equal to OFF, system exits the simulation mode and does not determine if the controller is in the debug status. When FIELD_STA = SIM_STA, the statu processing is working according to STATUS_OPTS and calculate PV_STA, OUT_STA and OUT_ERR.

Under the real controller, when the controller is in the debug status and the SWSIM is equal to ON, system enters the simulation mode. And when the SWSIM is equal to OFF, system exits the simulation mode.

16.3.4 Panel Parameter

The function block panel of FFAI is shown as figure below.

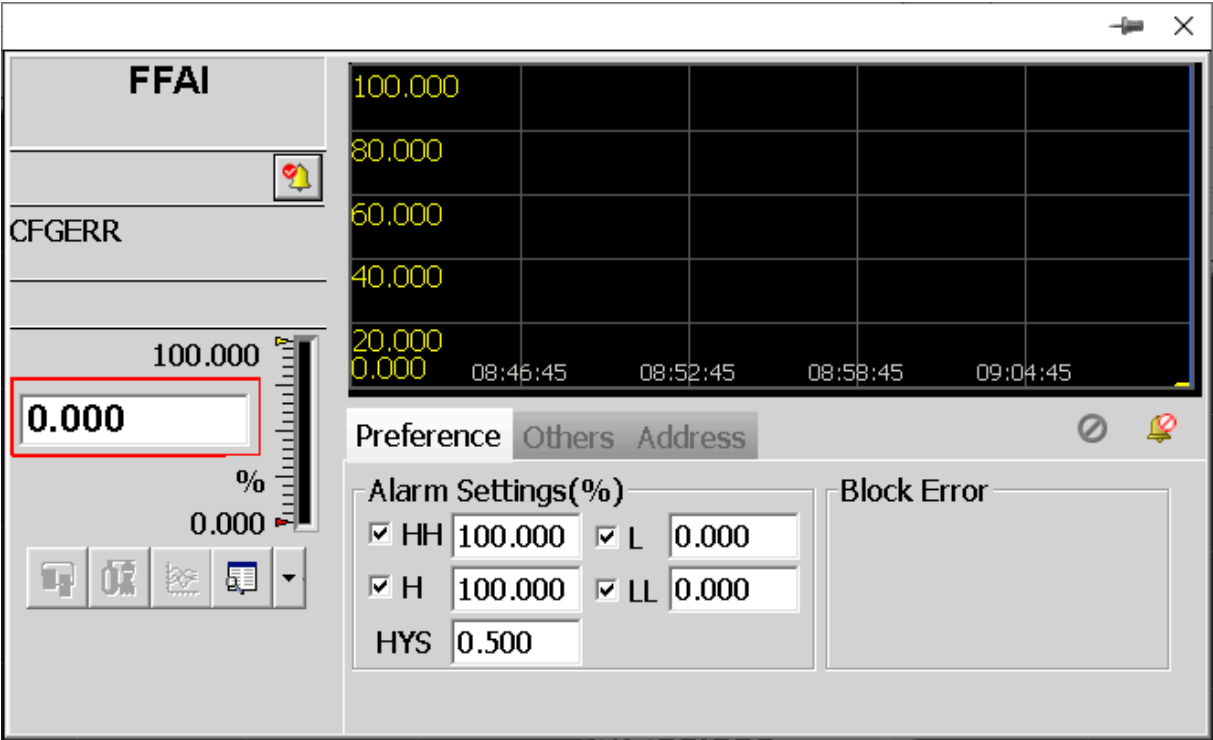


Figure 16.2 Preference Panel of FFAI

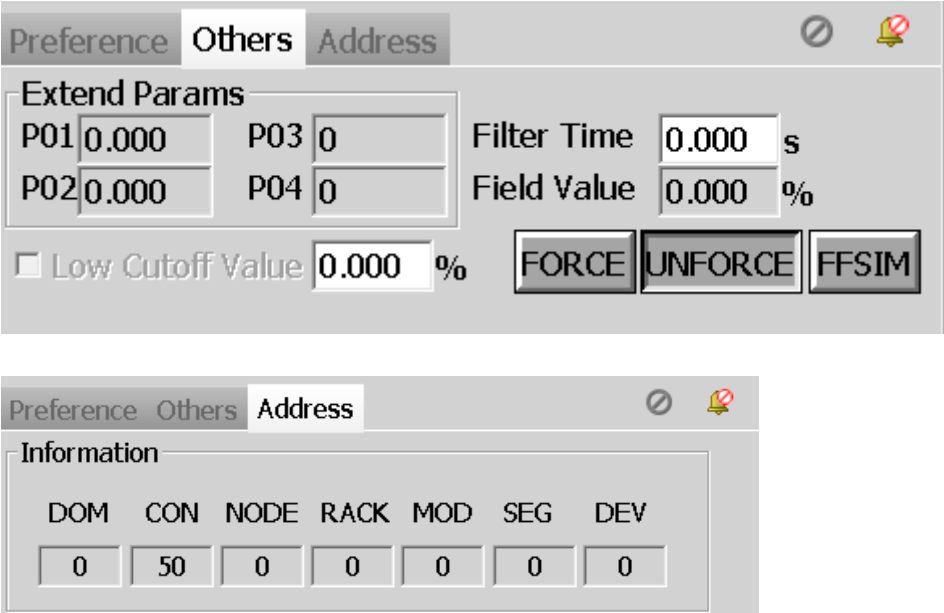


Figure 16.3 Other Panel of FFAI

Table 16.6 FFAI Panel Parameters Instruction

Panel Parameters			FBD Parameter	Initial Value
Preference	Alarm Settings	HH	HH_LIM	100.0
		H	H_LIM	100.0
		L	L_LIM	0.0

Table 16.6 FFAI Panel Parameters Instruction (continued)

Panel Parameters			FBD Parameter	Initial Value
Others		LL	LL_LIM	0.0
		HYS	ALM_HYS	0.5
	Extend Params	P01	P01	0.0
		P02	P02	0.0
		P03	P03	0
		P04	P04	0
	Filter Time		PV_FTIME	0
	Field Value		FLD_VAL	0
	Low Cut		LOW_CUT	0

16.3.5 Flag

FFAI flag instruction is shown as below.

Table 16.7 Flag of FFAI

Flag	Alarm	Instruction
D0	OOS	Disable
D3	FORCE	Force
D4	UNFORCE	Unforce
D8	FF_ALARM	FF Block Alarm
D11	PVL	PV L Limit Alarm
D12	PVLL	PV LL Limit Alarm
D13	PVH	PV H Limit Alarm
D14	PVHH	PV HH Limit Alarm
D25	SIMUL	-
D27	CFGERR	Configuration Error
D29	ERR	Fault
D30	AOF	Suppress Alarm

16.4 FFPID

16.4.1 Overview

FFPID block represents the field device function block PID, by which DCS can monitor and control the field device PID.

16.4.2 Parameter Description

Table 16.8 FFPID parameter description

Parameter Name			Description	Upload	Property	FF Parameter Name	Application Instruction
Basic Parameters	Limits Setting	MVH_-LIM	MV H Limit Value	TRUE	Operation Parameter	OUT_HI_LIM	Value Range [MVS-CL,MVSCH]
		MVL_-LIM	MV L Limit Value	TRUE	Operation Parameter	OUT_LO_LIM	Value Range [MVS-CL,MVSCH]
		SVH_-LIM	SV H Limit Value	TRUE	Operation Parameter	SP_HI_LIM	Value Range [SVS-CL,SVSCH]
		SVL_-LIM	SV L Limit Value	TRUE	Operation Parameter	SP_LO_LIM	Value Range [SVS-CL,SVSCH]
		SVRH_-LIM	SV Velocity H Limit Value	TRUE	Operation Parameter	SP_RATE_UP	Working in AUTO mode.
		SVR-L_-LIM	SV Velocity L Limit Value	TRUE	Operation Parameter	SP_RATE_DN	
	Options Setting	CTR_-OPTS	Control options, It can be viewed and configured by clicking "Settings" button.	TRUE	Configuration Parameter	CONTROL_-OPTS	Configure functions such as bypass, SV track, direct/indirect acting, track mode and output limit, etc. Select by default: SP-PV Track in Man, SP-PV Track in Rout, SP-PV Track in LO or IMan
		STA_-OPTS	Status options. It can be viewed and configured by click-	TRUE	Configuration Parameter	STATUS_OPTS	Function configuration of status.

Table 16.8 FFPID parameter description (continued)

Parameter Name			Description	Upload	Property	FF Parameter Name	Application Instruction
	Scale Setting		ing "Settings" button.				Select by default: Target to Manual if BAD IN
		FF_-SCH	FF_VAL Scale High Limit	TRUE	Configuration Parameter	FF_SCALE	Parameter of FF_VAL Scale
		FF_-SCL	FF_VAL Scale Low Limit	TRUE	Configuration Parameter	FF_SCALE	
		FF_-EU	FF_VAL Engineering Unit	TRUE	Configuration Parameter	FF_SCALE	
		FF_-DLEN	FF_VAL Decimal Digits	TRUE	Configuration Parameter	FF_SCALE	
		MV_-SCH	MV Scale H Limit	TRUE	Configuration Parameter	OUT_SCALE	Parameter of MV Scale
		MV_-SCL	MV Scale L Limit	TRUE	Configuration Parameter	OUT_SCALE	
		MV_-EU	MV Engineering Unit	TRUE	Configuration Parameter	OUT_SCALE	
		MV_-DLEN	MV Decimal Digits	TRUE	Configuration Parameter	OUT_SCALE	
		PV_-SCH	PV Scale H Limit	TRUE	Configuration Parameter	PV_SCALE	Parameter of PV and SV Scales
		PV_-SCL	PV Scale H Limit	TRUE	Configuration Parameter	PV_SCALE	
		PV_-EU	PV Engineering Unit	TRUE	Configuration Parameter	PV_SCALE	
		PV_-DLEN	PV Decimal Digits	TRUE	Configuration Parameter	PV_SCALE	
		TR_-SCH	TV Scale H Limit	TRUE	Configuration Parameter	TRK_SCALE	Parameter of TV Scale

Table 16.8 FFPID parameter description (continued)

Parameter Name			Description	Upload	Property	FF Parameter Name	Application Instruction
Extended Parameters		TR_-SCL	TV Scale H Limit	TRUE	Configuration Parameter	TRK_SCALE	
		TR_-EU	TV Engineering Unit	TRUE	Configuration Parameter	TRK_SCALE	
		TR_-DLEN	TV Decimal Digits	TRUE	Configuration Parameter	TRK_SCALE	
	Input Pin	BKIN	Feedback Input	-	Input Pin	BKCAL_IN	Connect to BKOUT pin of downstream function block, and achieve troubleshooting and anti-windup functions.
		BKIN-ERR	Feedback Input Quality	-	Input Pin	-	When the downstream is DCS function block, connect to the BKOUTERR pin.
		BKIN_-STA	Feedback input status. It can be viewed and configured by clicking "Settings" button.	-	Input Pin	-	-
		CSV	Cascade Input	-	Input Pin	CAS_IN	Cascade input SV, assigned by program link. Used in CAS mode.
		CSV_-ERR	Cascade Input Quality	-	Input Pin	-	-
		CSV_-STA	Cascade input status. It can be viewed and configured by clicking "Settings" button.	-	Input Pin	CAS_IN	-
		IN	Analog Input Value	-	Input Pin	IN	Process variable input value.

Table 16.8 FFPID parameter description (continued)

Parameter Name		Description	Upload	Property	FF Parameter Name	Application Instruction
	IN_-ERR	Analog Input Value Quality	-	Input Pin	-	When AI is DCS tag, if PID is required to process AI fault, it could connect ERR pin of AI tag.
	IN_-STA	Analog input value status. It can be viewed and configured by clicking "Settings" button.	-	Input Pin	IN	-
	FF_-VAL	Feedforward Value	-	Input Pin	FF_VAL	-
	FF_-ERR	Feedforward Value Quality	-	Input Pin	-	-
	FF_-STA	Feedforward status. It can be viewed and configured by clicking "Settings" button.	-	Input Pin	FF_VAL	-
	SWTR	Track Switch	-	Input Pin	TRK_IN_D	Work with "Track Enable" function of CTR_OPTS to enable track function.
	SWTR_-ERR	Track Switch Quality	-	Input Pin	-	-
	SWTR_-STA	Track switch status. It can be viewed and configured by clicking "Settings" button.	-	Input Pin	TRK_IN_D	-
	TV	Track Input Value	-	Input Pin	TRK_VAL	Input Value in LO Mode
	TV_-ERR	Track Input Value Quality	-	Input Pin	-	-
	TV_-STA	Track input value status. It can be	-	Input Pin	TRK_VAL	-

Table 16.8 FFPID parameter description (continued)

Parameter Name			Description	Upload	Property	FF Parameter Name	Application Instruction
	Output Pin		viewed and configured by clicking "Settings" button.				
		MV	Operation Output Value	-	Output Pin	OUT	-
		MV_ ERR	Operation Output Value Quality	-	Output Pin	-	-
		MV_ STA	Operation output status, it can be viewed by clicking "Settings" button.	-	Output Pin	OUT	-
		BKOUT	Feedback Output Value	-	Output Pin	BKCAL_OUT	If the upstream function block supporting feedback, connect to its BKIN pin.
		BKOUTERR	Feedback Output Status	-	Output Pin	-	If the upstream function block supports feedback and is DCS function block, connect to its BKINERR pin.
	Re-remote Params	BKO_ STA	Feedback output status, it can be viewed by clicking "Settings" button.	-	Output Pin	BKCAL_OUT	-
		RSVI	Remote Set-point Value	TRUE	Operation Parameter	RCAS_IN	RCAS mode, SV calculation source.
		RSVI_ STA	Remote set-point status. It can be viewed and configured by clicking "Settings" button.	TRUE	Operation Parameter	RCAS_IN	-
		RS-VO	Remote Cascade Output	TRUE	Operation Parameter	RCAS_OUT	Feedback output value in RCAS mode, connect to BKIN of function block

Table 16.8 FFPID parameter description (continued)

Parameter Name			Description	Upload	Property	FF Parameter Name	Application Instruction
							providing RSVI parameter.
		RS-VO_STA	Remote cascade output status. It can be viewed and configured by clicking "Settings" button.	TRUE	Operation Parameter	RCAS_OUT	-
		ROI	Input Value of Remote Output Mode	TRUE	Operation Parameter	ROUT_IN	ROUT mode, input value.
		ROI_STA	Input status of remote output mode. It can be viewed and configured by clicking "Settings" button.	TRUE	Operation Parameter	ROUT_IN	-
		ROO	Output Value of Remote Output Mode	TRUE	Operation Parameter	ROUT_OUT	In ROUT mode, feedback output value, connects with BKIN pin of function block providing ROI parameter.
		ROO_STA	Output status of remote output mode. It can be viewed and configured by clicking "Settings" button.	TRUE	Operation Parameter	ROUT_OUT	-
	Alarm Indication	BLCK_ERR	Block alarm, it can be viewed by clicking "Settings" button.	-	Monitoring Parameter	BLOCK_ERR	-
		FLAG	Flag	-	Monitoring Parameter	-	-
		PEI	Deviation High Alarm	-	Monitoring Parameter	DV_HI_ALM	Alarm indication. ON when device generates the alarm.
		NEI	Deviation Low Alarm	-	Monitoring Parameter	DV_LO_ALM	

Table 16.8 FFPID parameter description (continued)

Parameter Name			Description	Upload	Property	FF Parameter Name	Application Instruction
		PVHH	PV HH Alarm	-	Monitoring Parameter	HI_HI_ALM	
		PVH	PV H Alarm	-	Monitoring Parameter	HI_ALM	
		PVL	PV L Alarm	-	Monitoring Parameter	LO_ALM	
		PVLL	PV LL Alarm	-	Monitoring Parameter	LO_LO_ALM	
	Real Status	PV	Process Value	-	Monitoring Parameter	PV	Process variable value of IN after processing such as filter, count output value with SV.
		PV - STA	Process Value Status, it can be viewed by clicking "Settings" button.	-	Monitoring Parameter	PV	-
		ST - REV	Static Revision	-	Monitoring Parameter	ST_REV	It will be incremented each time a static parameter is changed.
	Alarm Management	AOF	Suppress Module Alarm	TRUE	Operation Parameter	-	-
		ENALM	Enable field-bus alarm in device. It can be viewed and configured by clicking "Settings" button.	TRUE	Operation Parameter	-	Device Alarm Enabled
		ENALM - EX	Enable alarm in controller. It can be viewed and configured by clicking "Settings" button.	TRUE	Operation Parameter	-	Controller Alarm Enabled Supports: PVHH, PVLL, PVH, PVL, SVH, SVL, MVH, MVL, PEI, NEI, ERR, CFGERR, FF - ALARM, MOD-EALM ^{Note 1}

Table 16.8 FFPID parameter description (continued)

Parameter Name			Description	Upload	Property	FF Parameter Name	Application Instruction
	Operate Command	MOD-E-ACT	Actual mode, it can be viewed by clicking "Settings" button.	-	Monitoring Parameter	MODE_BLK	Actual mode
		MAN-MV	Manual Operate Output Value	TRUE	Operation Parameter	-	In OOS and MAN modes, change MANMV to change MV.
		SV	Setpoint Value	TRUE	Operation Parameter	SP	Setpoint Value, count output value with PV.
		SV-STA	Setpoint value status. It can be viewed and configured by clicking "Settings" button.	TRUE	Operation Parameter	SP	-
		MOD-E-TRG	Target mode. It can be viewed and configured by clicking "Settings" button.	TRUE	Operation Parameter	ALARM_SUM	Target mode, it should be one of the permitted modes.
		MOD-E-PRM	Permit mode. It can be viewed and configured by clicking "Settings" button.	TRUE	Operation Parameter	ALARM_SUM	Permit Mode
		MOD-E_NR	Normal mode. It can be viewed and configured by clicking "Settings" button.	TRUE	Operation Parameter	ALARM_SUM	Supporting mode, not influence the control logic.
	Advanced Options	FF-GAIN	Feedforward Gain Value	TRUE	Operation Parameter	FF_GAIN	-
		BY-PASS	Bypass. It can be viewed and configured by clicking "Settings" button.	TRUE	Operation Parameter	BYPASS	Bypass Switch
		PV-FTIME	Filter Time Constant	TRUE	Operation Parameter	PV_FTIME	Filter time. Not filter when it is 0.

Table 16.8 FFPID parameter description (continued)

Parameter Name			Description	Upload	Property	FF Parameter Name	Application Instruction
	PID Params	KP	Proportional Gain Value	TRUE	Operation Parameter	GAIN	Final proportional coefficient. Proportional action varies with KP.
		TI	Integral Time	TRUE	Operation Parameter	RESET	Integral Time. Unit: seconds. Less the TI is, the more powerful integral action is.
		TD	Derivative Time	TRUE	Operation Parameter	RATE	Derivative Time. Unit: seconds. Derivative action varies with TD.
	Alarm Limits Setting	ALM_-HYS	Process Value Alarm Hysteresis	TRUE	Operation Parameter	ALARM_HYS	-
		PEI_-LIM	H Deviation Alarm Limit	TRUE	Operation Parameter	DV_HI_LIM	-
		NEI_-LIM	L Deviation Alarm Limit	TRUE	Operation Parameter	DV_LO_LIM	-
		PVH-H_-LIM	PVHH Limit Alarm Value	TRUE	Operation Parameter	HI_HI_LIM	-
		PVH_-LIM	PVH Limit Alarm Value	TRUE	Operation Parameter	HI_LIM	-
		PVL_-LIM	PVL Limit Alarm Value	TRUE	Operation Parameter	LO_LIM	-
		PVL-L_-LIM	PVLL Limit Alarm Value	TRUE	Operation Parameter	LO_LO_LIM	-
	Fase/Slow/Increase/Decrease Value Settings	SMV	Manual Slow Increase/Decrease Value	TRUE	Operation Parameter	-	-
		FMV	Manual Fast Increase/Decrease Value	TRUE	Operation Parameter	-	-
		SSV	Setpoint Value Manual Slow Increase/Decrease Value	TRUE	Operation Parameter	-	-

Table 16.8 FFPID parameter description (continued)

Parameter Name			Description	Upload	Property	FF Parameter Name	Application Instruction
		FSV	Setpoint Value Manual Fast Increase/Decrease Value	TRUE	Operation Parameter	-	-
	Extend Pin	P01	Extend Pin1	-	Extend Pin	Extend pin of actual configuration associated device function block	-
		P01_-STA	Extend Pin1 status, it can be viewed by clicking "Settings" button.	-	Extend Pin	Extend pin status of actual configuration associated device function block	-
		P02	Extend Pin2	-	Extend Pin	Extend pin of actual configuration associated device function block	-
		P02_-STA	Extend Pin2 status, it can be viewed by clicking "Settings" button.	-	Extend Pin	Extend pin status of actual configuration associated device function block	-
		P03	Extend Pin3	-	Extend Pin	Extend pin of actual configuration associated device function block	-
		P03_-STA	Extend Pin3 status, it can be viewed by clicking "Settings" button.	-	Extend Pin	Extend pin status of actual configuration associated device function block	-
		P04	Extend Pin4	-	Extend Pin	Extend pin of actual configuration associated device function block.	-
		P04_-STA	Extend Pin4 status, it can be viewed by clicking "Settings" button.	-	Extend Pin	Extend pin status parameter supported by device function	-

Table 16.8 FFPID parameter description (continued)

Parameter Name			Description	Upload	Property	FF Parameter Name	Application Instruction
						block associating based on actual configuration.	
	Simulation Function	SWSIM	Simulation switch	-	Extend Pin	-	The controller is in debug mode and when SWSIM is equal to ON, system enters the simulation status. When SWSIM is equal to OFF, system exits the simulation mode.
		PID_ OPT	PID type selection. 0:PID,1:PD_I	-	Extend Pin	-	-

Note 1: MODEALM - Abnormal Mode Switching Alarm

The abnormal mode switching alarm (MODEALM) refers to the alarm generated when the FFPID function block within the FF instrument switches to MAN mode yet not triggered by the mapping function block, or when it switches to IMAN mode and lasts for at least 2 seconds. This alarm is enabled by default.

16.4.3 Instruction Details**Schematic of PID**

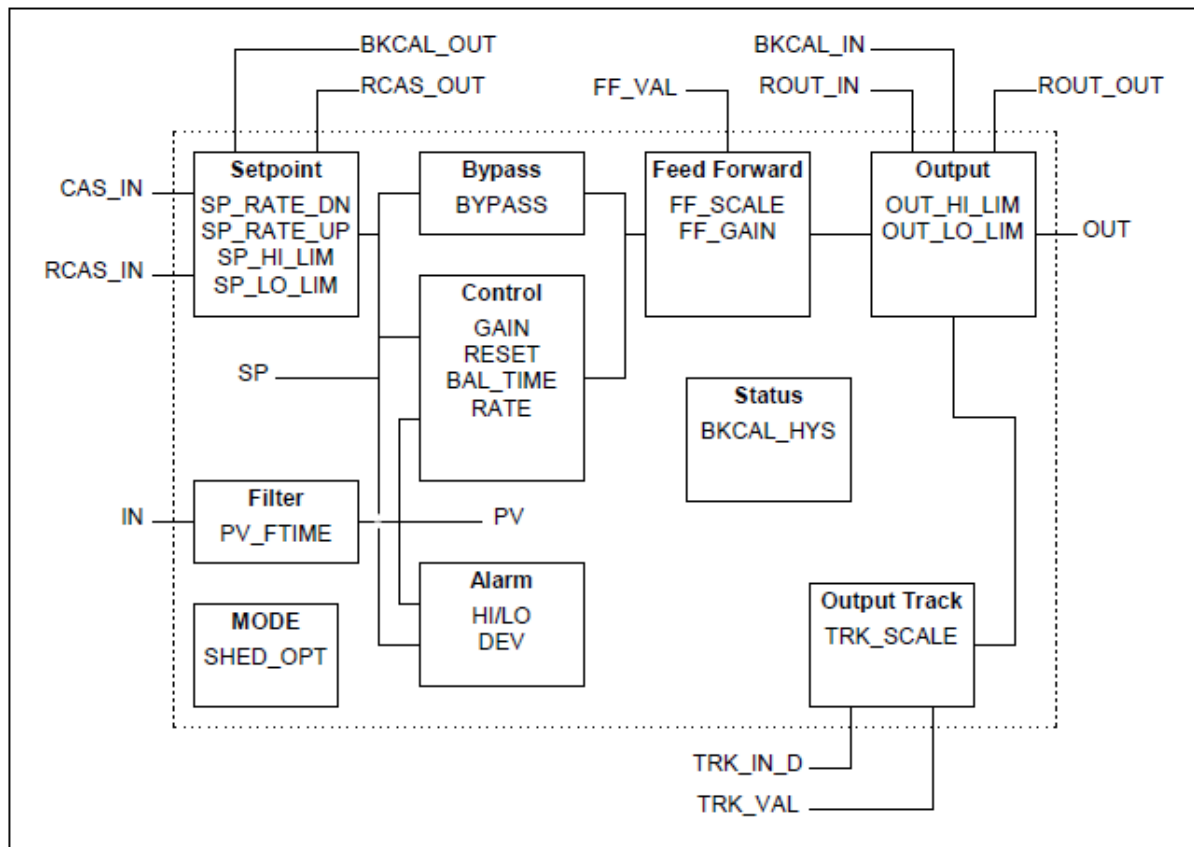


Figure 16.4 Schematic of PID

Algorithm

- Input Process**
 PID performs first-order filter to work out PV, the filter time is PV_FTIME. PV and SV calculate the output value.
- SV Process**
 In AUTO mode, SV is determined by operator. In CAS mode, SV is calculated by CAS_IN. In RCAS mode, SV is calculated by RCAS_IN. SV is the SP of Schematic.
 Perform SP_HI_LIM, SP_LO_LIM and SP_RATE_DN, SP_RATE_UP for input value. Via "Obey SP limits if Cas or RCas" of CTR_OPTS, whether to perform SV limit in modes of CAS and RCAS.
 Via CTR_OPTS, function of tracking PV in different modes can be started. In modes of IMAN, LO, ROUT and MAN, if SV tracks PV, limit will make the SV not be equal with PV.
- Direct/Indirect Action**
 Set the Direct/Indirect Action via changing Direct Acting options of CTR_OPTS. Selected means direct acting, unselected means indirect action.
- Bypass**
 If the bypass is enabled, output is equal to the value of SP after scale conversion.

- PID Algorithm
GAIN means KP.
RESET means Integral Time, the Unit is second.
RATE means Derivative Time, Unit is second.
BAL_TIME means time of anti-integral windup.
- Output Limit
OUT limit should be between OUT_HI_LIM and OUT_LO_LIM.
- Feedforward Action
After scale switch, add FF_VAL to PID algorithm Output. For example, if FF_VAL is BAD, apply last good value for calculation.
- Supported Modes
OOS, IMAN, LO, MAN, AUTO, CAS, RCAS, ROUT.
 - OOS: set Target Mode in OOS mode, or run the mode when configuration error occurring. OOS keeps output.
 - IMAN: applied the mode when: 1. downstream block connecting FF block, the downstream block is not in CAS mode. 2. downstream block connecting DCS system block, BKINERR is ON. Output tracks the downstream block Feedback.
 - LO: start SWTR switch, and set the status is good, check the Track Enable box of CTR_OPTS. Run the LO mode, Output Value tracks TV.
 - MAN: Target Mode is MAN, and not meets the condition of high priority. Set the Output Value as MANOUT.
 - AUTO: Target Mode is AUTO, and not meets the condition of high priority. Operator change the SV, count Output Value with PV.
 - CAS: Target Mode is CAS, and not meets the condition of high priority. SV is worked out via CSV set by upstream, and count Output Value with PV. Provide BKOUT feedback to upstream block.
 - RCAS: Target Mode is RCAS, and not meets the condition of high priority. SV is worked out via RSVI, and count Output Value with PV. Provide RSVO feedback to upstream block.
 - ROUT: Target Mode is ROUT, and not meets the condition of high priority. ROUT is like manual mode, while Output Value is set by ROI. Provide ROO feedback to upstream block.

Among them, CAS, RCAS, ROUT modes can be run with upstream block. Upstream/downstream blocks are all needed, and through the 4 pins. For example, in CAS mode, the block initialization should be achieved via status transmission of the 4 pins, BKIN and OUT of upstream block and CSV and BKOUT of downstream block. User can build the relation of block upstream/downstream, or via pin assignment association in program.

- **Alarm**
Process Alarm from Device: 1. The function block can perform alarm process, including HH, H, L, LL, for OUT, each can has hysteresis. 2. Perform H/L limit alarm for deviation.
 - Process alarm from FFPID.
 - Unified ERR and FF_ALARM alarms.
 - MVH and MVL of output.
 - SVH and SVL of SV.
- **Panel**
Input tag name in supervision to pop up the operation panel of FF block, the device panel displays MV, PV, SV trends.
- **Other**
FFPID does not support the parameter alarm priority.

Simulation Description

The block supports OOS, IMAN, LO, MAN, AUTO and CAS modes in the simulation mode.

- **OOS**
When MODE_TRG is equal to OOS, the function block enters the OOS mode and MODE_ACT is equal to OOS.
- **IMAN**
When MODE_TRG ! is equal to OOS, if BKINERR is equal to ON, the function block enters the IMAN mode and MODE_ACT is equal to IMAN.
- **LO**
When the OOS and IMAN conditions are not met, CTR_OPTS Track Enable is set. When Target to Man if BAD TRK_IN_D is set in STATUS_OPTS, if it is in AUTO and CAS mode and SWTR is non-zero, SWTR_ERR is equal to OFF and the function block enters LO mode. When the OOS and IMAN conditions are not met, CTR_OPTS Track Enable is set. When Target to Man if BAD TRK_IN_D is not set in STATUS_OPTS, if it is in AUTO and CAS mode and SWTR is non-zero, enters LO mode. When the OOS and IMAN conditions are not met, when the CTR_OPTS Track Enable /Track in Manual is set, the Target to Man if BAD TRK_IN_D in the STATUS_OPTS is set. If the MODE_TRG is in the MAN mode, the SWTR is non-zero and SWTR_ERR is equal to OFF, enter the LO mode. When the OOS and IMAN conditions are not met, and the Target to Man if BAD TRK_IN_D is not set in the STATUS_OPTS when the CTR_OPTS Track Enable / Track in Manual is set, if the MODE_TRG is in the MAN mode, the SWTR is non-zero and enters the LO mode.
- **MAN**
When the conditions for entering OOS and IMAN and LO are not satisfied, and Target to Man if BAD TRK_IN_D is set in STATUS_OPTS, SWTR_ERR is equal to ON, then MODE_TRG is

equal to MAN. When the OOS, IMAN and LO conditions are not met, MODE_TRG is equal to MAN. When the OOS, IMAN and LO conditions are not met, MODE_TRG is equal to AUTO/CAS, but the IN_ERR=ON is inputted.

- **AUTO**

When the conditions for entering OOS, IMAN, LO, and MAN are not satisfied, MODE_TRG is equal to AUTO. When the conditions for entering OOS, IMAN, LO, and MAN are not satisfied, MODE_TRG is equal to CAS, but CSV_ERR is equal to ON.CAS

- **CAS**

When the conditions for entering OOS, IMAN, LO, MAN and AUTO are not satisfied,MODE_TRG is equal to CAS.

16.4.4 Panel Parameter

The function block panel of FFPID is shown as figure below.

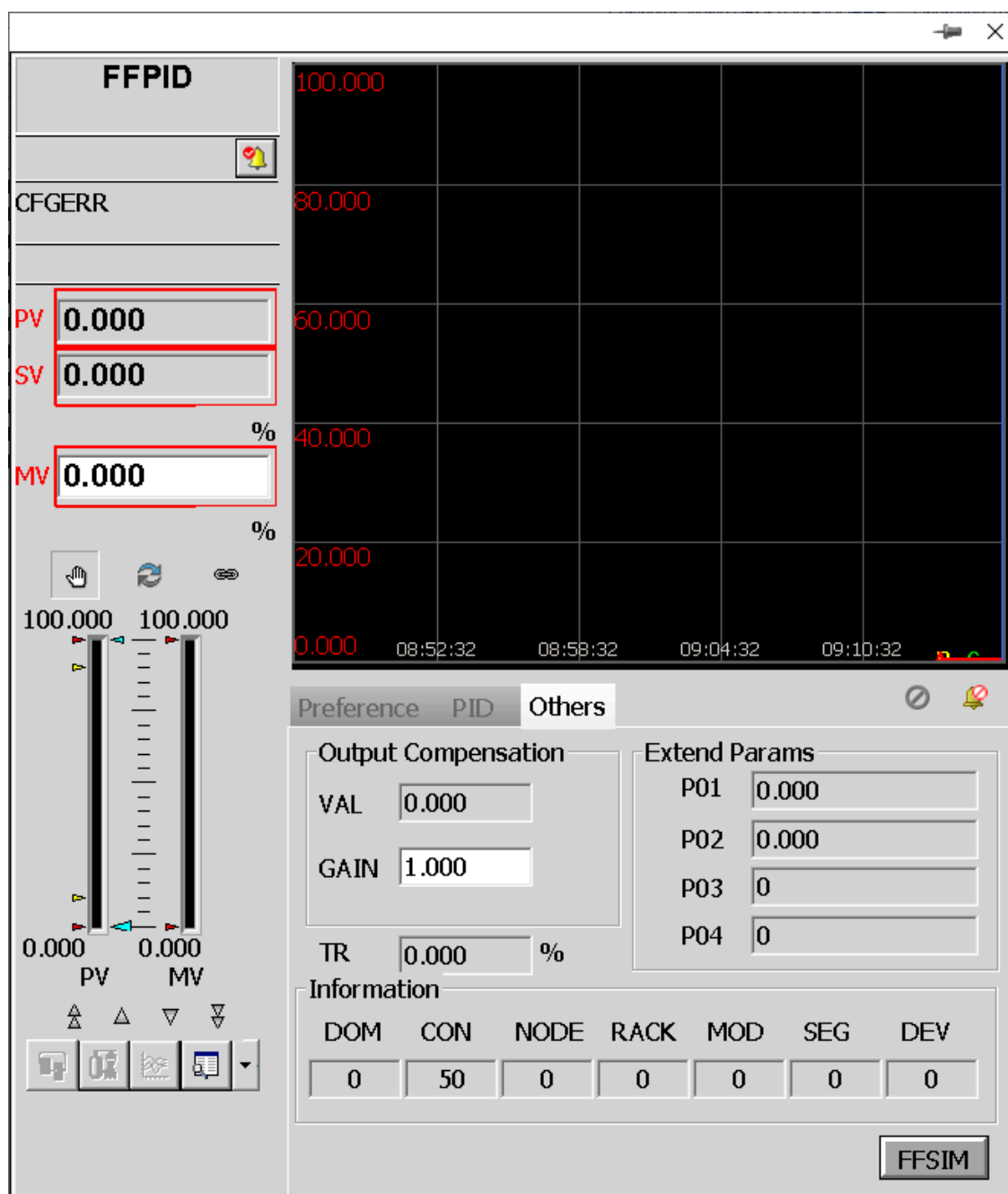


Figure 16.5 Preference Panel of FFPID

Preference **PID** Others

PID Params

KP

TI s

TD s

Control Direction

☐ Direct

☒ Indirect

PID Action

☒ Run

☐ Bypass

PV Filter Time s

Preference PID **Others**

Output Compensation

VAL

GAIN

TR %

Extend Params

P01

P02

P03

P04

Information

DOM	CON	NODE	RACK	MOD	SEG	DEV
0	50	0	0	0	0	0

FFSIM

Figure 16.6 other Panel of FFPID

Table 1 describes the FFPID panel parameters and those related parameters of FBD.

Table 16.9 FFPID Panel Parameters Instruction

Panel Parameter			FBD Parameter	Initial other	Range
PV			PV	0.0	-
SV			SV	0.0	-
MV			MV	0.0	-
Preference	PV Alarm Limits	HH	PVHH_LIM	100.0	-
		H	PVH_LIM	90.0	-

Table 16.9 FFPID Panel Parameters Instruction (continued)

Panel Parameter			FBD Parameter	Initial other	Range
		L	PVL_LIM	10.0	-
		LL	PVLL_LIM	0.0	-
		HYS	ALM_HYS	0.5	-
	SV Limits	H	SVH_LIM	100.0	-
		L	SVL_LIM	0.0	-
	MV Limits	H	MVH_LIM	100.0	-
		L	MVL_LIM	0.0	-
	EI Alarm	PEI	PEI_LIM	0.0	No less than 0
		NEI	NEI_LIM	0.0	No less than 0
	Up Velocity		SVRH_LIM	100.0	-
	Down Velocity		SVRL_LIM	100.0	-
PID	PID Param	KP	KP	0.5	No less than 0.1
		TI	TI	20.0	No less than 0.1
		TD	TD	0.0	No less than 0
	PV Filter Time		PV_FTIME	10.0	No less than 0
	Output Com- pensation	GAIN	FF_GAIN	1.0	-
	Extend Params	P01	P01	0.0	-
		P02	P01	0.0	-
		P03	P01	0	-
		P04	P01	0	-
	TR		TV	0.0	-

16.4.5 Flag

FFPID flag instruction is shown as below.

Table 16.10 Flag of FFPID

Flag	Alarm	Instruction
D0	OOS	Disable

Table 16.10 Flag of FFPID (continued)

Flag	Alarm	Instruction
D1	IMAN	Initialize Manually
D2	LO	On-site
D3	MAN	Manual
D4	AUTO	Auto
D5	CAS	Cascade
D6	RCAS	Remote Cascade
D7	ROUT	Remote Output
D8	FF_ALARM	FF Block Alarm
D9	NEI	Negative Deviation Alarm
D10	PEI	Positive Deviation Alarm
D11	PVL	PV L Limit Alarm
D12	PVLL	PV LL Limit Alarm
D13	PVH	PV H Limit Alarm
D14	PVHH	PV HH Limit Alarm
D16	MVH	Output H Limit Alarm
D17	MVL	Output L Limit Alarm
D18	SVH	SV H Limit Alarm
D19	SVL	SV L Limit Alarm
D25	SIMUL	Simulation
D27	CFGERR	Configuration Error
D29	ERR	Fault
D30	AOF	Suppress Limit

16.5 FFAO

16.5.1 Overview

FFAO block represents the field device function block AO, by which DCS can monitor and control field device AO.

16.5.2 Parameter Description

Table 16.11 FFAO parameter description

Parameter Name			Description	Upload	Property	FF Parameter Name	Application Instruction
Basic Parameters	Limits Setting	SVH_-LIM	SV H Limit Value	TRUE	Operation Parameter	SP_HI_LIM	Value Range [SVS-CL,SVSCH]
		SVL_-LIM	SV L Limit Value	TRUE	Operation Parameter	SP_LO_LIM	Value Range [SVS-CL,SVSCH]
		SVRH_-LIM	SV Velocity H Limit Value	TRUE	Operation Parameter	SP_RATE_-UP	Working in AUTO, CAS, RCAS modes.
		SVRL_-LIM	SV Velocity L Limit Value	TRUE	Operation Parameter	SP_RATE_-DN	
	Signal Convert Setting	CHANNEL	Channel	TRUE	Configuration Parameter	CHANNEL	Associate transducer block with same type of device.
		IO_OPTS	IO options. It can be viewed and configured by clicking "Settings" button.	TRUE	Configuration Parameter	IO_OPTS	Have function such as setting SV tracking PV, direct/indirect action and fail-safe, etc.
		STA_OPTS	Status options. It can be viewed and configured by clicking "Settings" button.	TRUE	Configuration Parameter	STATUS_-OPTS	Whether generate alarm and transition when it is in statuses such as configuration performer fault/ LO Activation/ failsafe start.
	Scale Setting	PV_SCH	PV Scale H Limit	TRUE	Configuration Parameter	PV_SCALE	Used by PV and SV.
		PV_SCL	PV Scale H Limit	TRUE	Configuration Parameter	PV_SCALE	

Table 16.11 FFAO parameter description (continued)

Parameter Name			Description	Upload	Property	FF Parameter Name	Application Instruction
Extended Parameters		PV_EU	PV Engineering Unit	TRUE	Configuration Parameter	PV_SCALE	
		PV_-DLEN	PV Decimal Digits	TRUE	Configuration Parameter	PV_SCALE	
		XD_SCH	Field Signal Scale H Limit	TRUE	Configuration Parameter	XD_SCALE	
		XD_SCL	Field Signal Scale H Limit	TRUE	Configuration Parameter	XD_SCALE	
		XD_EU	Field Signal Unit	TRUE	Configuration Parameter	XD_SCALE	
		XD_-DLEN	Field Signal Decimal Digits	TRUE	Configuration Parameter	XD_SCALE	
	Input Pin	CSV	Cascade Input	-	Input Pin	CAS_IN	Cascade input, set by user program.
		CSV_-ERR	Cascade Input Quality	-	Input Pin	-	-
		CSV_S-TA	Cascade input status. It can be viewed and configured by clicking "Settings" button.	-	Input Pin	CAS_IN	-
	Output Pin	OUT	Output Value	-	Output Pin	OUT	-
		OUT_-ERR	Output Quality	-	Output Pin	-	-
		OUT_S-TA	Output status, it can be viewed by clicking "Settings" button.	-	Output Pin	OUT	-
		BKOUT	Feedback Output Value	-	Output Pin	BKCAL_OUT	Connect to BKIN of upstream block.

Table 16.11 FFAO parameter description (continued)

Parameter Name			Description	Upload	Property	FF Parameter Name	Application In-struction
		BKOUTERR	Feedback Output Sta- tus	-	Output Pin	-	When up- stream block is DCS func- tion block, connect the pin to BKIN- ERR pin of up- stream block.
		BKO_S- TA	Feedback output sta- tus, it can be viewed by clicking “Settings” button.	-	Output Pin	BKCAL_OUT	-
	Alarm Indica- tion	BLCK_- ERR	Block alarm, it can be viewed by clicking “Settings” button.	-	Monitor- ing Para- meter	BLOCK_ERR	-
		FLAG	Flag	-	Monitor- ing Para- meter	-	
	Real Status	PV	Process Value	-	Monitor- ing Para- meter	PV	Original check or simulation, PV_SCAL scale.
		PV_STA	Process Value Sta- tus, it can be viewed by clicking “Settings” button.	-	Monitor- ing Para- meter	PV	-
		RBACK	Read Back Value	-	Monitor- ing Para- meter	READBACK	Original check or simulation, XD_SCALE scale.
		RBACK_- STA	Read Back Value sta- tus, it can be viewed by clicking “Settings” button.	-	Monitor- ing Para- meter	READBACK	-
		ST_REV	Static Revi- sion	-	Monitor- ing Para- meter	ST_REV	When stat- ic parameter changes, the

Table 16.11 FFAO parameter description (continued)

Parameter Name			Description	Upload	Property	FF Parameter Name	Application Instruction
	Operate Command						static revision will be incremented.
		MODE_-ACT	Actual mode, it can be viewed by clicking "Settings" button.	-	Monitoring Parameter	MODE_BLK	-
		MANOUT	Manual Operate Output Value	TRUE	Operation Parameter	-	Change the parameter in OOS and MAN modes, to change OUT parameter.
		SV	Setpoint Value	TRUE	Operation Parameter	SP	-
		SV_STA	Setpoint value status. It can be viewed and configured by clicking "Settings" button.	TRUE	Operation Parameter	SP	-
		MODE_-TRG	Target mode. It can be viewed and configured by clicking "Settings" button.	TRUE	Operation Parameter	MODE_BLK	-
		MODE_-PRM	Permit mode. It can be viewed and configured by clicking "Settings" button.	TRUE	Operation Parameter	MODE_BLK	-
		MODE_-NR	Normal mode. It can be viewed and configured by clicking	TRUE	Operation Parameter	MODE_BLK	-

Table 16.11 FFAO parameter description (continued)

Parameter Name			Description	Upload	Property	FF Parameter Name	Application Instruction
			"Settings" button.				
		EN-BKERR	The output feedback fault filtering enable. ON by default.	FALSE	Monitoring Parameter	-	<ul style="list-style-type: none"> When EN-BKERR is ON, and the BKOUTERR transitions from OFF to ON, and this state is maintained for less than 3 seconds, BKOUTERR will be set to OFF. However, if the duration exceeds 3 seconds, BKOUTERR will be set to ON, generating the corresponding fault alarm.

Table 16.11 FFAO parameter description (continued)

Parameter Name			Description	Upload	Property	FF Parameter Name	Application Instruction
							<ul style="list-style-type: none"> When EN-BKERR is OFF and the BKOUTERR transitions from OFF to ON, and this state is maintained for only 1 second, it will also generate the corresponding fault alarm.
			AOF	Suppress Module Alarm	TRUE	Operation Parameter	-
			ENALM_EX	Enable alarm in controller. It can be viewed and configured by clicking "Settings" button.	TRUE	Operation Parameter	-
							Mapping function block alarm enabled.
			RSVI	Remote Cascade Input	TRUE	Operation Parameter	RCAS_IN
			RSVI_S-TA	Remote set-point status. It can be viewed and	TRUE	Operation Parameter	RCAS_IN
							In RCAS mode, input value.
							-

Table 16.11 FFAO parameter description (continued)

Parameter Name			Description	Upload	Property	FF Parameter Name	Application Instruction
			configured by clicking "Settings" button.				
		RSVO	Remote Cascade Output	TRUE	Monitoring Parameter	RCAS_OUT	In RCAS mode, feedback output value.
		RSVO_STA	Remote cascade output status. It can be viewed and configured by clicking "Settings" button.	TRUE	Monitoring Parameter	RCAS_OUT	-
	Advanced Options	FST_TIME	Failure Time, (Unit: S)	TRUE	Operation Parameter	FSTATUS_TIME	Activate fail-safe function when reaching the failure time.
		FST_VAL	Fault Value	TRUE	Operation Parameter	FSTATUS_VAL	Output the value when "Fault Status to Value" of IO_OPTS enabled and fail-safe function activated.
		SHED_OPT	Action of remote control timeout. It can be viewed and configured by clicking "Settings" button.	TRUE	Operation Parameter	SHED_OPT	-
	Extend Pin	P01	Extend Pin1	-	Extend Parameter	Extend pin of actual configuration associated device function block	-
		P01_STA	Extend Pin1 status, it can be viewed by clicking	-	Extend Pin	Extend pin status of actual configuration associated de-	-

Table 16.11 FFAO parameter description (continued)

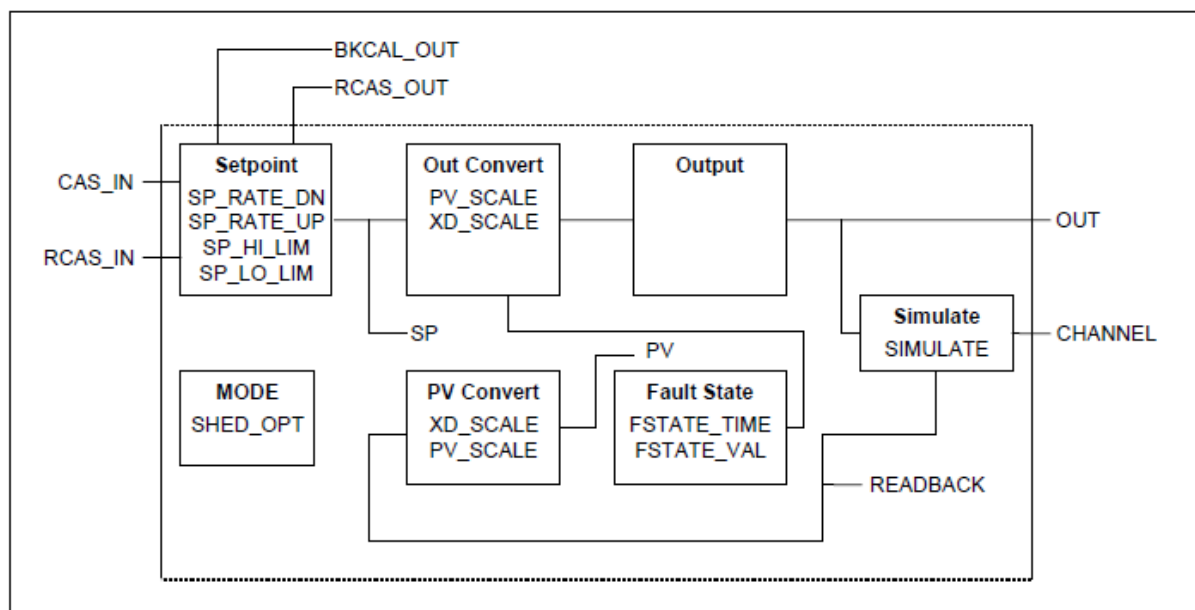
Parameter Name			Description	Upload	Property	FF Parameter Name	Application Instruction
			"Settings" button.			vice function block	
		P02	Extend Pin2	-	Extend Pin	Extend pin of actual configuration associated device function block	-
		P02_S-TA	Extend Pin2 status, it can be viewed by clicking "Settings" button.	-	Extend Pin	Extend pin status of actual configuration associated device function block	-
		P03	Extend Pin3	-	Extend Pin	Extend pin of actual configuration associated device function block	-
		P03_S-TA	Extend Pin3 status, it can be viewed by clicking "Settings" button.	-	Extend Pin	Extend pin status of actual configuration associated device function block	-
		P04	Extend Pin4	-	Extend Pin	Extend pin of actual configuration associated device function block.	-
		P04_S-TA	Extend Pin4 status, it can be viewed by clicking "Settings" button.	-	Extend Pin	Extend pin status parameter supported by device function block associating based on actual configuration.	-
	Simulation Function	SWSIM	Simulation switch	-	Extend Pin	-	When the controller is in the debug status and SWSIM is equal to ON, the simulation function is enabled. When

Table 16.11 FFAO parameter description (continued)

Parameter Name	Description	Upload	Property	FF Parameter Name	Application Instruction
					SWSIM is equal to OFF, exit the simulation function.
	FF_- FAULT	FF fault	-	Extend Pin	-

16.5.3 Instruction Details

Schematic of AO

**Figure 16.7 Figure 16-7 Schematic of AO**

Algorithm

- **Channel Setting**
Associate function block and transducer via CHANNEL. Details refer to "I/O Block Channel Setting".
- **SV Process**
In CAS mode, SP can be worked out by CAS_IN. In RCAS mode, SP can be worked out by RCAS_IN.
Perform H/L limits for SV via SP_HI_LIM, SP_LO_LIM. Perform rate limit for SV via SP_RATE_DN and SP_RATE_UP.
- **Direct/Indirect Action**

Set the direct/indirect action of AO via "Increase to close" option of IO_OPTS. When enabled, invert the output value of AO in scale AO, and output to corresponding channel.

- **Signal Conversion**

$$\text{Temp} = (\text{SV} - \text{PV_SCL}) / (\text{PV_SCH} - \text{PV_SCL})$$

$$\text{OUT} = \text{Temp} * (\text{XD_SCH} - \text{XD_SCL}) + \text{XD_SCL}$$

$$\text{Temp} = (\text{READBACK} - \text{XD_SCL}) / (\text{XD_SCH} - \text{XD_SCL})$$

$$\text{PV} = \text{Temp} * (\text{PV_SCH} - \text{PV_SCL}) + \text{PV_SCL}$$
- **Supported Modes**

OOS, IMAN, LO, MAN, AUTO, CAS, RCAS.

 - OOS: set Target Mode in OOS mode, or run the mode when configuration error occurring. OOS keeps output.
 - IMAN: when block output value cannot reach final output terminal via transducer block, for example, the corresponding transducer block is in manual mode.
 - LO: running the mode when failsafe function is activated.
 - MAN: Target Mode is MAN, and not meets the condition of high priority. Set the output value as MANOUT.
 - AUTO: Target Mode is AUTO, and not meets the condition of high priority. Operator change the SV, use SV to calculate output value.
 - CAS: Target Mode is CAS, and not meets the condition of high priority. SV is worked out via CSV set by upstream, and count Output Value with SV. Provide BKOUT feedback to upstream block.
 - RCAS: Target Mode is RCAS, and not meets the condition of high priority. SV is worked out via RSVI, and count Output Value with SV. Provide RSVO feedback to upstream block.
- **Failsafe Function**

Counting time started once the fault of block is detected. When it reaches FST_TIME, failsafe function is activated. Keep output or output fault value. Details please refer to "Failsafe Function".
- **Panel**

Input tag name in supervision to pop up the operation panel of FF block, the device panel displays OUT trends.
- **Other**

FFAO does not support simulation and parameter alarm priority.

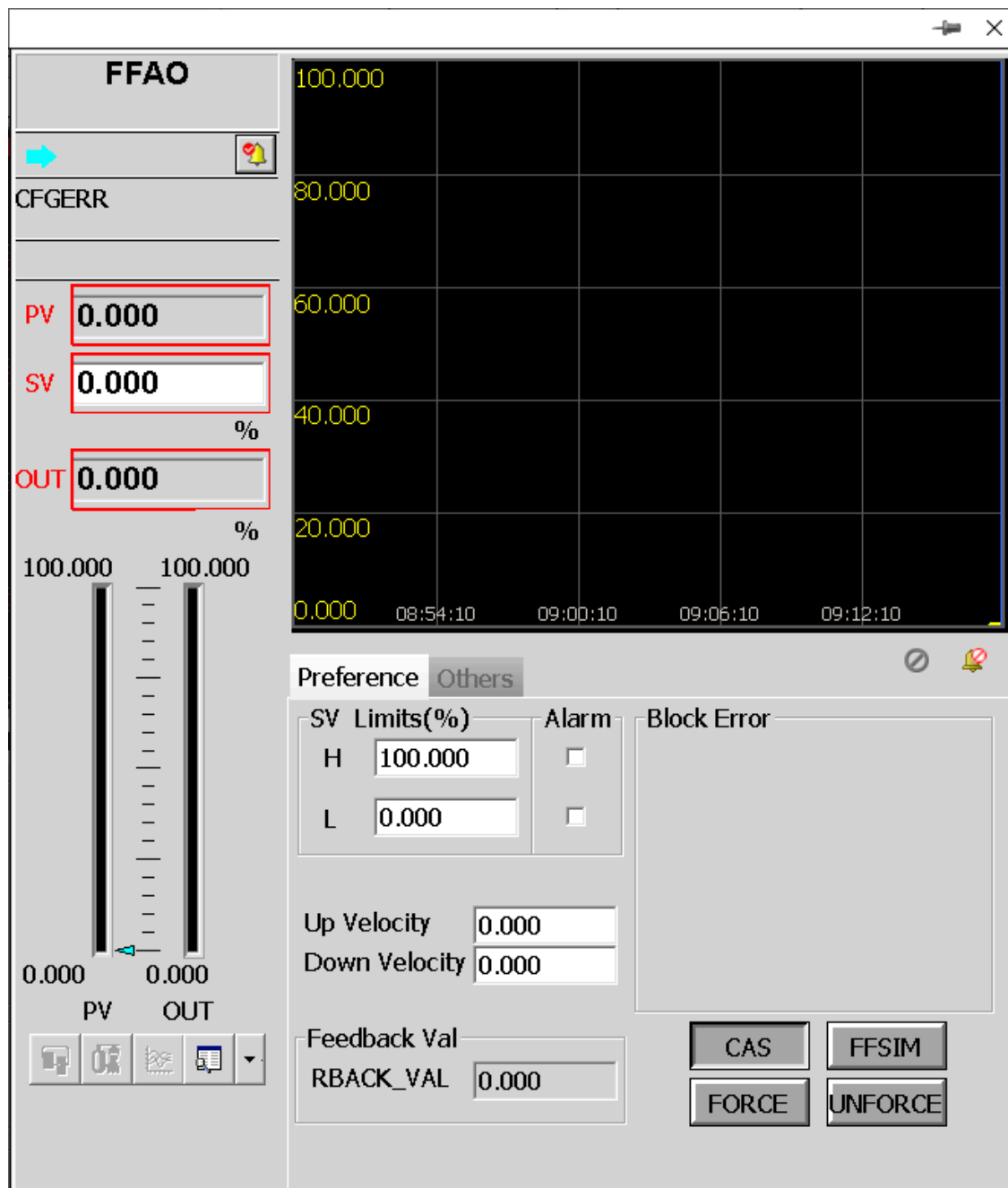
Simulation Description

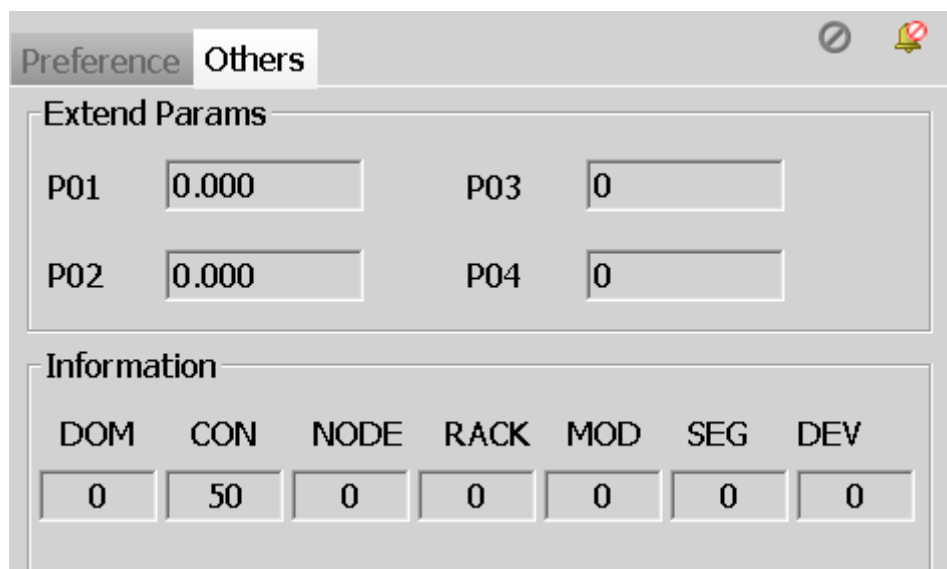
In the simulation status, the function supports OOS, LO, CAS, AUTO, and MAN modes.

- OOS mode: MODE_TRG is equal to OOS, enters OOS mode.
- LO mode: in non-OOS mode, when FF_FAULT is equal to ON and its accumulated time exceeds FST_TIME, enters LO mode.
- MAN mode: the OOS and LO mode conditions are not met and MODE_TRG is equal to MAN, enters MAN mode.
- AUTO mode: the OOS and LO mode conditions are not met, and the AUTO mode is entered when the following conditions are met.
 - When MODE_TRG is equal to AUTO, enters AUTO mode.
 - When MODE_TRG is equal to CAS, and CSV_ERR=ON, enters AUTO mode.
- CAS mode: if the OOS and LO mode conditions are not met, MODE_TRG is equal to CAS, and CSV_ERR is equal to OFF, enters CAS mode.

16.5.4 Panel Parameter

The function block panel of FFAO is shown as figure below.





The screenshot shows a software interface for the FFAO panel. It has two tabs: 'Preference' and 'Others'. The 'Extend Params' section contains four input fields: P01 (0.000), P02 (0.000), P03 (0), and P04 (0). The 'Information' section displays a table of parameters:

DOM	CON	NODE	RACK	MOD	SEG	DEV
0	50	0	0	0	0	0

Figure 16.8 Panel of FFAO

The table below describes the FFAO panel parameters and those related parameters of FBD.

Table 16.12 FFAO Panel Parameters Instruction

Panel Parameter			FBD Parameter	Initial Value	Range
PV			PV	0.0	-
SV			SV	0.0	-
OUT			OUT	0.0	-
Preference	SV Limits	H	SVH_LIM	100.0	-
		L	SVL_LIM	0.0	-
	Up Velocity		SVRH_LIM	0.0	-
	Down Velocity		SVRL_LIM	0.0	-
	RBACK_VAL		RBACK	0.0	-
Others	Extend Params	P01	P01	0.0	-
		P02	P02	0.0	-
		P03	P03	0.0	-
		P04	P04	0.0	-

16.5.5 Flag

FFAO flag instruction is shown as below.

Flag	Alarm	Instruction
D0	OOS	Disable
D1	IMAN	Initialize Manually
D2	LO	On-site
D3	FORCE	Force
D4	UNFORCE	Unforce
D5	CAS	Cascade
D6	RCAS	Remote Cascade
D8	FF_ALARM	FF Block Alarm
D18	SVH	SV H Limit Alarm
D19	SVL	SV L Limit Alarm
D25	SIMUL	Simulation
D27	CFGERR	Configuration Error
D29	ERR	Fault
D30	AOF	Suppress Alarm

16.6 FFDI

16.6.1 Overview

FFDI block represents the field device function block DI, by which DCS can monitor and control the field device DI.

16.6.2 Parameter Description

Table 16.13 FFDI parameter description

Parameter Name			Description	Upload	Property	FF Parameter Name	Application Instruction
Basic Parameters	Signal Convert Setting	CHAN-NEL	Channel	TRUE	Configuration Parameter	CHANNEL	Associate transducer block with same type of device.
		IO_-OPTS	IO options. It can be viewed	TRUE	Configuration	IO_OPTS	Configure "Invert" options,

Table 16.13 FFDI parameter description (continued)

Parameter Name			Description	Upload	Property	FF Parameter Name	Application Instruction
			and configured by clicking "Settings" button.		Parameter		whether to invert when saving field detecting value to PV.
		STA_OPTS	Status options. It can be viewed and configured by clicking "Settings" button.	TRUE	Configuration Parameter	STATUS_OPTS	-
Extended Parameters	Output Pin	OUT	Output Value	-	Output Pin	OUT_D	-
		OUT_ERR	Output Quality When OUT_ERR=ON, generate OUT_ERR alarm that lasts for at least 2 seconds.	-	Output Pin	-	-
		OUT_STA	Output status, it can be viewed by clicking "Settings" button.	-	Output Pin	OUT_D	-
	Alarm Indication	BLCK_ERR	Block alarm, it can be viewed by clicking "Settings" button.	-	Monitoring Parameter	BLOCK_ERR	-
		DISC_ALM	Switch Alarm	-	Monitoring Parameter	DISC_ALM	Discrete Alarm
		FLAG	Flag	-	Monitoring Parameter	-	
	Real Status	FLD_VAL	Raw Input Value	-	Monitoring Parameter	FIELD_VAL_D	Detecting Value of Hardware Channel
		FLD_STA	Raw input status, it can be viewed by clicking "Settings" button.	-	Monitoring Parameter	FIELD_VAL_D	-

Table 16.13 FFDI parameter description (continued)

Parameter Name			Description	Upload	Property	FF Parameter Name	Application Instruction
		PV	Process Value	-	Monitoring Parameter	PV_D	-
		PV_S-TA	Process Value Status, it can be viewed by clicking "Settings" button.	-	Monitoring Parameter	PV_D	-
		ST_-REV	Static Revision	-	Monitoring Parameter	ST_REV	-
	Operate Command	MOD-E_-ACT	Actual mode, it can be viewed by clicking "Settings" button.	-	Monitoring Parameter	MODE_BLK	Actual mode
		MANOUT	Manual Operate Output Value	TRUE	Operation Parameter	-	In OOS and MAN modes, change MANOUT to change Output Value.
		MOD-E_-TRG	Target mode. It can be viewed and configured by clicking "Settings" button.	TRUE	Operation Parameter	MODE_BLK	Target mode should be one of the permitted modes.
		MOD-E_-PRM	Permit mode. It can be viewed and configured by clicking "Settings" button.	TRUE	Operation Parameter	MODE_BLK	Permit Mode
		MOD-E_NR	Normal mode. It can be viewed and configured by clicking "Settings" button.	TRUE	Operation Parameter	MODE_BLK	Normal Mode
	Alarm Management	AOF	Suppress Module Alarm	TRUE	Operation Parameter	-	-
		ENALM	Enable field-bus alarm in device. It can be viewed and configured by	TRUE	Operation Parameter	ALARM_SUM	-

Table 16.13 FFDI parameter description (continued)

Parameter Name			Description	Upload	Property	FF Parameter Name	Application Instruction
			clicking "Settings" button.				
		ENALM_EX	Enable alarm in controller. It can be viewed and configured by clicking "Settings" button.	TRUE	Operation Parameter	-	-
	Signal Convert Setting	PV_FTIME	Filter Constant	TRUE	Operation Parameter	PV_FTIME	-
	Status Definition	OUT_STT	Output status	TRUE	Operation Parameter	OUT_STATUS	-
		XD_STT	Status of Field Value	TRUE	Operation Parameter	XD_STATUS	-
	Alarm Limits Setting	DISC_LIM	Discrete Alarm Status Options	TRUE	Operation Parameter	DISC_LIM	Discrete Alarm Value
	Extend Pin	P01	Extend Pin1	-	Extend Pin	Extend pin of actual configuration associated device function block	-
		P01_STA	Extend Pin1 status, it can be viewed by clicking "Settings" button.	-	Extend Pin	Extend pin status of actual configuration associated device function block	-
		P02	Extend Pin2	-	Extend Pin	Extend pin of actual configuration associated device function block	-
		P02_STA	Extend Pin2 status, it can be viewed by clicking "Settings" button.	-	Extend Pin	Extend pin status of actual configuration associated device function block	-
		P03	Extend Pin3	-	Extend Pin	Extend pin of actual configuration asso-	-

Table 16.13 FFDI parameter description (continued)

Parameter Name			Description	Upload	Property	FF Parameter Name	Application Instruction
						ciated device function block	
		P03_-STA	Extend Pin3 status, it can be viewed by clicking "Settings" button.	-	Extend Pin	Extend pin status of actual configuration associated device function block	-
		P04	Extend Pin4	-	Extend Pin	Extend pin of actual configuration associated device function block.	-
		P04_-STA	Extend Pin4 status, it can be viewed by clicking "Settings" button.	-	Extend Pin	Extend pin status parameter supported by device function block associating based on actual configuration.	-
	Simulation Function	SWSIM	Simulation switch	-	Extend Pin	-	When the controller is in debug mode and SWSIM is equal to ON, enters the simulation status. When SWSIM is equal to OFF, exits the simulation mode.
		SIM_-VAL	Simulate raw input values	-	Extend Pin	-	-
		FF_-FAULT	FF fault	-	Extend Pin	-	-

16.6.3 Instruction Details

Schematic of DI

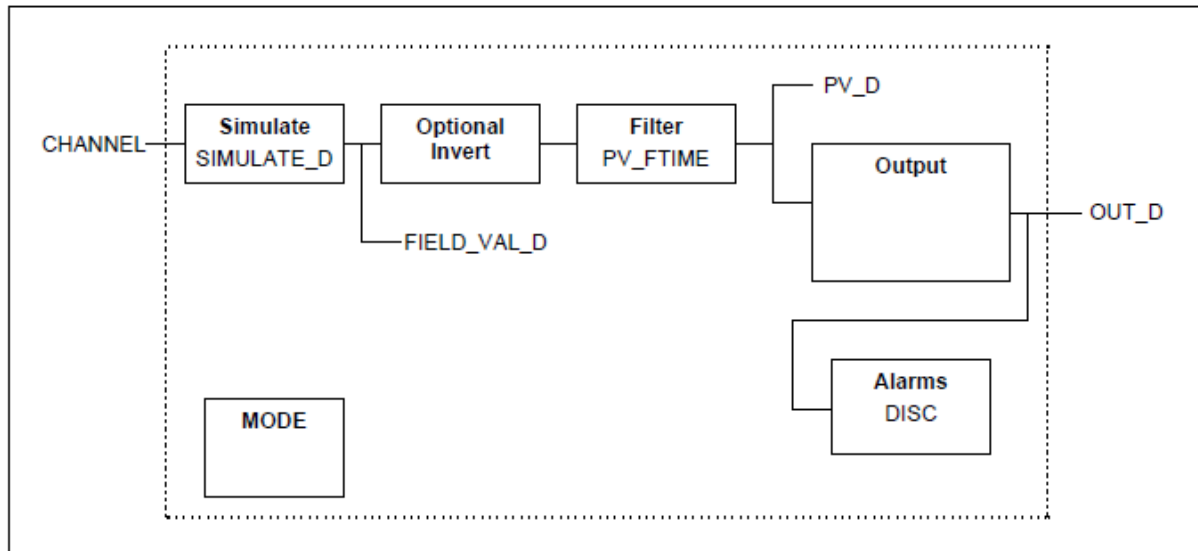


Figure 16.9 Schematic of DI

Algorithm

- Filter Process
- Direct/Indirect Action
- Supported Modes
OOS, MAN, AUTO.
- Panel
Input tag name in supervision to pop up the operation panel of FF block, the device panel displays OUT trends.
- Other
FFDI does not support the parameter alarm priority.

Simulation Description

The simulation supports OOS, AUTO and MAN modes.

- OOS mode
Enter OOS mode when MODE_TRG is equal to OOS.
- AUTO mode
Enter AUTO mode when MODE_TRG is equal to AUTO.
- MAN mode
Enter MAN mode when MODE_TRG is equal to MAN.

16.6.4 Panel Parameter

The function block panel of FFDI is shown as figure below.

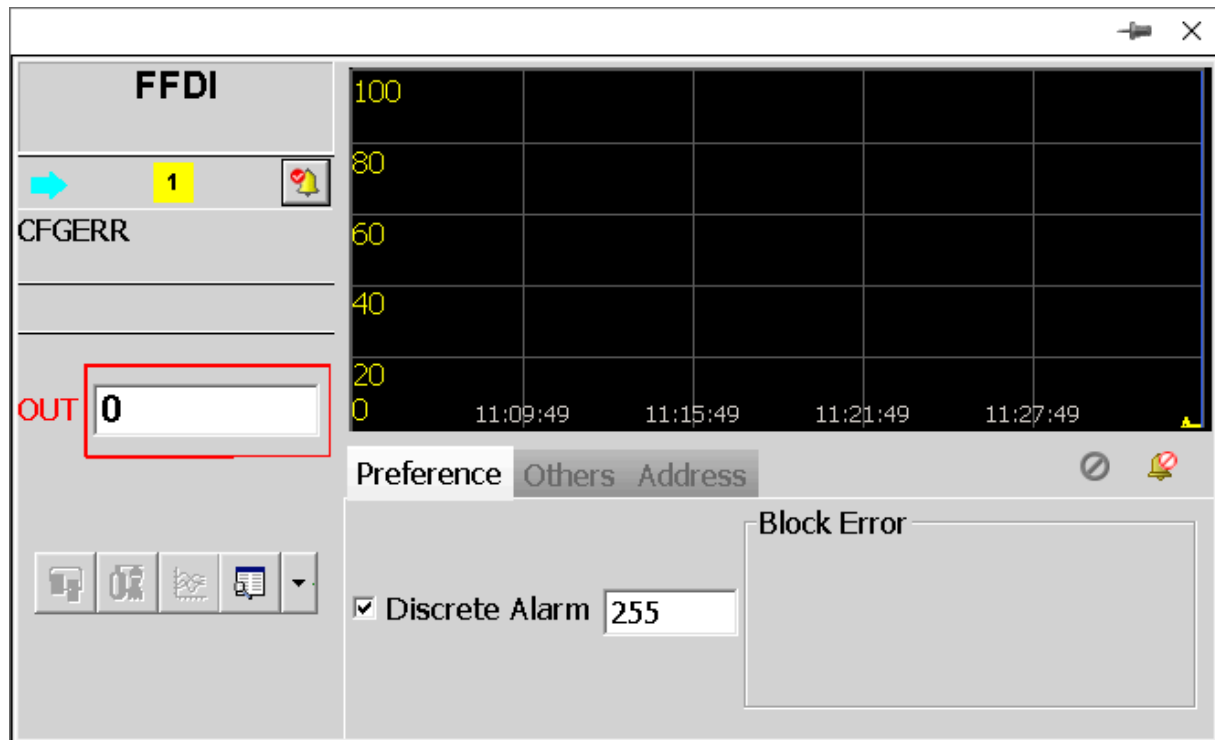


Figure 16.10 Preference Panel of FFDI

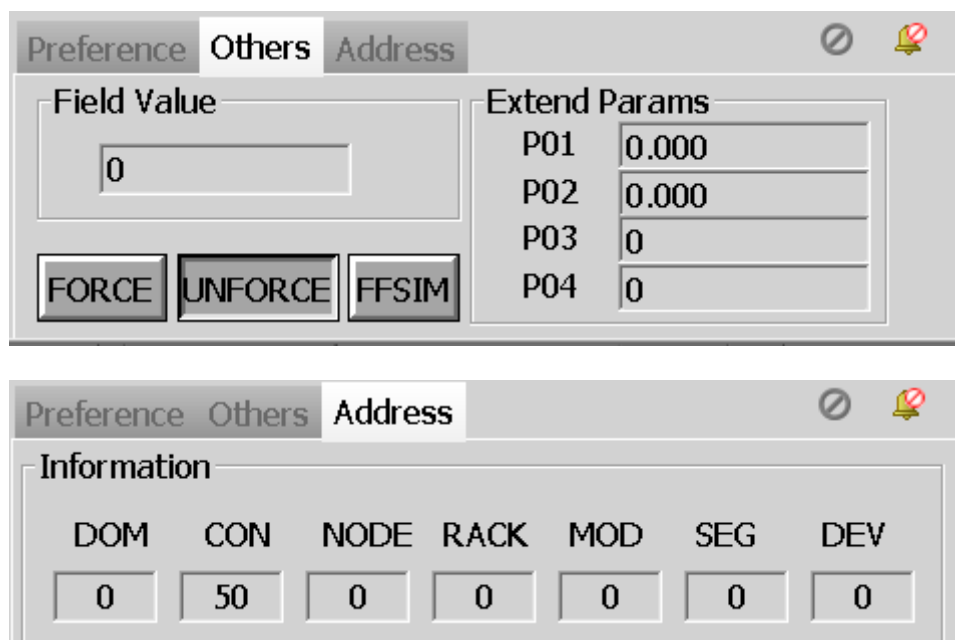


Figure 16.11 Other Panel of FFDI

Table 1 describes the FFDI panel parameters and those related parameters of FBD.

Table 16.14 FFDI Panel Parameters Instruction

Panel Parameters	FBD Parameter	Initial Value	Range
OUT	OUT	0.0	-

Table 16.14 FFDI Panel Parameters Instruction (continued)

Panel Parameters			FBD Parameter	Initial Value	Range
Preference	Discrete Alarm		DISC_ALM	OFF	-
Others	Extend Params	P01	P01	0.0	-
		P02	P02	0.0	-
		P03	P03	0	-
		P04	P04	0	-
	Field Value		FLD_VAL	0.0	-

16.6.5 Flag

FFDI flag instruction is shown as below.

Table 16.15 Flag of FFDI

Flag	Alarm	Instruction
D0	OOS	Disable
D3	FORCE	Force
D4	UNFORCE	Unforce
D8	FF_ALARM	FF Block Alarm
D15	DISCALM	Digital Status Alarm
D25	SIMUL	Simulation
D27	CFGERR	Configuration Error
D28	HOLD	Hold
D29	ERR	Fault
D30	AOF	Suppress Alarm

16.7 FFDO

16.7.1 Overview

FFDO block represents the field device function block DO, by which DCS can monitor and control the field device DO.

16.7.2 Parameter Description

Table 16.16 FFDO parameter description

Parameter Name			Description	Upload	Property	FF Parameter Name	Application Instruction
Basic Parameters	Signal Convert Setting	CHAN-NEL	Channel	TRUE	Configuration Parameter	CHANNEL	Associate transducer block with same type of device.
		IO_-OPTS	IO options. It can be viewed and configured by clicking "Settings" button.	TRUE	Configuration Parameter	IO_OPTS	Configure process variable invert, track options of SV, failsafe mode and output invert, etc.
		STA_-OPTS	Status options. It can be viewed and configured by clicking "Settings" button.	TRUE	Configuration Parameter	STATUS_-OPTS	Whether generate alarm and transition when it is in statuses such as configuration performer fault/ LO Activation/ failsafe start.
Extended Parameters	Input Pin	CSV	Cascade Input	-	Input Pin	CAS_IN_D	-
		CSV_-ERR	Cascade Input Quality	-	Input Pin	-	-
		CSV_-STA	Cascade input status. It can be viewed and configured by clicking "Settings" button.	-	Input Pin	CAS_IN_D	-
	Output Pin	OUT	Output Value	-	Output Pin	OUT_D	-
		OUT_-ERR	Output Quality	-	Output Pin	-	-
		OUT_-STA	Output status, it can be viewed by clicking "Settings" button.	-	Output Pin	OUT_D	-

Table 16.16 FFDO parameter description (continued)

Parameter Name			Description	Upload	Property	FF Parameter Name	Application Instruction
		BKOUT	Feedback Output Value	-	Output Pin	BKCAL_OUT_D	-
		BKOUTERD	Feedback Output Status	-	Output Pin	-	-
		BKO_STA	Feedback output status, it can be viewed by clicking "Settings" button.	-	Output Pin	BKCAL_OUT_D	-
	Alarm Indication	BLCK_ERR	Block alarm, it can be viewed by clicking "Settings" button.	-	Monitoring Parameter	BLOCK_ERR	-
	Real Status	PV	Process Value	-	Monitoring Parameter	PV_D	-
		PV_STA	Process Value Status, it can be viewed by clicking "Settings" button.	-	Monitoring Parameter	PV_D	-
		RBCK	Read Back Value	-	Monitoring Parameter	READ-BACK_D	-
		RBCK_STA	Read Back Value Status	-	Monitoring Parameter	READ-BACK_D	-
		ST_REV	Static Revision	-	Monitoring Parameter	ST_REV	-
	Operate Command	MODE_ACT	Actual mode, it can be viewed by clicking "Settings" button.	-	Monitoring Parameter	MODE_BLK	Actual mode
		MANOUT	Manual Operate Output Value	TRUE	Operation Parameter	-	In OOS and MAN modes, change MANOUT to change Output Value.

Table 16.16 FFDO parameter description (continued)

Parameter Name			Description	Upload	Property	FF Parameter Name	Application Instruction
		MOD-E_-TRG	Target mode. It can be viewed and configured by clicking "Settings" button.	TRUE	Operation Parameter	MODE_BLK	Target Mode
		MOD-E_-PRM	Permit mode. It can be viewed and configured by clicking "Settings" button.	TRUE	Operation Parameter	MODE_BLK	Permit Mode
		MOD-E_-NR	Normal mode. It can be viewed and configured by clicking "Settings" button.	TRUE	Operation Parameter	MODE_BLK	Normal Mode
		SV	Setpoint Value	TRUE	Operation Parameter	SP_D	-
		SV_S-TA	Setpoint value status. It can be viewed and configured by clicking "Settings" button.	TRUE	Operation Parameter	SP_D	-
	Alarm Management	AOF	Suppress Module Alarm	TRUE	Operation Parameter	-	-
		FLAG	Flag	-	Extend Pin	-	-
	Advanced Options	FST_-VAL	Fault Value	TRUE	Operation Parameter	FSTATUS_-VAL_D	Activate failsefe function when reaching the failure time.
		FST_-TIME	Failure Time	TRUE	Operation Parameter	FSTATUS_-TIME	Output the value when "Fault Status to Value" of IO_OPTS enabled

Table 16.16 FFDO parameter description (continued)

Parameter Name			Description	Upload	Property	FF Parameter Name	Application Instruction
							and failsafe function activated.
		SHED_-OPT	Action of remote control timeout. It can be viewed and configured by clicking "Settings" button.	TRUE	Operation Parameter	SHED_OPT	-
	Remote Params	RSVI	Remote Cascade Input	TRUE	Operation Parameter	RCAS_IN_D	In RCAS mode, input value.
		RSVI_-STA	Remote set-point status. It can be viewed and configured by clicking "Settings" button.	TRUE	Operation Parameter	RCAS_IN_D	-
		RSVO	Remote Cascade Output	TRUE	Operation Parameter	RCAS_-OUT_D	RCAS mode, feedback output value.
		RS-VO_-STA	Remote cascade output status. It can be viewed and configured by clicking "Settings" button.	TRUE	Operation Parameter	RCAS_-OUT_D	-
	Status Definition	XD_-STT	Output status	TRUE	Operation Parameter	XD_STATUS	-
		PV_-STT	Status of Field Value	TRUE	Operation Parameter	PV_STATUS	-
	Extend Pin	P01	Extend Pin1	-	Extend Pin	Extend pin of actual configuration associated device function block	-
		P01_-STA	Extend Pin1 status, it can be viewed by clicking	-	Extend Pin	Extend pin status of actual configuration associ-	-

Table 16.16 FFDO parameter description (continued)

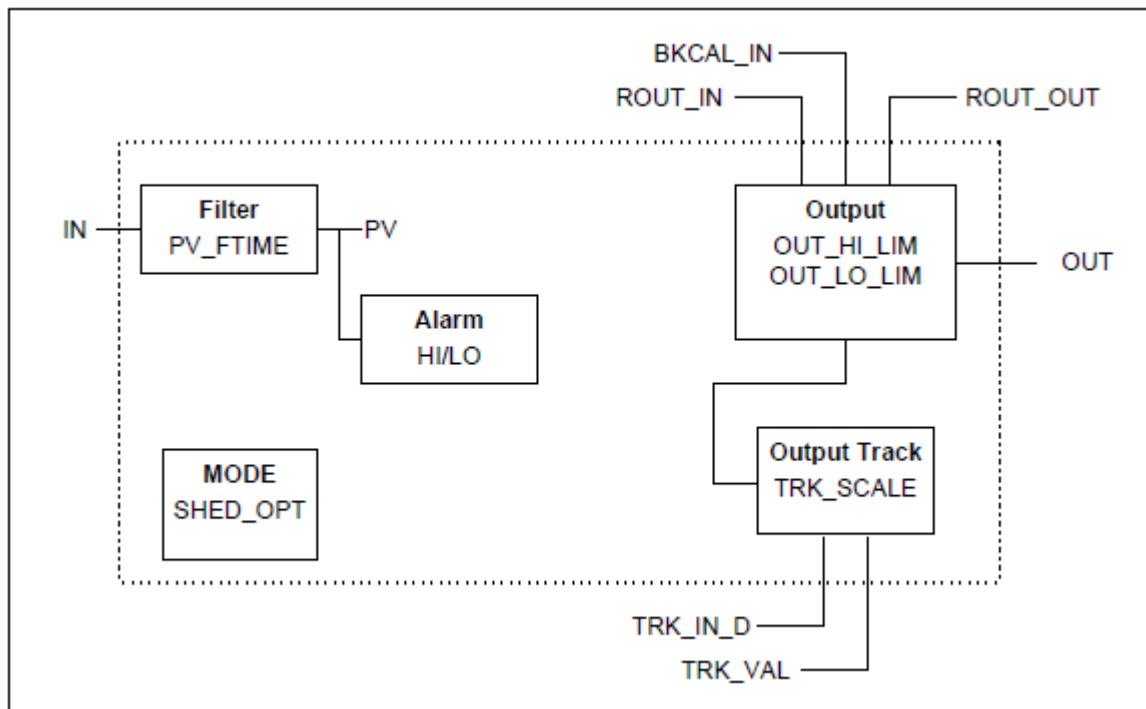
Parameter Name			Description	Upload	Property	FF Parameter Name	Application Instruction
			"Settings" button.			ated device function block	
		P02	Extend Pin2	-	Extend Pin	Extend pin of actual configuration associated device function block	-
		P02_-STA	Extend Pin2 status, it can be viewed by clicking "Settings" button.	-	Extend Pin	Extend pin status of actual configuration associated device function block	-
		P03	Extend Pin3	-	Extend Pin	Extend pin of actual configuration associated device function block	-
		P03_-STA	Extend Pin3 status, it can be viewed by clicking "Settings" button.	-	Extend Pin	Extend pin status of actual configuration associated device function block	-
		P04	Extend Pin4	-	Extend Pin	Extend pin of actual configuration associated device function block.	-
		P04_-STA	Extend Pin4 status, it can be viewed by clicking "Settings" button.	-	Extend Pin	Extend pin status parameter supported by device function block associating based on actual configuration.	-
	Simulation Function	SWSIM	Simulation switch	-	Extend Pin	-	When the controller is in debug mode and SWSIM is equal to ON, enters the simulation status. When SWSIM is equal to OFF,

Table 16.16 FFDO parameter description (continued)

Parameter Name			Description	Upload	Property	FF Parameter Name	Application Instruction
							exits the simulation mode.
		FF_- FAULT	FF fault	-	Extend Pin	-	-

16.7.3 Instruction Details

Schematic of DO

**Figure 16.12 Schematic of DO**

Algorithm

- Failsafe Function
Details please refer to "Failsafe Function".
- Supported Modes
OOS, LO, IMAN, MAN, AUTO, CAS, and RCAS. The MAN mode can be used to force the output. It may be that MAN mode is not permitted, but it must be supported so that MAN mode may be entered when leaving O/S. The IMAN mode is used to indicate that there is no path to the final element.
- Panel

Input tag name in supervision to pop up the operation panel of FF block, the device panel displays OUT trends.

- Other
FFDO does not support the parameter alarm priority.

Simulation Description

The simulation supports OOS, LO, CAS, AUTO, and MAN modes.

- OOS mode
Enter OOS mode when MODE_TRG is equal to OOS.
- LO mode
In non-OOS mode, when FF_FAULT is equal to ON and its accumulated time exceeds FST_TIME, it enters LO mode.
- MAN mode
When the OOS and LO mode conditions are not met and MODE_TRG is equal to MAN, enters the MAN mode.
- AUTO mode: do not enter OOS and LO mode.
 - When MODE_TRG is equal to AUTO, enters AUTO mode.
 - When MODE_TRG is equal to CAS, and CSV_ERR is equal to ON, enters AUTO mode.
- CAS mode: do not entering OOS and LO mode. When MODE_TRG is equal to CAS and CSV_ERR is equal to OFF, enters CAS mode.

16.7.4 Panel Parameter

The function block panel of FFDO is shown as figure below.

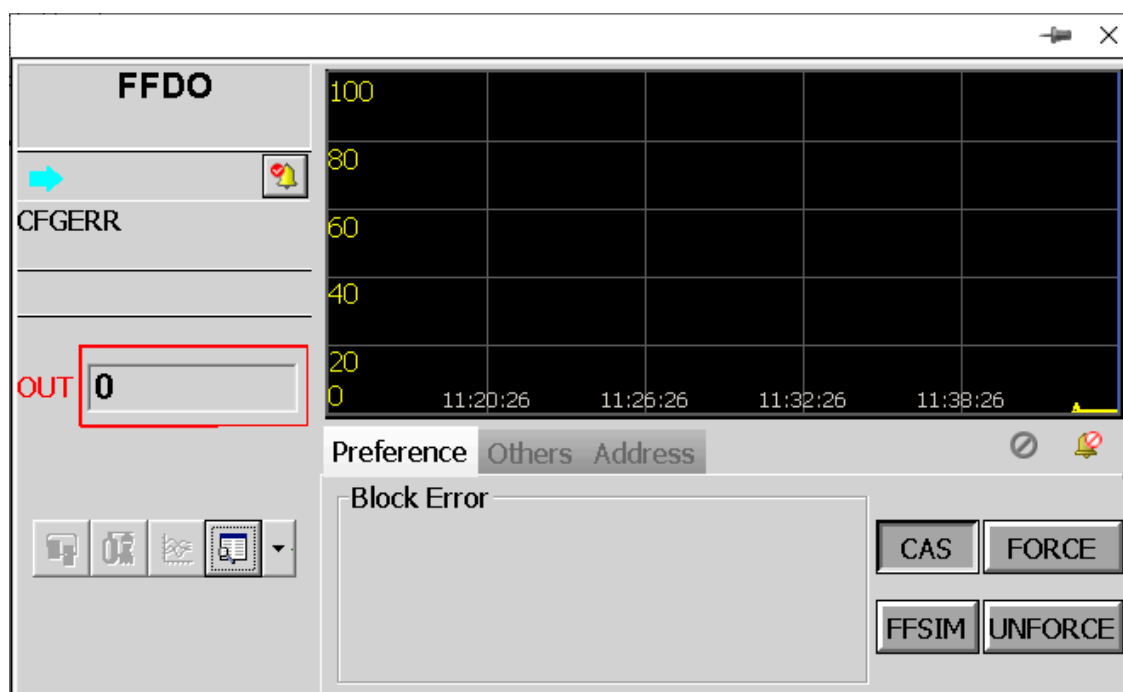


Figure 16.13 Preference Panel of FFDO

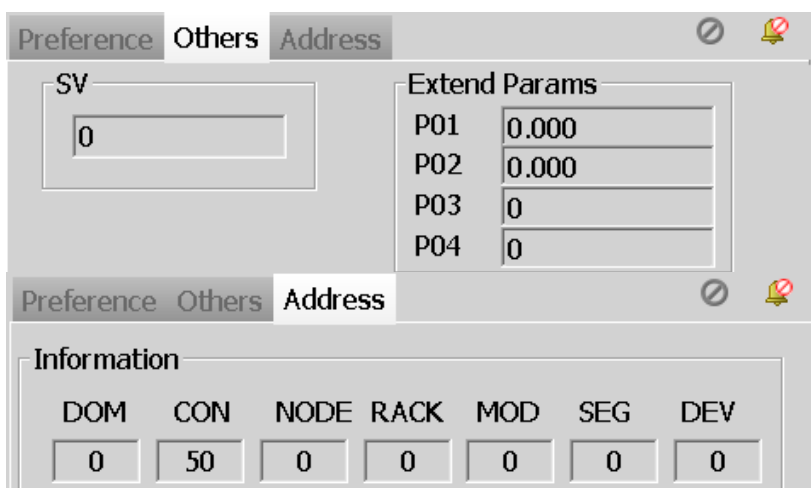


Figure 16.14 Other Panel of FFDO

Table 1 describes the FFDO panel parameters and those related parameters of FBD.

Table 16.17 FFDO Panel Parameters Instruction

Panel Parameters			FBD Parameter	Initial Value	Range
OUT			OUT	0.0	-
Others	Extend Params	P01	P01	0.0	-
		P02	P02	0.0	-
		P03	P03	0	-
		P04	P04	0	-

Table 16.17 FFDO Panel Parameters Instruction (continued)

Panel Parameters		FBD Parameter	Initial Value	Range
	SV	SV	0.0	-

16.7.5 Flag

FFDO flag instruction is shown as below.

Table 16.18 Flag of FFDO

Flag	Alarm	Instruction
D0	OOS	Disable
D1	IMAN	Initialize Manually
D2	LO	On-site
D3	FORCE	Force
D4	UNFORCE	Unforce
D5	CAS	Cascade
D6	EILVDT	LVDT Large-deviation Alarm
D8	FF_ALARM	FF Block Alarm
D25	SIMUL	Simulation
D27	CFGERR	Configuration Error
D28	HOLD	Hold
D29	ERR	Fault
D30	AOF	Suppress Alarm

16.8 FFARTHM

16.8.1 Overview

FFARTHM block represents the field device function block DO, by which DCS can monitor and control the field device DO.

FFARTHM block provides general calculation function.

16.8.2 Parameter Description

Table 16.19 FFARTHM parameter description

Parameter Name			Description	Upload	Property	FF Parameter Name	Application Instruction
Basic Parameters	Operate Param	ARTH_TPY	Arithmetic type. It can be viewed and configured by clicking "Settings" button.	TRUE	Operation Parameter	ARITH_TYPE	Set Function Block Arithmetic Type
		IN_OPTS	Input option settings. It can be viewed and configured by clicking "Settings" button.	TRUE	Operation Parameter	INPUT_OPTS	Configure the process method when status of input pin is failed or suspicious.
	Gain and Bias	BIAS	Bias Value	TRUE	Operation Parameter	BIAS	Output Compensation Bias Value
		BIAS1	Bias Value for IN1	TRUE	Operation Parameter	BIAS_IN_1	Bias Value for IN1
		BIAS2	Bias Value for IN2	TRUE	Operation Parameter	BIAS_IN_2	Bias Value for IN2
		BIAS3	Bias Value for IN3	TRUE	Operation Parameter	BIAS_IN_3	Bias Value for IN3
		GAIN	Gain Value	TRUE	Operation Parameter	GAIN	Feedforward Gain Value
		GAIN1	Gain Value for IN1	TRUE	Operation Parameter	GAIN_IN_1	Gain Value for IN1
		GAIN2	Gain Value for IN2	TRUE	Operation Parameter	GAIN_IN_2	Gain Value for IN2
		GAIN3	Gain Value for IN3	TRUE	Operation Parameter	GAIN_IN_3	Gain Value for IN3
	Limits Settings	CMPH_LIM	Input Compensation H Limit	TRUE	Operation Parameter	COMP_HI_LIM	-
		CMPL_LIM	Input Compensation L Limit	TRUE	Operation Parameter	COMP_LO_LIM	-
		OUT_H_LIM	Output H Limit	TRUE	Operation Parameter	OUT_HI_LIM	-
		OUT_L_LIM	Output L Limit	TRUE	Operation Parameter	OUT_LO_LIM	-
		INH_LIM	Input H Limit	TRUE	Operation Parameter	RANGE_HI	-

Table 16.19 FFARTHM parameter description (continued)

Parameter Name			Description	Upload	Property	FF Parameter Name	Application Instruction
	Scale Setting	INL_-LIM	Input L Limit	TRUE	Operation Parameter	RANGE_LO	-
		OUT_-SCH	Output Scale H Limit	TRUE	Configuration Parameter	OUT_-RANGE	-
		OUT_-SCL	Output Scale H Limit	TRUE	Configuration Parameter		-
		OUT_-EU	Output Scale	TRUE	Configuration Parameter		-
		OUT_-DLEN	Output Decimal Digits	TRUE	Configuration Parameter		-
		PV_-SCH	PV Scale H Limit	TRUE	Configuration Parameter	PV_SCALE	-
		PV_-SCL	PV Scale H Limit	TRUE	Configuration Parameter		-
		PV_-EU	PV UNIT	TRUE	Configuration Parameter		-
		PV_-DLEN	PV Decimal Digits	TRUE	Configuration Parameter		-
Extended Pin	Input Pin	IN	Input Value	-	Input Pin	IN	-
		IN_-ERR	Input Quality	-	Input Pin	-	-
		IN_-STA	Input status. It can be viewed and configured by clicking "Settings" button.	-	Input Pin	IN	-
		IN_LO	Local Input	-	Input Pin	IN_LO	-
		IN_-LO_-ERR	Local Input Quality	-	Input Pin	-	-
		IN_-LO_-STA	Local input status. It can be viewed and	-	Input Pin	IN_LO	-

Table 16.19 FFARTHM parameter description (continued)

Parameter Name			Description	Upload	Property	FF Parameter Name	Application Instruction
			configured by clicking “Set-tings” button.				
		IN1	IN1	-	Input Pin	IN_1	-
		IN1_-ERR	IN1 Quality	-	Input Pin	-	-
		IN1_S-TA	IN1 status. It can be viewed and config-ured by click-ing “Settings” button.	-	Input Pin	IN_1	-
		IN2	IN2	-	Input Pin	IN_2	-
		IN2_-ERR	IN2 Quality	-	Input Pin	-	-
		IN2_S-TA	IN2 status. It can be viewed and config-ured by click-ing “Settings” button.	-	Input Pin	IN_2	-
		IN3	IN3	-	Input Pin	IN_3	-
		IN3_-ERR	IN3 Quality	-	Input Pin	-	-
		IN3_S-TA	IN3 status. It can be viewed and config-ured by click-ing “Settings” button.	-	Input Pin	IN_3	-
	Output Pin	OUT	Output Value	-	Output Pin	OUT	-
		OUT_-ERR	Output Quality	-	Output Pin	-	-
		OUT_-STA	Output sta-tus, it can be viewed by clicking “Set-tings” button.	-	Output Pin	OUT	-
	Alarm Param	BLCK_-ERR	Block error, it can be viewed by clicking “Settings” but-ton.	-	Monitoring Parameter	BLOCK_ERR	-

Table 16.19 FFARTHM parameter description (continued)

Parameter Name			Description	Upload	Property	FF Parameter Name	Application Instruction
		FLAG	Flag	-	Monitoring Parameter	-	-
		AOF	Suppress Module Alarm	TRUE	Operation Parameter	-	-
		ENALM_EX	Enable alarm in controller. It can be viewed and configured by clicking "Settings" button.	TRUE	Operation Parameter	-	-
	Real Status	POUT	Calculated Output Value	-	Monitoring Parameter	PRE_OUT	Function block calculated value, in AUTO mode, Output Value OUT is equal to POUT.
		POUT_STA	Calculated output status, it can be viewed by clicking "Settings" button.	-	Monitoring Parameter	PRE_OUT	-
		PV	Process Value	-	Monitoring Parameter	PV	Input value of IN and IN_LO linear.
		PV_STA	Process Value Status, it can be viewed by clicking "Settings" button.	-	Monitoring Parameter	PV	-
		ST_REV	Static Revision	-	Monitoring Parameter	ST_REV	-
		MANOUT	Manual Operate Output Value	TRUE	Operation Parameter	-	In OOS and MAN modes, change MANOUT to change Output Value.
	Operate Param	MODE_ACT	Actual mode, it can be viewed by clicking	-	Monitoring Parameter	MODE_BLK	Actual mode

Table 16.19 FFARTHM parameter description (continued)

Parameter Name			Description	Upload	Property	FF Parameter Name	Application Instruction
			“Settings” button.				
		BAL_-TIME	Balanced Time	TRUE	Operation Parameter	BAL_TIME	Introduced balanced time to avoid jump when switching manual to auto.
		MOD-E_-TRG	Target mode. It can be viewed and configured by clicking “Settings” button.	TRUE	Operation Parameter	MODE_BLK	Target mode should be one of the permitted modes.
		MOD-E_-PRM	Permit mode. It can be viewed and configured by clicking “Settings” button.	TRUE	Operation Parameter	MODE_BLK	Permit Mode
		MOD-E_NR	Normal mode. It can be viewed and configured by clicking “Settings” button.	TRUE	Operation Parameter	MODE_BLK	Normal mode. Have no influence for control.
	Extend Pin	P01	Extend Pin1	-	Extend Pin	Extend pin of actual configuration associated device function block	-
		P01_-STA	Extend Pin1 status, it can be viewed by clicking “Settings” button.	-	Extend Pin	Extend pin status of actual configuration associated device function block	-
		P02	Extend Pin2	-	Extend Pin	Extend pin of actual configuration associated device function block	-
		P02_-STA	Extend Pin2 status, it can be viewed by clicking “Settings” button.	-	Extend Pin	Extend pin status of actual configuration associated device function block	-

Table 16.19 FFARTHM parameter description (continued)

Parameter Name			Description	Upload	Property	FF Parameter Name	Application Instruction
		P03	Extend Pin3	-	Extend Pin	Extend pin of actual configuration associated device function block	-
		P03_-STA	Extend Pin3 status, it can be viewed by clicking “Settings” button.	-	Extend Pin	Extend pin status of actual configuration associated device function block	-
		P04	Extend Pin4	-	Extend Pin	Extend pin of actual configuration associated device function block.	-
		P04_-STA	Extend Pin4 status, it can be viewed by clicking “Settings” button.	-	Extend Pin	Extend pin status parameter supported by device function block associating based on actual configuration.	-
	Simulation Function	SWSIM	Simulation switch	-	Extend Pin	-	When the controller is in debug mode and SWSIM is equal to ON, enters the simulation status. When SWSIM is equal to OFF, exits the simulation mode.

16.8.3 Instruction Details

Schematic of AR

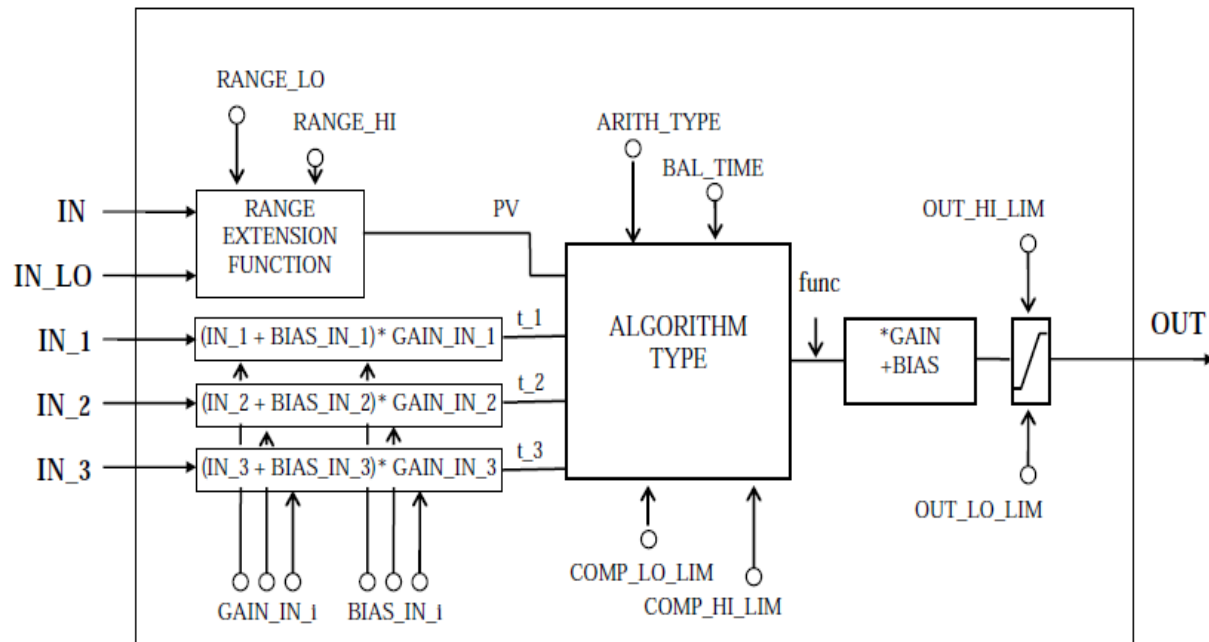


Figure 16.15 Schematic of AR

Algorithm

Use IN and IN_LO to work out PV, and combine PV with IN1, IN2, IN3 to work out the function value via selected ARTH_TYPE. Then perform gain and compensation, and limit process to work out the final value. Count the Output Value according to mode.

- Equation for PV

$$PV = G \times IN + (1-G) \times IN_LO$$

G is 0 for IN less than INL_LIM (FF parameter RANGE_LO), and it is 1 when IN is greater than INH_LIM (FF parameter RANGE_HI). It is interpolated from 0 to 1 over the range of INL_LIM to INH_LIM.

- Input Compensation

For each of IN1, IN2, IN3, there is a Gain and Bias, the compensation way is shown below.

$$IN(k) \text{ enabled: } t(k) = GAIN(k) \times (BIAS(k) + IN(k))$$

IN(k) disabled, $t(k)$ applies the last good value.

- Calculation Modes

- Linear

$$func = f \times PV$$

$$f = t(1)/t(2)$$

- Square Root

$$func = f \times PV$$

$$f = \sqrt{t(1)/t(2)}$$

- Approximate

$$func = f \times PV$$

$$f = \sqrt{t(1) * t(2) * t(3)}$$
- BTU Flow

$$func = f \times PV$$

$$f = t(1) - t(2)$$
- Traditional Multiply Divide

$$func = f \times PV$$

$$f = (t(1)/t(2)) + t(3)$$
- Average

$$func = (PV + t(1) + t(2) + t(3))/f$$

f = number of inputs used in computation (unusable inputs are not used).
- Traditional Summer

$$func = PV + t(1) + t(2) + t(3)$$
- Fourth order polynomial

$$func = PV + t(1)^2 + t(2)^3 + t(3)^4$$
- Simple HTG compensated level

$$func = \frac{(PV - t(1))}{(PV - t(2))}$$
- Fourth order polynomial based on PV

$$func = PV + GAIN1 \times PV^2 + GAIN2 \times PV^3 + GAIN3 \times PV^4$$
- Output Compensation

Perform output compensation for calculated *func* by GAIN and BAIS. Compensation mode is same with input compensation.
- Output Limit

Perform H/L limits for value performed output compensation and work out Algorithm Output Value POUT (FF parameter PRE_OUT). In AUTO mode, Output Value is equal to POUT.
- Supported Modes

OOS, MAN, AUTO.

Simulation Description

In the simulation status, the function block supports OOS, MAN and AUTO modes.

- OOS mode

When MODE_TRG is equal to OOS, enters OOS mode.
- MAN mode

When MODE_TRG is equal to MAN, enters MAN mode.

- AUTO mode

When MODE_TRG is equal to AUTO, enters the AUTO mode.

**ATTENTION:**

In simulation status, the operation mode of switching function will cause the output to jump. In non-OOS mode, the OUTH/OUTL OUT alarm is enabled and alarm is generated (OUT is over OUTH_LIM/OUTL_LIM), and Flag is set accordingly.

16.8.4 Panel Parameter

The function block panel of FFARTHM is shown as figure below.

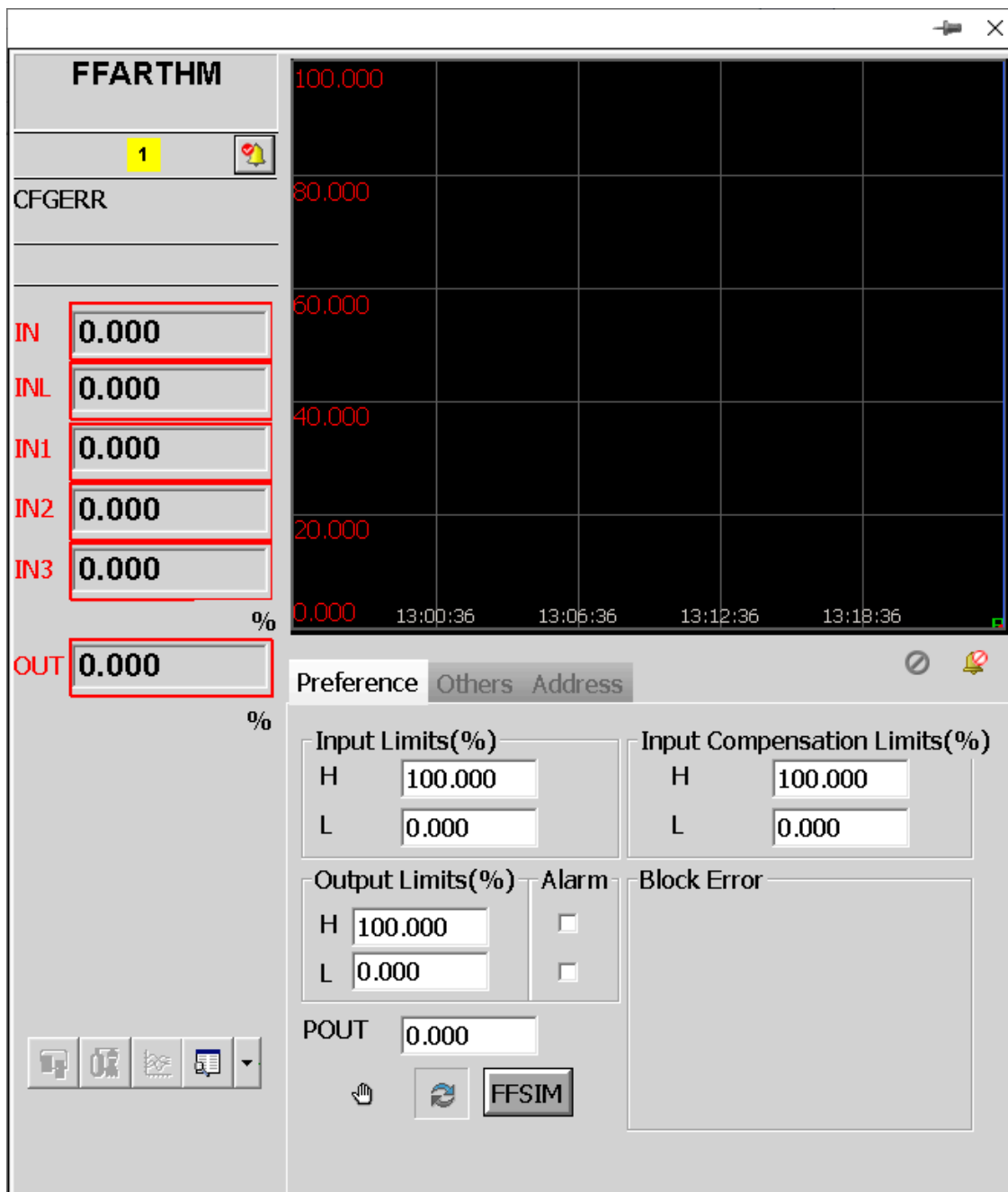


Figure 16.16 Preference Panel of FFARTHM

The figure displays two screenshots of the FFARTHM 'Others' panel. The top screenshot shows the 'Bias' and 'Gain Value' sections. The 'Bias' section has input fields for IN, IN1, IN2, and IN3, all set to 0.000. The 'Gain Value' section has input fields for IN, IN1, IN2, and IN3, all set to 1.000. The 'Calc Mode' section has checkboxes for Linear (checked), SQRT, Approx, BTU, Mul&Div, AVE, SUM, Polynomial, and HTG. The 'Extend Params' section has input fields for P01, P02, P03, and P04, with P01 and P02 set to 0.000, and P03 and P04 set to 0. The bottom screenshot shows the 'Information' section with a table of parameters: DOM (0), CON (50), NODE (0), RACK (0), MOD (0), SEG (0), and DEV (0).

Figure 16.17 Other Panel of FFARTHM

Table 1 describes the FFARTHM panel parameters and those related parameters of FBD.

Table 16.20 FFARTHM Panel Parameters Instruction

Panel Parameter			FBD Parameter	Initial	Range
IN			IN	0.0	-
INL			IN_LO	0.0	-
IN1			IN1	0.0	-
IN2			IN2	0.0	-
IN3			IN3	0.0	-
OUT			OUT	0.0	-
Others	Bias	IN	BIAS	0.0	-
		IN1	BIAS1	0.0	-
		IN2	BIAS2	0.0	-
		IN3	BIAS3	0.0	-
	Gain Value	IN	GAIN	1.0	-

Table 16.20 FFARTHM Panel Parameters Instruction (continued)

Panel Parameter			FBD Parameter	Initial	Range
		IN1	GAIN	1.0	-
		IN2	GAIN	1.0	-
		IN3	GAIN	1.0	-
	Calc Mode		-	-	-

16.8.5 Flag

FFARTHM flag instruction is shown as below.

Table 16.21 Flag of FFARTHM

Flag	Alarm	Instruction
D0	OOS	Disable
D3	MAN	Manual
D4	AUTO	Auto
D8	FF_ALARM	FF Block Alarm
D16	OUTH	Output H Limit Alarm
D17	OUTL	Output L Limit Alarm
D25	SIMUL	Simulation
D27	CFGERR	Configuration Error
D28	HOLD	Hold
D29	ERR	Fault
D30	AOF	Suppress Alarm

16.9 FFCTLSSL

16.9.1 Overview

FFCTLSSL block represents the field device function block Control Selector, by which DCS can monitor and control the field device CS. FFCTLSSL is mainly used to select control output variable.

16.9.2 Parameter Description

Table 16.22 FFCTLSL parameter description

Parameter Name			Description	Upload	Property	FF Parameter Name	Application Instruction
Basic Parameters	Operate Param	SEL_TPYE	Input options type. It can be viewed and configured by clicking "Settings" button.	TRUE	Operation Parameter	SEL_TPYE	Control options, have 3 choices, high, low, middle.
	Scale Setting	OUT_SCH	Output Scale H Limit	TRUE	Configuration Parameter	OUT_SCALE	Output Scale
		OUT_SCL	Output Scale L Limit	TRUE	Configuration Parameter		
		OUT_EU	Output Unit	TRUE	Configuration Parameter		
		OUT_DLEN	Output Decimal Digits	TRUE	Configuration Parameter		
		IN_SCH	Input Scale H Limit	TRUE	Configuration Parameter	-	Input scale, not FF parameter. It will not influence function block logic process but only display them.
		IN_SCL	Input Scale L Limit	TRUE	Configuration Parameter		
		IN_EU	Input Value Unit	TRUE	Configuration Parameter		
		IN_DLEN	Input Decimal Digits	TRUE	Configuration Parameter		
Extended Parameters	Input Param	IN1	IN1	-	Input Pin	SEL_1	-
		IN1_ERR	IN1 Quality	-	Input Pin	-	-
		IN1_STA	IN1 status. It can be viewed and configured by clicking "Settings" button.	-	Input Pin	SEL_1	-
		IN2	IN2	-	Input Pin	SEL_2	-

Table 16.22 FFCTLSL parameter description (continued)

Parameter Name			Description	Upload	Property	FF Parameter Name	Application In-struction
		IN2_- ERR	IN2 Quality	-	Input Pin	-	-
		IN2_- STA	IN2 status. It can be viewed and configured by clicking “Settings” button.	-	Input Pin	SEL_2	-
		IN3	IN3	-	Input Pin	SEL_3	-
		IN3_- ERR	IN3 Quality	-	Input Pin	-	-
		IN3_- STA	IN3 status. It can be viewed and configured by clicking “Settings” button.	-	Input Pin	SEL_3	-
		BKIN	Feedback Input	-	Input Pin	-	Connect to BKOUT of downstream function block.
		BKIN- ERR	Feedback Input Quality	-	Input Pin	-	When down-stream block is DCS function block, connect to BKOUTERR of downstream function block.
		BKIN_- STA	Feedback input status. It can be viewed and configured by clicking “Settings” button.	-	Input Pin	-	-
	Output Param	BKOUT	Feedback Output Value1	-	Output Pin	BKCAL_- SEL1	Connect to BKIN of up-stream block providing IN1.
		BKOUT_- ERR	Feedback Output Value1 Quality	-	Output Pin	-	If the upstream block connected to IN1 is DCS block, connect the pin with BKIN-

Table 16.22 FFCTLSL parameter description (continued)

Parameter Name		Description	Upload	Property	FF Parameter Name	Application Instruction
						ERR pin of upstream block.
	BKO1_STA	Feedback Output Value1 status, it can be viewed by clicking "Settings" button.	-	Output Pin	BKCAL_SEL1	-
	BKOUT2	Feedback Output Value2	-	Output Pin	BKCAL_SEL2	Connect to BKIN of upstream block providing IN2.
	BKO2_ERR	Feedback Output Value2 Quality	-	Output Pin	-	If the upstream block connected to IN2 is DCS block, connect the pin with BKIN-ERR pin of upstream block.
	BKO2_STA	Feedback output status, it can be viewed by clicking "Settings" button.	-	Output Pin	BKCAL_SEL2	-
	BKOUT3	Feedback Output Value3	-	Output Pin	BKCAL_SEL3	Connect to BKIN of upstream block providing IN3.
	BKO3_ERR	Feedback Output Value3 Quality	-	Output Pin	-	If the upstream block connected to IN3 is DCS block, connect the pin with BKIN-ERR pin of upstream block.
	BKO3_STA	Feedback Output Value3 status, it can be viewed by clicking "Settings" button.	-	Output Pin	BKCAL_SEL3	-

Table 16.22 FFCTLSL parameter description (continued)

Parameter Name			Description	Upload	Property	FF Parameter Name	Application Instruction
		OUT	Output Value	-	Output Pin	OUT	-
		OUT_ERR	Output Quality	-	Output Pin	-	-
		OUT_STA	Output status, it can be viewed by clicking "Settings" button.	-	Output Pin	OUT	-
	Alarm Param	BLCK_ERR	Block error, it can be viewed by clicking "Settings" button.	-	Monitoring Parameter	BLOCK_ERR	-
		FLAG	Flag	-	Monitoring Parameter	-	-
		AOF	Suppress Module Alarm	TRUE	Operation Parameter	-	-
		ENALM_EX	Enable alarm in controller. It can be viewed and configured by clicking "Settings" button.	TRUE	Operation Parameter	-	-
	Real Status	ST_REV	Static Revision	-	Monitoring Parameter	ST_REV	-
	Operate Param	MODE_ACT	Actual mode, it can be viewed by clicking "Settings" button.	-	Monitoring Parameter	MODE_BLK	Actual mode
		MANOUT	Manual Operate Output Value	TRUE	Operation Parameter	-	In MAN and OOS modes, change MANOUT to change Output Value

Table 16.22 FFCTLSL parameter description (continued)

Parameter Name			Description	Upload	Property	FF Parameter Name	Application Instruction
		MOD-E-TRG	Target mode. It can be viewed and configured by clicking "Settings" button.	TRUE	Operation Parameter	MODE_BLK	Target mode should be one of the permitted modes.
		MOD-E-PRM	Permit mode. It can be viewed and configured by clicking "Settings" button.	TRUE	Operation Parameter	MODE_BLK	Permit Mode
		MOD-E-NR	Normal mode. It can be viewed and configured by clicking "Settings" button.	TRUE	Operation Parameter	MODE_BLK	Normal Mode
		STA-OP-TS	Status options. It can be viewed and configured by clicking "Settings" button.	TRUE	Configuration Parameter	STATUS-OPTS	Status process options.
	Limits Setting	OUT-H-LIM	Output H Limit Value	TRUE	Operation Parameter	OUT_HI_LIM	-
		OUT-L-LIM	Output L Limit Value	TRUE	Operation Parameter	OUT_LO_LIM	-
	Extend Pin	P01	Extend Pin1	-	Extend Pin	Extend pin of actual configuration associated device function block	-
		P01-STA	Extend Pin1 status, it can be viewed by clicking "Settings" button.	-	Extend Pin	Extend pin status of actual configuration associated device function block	-

Table 16.22 FFCTLSL parameter description (continued)

Parameter Name			Description	Upload	Property	FF Parameter Name	Application Instruction
		P02	Extend Pin2	-	Extend Pin	Extend pin of actual configuration associated device function block	-
		P02_-STA	Extend Pin2 status, it can be viewed by clicking "Settings" button.	-	Extend Pin	Extend pin status of actual configuration associated device function block	-
		P03	Extend Pin3	-	Extend Pin	Extend pin of actual configuration associated device function block	-
		P03_-STA	Extend Pin3 status, it can be viewed by clicking "Settings" button.	-	Extend Pin	Extend pin status of actual configuration associated device function block	-
		P04	Extend Pin4	-	Extend Pin	Extend pin of actual configuration associated device function block.	-
		P04_-STA	Extend Pin4 status, it can be viewed by clicking "Settings" button.	-	Extend Pin	Extend pin status parameter supported by device function block associating based on actual configuration.	-
	Simulation Function	SWSIM	Simulation switch	-	Extend Pin	-	When the controller is in debug mode and SWSIM is equal to ON, enters the simulation status. When SWSIM is equal to OFF, exits the simulation mode.

16.9.3 Instruction Details

Schematic of CS

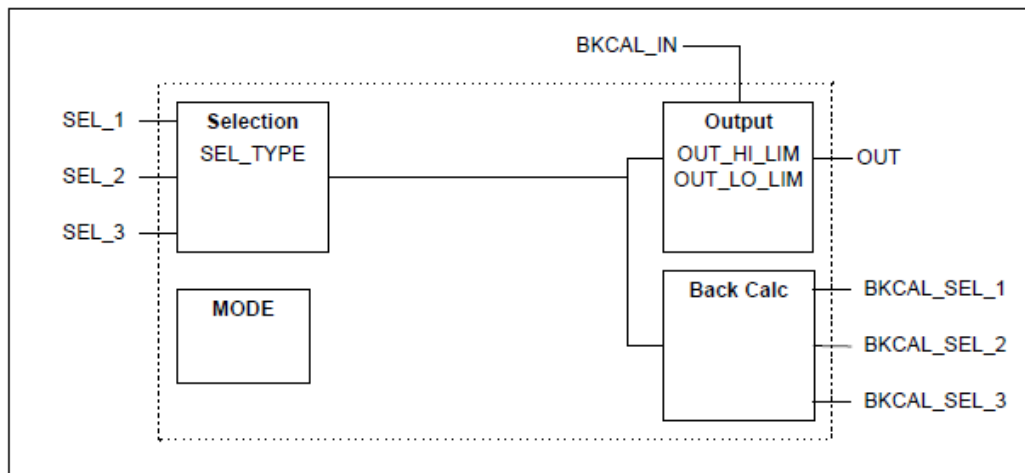


Figure 16.18 Schematic of CS

Algorithm

Function block provides 3 Input Pins for option, which connect Output Values of 3 upstream PID blocks separately, through FFCTLSL, and select a valid output, to achieve the control of filed execution device.

1. Mode

OOS: function block stops control logic calculation.

MAN: function block output does not calculated according to input, change the Output Value via change MANOUT manually.

AUTO: according to input status, SEL_TYPE selects a channel input to output for the function block.

2. Feedback Calculation

Function block provides 3 channels Feedback, which correspond to 3 channels Input Pin separately. User connects Feedback pin to corresponding upstream function block providing Input Pin, to achieve non-reference switch between different channels.

Status information of Feedback pin reflects that whether its Input Pin is selected or not.

Simulation Description

The function block supports OOS, IMAN, MAN, and AUTO modes.

- OOS mode

When MODE_TRG is equal to OOS, it enters OOS mode.

- IMAN mode
In non-OOS mode, when BKINERR is equal to ON, it enters IMAN mode.
- MAN mode
In non-OOS and IMAN modes, when MODE_TRG is equal to MAN or any INx_ERR is equal to ON, it enters MAN mode.
- AUTO mode
In non-OOS and IMAN modes, when MODE_TRG is equal to AUTO, it enters AUTO mode.
In non-OOS mode, the OUTH/OUTL alarm is enabled and alarm is generated (OUT over OUTH_LIM, OUTL_LIM), and the corresponding position of Flag is set.

16.9.4 Panel Parameter

The function block panel of FFCTLSL is shown as figure below.

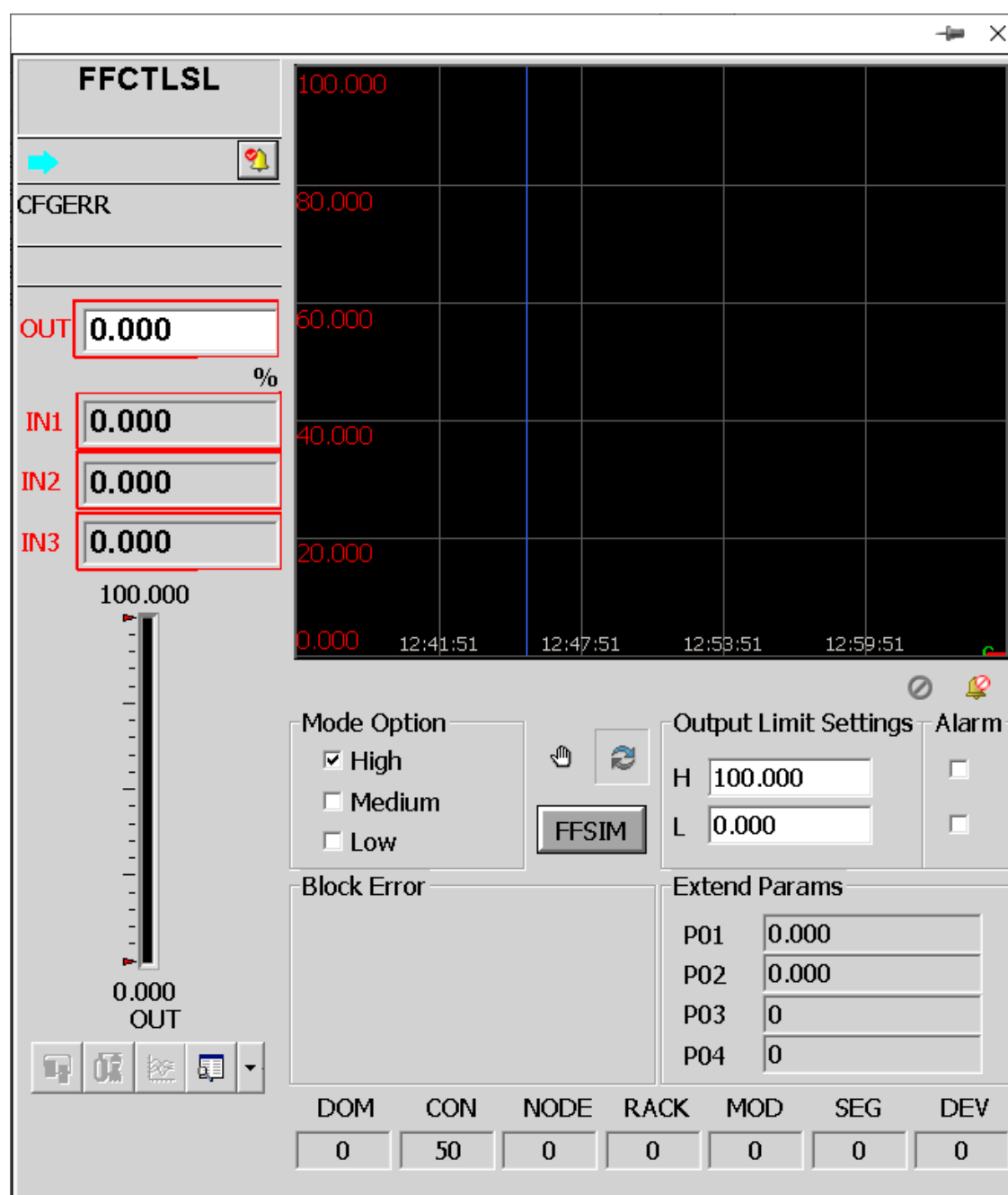


Figure 16.19 Preference Panel of FFCTL SL

Table below describes the FFCTL SL panel parameters and those related parameters of FBD.

Table 16.23 FFCTL SL Panel Parameters Instruction

Panel Parameter	FBD Parameter	Initial	Range
IN1	IN1	0.0	-
IN2	IN2	0.0	-
IN3	IN3	0.0	-
OUT	OUT	0.0	-

Table 16.23 FFCTLSL Panel Parameters Instruction (continued)

Panel Parameter		FBD Parameter	Initial	Range
Mode		-	-	-
OutOut Limit Range	H	OUTH_LIM	100.0	
	L	OUTL_LIM	0.0	-

16.9.5 Flag

FFCTLSL flag instruction is shown as below.

Table 16.24 Flag of FFCTLSL

Flag	Alarm	Instruction
D0	OOS	Disable
D1	IMAN	Initialize Manually
D3	AUTO	Auto
D4	MAN	Manual
D8	FF_ALARM	FF Block Alarm
D16	OUTH	Output H Limit Alarm
D17	OUTL	Output L Limit Alarm
D25	SIMUL	Simulation
D27	CFGERR	Configuration Error
D28	HOLD	Hold
D29	ERR	Fault
D30	AOF	Suppress Alarm

16.10 FFCUSTOM

16.10.1 Overview

FFCUSTOM is used to connect FF function blocks, excepting the supported 15 function blocks, with the system. These function blocks can be FF standard function block, like RATIO, or custom function blocks of manufacturer.

16.10.2 Parameter Description

Table 16.25 FFCUSTOM parameter description

Parameter Name			Description	Upload	Property	FF Parameter Name	Application Instruction
Basic Parameters	Input Param	IN1	Unassigned, user can customize it.	-	Input Pin	Associate with selected FF parameter. If not selected, not associate with FF parameter.	After associated with pin provided by corresponding device function block, update and write the associated pin. If there is no associated pin, it does not represent of FF parameter.
		IN2	Unassigned, user can customize it.	-	Input Pin		
		IN3	Unassigned, user can customize it.	-	Input Pin		
		IN4	Unassigned, user can customize it.	-	Input Pin		
		IN5	Unassigned, user can customize it.	-	Input Pin		
		IN6	Unassigned, user can customize it.	-	Input Pin		
		IN7	Unassigned, user can customize it.	-	Input Pin		
		IN8	Unassigned, user can customize it.	-	Input Pin		
		IN9	Unassigned, user can customize it.	-	Input Pin		
		IN10	Unassigned, user can customize it.	-	Input Pin		
		IN11	Unassigned, user can customize it.	-	Input Pin		
		IN12	Unassigned, user can customize it.	-	Input Pin		
	Output Param	OUT1	Unassigned, user can customize it.	-	Output Pin	Associate with selected FF parameter. If not selected, not	After associated with pin provided by corresponding de-

Table 16.25 FFCUSTOM parameter description (continued)

Parameter Name			Description	Upload	Property	FF Parameter Name	Application In-struction
		OUT2	Unassigned, user can customize it.	-	Output Pin	associate with FF parameter.	vice function block, update the associated pin. If there is no associated pin, it does not represent of FF parameter.
		OUT3	Unassigned, user can customize it.	-	Output Pin		
		OUT4	Unassigned, user can customize it.	-	Output Pin		
		OUT5	Unassigned, user can customize it.	-	Output Pin		
		OUT6	Unassigned, user can customize it.	-	Output Pin		
		OUT7	Unassigned, user can customize it.	-	Output Pin		
		OUT8	Unassigned, user can customize it.	-	Output Pin		
		OUT9	Unassigned, user can customize it.	-	Output Pin		
		OUT10	Unassigned, user can customize it.	-	Output Pin		
		OUT11	Unassigned, user can customize it.	-	Output Pin		
		OUT12	Unassigned, user can customize it.	-	Output Pin		
	Operate Param	MOD-E_-TRG	Target mode. It can be viewed and configured by clicking “Set-tings” but-ton.	TRUE	Operation Parameter	MODE_BLK	Target Mode
		MOD-E_-PRM	Permit mode. It can be viewed and con-	TRUE	Operation Parameter	MODE_BLK	Permit Mode

Table 16.25 FFCUSTOM parameter description (continued)

Parameter Name			Description	Upload	Property	FF Parameter Name	Application Instruction
			figured by clicking “Settings” button.				
		MODE_NR	Normal mode. It can be viewed and configured by clicking “Settings” button.	TRUE	Operation Parameter	MODE_BLK	Normal Mode
Extended Parameters	Input Param	IN1S-TA	IN1 status. It can be viewed and configured by clicking “Settings” button.	-	Input Pin	Represent of the FF parameter status associated with corresponding pin. If not selected, it will not associate with FF parameter.	If the corresponding pin manages device function block pin, the pin associates with FF pin status. If not associated, it will not represent of FF parameter.
		IN2S-TA	IN2 status. It can be viewed and configured by clicking “Settings” button.	-	Input Pin		
		IN3S-TA	IN3 status. It can be viewed and configured by clicking “Settings” button.	-	Input Pin		
		IN4S-TA	IN4 status. It can be viewed and configured by clicking “Settings” button.	-	Input Pin		
		IN5S-TA	IN5 status. It can be viewed and configured by clicking “Settings” button.	-	Input Pin		
		IN6S-TA	IN6 status. It can be viewed and configured	-	Input Pin		

Table 16.25 FFCUSTOM parameter description (continued)

Parameter Name			Description	Upload	Property	FF Parameter Name	Application Instruction
			by clicking "Settings" button.				
		IN7S-TA	IN7 status. It can be viewed and configured by clicking "Settings" button.	-	Input Pin		
		IN8S-TA	IN8 status. It can be viewed and configured by clicking "Settings" button.	-	Input Pin		
		IN9S-TA	IN9 status. It can be viewed and configured by clicking "Settings" button.	-	Input Pin		
		IN10S-TA	IN10 status. It can be viewed and configured by clicking "Settings" button.	-	Input Pin		
		IN11S-TA	IN11 status. It can be viewed and configured by clicking "Settings" button.	-	Input Pin		
		IN12S-TA	IN12 status. It can be viewed and configured by clicking "Settings" button.	-	Input Pin		
	Output Param	OUT1S-TA	Output value1 status, it can be viewed by clicking "Set-	-	Output Pin	Represent of the FF parameter status associated with corresponding	If the corresponding pin manages device function block pin, the pin asso-

Table 16.25 FFCUSTOM parameter description (continued)

Parameter Name		Description	Upload	Property	FF Parameter Name	Application Instruction
		tings" button.			pin. If not selected, it will not associate with FF parameter.	ciates with FF pin status. If not associated, it will not represent of FF parameter.
	OUT2S-TA	Output value2 status, it can be viewed by clicking "Settings" button.	-	Output Pin		
	OUT3S-TA	Output value3 status, it can be viewed by clicking "Settings" button.	-	Output Pin		
	OUT4S-TA	Output value4 status, it can be viewed by clicking "Settings" button.	-	Output Pin		
	OUT5S-TA	Output value5 status, it can be viewed by clicking "Settings" button.	-	Output Pin		
	OUT6S-TA	Output value6 status, it can be viewed by clicking "Settings" button.	-	Output Pin		
	OUT7S-TA	Output value7 status, it can be viewed by clicking "Settings" button.	-	Output Pin		
	OUT8S-TA	Output value8 status, it can be viewed by clicking "Set-	-	Output Pin		

Table 16.25 FFCUSTOM parameter description (continued)

Parameter Name			Description	Upload	Property	FF Parameter Name	Application Instruction
			tings" button.				
		OUT9S-TA	Output value9 status, it can be viewed by clicking "Settings" button.	-	Output Pin		
		OUT10S-TA	Output value10 status, it can be viewed by clicking "Settings" button.	-	Output Pin		
		OUT11S-TA	Output value11 status, it can be viewed by clicking "Settings" button.	-	Output Pin		
		OUT12S-TA	Output value12 status, it can be viewed by clicking "Settings" button.	-	Output Pin		
		FLAG	Flag	-	Monitoring Parameter	-	-
		AOF	Suppress Module Alarm	TRUE	Operation Parameter	-	-
		BLCK_ERR	Block error, it can be viewed by clicking "Settings" button.	-	Monitoring Parameter	BLOCK_ERR	Correspond to Device Function Block
	Real-time Status	ST_REV	Static Revision	-	Monitoring Parameter	ST_REV	-
	Operate Param	MODE_ACT	Actual mode, it can be viewed by clicking	-	Monitoring Parameter	MODE_BLK	-

Table 16.25 FFCUSTOM parameter description (continued)

Parameter Name			Description	Upload	Property	FF Parameter Name	Application Instruction
			"Settings" button.				

16.10.3 Instruction Details

FFCUSTOM does not for a specific device function block, thus its algorithm is same with the algorithm of specified device function block. FFCUSTOM can achieve data display and sending of device function block pin.

User allocates FFCUSTOM to device function block, then configures each pin, and associates them to pins of specified device function block. After configuration, the pin of device function block can be monitored.

FFCUSTOM does not support the non-pin parameter of device function block.

Type parameter and BLOCK_ERR of function block associate corresponding parameter of device function block as default.

16.10.4 Flag

FFCUSTOM flag instruction is shown as below.

Table 16.26 Flag of FFCUSTOM

Flag	Alarm	Instruction
D0	OOS	Disable
D3	MAN	Manual
D4	AUTO	Auto
D8	FF_ALARM	FF Block Alarm
D27	CFGERR	Configuration Error
D28	HOLD	Hold
D29	ERR	Fault
D30	AOF	Suppress Alarm

16.11 FFINT

16.11.1 Overview

FFINT block represents the field device integral function block Integrator, by which DCS can monitor and control the field device Integrator.

FFINT can achieve accumulation for 2-channel input. It supports to accumulate rate signal and accumulation signal. With the accumulation for flow signal by FFINT, total quality or total volume of a period can be provided. FFINT has 2 accumulation modes, positive and negative, and it provides accumulated reset function.

16.11.2 Parameter Description

Table 16.27 FFINT parameter description

Parameter Name		Description	Upload	Property	FF Parameter Name	Application Instruction
Basic Parameters	Operate Param	CLCK_PER Integration Period	TRUE	Operation Parameter	CLOCK_PER	Reset period. When setting as periodic reset mode, reset will be performed after the period.
		GOOD_LIM Good Status Limit Value	TRUE	Operation Parameter	GOOD_LIM	It will influence whether the final output value status is good. Details refer to status process of Algorithm.
		PRE_TRIP Distance Before Trip Limit	TRUE	Operation Parameter	PRE_TRIP	When accumulated SV distance is less than the value, PTRIP indication will be generated and output.
		SV Integration Setpoint Value	TRUE	Operation Parameter	TOTAL_SP	When apply SV reset mode, when accumulation reaches SV, TRIP indication generates, perform reset or not according to the mode.
		UN-CR_LIM Uncertain Status L Limit Value	TRUE	Operation Parameter	UNCERT_LIM	Influence whether the final out value status is uncertain. Details

Table 16.27 FFINT parameter description (continued)

Parameter Name			Description	Upload	Property	FF Parameter Name	Application Instruction
							refer to status process in Algorithm.
		Integration Mode	IN-T-OP-TS Integration options. It can be viewed and configured by clicking "Settings" button.	TRUE	Configuration Parameter	INTEG_OPTS	Set the input signal and define status process mode, etc.
			IN-T-TYPE Integration type. It can be viewed and configured by clicking "Settings" button.	TRUE	Configuration Parameter	INTEG_TYPE	Set integration direction and reset mode, etc.
	Scale Setting	OUT-SCH	Output Scale H Limit	TRUE	Configuration Parameter	OUT_RANGE	Have no influence for control algorithm.
		OUT-SCL	Output Scale L Limit	TRUE	Configuration Parameter	OUT_RANGE	
		OUT-EU	Output Unit	TRUE	Configuration Parameter	OUT_RANGE	
		OUT-DLEN	Output Decimal Digits	TRUE	Configuration Parameter	OUT_RANGE	
Extended Parameters	Input Param	IN1	IN1	-	Input Pin	IN_1	-
		IN1-ERR	IN1 Quality	-	Input Pin	-	
		IN1-STA	IN1 status. It can be viewed and configured by clicking "Settings" button.	-	Input Pin	IN_1	
		IN2	IN2	-	Input Pin	IN_2	-
		IN2-ERR	IN2 Quality	-	Input Pin	-	

Table 16.27 FFINT parameter description (continued)

Parameter Name		Description	Upload	Property	FF Parameter Name	Application Instruction
	IN2_ STA	IN2 status. It can be viewed and configured by clicking "Settings" button.	-	Input Pin	IN_2	
	RIN	Reset Command	-	Input Pin	RESET_IN	Program Reset Signal Input
	RIN_ ERR	Reset Command Quality	-	Input Pin	-	
	RIN_ STA	Reset command status. It can be viewed and configured by clicking "Settings" button.	-	Input Pin	RESET_IN	
	REV1	IN1 Positive/Negative Integral Type	-	Input Pin	REV_FLOW1	IN1 Positive/Negative Integral Type
	REV1_ ERR	IN1 Positive/Negative Integral Type Quality	-	Input Pin	-	
	REV1_ STA	IN1 Positive/negative integral type status. It can be viewed and configured by clicking "Settings" button.	-	Input Pin	REV_FLOW1	
	REV2	IN2 Positive/Negative Integral Type	-	Input Pin	REV_FLOW2	IN2 Positive/Negative Integral Type
	REV2_ ERR	IN2 Positive/Negative Integral Type Quality	-	Input Pin	-	

Table 16.27 FFINT parameter description (continued)

Parameter Name			Description	Upload	Property	FF Parameter Name	Application Instruction
	Output Param	REV2_STA	IN2 Positive/negative integral type status. It can be viewed and configured by clicking "Settings" button.	-	Input Pin	REV_FLOW2	
		OUT	Output Value	-	Output Pin	OUT	Integration Output Value
		OUT_ERR	Output Quality	-	Output Pin	-	
		OUT_STA	Output status, it can be viewed by clicking "Settings" button.	-	Output Pin	OUT	
		PTRP	Integration Pre-finished Sign	-	Output Pin	OUT_PTRIP	Work with PRE_TRIP to indicate pre-integration.
		PTRP_ERR	Integration Pre-finished Sign Quality	-	Output Pin	-	
		PTRP_STA	Integration pre-finished sign status, it can be viewed by clicking "Settings" button.	-	Output Pin	OUT_PTRIP	
		TRIP	Integration Finished Sign	-	Output Pin	OUT_TRIP	Integration Finished Sign
		TRIP_ERR	Integration Finished Sign Quality	-	Output Pin	-	
		TRIP_STA	Integration Finished sign status, it can be viewed by clicking "Settings" button.	-	Output Pin	OUT_TRIP	

Table 16.27 FFINT parameter description (continued)

Parameter Name			Description	Upload	Property	FF Parameter Name	Application Instruction
	Alarm Param	BLCK_ERR	Block alarm, it can be viewed by clicking "Settings" button.	-	Monitoring Parameter	BLOCK_ERR	-
		FLAG	Flag	-	Monitoring Parameter	-	-
		AOF	Suppress Module Alarm	TRUE	Operation Parameter	-	-
	Real Status	NUM_RST	Reset Counter	-	Monitoring Parameter	N_RESET	-
		PCT_INCL	Percent of Integral Value with Good Status	-	Monitoring Parameter	PCT_INCL	-
		RTO-TAL	Accumulated Absolute Value of Input With Rejected Status	-	Monitoring Parameter	RTOTAL	-
		SRTOTAL	RTOTAL Value Before Reset	-	Monitoring Parameter	SRTOTAL	-
		SSV	SV Value Before Reset	-	Monitoring Parameter	SSP	-
		STOTAL	TOTAL Value Before Reset	-	Monitoring Parameter	STOTAL	-
	Other Param	ST_REV	Static Revision	-	Monitoring Parameter	ST_REV	-
	Operate Param	MODE_ACT	Actual mode, it can be viewed by clicking "Settings" button.	-	Monitoring Parameter	MODE_BLK	-
		MODE_TRG	Target mode. It can be viewed	TRUE	Operation Parameter	MODE_BLK	-

Table 16.27 FFINT parameter description (continued)

Parameter Name			Description	Upload	Property	FF Parameter Name	Application Instruction
			and configured by clicking "Settings" button.				
		MOD-E-PRM	Permit mode. It can be viewed and configured by clicking "Settings" button.	TRUE	Operation Parameter	MODE_BLK	-
		MOD-E-NR	Normal mode. It can be viewed and configured by clicking "Settings" button.	TRUE	Operation Parameter	MODE_BLK	-
		RST	Reset Command	TRUE	Operation Parameter	OP_CMD_INT	Operate reset command, parameter will reset automatically.
		OT-G-LIM	Initialization Limit Time	TRUE	Operation Parameter	OUTAGE_LIM	-
		PLS-VAL1	IN1 Coefficient	TRUE	Operation Parameter	PULSE_VAL1	When IN1 is pulse signal, it means the actual value represented by one pulse of IN1.
		PLS-VAL2	IN2 Coefficient	TRUE	Operation Parameter	PULSE_VAL2	When IN2 is pulse signal, it means the actual value represented by one pulse of IN2.
		UNIT-CONV	Convert Coefficient from IN2 to IN1	TRUE	Operation Parameter	UNIT_CONV	When the two channels are rate signals, convert IN2 to IN1 by the parameter.

Table 16.27 FFINT parameter description (continued)

Parameter Name			Description	Upload	Property	FF Parameter Name	Application Instruction
	Time Unit	MANOUT	Manual Operation Rate Output Value	TRUE	Operation Parameter	-	In OOS and MAN modes, change MANOUT to change output value.
		T_-UNIT1	IN1 Rate Time Type	TRUE	Configuration Parameter	TIME_UNIT1	-
		T_-UNIT2	IN2 Rate Time Type	TRUE	Configuration Parameter	TIME_UNIT2	-
	Extend Pin	P01	Extend Pin1	-	Extend Pin	Extend pin of actual configuration associated device function block	-
		P01_-STA	Extend Pin1 status, it can be viewed by clicking "Settings" button.	-	Extend Pin	Extend pin status of actual configuration associated device function block	-
		P02	Extend Pin2	-	Extend Pin	Extend pin of actual configuration associated device function block	-
		P02_-STA	Extend Pin2 status, it can be viewed by clicking "Settings" button.	-	Extend Pin	Extend pin status of actual configuration associated device function block	-
		P03	Extend Pin3	-	Extend Pin	Extend pin of actual configuration associated device function block	-
		P03_-STA	Extend Pin3 status, it can be viewed by clicking "Settings" button.	-	Extend Pin	Extend pin status of actual configuration associated device function block	-
		P04	Extend Pin4	-	Extend Pin	Extend pin of actual configuration associated	-

Table 16.27 FFINT parameter description (continued)

Parameter Name			Description	Upload	Property	FF Parameter Name	Application Instruction
						ed device function block.	
		P04_STA	Extend Pin4 status, it can be viewed by clicking "Settings" button.	-	Extend Pin	Extend pin status parameter supported by device function block associating based on actual configuration.	-
	Simulation Function	SWSIM	Simulation switch	-	Extend Pin	-	When the controller is in debug mode and SWSIM is equal to ON, enters the simulation status. When SWSIM is equal to OFF, exits the simulation mode.

16.11.3 Instruction Details

Schematic of Integrator

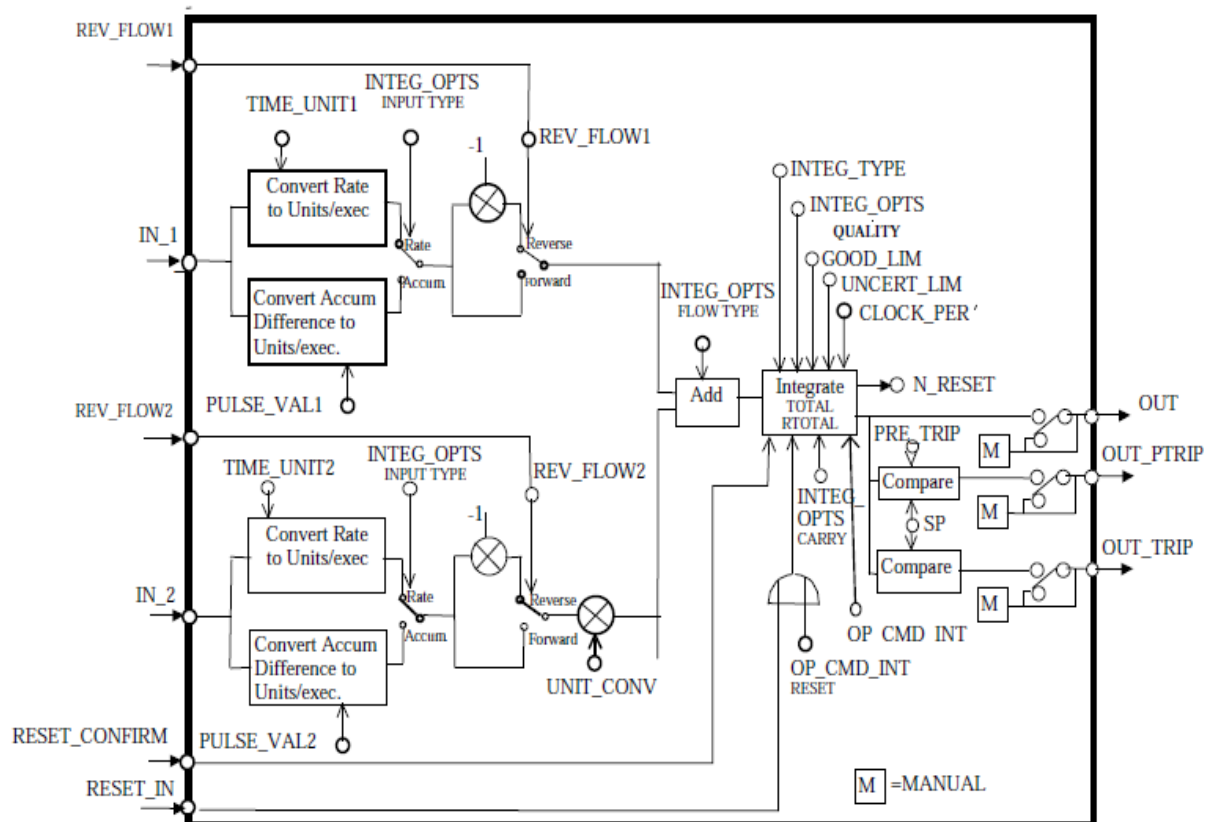


Figure 16.20 Schematic of Integrator

Algorithm

1. Inputs

The basic function of the FFINT block is to integrate an analog value over time. It can also accumulate the pulses coming from Pulse Input block or from other FFINT. The block has 2 dual purpose inputs, IN1 and IN2. If IN2 is not connected, then calculations for IN2 may be omitted. Input signals include rate signal and accumulation signal. User can select signal type via IN1 accumulation and IN2 accumulation option of INT_OPTS. When selected, it is accumulation signal, otherwise, it is rate signal.

● Rate

Rate input signal requires for rate time, and each input needs a parameter to define the rate time unit: T_UNIT1 or T_UNIT2. The time units are used to convert the two rates in unit of second.

The second input may have to be converted into the same units of the first input. This is achieved by a unit conversion factor, given by the parameter UNIT_CONV.

The following diagram is an example of the use of two rate inputs:

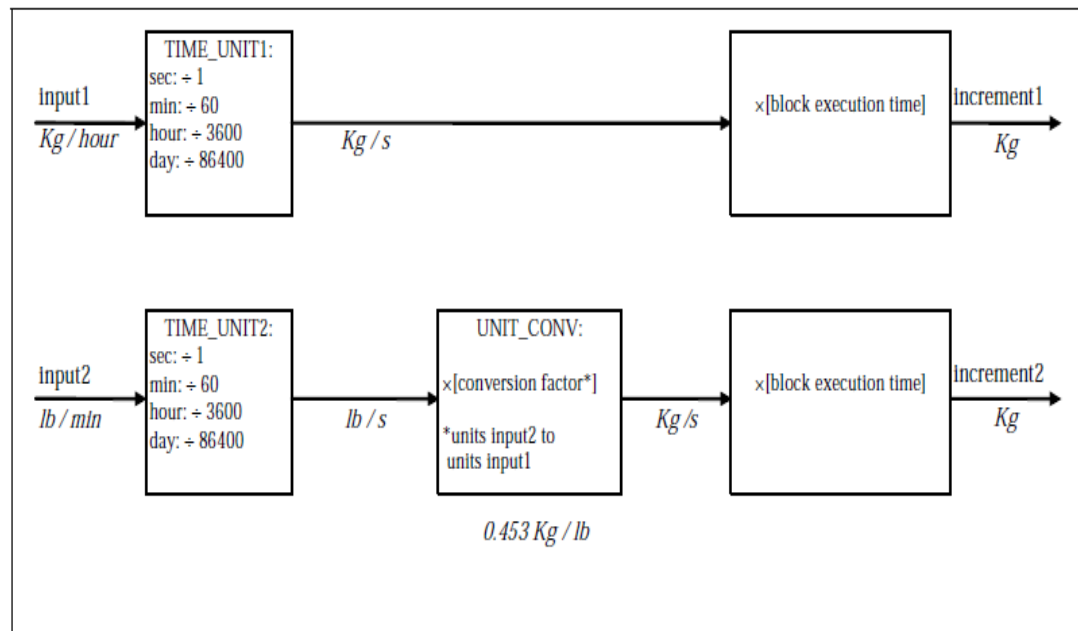


Figure 16.21 Increment Calculation with Rate Input

- Accum

When input signal comes from pulse block output, the input signal represents a continuous accumulation of pulses signal, and the block should determine the deviation value since the last execution.

The pulse signal will restart from 0 once it reaches a certain number. This situation should be distinguished by integral block and perform special process. The pulse accumulation of integral block wraps up when the counting reaches 999,999 and does not increment or decrement by more than 499,999 per cycle, which means the block can only accumulate the output pulse signal by above method.

The block can convert the accumulation of pulse to actual value to output via PLS_VAL1 and PLS_VAL2, for example, quality, volume, etc.

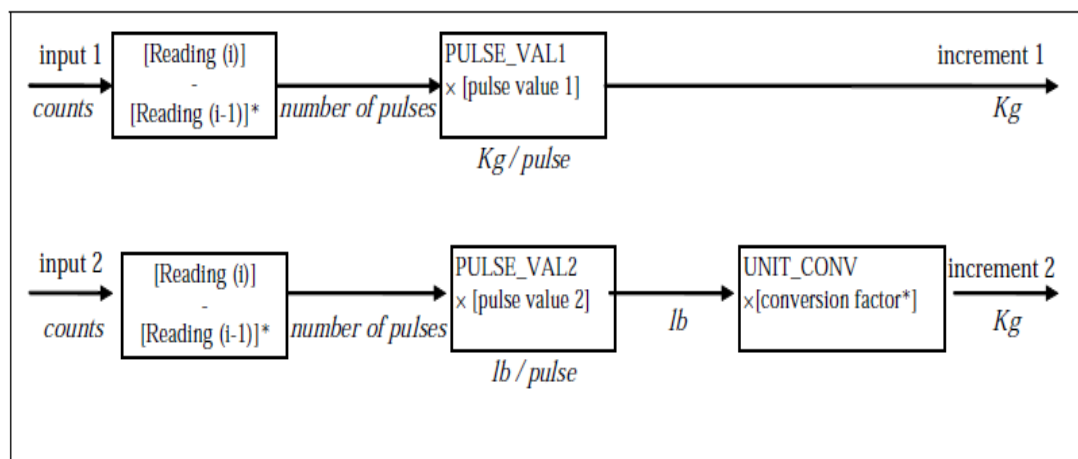


Figure 16.22 Increment Calculation with Counter Input

2. Positive/Negative Accumulation

User can indicate 2 channels input value as positive and negative accumulation. When $REV^*=1$, invert IN^* and accumulate. For example, for a device with inflow and outflow, set the input of inflow as positive accumulation, and set the $REV2$ of outflow $IN2$ as 1 to achieve negative accumulation, to accumulate the net flow of device. Accumulation Method: Output value can start positive accumulation from 0, and start negative accumulation from SV. It provides reset methods, such as automatic reset, period reset and command reset when accumulating. Above function can be configured via INT_TYPE , and following methods can be supported:

- 0 to SP-auto reset at SP: start positive accumulation from 0 to SV. When the accumulation reaches SV, automatic reset for function block will be performed.
- 0 to SP-demand reset: start positive accumulation from 0 to SV. Automatic reset for function block will not be performed only when inputting reset.
- SP to 0-auto reset at SP: start negative accumulation from SV to 0. When the accumulation reaches 0, automatic reset for function block will be performed.
- SP to 0-demand reset: start negative accumulation from SV to 0. Automatic reset for function block will not be performed only when inputting reset.
- 0 to ?-periodic reset: start positive accumulation from 0, reset for function block will be performed based on the reset period $CLOCK_PE$.
- 0 to ?-demand reset: start positive accumulation from 0. Automatic reset for function block will not be performed only when inputting reset.
- 0 to ?-periodic and demand reset: start positive accumulation from 0. Period reset for function block will be performed by time, or when inputting reset.

TRIP and PTRIP can calculate for the former 4 accumulation methods, but for later 3 modes, SV, TRIP, PTRIP will not work. For the fifth accumulation mode, it will not respond for the RIN reset of program input, but will respond for the RST reset command.

3. Reset

● Reset Method

Perform reset via RIN (FF parameter $RESET_IN$) input pin. When input is 1, it is the reset signal. When input is 0, not perform reset.

Operator performs reset for function block via RST (FF parameter OP_CMD_INT). RST is an instant switch. Once reset command is reached and reset function is enabled, initialization of RST as OFF will start right now.

● Save Reset Value

When resetting, function block will save current accumulation types OUT, RTOTAL, SV to STOTAL, SRTOTAL, SSV separately. These values will keep until next reset.

● Reset Time Limit

Function block will not respond to the new reset requirement in 5s last reset started.

- **Reset Counter**

Function block counts the reset times and saves in NUM_RST. NUM_RST cannot be changed and reset. It will accumulate from 0 to 999999 in cycle.

4. **Output Completion Indication**

In positive accumulation, when difference between output value and SV is equal to or less than PRE_TRIP, function block generates indication, and Discrete Output PTRIP is ON. When Output Value is equal to or larger than SV, function block generates indication, Discrete Output TRIP is ON.

In negative accumulation, Output Value is equal to or less than PRE_TRIP, function block generates indication, Discrete Output PTRIP is ON. When Output Value reaches 0, function block generates indication, Discrete Output TRIP is ON.

5. **Supported Modes**

OOS, MAN, AUTO.

In MAN mode, function block will not start accumulation. User can change MANOUT to change OUT. When mode of function block turns from MAN to AUTO, function block accumulates from current value. Reset Counter will count the times that OUT is changed via MANOUT.

6. **Status Process**

Function block determine the input signal status, and combines "Use Uncertain" and "Use Bad", "Add zero if bad" options of INT_OPTS, to perform different types of accumulation for input with bad or suspicious status.

PCT_INCL refers to the percent of input value with good status in total accumulation.

- When $PCT_INCL \geq GOOD_LIM$, OUT status is Good.
- When $PCT_INCL \geq UNCR_LIM$, OUT status is Uncertain.
- Else, OUT status is Bad.

Simulation Description

In simulation mode, the function block supports OOS, MAN, and AUTO modes.

- **OOS mode**
When MODE_TRG is equal to OOS, it enters OOS mode.
- **MAN mode**
When MODE_TRG is equal to MAN, it enters MAN mode.
- **AUTO mode**
When MODE_TRG is equal to AUTO, enter AUTO mode.

16.11.4 Panel Parameter

The function block panel of FFINT is shown as figure below.

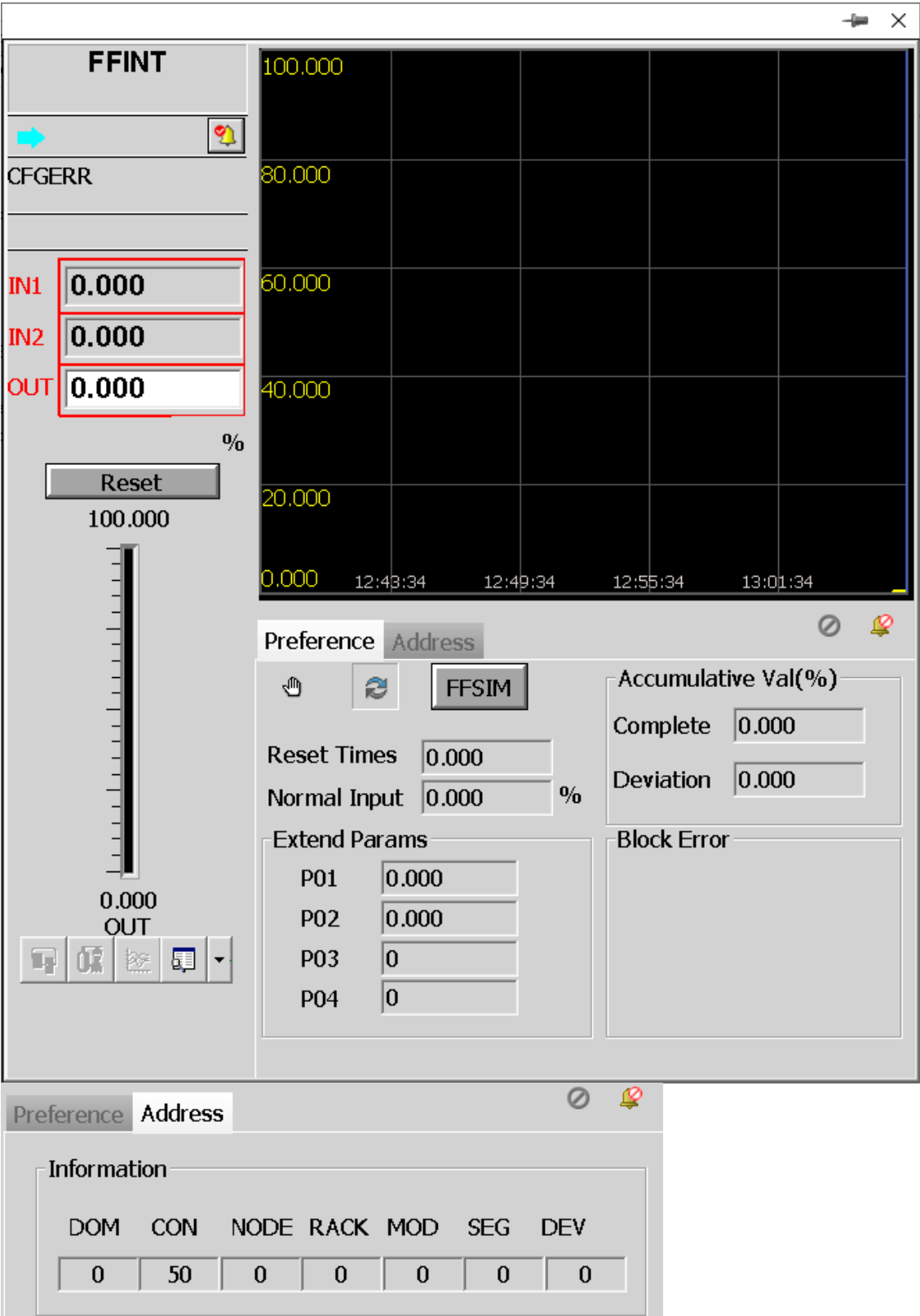


Figure 16.23 Preference Panel of FFINT

Table 1 describes the FFINT panel parameters and those related parameters of FBD.

Table 16.28 FFINT Panel Parameters Instruction

Panel Parameter			FBD Parameter	Initial	Range
IN1			IN1	0.0	-
IN2			IN2	0.0	-
OUT			OUT	0.0	-
Preference	Reset Times		NUM_RST	0.0	-
	Normal Input		PCT_INCL	0.0	-
	Accumulative Val	Complete	SV	0.0	-
		Deviation	PRE_TRIP	0.0	-

16.11.5 Flag

FFINT flag instruction is shown as below.

Table 16.29 Flag of FFINT

Flag	Alarm	Instruction
D0	OOS	Disable
D3	MAN	Manual
D4	AUTO	Auto
D8	FF_ALARM	FF Block Alarm
D25	SIMUL	Simulation
D27	CFGERR	Configuration Error
D28	HOLD	Hold
D29	ERR	Fault
D30	AOF	Suppress Alarm

16.12 FFISEL

FFISEL represents the field device input selection function block ISEL, by which DCS can monitor and control the field device ISEL.

FFISEL selects from the 4-channel input signals based on configuration and gets the final output value. Generally, it receives check signal from AI block, and supports selection modes such as maximum, minimum, middle average and first good. It provides a soft switch.

16.12.1 Parameter Description

Table 16.30 FFISEL parameter description

Parameter Name			Description	Upload	Property	FF Parameter Name	Application Instruction
Basic Parameters	Operate Param	MIN_-GOOD	Minimum Limit With Good Input Status	-	Operation Parameter	MIN_GOOG	Output Bad when number of input signal with good status is less than the parameter.
	Options Setting	SEL_-TYPE	Input options type. It can be viewed and configured by clicking "Settings" button.	-	Operation Parameter	SELECT_-TYPE	Set selection modes: maximum, minimum, middle average and first good, etc.
		STA_-OPTS	Status options. It can be viewed and configured by clicking "Settings" button.	TRUE	Configuration Parameter	STATUS_-OPTS	Status process options.
	Configuration Parameter	OUT_-SCH	Output Scale H Limit	TRUE	Configuration Parameter	OUT_RANGE	-
		OUT_-SCL	Output Scale H Limit	TRUE	Configuration Parameter	OUT_RANGE	-
		OUT_-EU	Output Unit	TRUE	Configuration Parameter	OUT_RANGE	-
		OUT_-DLEN	Output Decimal Digits	TRUE	Configuration Parameter	OUT_RANGE	-
Extended Parameters	Input Param	IN1	IN1	-	Input Pin	IN_1	-
		IN1_-ERR	IN1 Quality	-	Input Pin	-	-
		IN1_-STA	IN1 status. It can be viewed and configured by clicking	-	Input Pin	IN_1	-

Table 16.30 FFISEL parameter description (continued)

Parameter Name		Description	Upload	Property	FF Parameter Name	Application Instruction
		"Settings" button.				
	IN2	IN2	-	Input Pin	IN_2	-
	IN2_-ERR	IN2 Quality	-	Input Pin	-	-
	IN2_-STA	IN2 status. It can be viewed and configured by clicking "Settings" button.	-	Input Pin	IN_2	-
	IN3	IN3	-	Input Pin	IN_3	-
	IN3_-ERR	IN3 Quality	-	Input Pin	-	-
	IN3_-STA	IN3 status. It can be viewed and configured by clicking "Settings" button.	-	Input Pin	IN_3	-
	IN4	IN4	-	Input Pin	IN_4	-
	IN4_-ERR	IN4 Quality	-	Input Pin	-	-
	IN4_-STA	IN4 status. It can be viewed and configured by clicking "Settings" button.	-	Input Pin	IN_4	-
	DIS1	IN1 Disable Switch	-	Input Pin	DISABLE_1	-
	DIS1_-ERR	IN1 Disable Switch Quality	-	Input Pin	-	-
	DIS1_-STA	IN1 Disable Switch Status. It can be viewed and configured by clicking "Settings" button.	-	Input Pin	DISABLE_1	-

Table 16.30 FFISEL parameter description (continued)

Parameter Name		Description	Upload	Property	FF Parameter Name	Application Instruction
	DIS2	IN2 Disable Switch	-	Input Pin	DISABLE_2	-
	DIS2 - ERR	IN2 Disable Switch Quality	-	Input Pin	-	-
	DIS2 - STA	IN2 Disable Switch Status. It can be viewed and configured by clicking "Settings" button.	-	Input Pin	DISABLE_2	-
	DIS3	IN3 Disable Switch	-	Input Pin	DISABLE_3	-
	DIS3 - ERR	IN3 Disable Switch Quality	-	Input Pin	-	-
	DIS3 - STA	IN3 Disable Switch Status. It can be viewed and configured by clicking "Settings" button.	-	Input Pin	DISABLE_3	-
	DIS4	IN4 Disable Switch	-	Input Pin	DISABLE_4	-
	DIS4 - ERR	IN4 Disable Switch Quality	-	Input Pin	-	-
	DIS4 - STA	IN4 Disable Switch Status. It can be viewed and configured by clicking "Settings" button.	-	Input Pin	DISABLE_4	-
	OP - SEL	Input Selected Number	-	Input Pin	OP_SELECT	-
	OP - S - ERR	Input Selected Number Quality	-	Input Pin	-	-

Table 16.30 FFISEL parameter description (continued)

Parameter Name			Description	Upload	Property	FF Parameter Name	Application Instruction
	Output Param	OP_ S_ STA	Input Selected Number Status	-	Input Pin	OP_SELECT	-
		OUT	Output Value	-	Output Pin	OUT	-
		OUT_ ERR	Output Quality	-	Output Pin	-	-
		OUT_ STA	Output status, it can be viewed by clicking "Settings" button.	-	Output Pin	OUT	-
		SEL	Selected Parameter	-	Output Pin	SELECTED	Select input number. When not select, it is 0.
		SEL_ ERR	Selected Parameter Quality	-	Output Pin	-	-
		SEL_ STA	Selected Parameter status, it can be viewed by clicking "Settings" button.	-	Output Pin	SELECTED	-
	Alarm Param	BLCK_ ERR	Block alarm, it can be viewed by clicking "Settings" button.	-	Monitoring Parameter	BLOCK_ERR	-
		FLAG	Flag	-	Monitoring Parameter	-	-
		AOF	Suppress Module Alarm	TRUE	Operation Parameter	-	-
	Real Status	ST_ REV	Static Revision	-	Monitoring Parameter	ST_REV	-
		MANOU Rate Output Value	Manual Operate Output Value	TRUE	Operation Parameter	-	-

Table 16.30 FFISEL parameter description (continued)

Parameter Name			Description	Upload	Property	FF Parameter Name	Application Instruction
	Operate Param	MOD-E_-ACT	Actual mode, it can be viewed by clicking "Settings" button.	-	Monitoring Parameter	MODE_BLK	-
		MOD-E_-TRG	Target mode. It can be viewed and configured by clicking "Settings" button.	TRUE	Operation Parameter	MODE_BLK	-
		MOD-E_-PRM	Permit mode. It can be viewed and configured by clicking "Settings" button.	TRUE	Operation Parameter	MODE_BLK	-
		MOD-E_-NR	Normal mode. It can be viewed and configured by clicking "Settings" button.	TRUE	Operation Parameter	MODE_BLK	-
	Extend Pin	P01	Extend Pin1	-	Extend Pin	Extend pin of actual configuration associated device function block	-
		P01_-STA	Extend Pin1 status, it can be viewed by clicking "Settings" button.	-	Extend Pin	Extend pin status of actual configuration associated device function block	-
		P02	Extend Pin2	-	Extend Pin	Extend pin of actual configuration associated device function block	-
		P02_-STA	Extend Pin2 status, it can be viewed by clicking	-	Extend Pin	Extend pin status of actual configuration associ-	-

Table 16.30 FFISEL parameter description (continued)

Parameter Name			Description	Upload	Property	FF Parameter Name	Application Instruction
			"Settings" button.			ated device function block	
		P03	Extend Pin3	-	Extend Pin	Extend pin of actual configuration associated device function block	-
		P03_STA	Extend Pin3 status, it can be viewed by clicking "Settings" button.	-	Extend Pin	Extend pin status of actual configuration associated device function block	-
		P04	Extend Pin4	-	Extend Pin	Extend pin of actual configuration associated device function block.	-
		P04_STA	Extend Pin4 status, it can be viewed by clicking "Settings" button.	-	Extend Pin	Extend pin status parameter supported by device function block associating based on actual configuration.	-
	Simulation Function	SWSIM	Simulation switch	-	Extend Pin	-	When the controller is in debug mode and SWSIM is equal to ON, enters the simulation status. When SWSIM is equal to OFF, exits the simulation mode.

16.12.2 Instruction Details

Schematic of ISEL

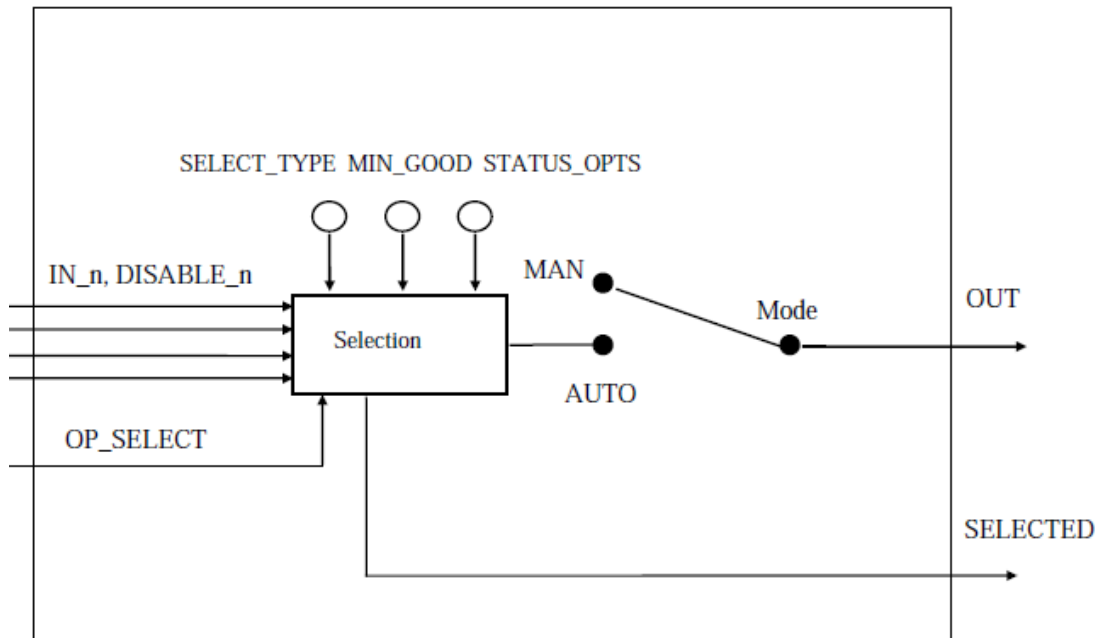


Figure 16.24 Schematic of ISEL

Algorithm

- Input Process

When input Pin DIS* is 1, function block will not process corresponding IN* pin.

Combine the “Use Uncertain as Good” and “Uncertain if Man mode” options of STA_OPTS to process Uncertain Status of Input Pin. Pin with Bad status will not be selected.

After above process, if there is no available Input Pin or the number of available Input Pin is less than MIN_GOOD, Output PinSEL is 0, and selection will not be performed.

- Select Modes

When OP_SEL is not 0, select input of serial number corresponding to OP_SEL. SEL_TYPE does not work. SEL is select serial number.

When OP_SEL is 0, select based on SEL_TYPE.

- First good: select the first available input with good status to output.
- Minimum: sort the available input pins, select the smallest input to output.
- Maximum: sort the available input pins, select the largest input to output.
- Middle: sort the available input pins, if the input pin number is odd, select the middle input to output, SEL is the serial number of selected input pin. If the number is even, remove the maximum and minimum and work out the average of left 2 input pins, SEL is 0.
- Average: calculate the average of available input pin to output.

Simulation Description

In simulation mode, the function block supports OOS, MAN, and AUTO modes.

- OOS mode
When MODE_TRG is equal to OOS, it enters OOS mode.
- MAN mode
When MODE_TRG is equal to MAN, it enters MAN mode.
- AUTO mode
When MODE_TRG is equal to AUTO, enter AUTO mode.

16.12.3 Panel Parameter

The function block panel of FFISEL is shown as figure below.

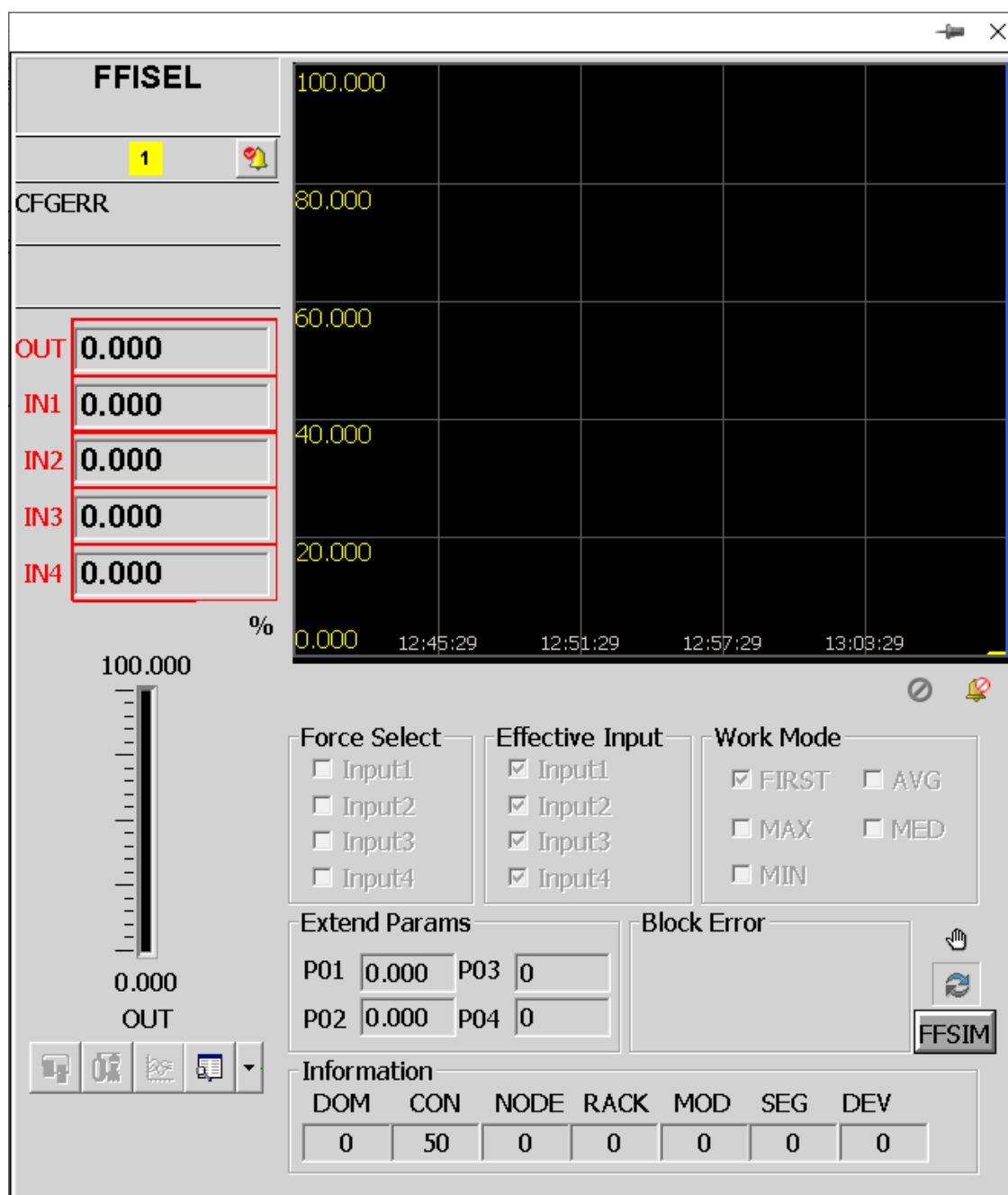


Figure 16.25 Panel of FFISEL

Table 1 describes the FFISEL panel parameters and those related parameters of FBD.

Table 16.31 FFISEL Panel Parameters Instruction

Panel Parameter	FBD Parameter	Initial	Range
IN1	IN1	0.0	-
IN2	IN2	0.0	-
IN3	IN3	0.0	-
IN4	IN4	0.0	-

Table 16.31 FFISEL Panel Parameters Instruction (continued)

Panel Parameter	FBD Parameter	Initial	Range
OUT	OUT	0.0	-

16.12.4 Flag

FFISEL flag instruction is shown as below.

Table 16.32 Flag of FFISEL

Flag	Alarm	Instruction
D0	OOS	Disable
D3	MAN	Manual
D4	AUTO	Auto
D8	FF_ALARM	FF Block Alarm
D25	SIMUL	Simulation
D27	CFGERR	Configuration Error
D28	HOLD	Hold
D29	ERR	Fault
D30	AOF	Suppress Alarm

16.13 FFISEL_EX

16.13.1 Overview

Main function of FFISEL_EX block please refers to "FFISEL".

16.13.2 Parameter Description

Table 16.33 FFISEL_EX parameter description

Parameter Name			Description	Upload	Property	FF Parameter Name	Application Instruction
Basic Parameters	Operate Param	MIN_-GOOD	Minimum Limit With Good Input Status	-	Operation Parameter	MIN_GOOG	Output Bad when number of input signal with good status is less than

Table 16.33 FFISEL_EX parameter description (continued)

Parameter Name			Description	Upload	Property	FF Parameter Name	Application Instruction
	Options Setting						the parameter.
		SEL_T-PYE	Input options type. It can be viewed and configured by clicking "Settings" button.	-	Operation Parameter	SELECT_TYPE	Set selection modes: maximum, minimum, middle average and first good, etc.
		STA_OPTS	Status options. It can be viewed and configured by clicking "Settings" button.	TRUE	Configuration Parameter	STATUS_OPTS	Status process options.
	Configuration Parameter	OUT_SCH	Output Scale H Limit	TRUE	Configuration Parameter	OUT_RANGE	-
		OUT_SCL	Output Scale H Limit	TRUE	Configuration Parameter	OUT_RANGE	-
		OUT_EU	Output Unit	TRUE	Configuration Parameter	OUT_RANGE	-
		OUT_DLEN	Output Decimal Digits	TRUE	Configuration Parameter	OUT_RANGE	-
	Input Param	IN1	IN1	-	Input Pin	IN_1	-
		IN1_ERR	IN1 Quality	-	Input Pin	-	-
		IN1_STA	IN1 status. It can be viewed and configured by clicking "Settings" button.	-	Input Pin	IN_1	-
		IN2	IN2	-	Input Pin	IN_2	-
		IN2_ERR	IN2 Quality	-	Input Pin	-	-
		IN2_STA	IN2 status. It can be	-	Input Pin	IN_2	-

Table 16.33 FFISEL_EX parameter description (continued)

Parameter Name		Description	Upload	Property	FF Parameter Name	Application Instruction
		viewed and configured by clicking "Settings" button.				
	IN3	IN3	-	Input Pin	IN_3	-
	IN3_-ERR	IN3 Quality	-	Input Pin	-	-
	IN3_-STA	IN3 status. It can be viewed and configured by clicking "Settings" button.	-	Input Pin	IN_3	-
	IN4	IN4	-	Input Pin	IN_4	-
	IN4_-ERR	IN4 Quality	-	Input Pin	-	-
	IN4_-STA	IN4 status. It can be viewed and configured by clicking "Settings" button.	-	Input Pin	IN_4	-
	IN5	IN5	-	Input Pin	IN_5	-
	IN5_-ERR	IN5 Quality	-	Input Pin	-	-
	IN5_-STA	IN5 status. It can be viewed and configured by clicking "Settings" button.	-	Input Pin	IN_5	-
	IN6	IN6	-	Input Pin	IN_6	-
	IN6_-ERR	IN6 Quality	-	Input Pin	-	-
	IN6_-STA	IN6 status. It can be viewed and configured by clicking "Settings" button.	-	Input Pin	IN_6	-

Table 16.33 FFISEL_EX parameter description (continued)

Parameter Name		Description	Upload	Property	FF Parameter Name	Application Instruction
	IN7	IN7	-	Input Pin	IN_7	-
	IN7_-ERR	IN7 Quality	-	Input Pin	-	-
	IN7_-STA	IN7 status. It can be viewed and configured by clicking "Settings" button.	-	Input Pin	IN_7	-
	IN8	IN8	-	Input Pin	IN_8	-
	IN8_-ERR	IN8 Quality	-	Input Pin	-	-
	IN8_-STA	IN8 status. It can be viewed and configured by clicking "Settings" button.	-	Input Pin	IN_8	-
	DIS1	IN1 Disable Switch	-	Input Pin	DISABLE_1	-
	DIS1_-ERR	IN1 Disable Switch Quality	-	Input Pin	-	-
	DIS1_-STA	IN1 Disable Switch Status. It can be viewed and configured by clicking "Settings" button.	-	Input Pin	DISABLE_1	-
	DIS2	IN2 Disable Switch	-	Input Pin	DISABLE_2	-
	DIS2_-ERR	IN2 Disable Switch Quality	-	Input Pin	-	-
	DIS2_-STA	IN2 Disable Switch Status. It can be viewed and configured by clicking	-	Input Pin	DISABLE_2	-

Table 16.33 FFISEL_EX parameter description (continued)

Parameter Name		Description	Upload	Property	FF Parameter Name	Application Instruction
		"Settings" button.				
	DIS3	IN3 Disable Switch	-	Input Pin	DISABLE_3	-
	DIS3 - ERR	IN3 Disable Switch Quality	-	Input Pin	-	-
	DIS3 - STA	IN3 Disable Switch Status. It can be viewed and configured by clicking "Settings" button.	-	Input Pin	DISABLE_3	-
	DIS4	IN4 Disable Switch	-	Input Pin	DISABLE_4	-
	DIS4 - ERR	IN4 Disable Switch Quality	-	Input Pin	-	-
	DIS4 - STA	IN4 Disable Switch Status. It can be viewed and configured by clicking "Settings" button.	-	Input Pin	DISABLE_4	-
	DIS5	IN5 Disable Switch	-	Input Pin	DISABLE_5	-
	DIS5 - ERR	IN5 Disable Switch Quality	-	Input Pin	-	-
	DIS5 - STA	IN5 Disable Switch Status. It can be viewed and configured by clicking "Settings" button.	-	Input Pin	DISABLE_5	-
	DIS6	IN6 Disable Switch	-	Input Pin	DISABLE_6	-
	DIS6 - ERR	IN6 Disable Switch Quality	-	Input Pin	-	-

Table 16.33 FFISEL_EX parameter description (continued)

Parameter Name			Description	Upload	Property	FF Parameter Name	Application Instruction
		DIS6 - STA	IN6 Disable Switch Status. It can be viewed and configured by clicking "Settings" button.	-	Input Pin	DISABLE_6	-
		DIS7	IN7 Disable Switch	-	Input Pin	DISABLE_7	-
		DIS7 - ERR	IN7 Disable Switch Quality	-	Input Pin	-	-
		DIS7 - STA	IN7 Disable Switch Status. It can be viewed and configured by clicking "Settings" button.	-	Input Pin	DISABLE_7	-
		DIS8	IN8 Disable Switch	-	Input Pin	DISABLE_8	-
		DIS8 - ERR	IN8 Disable Switch Quality	-	Input Pin	-	-
		DIS8 - STA	IN8 Disable Switch Status. It can be viewed and configured by clicking "Settings" button.	-	Input Pin	DISABLE_8	-
		OP - SEL	Input Selected Number	-	Input Pin	OP_SELECT	-
		OP - S - ERR	Input Selected Number Quality	-	Input Pin	-	-
		OP - S - STA	Input Selected Number Status	-	Input Pin	OP_SELECT	-
	Output Param	OUT	Output Value	-	Output Pin	OUT	-

Table 16.33 FFISEL_EX parameter description (continued)

Parameter Name		Description	Upload	Property	FF Parameter Name	Application Instruction	
		OUT_ERR	Output Quality	-	Output Pin	-	-
		OUT_STA	Output status, it can be viewed by clicking “Settings” button.	-	Output Pin	OUT	-
		SEL	Selected Parameter	-	Output Pin	SELECTED	Select input number. When not select, it is 0.
		SEL_ERR	Selected Parameter Quality	-	Output Pin	-	-
		SEL_STA	Selected Parameter status, it can be viewed by clicking “Settings” button.	-	Output Pin	SELECTED	-
		OUT_D	Discrete Output Value	-	Output Pin	OUT_D	-
		OUT_D_ERR	Discrete Output Quality	-	Output Pin	-	-
		OUT_D_ST	Discrete Output status	-	Output Pin	OUT_D	-
	Alarm Param	BLCK_ERR	Block alarm, it can be viewed by clicking “Settings” button.	-	Monitoring Parameter	BLOCK_ERR	-
		FLAG	Flag	-	Monitoring Parameter	-	-
		AOF	Suppress Module Alarm	TRUE	Operation Parameter	-	-
	Real Status	ST_REV	Static Revision	-	Monitoring Parameter	ST_REV	-

Table 16.33 FFISEL_EX parameter description (continued)

Parameter Name			Description	Upload	Property	FF Parameter Name	Application Instruction
	Operate Param	MOD-E_-ACT	Actual mode, it can be viewed by clicking “Settings” button.	-	Monitoring Parameter	MODE_BLK	-
		MANOU	Manual Operate Output Value	TRUE	Operation Parameter	-	-
		MOD-E_-TRG	Target mode. It can be viewed and configured by clicking “Settings” button.	TRUE	Operation Parameter	MODE_BLK	-
		MOD-E_-PRM	Permit mode. It can be viewed and configured by clicking “Settings” button.	TRUE	Operation Parameter	MODE_BLK	-
		MOD-E_-NR	Normal mode. It can be viewed and configured by clicking “Settings” button.	TRUE	Operation Parameter	MODE_BLK	-

16.13.3 Instruction Details

Instruction details of FFISEL_EX please refer to "Instruction Details".

16.13.4 Panel Parameter

The function block panel of FFISEL_EX is shown as figure below.

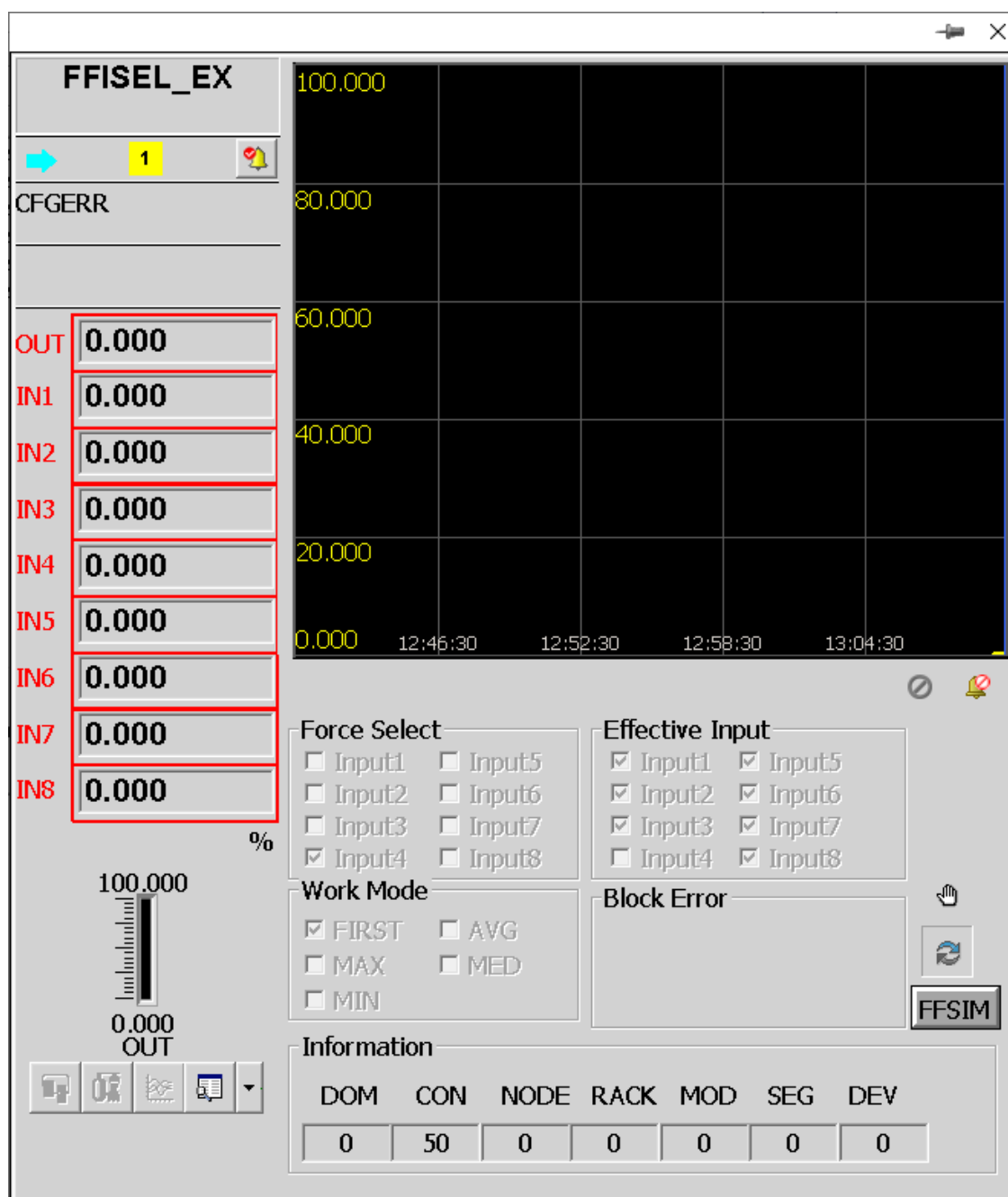


Figure 16.26 Panel of FFISEL_EX

Table 1 describes the FFISEL_EX panel parameters and those related parameters of FBD.

Table 16.34 FFISEL_EX Panel Parameters Instruction

Panel Parameter	FBD Parameter	Initial	Range
IN1	IN1	0.0	-
IN2	IN2	0.0	-
IN3	IN3	0.0	-
IN4	IN4	0.0	-

Table 16.34 FFISEL_EX Panel Parameters Instruction (continued)

Panel Parameter	FBD Parameter	Initial	Range
IN5	IN5	0.0	-
IN6	IN6	0.0	-
IN7	IN7	0.0	-
IN8	IN8	0.0	-
OUT	OUT	0.0	-

16.13.5 Flag

FFISEL_EX flag instruction is shown as below.

Table 16.35 Flag of FFISEL_EX

Flag	Alarm	Instruction
D0	OOS	Disable
D3	MAN	Manual
D4	AUTO	Auto
D8	FF_ALARM	FF Block Alarm
D25	SIMUL	Simulation
D27	CFGERR	Configuration Error
D28	HOLD	Hold
D29	ERR	Fault
D30	AOF	Suppress Alarm

16.14 FFMAI

16.14.1 Overview

FFMAI represents the field device input selection function block MAI, by which DCS can monitor and control the field device MAI.

FFMAI supports detect and input of 8-channel analog signal.

16.14.2 Parameter Description

Table 16.36 FFMAI parameter description

Parameter Name			Description	Upload	Property	FF Parameter Name	Application Instruction
Basic Parameters	Signal Convert Setting	CHANNEL	Channel	TRUE	Configuration Parameter	CHANNEL	Set the selection modes of 8 channels, including unified setting and separate setting.
	Configuration Parameter	OUT_SCH	Output Scale H Limit	-	Configuration Parameter	-	-
		OUT_SCL	Output Scale H Limit	-	Configuration Parameter	-	-
		OUT_EU	Output Unit	-	Configuration Parameter	-	-
Extended Parameters	Output Param	OUT1	Output Value1	-	Output Pin	OUT_1	-
		OUT1_ERR	Output Value1 Quality	-	Output Pin	-	-
		OUT1_STA	Output value1 status, it can be viewed by clicking "Settings" button.	-	Output Pin	OUT_1	-
		OUT2	Output Value2	-	Output Pin	OUT_2	-
		OUT2_ERR	Output Value2 Quality	-	Output Pin	-	-
		OUT2_STA	Output value2 status, it can be viewed by clicking "Settings" button.	-	Output Pin	OUT_2	-
		OUT3	Output Value3	-	Output Pin	OUT_3	-
		OUT3_ERR	Output Value3 Quality	-	Output Pin	-	-
		OUT3_STA	Output value3 sta-	-	Output Pin	OUT_3	-

Table 16.36 FFMAI parameter description (continued)

Parameter Name		Description	Upload	Property	FF Parameter Name	Application Instruction
		tus, it can be viewed by clicking "Settings" button.				
	OUT4	Output Value4	-	Output Pin	OUT_4	-
	OUT4_ERR	-Output Value4 Quality	-	Output Pin	-	-
	OUT4_STA	Output value4 status, it can be viewed by clicking "Settings" button.	-	Output Pin	OUT_4	-
	OUT5	Output Value5	-	Output Pin	OUT_5	-
	OUT5_ERR	-Output Value5 Quality	-	Output Pin	-	-
	OUT5_STA	Output value5 status, it can be viewed by clicking "Settings" button.	-	Output Pin	OUT_5	-
	OUT6	Output Value6	-	Output Pin	OUT_6	-
	OUT6_ERR	-Output Value6 Quality	-	Output Pin	-	-
	OUT6_STA	Output Value6 status, it can be viewed by clicking "Settings" button.	-	Output Pin	OUT_6	-
	OUT7	Output Value7	-	Output Pin	OUT_7	-
	OUT7_ERR	-Output Value7 Quality	-	Output Pin	-	-
	OUT7_STA	Output value7 status, it can	-	Output Pin	OUT_7	-

Table 16.36 FFMAI parameter description (continued)

Parameter Name			Description	Upload	Property	FF Parameter Name	Application Instruction
			be viewed by clicking "Settings" button.				
		OUT8	Output Value8	-	Output Pin	OUT_8	-
		OUT8_ERR	Output Value8 Quality	-	Output Pin	-	-
		OUT8_STA	Output value8 status, it can be viewed by clicking "Settings" button.	-	Output Pin	OUT_8	-
	Alarm Param	BLCK_ERR	Block alarm, it can be viewed by clicking "Settings" button.	-	Monitoring Parameter	BLOCK_ERR	-
		FLAG	Flag	-	Monitoring Parameter	-	-
		AOF	Suppress Module Alarm	TRUE	Operation Parameter	-	-
	Real Status	ST_REV	Static Revision	-	Monitoring Parameter	ST_REV	-
		MANO_U1	Manual Operate Output Value1	TRUE	Operation Parameter	-	-
		MANO_U2	Manual Operate Output Value2	TRUE	Operation Parameter	-	-
		MANO_U3	Manual Operate Output Value3	TRUE	Operation Parameter	-	-
		MANO_U4	Manual Operate Output Value4	TRUE	Operation Parameter	-	-
		MANO_U5	Manual Operate Output Value5	TRUE	Operation Parameter	-	-

Table 16.36 FFMAI parameter description (continued)

Parameter Name			Description	Upload	Property	FF Parameter Name	Application Instruction
		MANO_U6	Manual Operate Output Value6	TRUE	Operation Parameter	-	-
		MANO_U7	Manual Operate Output Value7	TRUE	Operation Parameter	-	-
		MANO_U8	Manual Operate Output Value8	TRUE	Operation Parameter	-	-
	Operate Param	MODE_ACT	Actual mode, it can be viewed by clicking "Settings" button.	-	Monitoring Parameter	MODE_BLK	-
		MODE_TRG	Target mode. It can be viewed and configured by clicking "Settings" button.	TRUE	Operation Parameter	MODE_BLK	-
		MODE_PRM	Permit mode. It can be viewed and configured by clicking "Settings" button.	TRUE	Operation Parameter	MODE_BLK	-
		MODE_NR	Normal mode. It can be viewed and configured by clicking "Settings" button.	TRUE	Operation Parameter	MODE_BLK	-
	Configuration Parameter	OUT_DLEN	Output Decimal Digits	-	Configuration Parameter	-	-
	Extend Pin	P01	Extend Pin1	-	Extend Pin	Extend pin of actual configuration associated device function block	-

Table 16.36 FFMAI parameter description (continued)

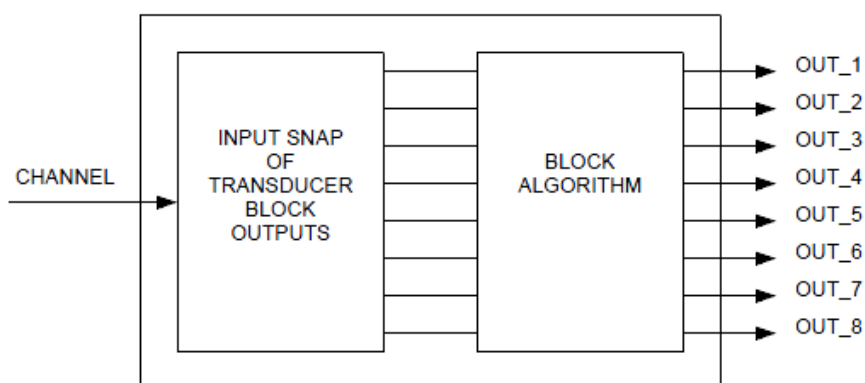
Parameter Name			Description	Upload	Property	FF Parameter Name	Application Instruction
		P01_STA	Extend Pin1 status, it can be viewed by clicking "Settings" button.	-	Extend Pin	Extend pin status of actual configuration associated device function block	-
		P02	Extend Pin2	-	Extend Pin	Extend pin of actual configuration associated device function block	-
		P02_STA	Extend Pin2 status, it can be viewed by clicking "Settings" button.	-	Extend Pin	Extend pin status of actual configuration associated device function block	-
		P03	Extend Pin3	-	Extend Pin	Extend pin of actual configuration associated device function block	-
		P03_STA	Extend Pin3 status, it can be viewed by clicking "Settings" button.	-	Extend Pin	Extend pin status of actual configuration associated device function block	-
		P04	Extend Pin4	-	Extend Pin	Extend pin of actual configuration associated device function block.	-
		P04_STA	Extend Pin4 status, it can be viewed by clicking "Settings" button.	-	Extend Pin	Extend pin status parameter supported by device function block associating based on actual configuration.	-
	Simulation Function	SWSIM	Simulation switch	-	Extend Pin	-	When the controller is in debug mode and SWSIM is equal to ON, enters the

Table 16.36 FFMAI parameter description (continued)

Parameter Name			Description	Upload	Property	FF Parameter Name	Application Instruction
							simulation status. When SWSIM is equal to OFF, exits the simulation mode.
		SIM_-VAL1- SIM_-VAL8	Simulate input value	-	Extend Pin	-	-
		SIM_-S-TA1- SIM_-S-TA8	Simulate input value status	-	Extend Pin	-	-

16.14.3 Instruction Details

Schematic of MAI Process Flowchart

**Figure 16.27 Schematic of MAI**

Algorithm

FFMAI can process 8 input channels simultaneously. It supports modes of OOS, MAN, AUTO.

Simulation Description

In simulation mode, the function block supports OOS, MAN, and AUTO modes.

- OOS mode
When MODE_TRG is equal to OOS, it enters OOS mode.
 - MAN mode
When MODE_TRG is equal to MAN, it enters MAN mode.
 - AUTO mode
When MODE_TRG is equal to AUTO, enter AUTO mode.
- CHANNEL selection is invalid during simulation.

16.14.4 Panel Parameter

The function block panel of FFMAI is shown as figure below.

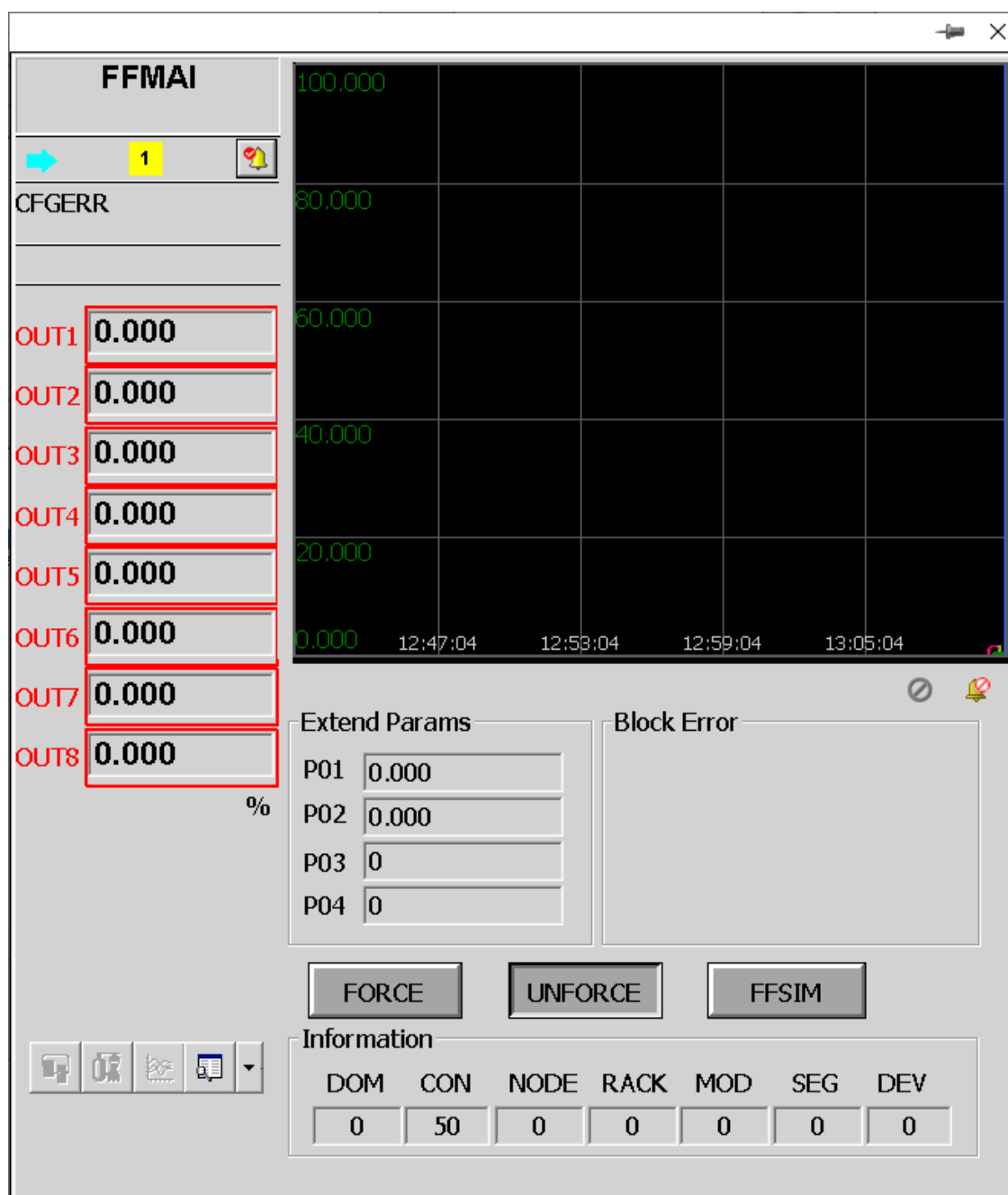


Figure 16.28 Panel of FFMAI

Table 1 describes the FFMAI panel parameters and those related parameters of FBD.

Table 16.37 FFMAI Panel Parameters Instruction

Panel Parameter	FBD Parameter	Initial	Range
OUT1	OUT1	0.0	-
OUT2	OUT2	0.0	-
OUT 3	OUT3	0.0	-
OUT 4	OUT4	0.0	-

Table 16.37 FFMAI Panel Parameters Instruction (continued)

Panel Parameter	FBD Parameter	Initial	Range
OUT 5	OUT5	0.0	-
OUT 6	OUT6	0.0	-
OUT 7	OUT7	0.0	-
OUT 8	OUT8	0.0	-

16.14.5 Flag

FFMAI flag instruction is shown as below.

Table 16.38 Flag of FFMAI

Flag	Alarm	Instruction
D0	OOS	Disable
D3	FORCE	Force
D4	UNFORCE	Unforce
D8	FF_ALARM	FF Block Alarm
D25	SIMUL	Simulation
D27	CFGERR	Configuration Error
D28	HOLD	Hold
D29	ERR	Fault
D30	AOF	Suppress Alarm

16.15 FFMAO

16.15.1 Overview

FFMAO represents the field device input selection function block MAO, by which DCS can monitor and control the field device MAO.

16.15.2 Parameter Description

Table 16.39 FFMAI parameter description

Parameter Name			Description	Upload	Property	FF Parameter Name	Application Instruction
Basic Parameters	Signal Convert Setting	CHAN-NEL	Channel	TRUE	Configuration Parameter	CHANNEL	Set the selection modes of 8 channels, including unified setting and separate setting.
Extended Parameters	Input Param	IN1	Remote SV1	-	Input Pin	IN_1	-
		IN1_-ERR	Remote SV1 Quality	-	Input Pin	-	-
		IN1_STA	Remote SV1 status. It can be viewed and configured by clicking "Settings" button.	-	Input Pin	IN_1	-
		IN2	Remote SV2	-	Input Pin	IN_2	-
		IN2_-ERR	Remote SV2 Quality	-	Input Pin	-	-
		IN2_STA	Remote SV2 status. It can be viewed and configured by clicking "Settings" button.	-	Input Pin	IN_2	-
		IN3	Remote SV3	-	Input Pin	IN_3	-
		IN3_-ERR	Remote SV3 Quality	-	Input Pin	-	-
		IN3_STA	Remote SV3 status. It can be viewed and configured by clicking "Settings" button.	-	Input Pin	IN_3	-
		IN4	Remote SV4	-	Input Pin	IN_4	-
		IN4_-ERR	Remote SV4 Quality	-	Input Pin	-	-
		IN4_STA	Remote SV4 status. It can be viewed and config-	-	Input Pin	IN_4	-

Table 16.39 FFMAI parameter description (continued)

Parameter Name		Description	Upload	Property	FF Parameter Name	Application Instruction
		ured by clicking "Settings" button.				
	IN5	Remote SV5	-	Input Pin	IN_5	-
	IN5_-ERR	Remote SV5 Quality	-	Input Pin	-	-
	IN5_STA	Remote SV5 status. It can be viewed and configured by clicking "Settings" button.	-	Input Pin	IN_5	-
	IN6	Remote SV6	-	Input Pin	IN_6	-
	IN6_-ERR	Remote SV6 Quality	-	Input Pin	-	-
	IN6_STA	Remote SV6 status. It can be viewed and configured by clicking "Settings" button.	-	Input Pin	IN_6	-
	IN7	Remote SV7	-	Input Pin	IN_7	-
	IN7_-ERR	Remote SV7 Quality	-	Input Pin	-	-
	IN7_STA	Remote SV7 status. It can be viewed and configured by clicking "Settings" button.	-	Input Pin	IN_7	-
	IN8	Remote SV8	-	Input Pin	IN_8	-
	IN8_-ERR	Remote SV8 Quality	-	Input Pin	-	-
	IN8_STA	Remote SV8 status. It can be viewed and configured by clicking "Settings" button.	-	Input Pin	IN_8	-

Table 16.39 FFMAI parameter description (continued)

Parameter Name			Description	Upload	Property	FF Parameter Name	Application Instruction
	Alarm Param	BLCK_-ERR	Block alarm, it can be viewed by clicking "Settings" button.	-	Monitoring Parameter	BLOCK_ERR	-
		FLAG	Flag	-	Monitoring Parameter	-	-
		AOF	Suppress Module Alarm	TRUE	Operation Parameter	-	-
	Actual Param	ST_REV	Static Revision	-	Monitoring Parameter	ST_REV	-
		FST_S-TA	Fault Indication	-	Monitoring Parameter	FSTATUS_S-TATUS	-
	Operate Param	MODE_-ACT	Actual mode, it can be viewed by clicking "Settings" button.	-	Monitoring Parameter	MODE_BLK	-
		MODE_-TRG	Target mode. It can be viewed and configured by clicking "Settings" button.	TRUE	Operation Parameter	MODE_BLK	-
		MODE_-PRM	Permit mode. It can be viewed and configured by clicking "Settings" button.	TRUE	Operation Parameter	MODE_BLK	-
		MODE_-NR	Normal mode. It can be viewed and configured by clicking "Settings" button.	TRUE	Operation Parameter	MODE_BLK	-
	Advanced Options	FST_-TIME	Failure Time	TRUE	Operation Parameter	FSTATUS_-TIME	-

Table 16.39 FFMAI parameter description (continued)

Parameter Name			Description	Upload	Property	FF Parameter Name	Application Instruction
		FST_-VAL1	Fault Value1	TRUE	Operation Parameter	FSTATUS_-VAL_1	Fault Value1
		FST_-VAL2	Fault Value2	TRUE	Operation Parameter	FSTATUS_-VAL_2	Fault Value2
		FST_-VAL3	Fault Value3	TRUE	Operation Parameter	FSTATUS_-VAL_3	Fault Value3
		FST_-VAL4	Fault Value4	TRUE	Operation Parameter	FSTATUS_-VAL_4	Fault Value4
		FST_-VAL5	Fault Value5	TRUE	Operation Parameter	FSTATUS_-VAL_5	Fault Value5
		FST_-VAL6	Fault Value6	TRUE	Operation Parameter	FSTATUS_-VAL_6	Fault Value6
		FST_-VAL7	Fault Value7	TRUE	Operation Parameter	FSTATUS_-VAL_7	Fault Value7
		FST_-VAL8	Fault Value8	TRUE	Operation Parameter	FSTATUS_-VAL_8	Fault Value8
		MO_-OPT	Failsafe options. It can be viewed and configured by clicking “Settings” button.	TRUE	Operation Parameter	MO_OPTS	-
	Extend Pin	P01	Extend Pin1	-	Extend Pin	Extend pin of actual configuration associated device function block	-
		P01_S-TA	Extend Pin1 status, it can be viewed by clicking “Settings” button.	-	Extend Pin	Extend pin status of actual configuration associated device function block	-
P02		Extend Pin2	-	Extend Pin	Extend pin of actual configuration asso-	-	

Table 16.39 FFMAI parameter description (continued)

Parameter Name			Description	Upload	Property	FF Parameter Name	Application Instruction
						ciated device function block	
		P02_S-TA	Extend Pin2 status, it can be viewed by clicking “Settings” button.	-	Extend Pin	Extend pin status of actual configuration associated device function block	-
		P03	Extend Pin3	-	Extend Pin	Extend pin of actual configuration associated device function block	-
		P03_S-TA	Extend Pin3 status, it can be viewed by clicking “Settings” button.	-	Extend Pin	Extend pin status of actual configuration associated device function block	-
		P04	Extend Pin4	-	Extend Pin	Extend pin of actual configuration associated device function block.	-
		P04_S-TA	Extend Pin4 status, it can be viewed by clicking “Settings” button.	-	Extend Pin	Extend pin status parameter supported by device function block associating based on actual configuration.	-
	Signal Convert Setting	IN_SCH	Input Value Scale H Limit	-	Extend Parameter	-	-
		IN_SCL	Input Value Scale H Limit	-	Extend Parameter	-	-
		IN_EU	Input Value Unit	-	Extend Parameter	-	-
		IN_DLEN	Input Decimal Digits	-	Extend Parameter	-	-

Table 16.39 FFMAI parameter description (continued)

Parameter Name			Description	Upload	Property	FF Parameter Name	Application Instruction
	Simu- lation Function	SWSIM	Simulation switch	-	Extend Pin	-	When the controller is in debug mode and SWSIM is equal to ON, enters the simulation status. When SWSIM is equal to OFF, exits the simulation mode.
		SIM_- OUT1- SIM_- OUT8	Simulate out- put value 1-8	-	Extend Pin	-	-
		SIM_- STA1- SIM_- STA8	Simulate out- put status 1-8	-	Extend Pin	-	-
		SIM_- ERR1- SIM_- ERR8	Simulate out- put quality 1-8	-	Extend Pin	-	-
		FF_- FAULT	FF fault	-	Extend Pin	-	-

16.15.3 Instruction Details

Schematic of MAO

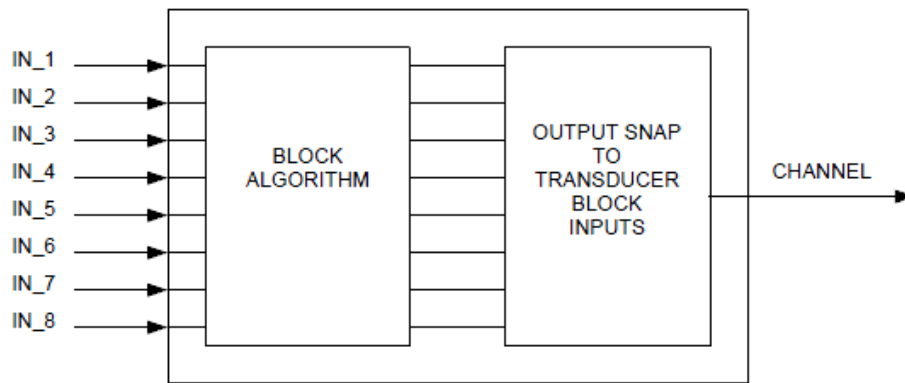


Figure 16.29 Schematic of MAO

Algorithm

FFMAO can process 8 input channels simultaneously. It supports modes of OOS, LO, AUTO. 8 channels support failsafe function individually.

Simulation Description

In simulation mode, the function block supports OOS, MAN, and AUTO modes.

- OOS mode
When MODE_TRG is equal to OOS, it enters OOS mode.
- MAN mode
When MODE_TRG is equal to MAN, it enters MAN mode.
- AUTO mode
When MODE_TRG is equal to AUTO, enter AUTO mode.
CHANNEL selection is invalid during simulation.

16.15.4 Panel Parameter

The function block panel of FFMAO is shown as figure below.

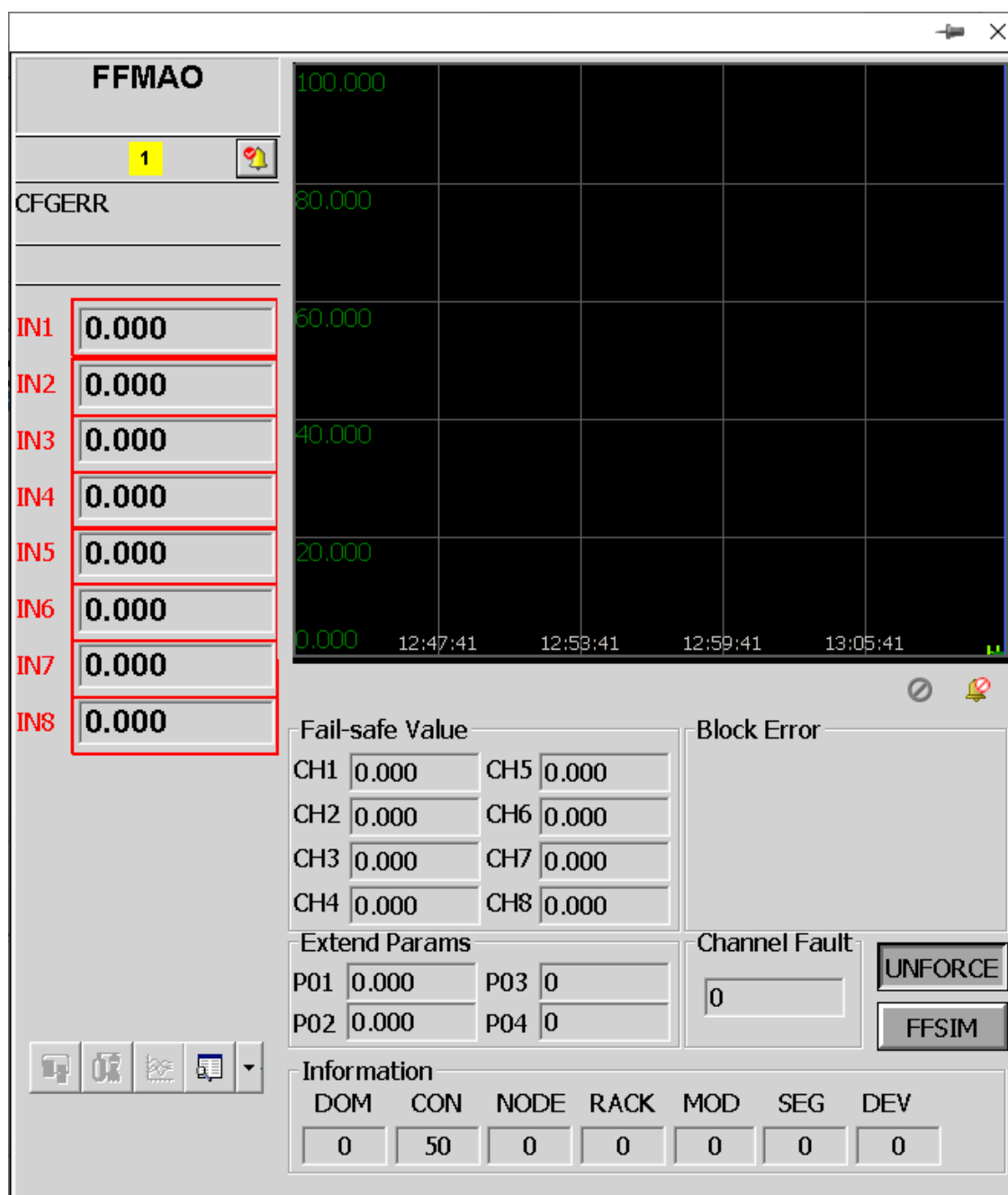


Figure 16.30 Panel of FFMAO

Table 1 describes the FFMAO panel parameters and those related parameters of FBD.

Table 16.40 FFMAO Panel Parameters Instruction

Panel Parameter	FBD Parameter	Initial	Range
IN1	IN1	0.0	-
IN2	IN2	0.0	-
IN3	IN3	0.0	-
IN4	IN4	0.0	-

Table 16.40 FFMAO Panel Parameters Instruction (continued)

Panel Parameter	FBD Parameter	Initial	Range
IN5	IN5	0.0	-
IN6	IN6	0.0	-
IN7	IN7	0.0	-
IN8	IN8	0.0	-
Fail-safe Value CH1-CH8	FST_VAL1~8	0.0	-
Channel Fault	CHANNEL	0	-

16.15.5 Flag

FFMAO flag instruction is shown as below.

Table 16.41 Flag of FFMAO

Flag	Alarm	Instruction
D0	OOS	Disable
D2	LO	On-site
D4	UNFORCE	Unforce
D8	FF_ALARM	FF Block Alarm
D27	CFGERR	Configuration Error
D28	HOLD	Hold
D29	ERR	Fault
D30	AOF	Suppress Alarm

16.16 FFMDI

16.16.1 Overview

FFMDI represent the field device input selection function block MDI, by which DCS can monitor and control the field device MDI.

FFMDI supports detect and input of 8-channel digital signal.

16.16.2 Parameter Description

Table 16.42 FFMDI parameter description

Parameter Name			Description	Upload	Property	FF Parameter Name	Application Instruction
Basic Parameters	Signal Convert Setting	CHAN-NEL	Channel	TRUE	Configura-tion Para-meter	CHANNEL	Set the selec-tion modes of 8 channels, including uni-fied setting and separate setting.
Extended Parameters	Output Param	OUT1	Output Val-ue1	-	Output Pin	OUT_D1	-
		OUT1_-ERR	Output Val-ue1 Quality	-	Output Pin	-	-
		OUT1_-STA	Output Val-ue1 status, it can be viewed by clicking "Set-tings" button.	-	Output Pin	OUT_D1	-
		OUT2	Output Val-ue2	-	Output Pin	OUT_D2	-
		OUT2_-ERR	Output Val-ue2 Quality	-	Output Pin	-	-
		OUT2_-STA	Output Val-ue2 status, it can be viewed by clicking "Set-tings" button.	-	Output Pin	OUT_D2	-
		OUT3	Output Val-ue3	-	Output Pin	OUT_D3	-
		OUT3_-ERR	Output Val-ue3 Quality	-	Output Pin	-	-
		OUT3_-STA	Output Val-ue3 status, it can be viewed by clicking "Set-tings" button.	-	Output Pin	OUT_D3	-
		OUT4	Output Val-ue4	-	Output Pin	OUT_D4	-
		OUT4_-ERR	Output Val-ue4 Quality	-	Output Pin	-	-
		OUT4_-STA	Output Val-ue4 status, it can be viewed by	-	Output Pin	OUT_D4	-

Table 16.42 FFMDI parameter description (continued)

Parameter Name		Description	Upload	Property	FF Parameter Name	Application Instruction
		clicking "Settings" button.				
	OUT5	Output Value5	-	Output Pin	OUT_D5	-
	OUT5_ERR	Output Value5 Quality	-	Output Pin	-	-
	OUT5_STA	Output Value5 status, it can be viewed by clicking "Settings" button.	-	Output Pin	OUT_D5	-
	OUT6	Output Value6	-	Output Pin	OUT_D6	-
	OUT6_ERR	Output Value6 Quality	-	Output Pin	-	-
	OUT6_STA	Output Value6 status, it can be viewed by clicking "Settings" button.	-	Output Pin	OUT_D6	-
	OUT7	Output Value7	-	Output Pin	OUT_D7	-
	OUT7_ERR	Output Value7 Quality	-	Output Pin	-	-
	OUT7_STA	Output Value7 status, it can be viewed by clicking "Settings" button.	-	Output Pin	OUT_D7	-
	OUT8	Output Value8	-	Output Pin	OUT_D8	-
	OUT8_ERR	Output Value8 Quality	-	Output Pin	-	-
	OUT8_STA	Output Value8 status, it can be viewed by clicking "Settings" button.	-	Output Pin	OUT_D8	-
Alarm Param	BLCK_ERR	Block alarm, it can be	-	Monitoring Parameter	BLOCK_ERR	-

Table 16.42 FFMDI parameter description (continued)

Parameter Name			Description	Upload	Property	FF Parameter Name	Application Instruction
			viewed by clicking "Settings" button.				
		FLAG	Flag	-	Monitoring Parameter	-	-
		AOF	Suppress Module Alarm	TRUE	Operation Parameter	-	-
	Real Status	ST_-REV	Static Revision	-	Monitoring Parameter	ST_REV	-
		MANOUT1	Manual Operate Output Value1	TRUE	Operation Parameter	-	-
		MANOUT2	Manual Operate Output Value2	TRUE	Operation Parameter	-	-
		MANOUT3	Manual Operate Output Value3	TRUE	Operation Parameter	-	-
		MANOUT4	Manual Operate Output Value4	TRUE	Operation Parameter	-	-
		MANOUT5	Manual Operate Output Value5	TRUE	Operation Parameter	-	-
		MANOUT6	Manual Operate Output Value6	TRUE	Operation Parameter	-	-
		MANOUT7	Manual Operate Output Value7	TRUE	Operation Parameter	-	-
		MANOUT8	Manual Operate Output Value8	TRUE	Operation Parameter	-	-
	Operate Param	MOD-E_-ACT	Actual mode, it can be viewed by clicking "Settings" button.	-	Monitoring Parameter	MODE_BLK	-
		MOD-E_-TRG	Target mode. It can be viewed and configured by	TRUE	Operation Parameter	MODE_BLK	-

Table 16.42 FFMDI parameter description (continued)

Parameter Name			Description	Upload	Property	FF Parameter Name	Application Instruction
			clicking "Settings" button.				
		MOD-E-PRM	Permit mode. It can be viewed and configured by clicking "Settings" button.	TRUE	Operation Parameter	MODE_BLK	-
		MOD-E_NR	Normal mode. It can be viewed and configured by clicking "Settings" button.	TRUE	Operation Parameter	MODE_BLK	-
	Extend Pin	P01	Extend Pin1	-	Extend Pin	Extend pin of actual configuration associated device function block	-
		P01_-STA	Extend Pin1 status, it can be viewed by clicking "Settings" button.	-	Extend Pin	Extend pin status of actual configuration associated device function block	-
		P02	Extend Pin2	-	Extend Pin	Extend pin of actual configuration associated device function block	-
		P02_-STA	Extend Pin2 status, it can be viewed by clicking "Settings" button.	-	Extend Pin	Extend pin status of actual configuration associated device function block	-
		P03	Extend Pin3	-	Extend Pin	Extend pin of actual configuration associated device function block	-
		P03_-STA	Extend Pin3 status, it can be viewed by clicking "Settings" button.	-	Extend Pin	Extend pin status of actual configuration associated device function block	-

Table 16.42 FFMDI parameter description (continued)

Parameter Name			Description	Upload	Property	FF Parameter Name	Application Instruction
		P04	Extend Pin4	-	Extend Pin	Extend pin of actual configuration associated device function block.	-
		P04 - STA	Extend Pin4 status, it can be viewed by clicking "Settings" button.	-	Extend Pin	Extend pin status parameter supported by device function block associating based on actual configuration.	-
	Simulation Function	SWSIM	Simulation switch	-	Extend Pin	-	When the controller is in debug mode and SWSIM is equal to ON, enters the simulation status. When SWSIM is equal to OFF, exits the simulation mode.
		SIM - VAL1 - SIM - VAL8	Simulate input value	-	Extend Pin	-	-
		SIM - STA1 - SIM - STA8	Simulate input value status	-	Extend Pin	-	-

16.16.3 Instruction Details

Schematic of MDI

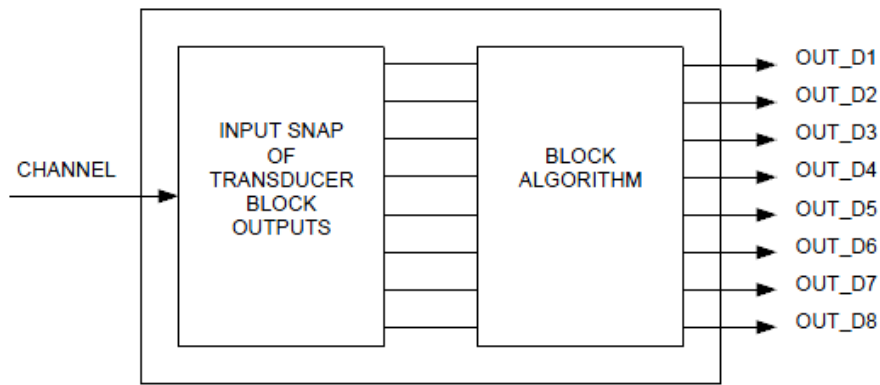


Figure 16.31 Schematic of MDI

Algorithm

FFMDI can process 8 discrete input channels simultaneously. It supports modes of OOS, MAN, AUTO.

Simulation Description

In simulation mode, the function block supports OOS, MAN, and AUTO modes.

- OOS mode When MODE_TRG is equal to OOS, it enters OOS mode.
 - MAN mode When MODE_TRG is equal to MAN, it enters MAN mode.
 - AUTO mode When MODE_TRG is equal to AUTO, enter AUTO mode.
- CHANNEL selection is invalid during simulation.

16.16.4 Panel Parameter

The function block panel of FFMDI is shown as figure below.

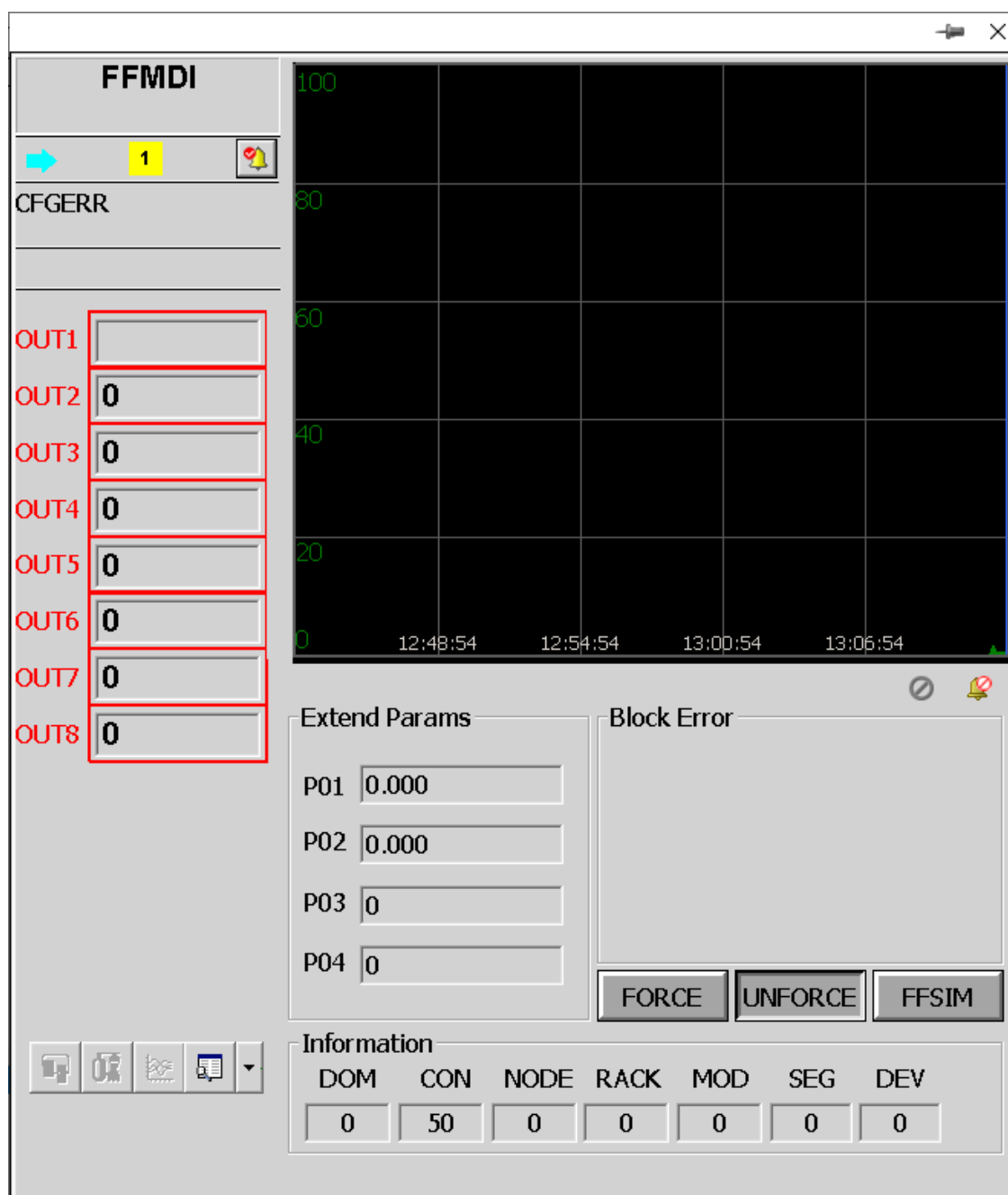


Figure 16.32 Preference Panel of FFMDI

The table below describes the FFMDI panel parameters and those related parameters of FBD.

Table 16.43 FFMDI Panel Parameters Instruction

Panel Parameter	FBD Parameter	Initial	Range
OUT1	OUT1	0.0	-
OUT2	OUT2	0.0	-
OUT3	OUT3	0.0	-
OUT4	OUT4	0.0	-

Table 16.43 FFMDI Panel Parameters Instruction (continued)

Panel Parameter	FBD Parameter	Initial	Range
OUT5	OUT5	0.0	-
OUT6	OUT6	0.0	-
OUT7	OUT7	0.0	-
OUT8	OUT8	0.0	-

16.16.5 Flag

FFMDI Flag instruction is shown as below.

Table 16.44 Flag of FFMDI

Flag	Alarm	Instruction
D0	OOS	Disable
D3	FORCE	Force
D4	UNFORCE	Unforce
D8	FF_ALARM	FF Block Alarm
D25	SIMUL	Simulation
D27	CFGERR	Configuration Error
D28	HOLD	Hold
D29	ERR	Fault
D30	AOF	Suppress Alarm

16.17 FFMDO

16.17.1 Overview

FFISEL is used to connect FF function blocks excepting the supported 15 function blocks, with the system. These function blocks can be FF standard function block, like RATIO, or custom function blocks of manufacturer.

16.17.2 Parameter Description

Table 16.45 FFMD0 parameter description

Parameter Name			Description	Upload	Property	FF Parameter Name	Application Instruction
Basic Parameters	Signal Convert Setting	CHAN-NEL	Channel	TRUE	Configura-tion Para-meter	CHANNEL	Set the selection modes of 8 channels, including unified setting and separate setting.
Extended Parameters	Input Param	IN1	Remote SV1	-	Input Pin	IN_D1	-
		IN1_-ERR	Remote SV1 Quality	-	Input Pin	-	-
		IN1_S-TA	Remote SV1 status. It can be viewed and configured by clicking "Set-tings" button.	-	Input Pin	IN_D1	-
		IN2	Remote SV2	-	Input Pin	IN_D2	-
		IN2_-ERR	Remote SV2 Quality	-	Input Pin	-	-
		IN2_S-TA	Remote SV2 status. It can be viewed and configured by clicking "Set-tings" button.	-	Input Pin	IN_D2	-
		IN3	Remote SV3	-	Input Pin	IN_D3	-
		IN3_-ERR	Remote SV3 Quality	-	Input Pin	-	-
		IN3_S-TA	Remote SV3 status. It can be viewed and configured by clicking "Set-tings" button.	-	Input Pin	IN_D3	-
		IN4	Remote SV4	-	Input Pin	IN_D4	-
		IN4_-ERR	Remote SV4 Quality	-	Input Pin	-	-

Table 16.45 FFMDO parameter description (continued)

Parameter Name		Description	Upload	Property	FF Parameter Name	Application Instruction
	IN4_S-TA	Remote SV4 status. It can be viewed and configured by clicking “Settings” button.	-	Input Pin	IN_D4	-
	IN5	Remote SV5	-	Input Pin	IN_D5	-
	IN5_-ERR	Remote SV5 Quality	-	Input Pin	-	-
	IN5_S-TA	Remote SV5 status. It can be viewed and configured by clicking “Settings” button.	-	Input Pin	IN_D5	-
	IN6	Remote SV6	-	Input Pin	IN_D6	-
	IN6_-ERR	Remote SV6 Quality	-	Input Pin	-	-
	IN6_S-TA	Remote SV6 status. It can be viewed and configured by clicking “Settings” button.	-	Input Pin	IN_D6	-
	IN7	Remote SV7	-	Input Pin	IN_D7	-
	IN7_-ERR	Remote SV7 Quality	-	Input Pin	-	-
	IN7_S-TA	Remote SV7 status. It can be viewed and configured by clicking “Settings” button.	-	Input Pin	IN_D7	-
	IN8	Remote SV8	-	Input Pin	IN_D8	-
	IN8_-ERR	Remote SV8 Quality	-	Input Pin	-	-

Table 16.45 FFMDO parameter description (continued)

Parameter Name			Description	Upload	Property	FF Parameter Name	Application Instruction
	Alarm Param	IN8_S-TA	Remote SV8 status. It can be viewed and configured by clicking “Settings” button.	-	Input Pin	IN_D8	-
		BLCK_ERR	Block alarm, it can be viewed by clicking “Settings” button.	-	Monitoring Parameter	BLOCK_ERR	-
		FLAG	Flag	-	Monitoring Parameter	-	-
		AOF	Suppress Module Alarm	TRUE	Operation Parameter	-	-
	Actual Param	ST_REV	Static Revision	-	Monitoring Parameter	ST_REV	-
		FST_S-TA	Fault Indication	-	Monitoring Parameter	FSTATUS_STATUS	-
	Operate Param	MODE_ACT	Actual mode, it can be viewed by clicking “Settings” button.	-	Monitoring Parameter	MODE_BLK	-
		MODE_TRG	Target mode. It can be viewed and configured by clicking “Settings” button.	TRUE	Operation Parameter	MODE_BLK	-
		MODE_PRM	Permit mode. It can be viewed and configured by clicking “Settings” button.	TRUE	Operation Parameter	MODE_BLK	-
		MODE_NR	Normal mode. It can be viewed	TRUE	Operation Parameter	MODE_BLK	-

Table 16.45 FFMDO parameter description (continued)

Parameter Name			Description	Upload	Property	FF Parameter Name	Application Instruction
	Ad- vanced Options		and configured by clicking “Settings” button.				
		FST_-TIME	Failure Time	TRUE	Operation Parameter	FSTATUS_-TIME	-
		FST_-VAL1	Fault Value1	TRUE	Operation Parameter	FSTATUS_-VAL_D1	-
		FST_-VAL2	Fault Value2	TRUE	Operation Parameter	FSTATUS_-VAL_D2	-
		FST_-VAL3	Fault Value3	TRUE	Operation Parameter	FSTATUS_-VAL_D3	-
		FST_-VAL4	Fault Value4	TRUE	Operation Parameter	FSTATUS_-VAL_D4	-
		FST_-VAL5	Fault Value5	TRUE	Operation Parameter	FSTATUS_-VAL_D5	-
		FST_-VAL6	Fault Value6	TRUE	Operation Parameter	FSTATUS_-VALD_6	-
		FST_-VAL7	Fault Value7	TRUE	Operation Parameter	FSTATUS_-VAL_D7	-
		FST_-VAL8	Fault Value8	TRUE	Operation Parameter	FSTATUS_-VAL_D8	-
		MO_-OPT	Failsafe options. It can be viewed and configured by clicking “Settings” button.	TRUE	Operation Parameter	MO_OPTS	-
	Extend Pin	P01	Extend Pin1	-	Extend Pin	Extend pin of actual configuration associated device function block	-
		P01_S-TA	Extend Pin1 status, it can be viewed by clicking “Settings” button.	-	Extend Pin	Extend pin status of actual configuration associated device function block	-
		P02	Extend Pin2	-	Extend Pin	Extend pin of actual config-	-

Table 16.45 FFMDO parameter description (continued)

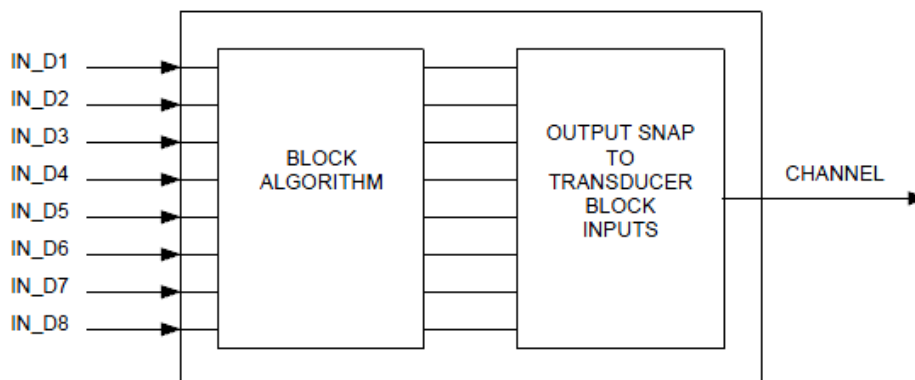
Parameter Name			Description	Upload	Property	FF Parameter Name	Application Instruction
						uration associated device function block	
		P02_S-TA	Extend Pin2 status, it can be viewed by clicking "Settings" button.	-	Extend Pin	Extend pin status of actual configuration associated device function block	-
		P03	Extend Pin3	-	Extend Pin	Extend pin of actual configuration associated device function block	-
		P03_S-TA	Extend Pin3 status, it can be viewed by clicking "Settings" button.	-	Extend Pin	Extend pin status of actual configuration associated device function block	-
		P04	Extend Pin4	-	Extend Pin	Extend pin of actual configuration associated device function block.	-
		P04_S-TA	Extend Pin4 status, it can be viewed by clicking "Settings" button.	-	Extend Pin	Extend pin status parameter supported by device function block associating based on actual configuration.	-
	Simulation Function	SWSIM	Simulation switch	-	Extend Pin	-	When the controller is in debug mode and SWSIM is equal to ON, enters the simulation status. When SWSIM is equal to OFF, exits the simulation mode.
		SIM_OUT1-	Simulate output value 1-8	-	Extend Pin	-	-

Table 16.45 FFMDO parameter description (continued)

Parameter Name		Description	Upload	Property	FF Parameter Name	Application Instruction
	SIM_-OUT8					
	SIM_-STA1-SIM_-STA8	Simulate output status 1-8	-	Extend Pin	-	-
	SIM_-ERR1-SIM_-ERR8	Simulate output quality 1-8	-	Extend Pin	-	-
	FF_-FAULT	FF fault	-	Extend Pin	-	-

16.17.3 Instruction Details

Schematic of MDO

**Figure 16.33 Schematic of MDO**

Algorithm

FFMDO can process 8 discrete output channels simultaneously. It supports modes of OOS, LO, AUTO. The 8-channel supports failsafe function separately.

Simulation Description

In simulation mode, the function block supports OOS, MAN, and AUTO modes.

- OOS mode When MODE_TRG is equal to OOS, it enters OOS mode.
- MAN mode When MODE_TRG is equal to MAN, it enters MAN mode.

- AUTO mode When MODE_TRG is equal to AUTO, enter AUTO mode.
CHANNEL selection is invalid during simulation.

16.17.4 Panel Parameter

The function block panel of FFMD0 is shown as figure below.

FFMD0

1

CFGERR

IN1 0

IN2 0

IN3 0

IN4 0

IN5 0

IN6 0

IN7 0

IN8 0

100

80

60

40

20

0

12:49:28 12:55:28 13:01:28 13:07:28

Fail-safe Value

CH1 0 CH5 0

CH2 0 CH6 0

CH3 0 CH7 0

CH4 0 CH8 0

Block Error

Extend Params

P01 0.000 P03 0

P02 0.000 P04 0

Channel Fault

0

UNFORCE **FFSIM**

Information

DOM	CON	NODE	RACK	MOD	SEG	DEV
0	50	0	0	0	0	0

Figure 16.34 Preference Panel of FFMD0

Table 1 describes the FFMD0 panel parameters and those related parameters of FBD.

Table 16.46 FFMDO Panel Parameters Instruction

Panel Parameter	FBD Parameter	Initial	Range
IN1	IN1	0.0	-
IN2	IN2	0.0	-
IN3	IN3	0.0	-
IN4	IN4	0.0	-
IN5	IN5	0.0	-
IN6	IN6	0.0	-
IN7	IN7	0.0	-
IN8	IN8	0.0	-
Fail-safe Value CH1~CH8	FST_VAL1~8	0.0	-
Channel Fault	CHANNEL	0	-

16.17.5 Flag

FFMDO flag instruction is shown as below.

Table 16.47 Flag of FFMDO

Flag	Alarm	Instruction
D0	OOS	Disable
D2	LO	On-site
D4	UNFORCE	Unforce
D8	FF_ALARM	FF Block Alarm
D25	SIMUL	Simulation
D27	CFGERR	Configuration Error
D28	HOLD	Hold
D29	ERR	Fault
D30	AOF	Suppress Alarm

16.18 FFSGCR

16.18.1 Overview

FFSGCR represents the field device input selection function block SGCR, by which DCS can monitor and control the field device SGCR.

FFSGCR provides 2-channel input and 2-channel output. It performs linear interpolation for 2-channel input value separately based on set group of coordinate value, and gets output value.

16.18.2 Parameter Description

Table 16.48 FFSGCR parameter description

Parameter Name			Description	Upload	Property	FF Parameter Name	Application Instruction
Basic Parameters	Scale Setting	X_SCH	X Scale H Limit	TRUE	Configuration Parameter	X_RANGE	Input range. Have no influence for control algorithm.
		X_SCL	X Scale H Limit	TRUE	Configuration Parameter	X_RANGE	
		X_EU	X Unit	TRUE	Configuration Parameter	X_RANGE	
		X_DLEN	X Decimal Digits	TRUE	Configuration Parameter	X_RANGE	
		Y_SCH	Y Scale H Limit	TRUE	Configuration Parameter	Y_RANGE	Output range. Have no influence for control algorithm.
		Y_SCL	Y Scale H Limit	TRUE	Configuration Parameter	Y_RANGE	
		Y_EU	Y Unit	TRUE	Configuration Parameter	Y_RANGE	
		Y_DLEN	Y Decimal Digits	TRUE	Configuration Parameter	Y_RANGE	
	Curve Definition	X1	X1 Points of Input Curve	TRUE	Configuration Parameter	CURVE_X	Describe X coordinate of interpolation curve. It must meet $X_i < X_{i+1}$, or the function block will generate alarm and turn to OOS. The parameter
		X2	X2 Points of Input Curve	TRUE	Configuration Parameter	CURVE_X	
		X3	X3 Points of Input Curve	TRUE	Configuration Parameter	CURVE_X	

Table 16.48 FFSGCR parameter description (continued)

Parameter Name		Description	Upload	Property	FF Parameter Name	Application Instruction
	X4	X4 Points of Input Curve	TRUE	Configuration Parameter	CURVE_X	should be set correctly in the first time. Online download of the parameter after modification is not supported.
	X5	X5 Points of Input Curve	TRUE	Configuration Parameter	CURVE_X	
	X6	X6 Points of Input Curve	TRUE	Configuration Parameter	CURVE_X	
	X7	X7 Points of Input Curve	TRUE	Configuration Parameter	CURVE_X	
	X8	X8 Points of Input Curve	TRUE	Configuration Parameter	CURVE_X	
	X9	X9 Points of Input Curve	TRUE	Configuration Parameter	CURVE_X	
	X10	X10 Points of Input Curve	TRUE	Configuration Parameter	CURVE_X	
	X11	X11 Points of Input Curve	TRUE	Configuration Parameter	CURVE_X	
	X12	X12 Points of Input Curve	TRUE	Configuration Parameter	CURVE_X	
	X13	X13 Points of Input Curve	TRUE	Configuration Parameter	CURVE_X	
	X14	X14 Points of Input Curve	TRUE	Configuration Parameter	CURVE_X	
	X15	X15 Points of Input Curve	TRUE	Configuration Parameter	CURVE_X	
	X16	X16 Points of Input Curve	TRUE	Configuration Parameter	CURVE_X	
	X17	X17 Points of Input Curve	TRUE	Configuration Parameter	CURVE_X	

Table 16.48 FFSGCR parameter description (continued)

Parameter Name		Description	Upload	Property	FF Parameter Name	Application Instruction
	X18	X18 Points of Input Curve	TRUE	Configuration Parameter	CURVE_X	
	X19	X19 Points of Input Curve	TRUE	Configuration Parameter	CURVE_X	
	X20	X20 Points of Input Curve	TRUE	Configuration Parameter	CURVE_X	
	X21	X21 Points of Input Curve	TRUE	Configuration Parameter	CURVE_X	
	Y1	Y1 Points of Input Curve	TRUE	Configuration Parameter	CURVE_Y	Describe X coordinate of interpolation curve. When input and output of channel2 converted, it must meet $Y_i < Y_{i+1}$, or the function block will generate alarm and turn to OOS. The parameter should be set correctly in the first time. Online download of the parameter after modification is not supported.
	Y2	Y2 Points of Input Curve	TRUE	Configuration Parameter	CURVE_Y	
	Y3	Y3 Points of Input Curve	TRUE	Configuration Parameter	CURVE_Y	
	Y4	Y4 Points of Input Curve	TRUE	Configuration Parameter	CURVE_Y	
	Y5	Y5 Points of Input Curve	TRUE	Configuration Parameter	CURVE_Y	
	Y6	Y6 Points of Input Curve	TRUE	Configuration Parameter	CURVE_Y	
	Y7	Y7 Points of Input Curve	TRUE	Configuration Parameter	CURVE_Y	
	Y8	Y8 Points of Input Curve	TRUE	Configuration Parameter	CURVE_Y	
	Y9	Y9 Points of Input Curve	TRUE	Configuration Parameter	CURVE_Y	
	Y10	Y10 Points of Input Curve	TRUE	Configuration Parameter	CURVE_Y	

Table 16.48 FFSGCR parameter description (continued)

Parameter Name			Description	Upload	Property	FF Parameter Name	Application Instruction
		Y11	Y11 Points of Input Curve	TRUE	Configuration Parameter	CURVE_Y	
		Y12	Y12 Points of Input Curve	TRUE	Configuration Parameter	CURVE_Y	
		Y13	Y13 Points of Input Curve	TRUE	Configuration Parameter	CURVE_Y	
		Y14	Y14 Points of Input Curve	TRUE	Configuration Parameter	CURVE_Y	
		Y15	Y15 Points of Input Curve	TRUE	Configuration Parameter	CURVE_Y	
		Y16	Y16 Points of Input Curve	TRUE	Configuration Parameter	CURVE_Y	
		Y17	Y17 Points of Input Curve	TRUE	Configuration Parameter	CURVE_Y	
		Y18	Y18 Points of Input Curve	TRUE	Configuration Parameter	CURVE_Y	
		Y19	Y19 Points of Input Curve	TRUE	Configuration Parameter	CURVE_Y	
		Y20	Y20 Points of Input Curve	TRUE	Configuration Parameter	CURVE_Y	
		Y21	Y21 Points of Input Curve	TRUE	Configuration Parameter	CURVE_Y	
Extended Parameters	Input Param	IN1	IN1	-	Input Pin	IN_1	-
		IN1_ERR	IN1 Quality	-	Input Pin	-	-
		IN1_STA	IN1 status. It can be viewed and configured by clicking "Settings" button.	-	Input Pin	IN_1	-

Table 16.48 FFSGCR parameter description (continued)

Parameter Name			Description	Upload	Property	FF Parameter Name	Application Instruction
		IN2	IN2	-	Input Pin	IN_2	-
		IN2_ERR	IN2 Quality	-	Input Pin	-	-
		IN2_STA	IN2 status. It can be viewed and configured by clicking "Settings" button.	-	Input Pin	IN_2	-
	Output Param	OUT1	OUT1	-	Output Pin	OUT_1	-
		OUT1_ERR	OUT1 Quality	-	Output Pin	-	-
		OUT1_STA	OUT1 status, it can be viewed by clicking "Settings" button.	-	Output Pin	OUT_1	-
		OUT2	OUT2	-	Output Pin	OUT_2	-
		OUT2_ERR	OUT2 Quality	-	Output Pin	-	-
		OUT2_STA	OUT2 status, it can be viewed by clicking "Settings" button.	-	Output Pin	OUT_2	-
	Alarm Param	BLCK_ERR	Block alarm, it can be viewed by clicking "Settings" button.	-	Monitoring Parameter	BLOCK_ERR	-
		FLAG	Flag	-	Monitoring Parameter	-	-
		AOF	Suppress Module Alarm	TRUE	Operation Parameter	-	-
	Actual Param	ST_REV	Static Revision	-	Monitoring Parameter	ST_REV	-

Table 16.48 FFSGCR parameter description (continued)

Parameter Name			Description	Upload	Property	FF Parameter Name	Application Instruction
	Operate Param	MODE_-ACT	Actual mode, it can be viewed by clicking “Settings” button.	-	Monitoring Parameter	MODE_BLK	-
		MODE_-TRG	Target mode. It can be viewed and configured by clicking “Settings” button.	TRUE	Operation Parameter	MODE_BLK	-
		MODE_-PRM	Permit mode. It can be viewed and configured by clicking “Settings” button.	TRUE	Operation Parameter	MODE_BLK	-
		MODE_-NR	Normal mode. It can be viewed and configured by clicking “Settings” button.	TRUE	Operation Parameter	MODE_BLK	-
		MANOUT1	Manual Operate Output Value1	TRUE	Operation Parameter	-	-
		MANOUT2	Manual Operate Output Value2	TRUE	Operation Parameter	-	-
		SWAP_2	Swap for OUT_2	TRUE	Configuration Parameter	SWAP_2	-
	Extend Pin	P01	Extend Pin1	-	Extend Pin	Extend pin of actual configuration associated device function block	-
		P01_STA	Extend Pin1 status, it can be viewed by clicking	-	Extend Pin	Extend pin status of actual configuration associ-	-

Table 16.48 FFSGCR parameter description (continued)

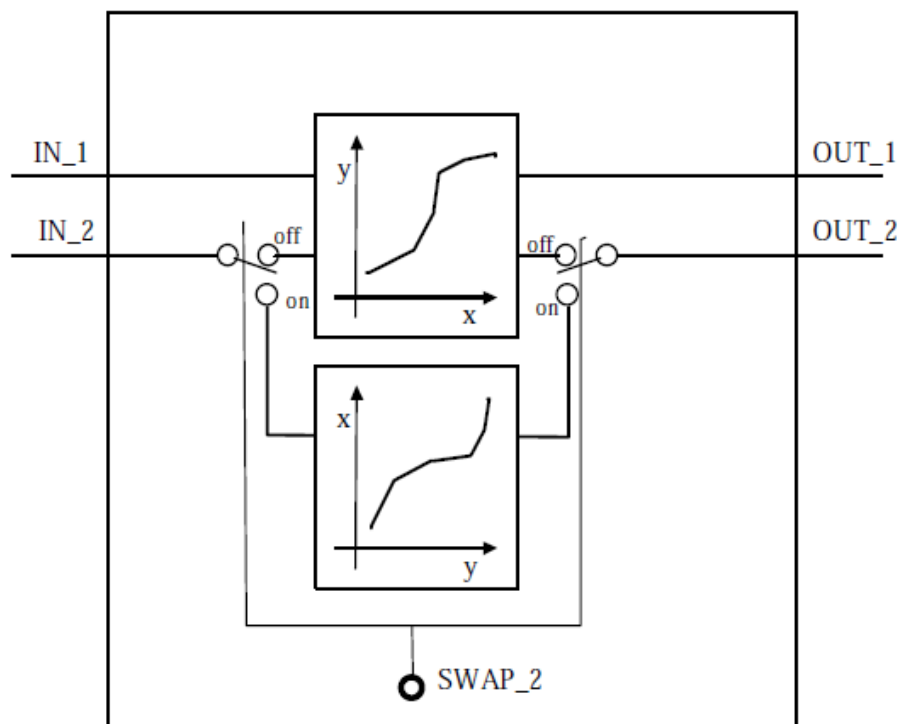
Parameter Name			Description	Upload	Property	FF Parameter Name	Application Instruction
			"Settings" button.			ated device function block	
		P02	Extend Pin2	-	Extend Pin	Extend pin of actual configuration associated device function block	-
		P02_STA	Extend Pin2 status, it can be viewed by clicking "Settings" button.	-	Extend Pin	Extend pin status of actual configuration associated device function block	-
		P03	Extend Pin3	-	Extend Pin	Extend pin of actual configuration associated device function block	-
		P03_STA	Extend Pin3 status, it can be viewed by clicking "Settings" button.	-	Extend Pin	Extend pin status of actual configuration associated device function block	-
		P04	Extend Pin4	-	Extend Pin	Extend pin of actual configuration associated device function block.	-
		P04_STA	Extend Pin4 status, it can be viewed by clicking "Settings" button.	-	Extend Pin	Extend pin status parameter supported by device function block associating based on actual configuration.	-
	Simulation Function	SWSIM	Simulation switch	-	Extend Pin	-	When the controller is in debug mode and SWSIM is equal to ON, enters the simulation status. When SWSIM is equal to OFF, exits

Table 16.48 FFSGCR parameter description (continued)

Parameter Name	Description	Upload	Property	FF Parameter Name	Application Instruction
					the simulation mode.

16.18.3 Instruction Details

Schematic of SGCR

**Figure 16.35 Schematic of SGCR**

Algorithm

- Interpolating Curve Definition**
 Draw a interpolating curve via parameters $X_1, X_2 \dots X_{21}$ and $Y_1, Y_2 \dots Y_{21}$, which includes following points:
 $[X_1, Y_1], [X_2, Y_2] \dots [X_{21}, Y_{21}]$
 $X_1, X_2, X_3 \dots X_{21}$ increase steadily, which means $X_i < X_{i+1}$, otherwise BLOCK_ERR will generate alarm and the block will enter OOS mode.
 In the curve, X axis associates with IN, and Y axis associates with OUT.
- Interpolating Value Calculation**
 IN1 combines interpolating curve to work out OUT1, IN2 combines interpolating curve to work out OUT2, the 2 channels calculation are separated.

Firstly, program judges that IN belonging to which segment in the 20 segments of X, then perform interpolating calculation, the algorithm is shown as following.

When IN is between X[i] and X[i+1]:

$$OUT = Y[i] + (IN - X[i]) * \frac{Y[i+1] - Y[i]}{X[i+1] - X[i]}$$

If IN < X1, output Y1. If IN > X21, output Y21.

If IN = X[i], OUT = Y[i].

- Input/Output Reverse

SWAP_2 can start reverse function between input and output of the second channel. When SWAP_2 is ON, IN2 associates with Y axis, OUT2 associates with X axis. Thus, Y2...Y21 should increase steadily, which means the interpolating curve should be single increasing curve, and both X and Y axis should increase steadily.

SWAP_2 is ON having no influence for the first channel.

FFSGCR does not support feedback output, while by the second channel reverse function, and apply the same interpolating curve, the feedback calculation can be provided.

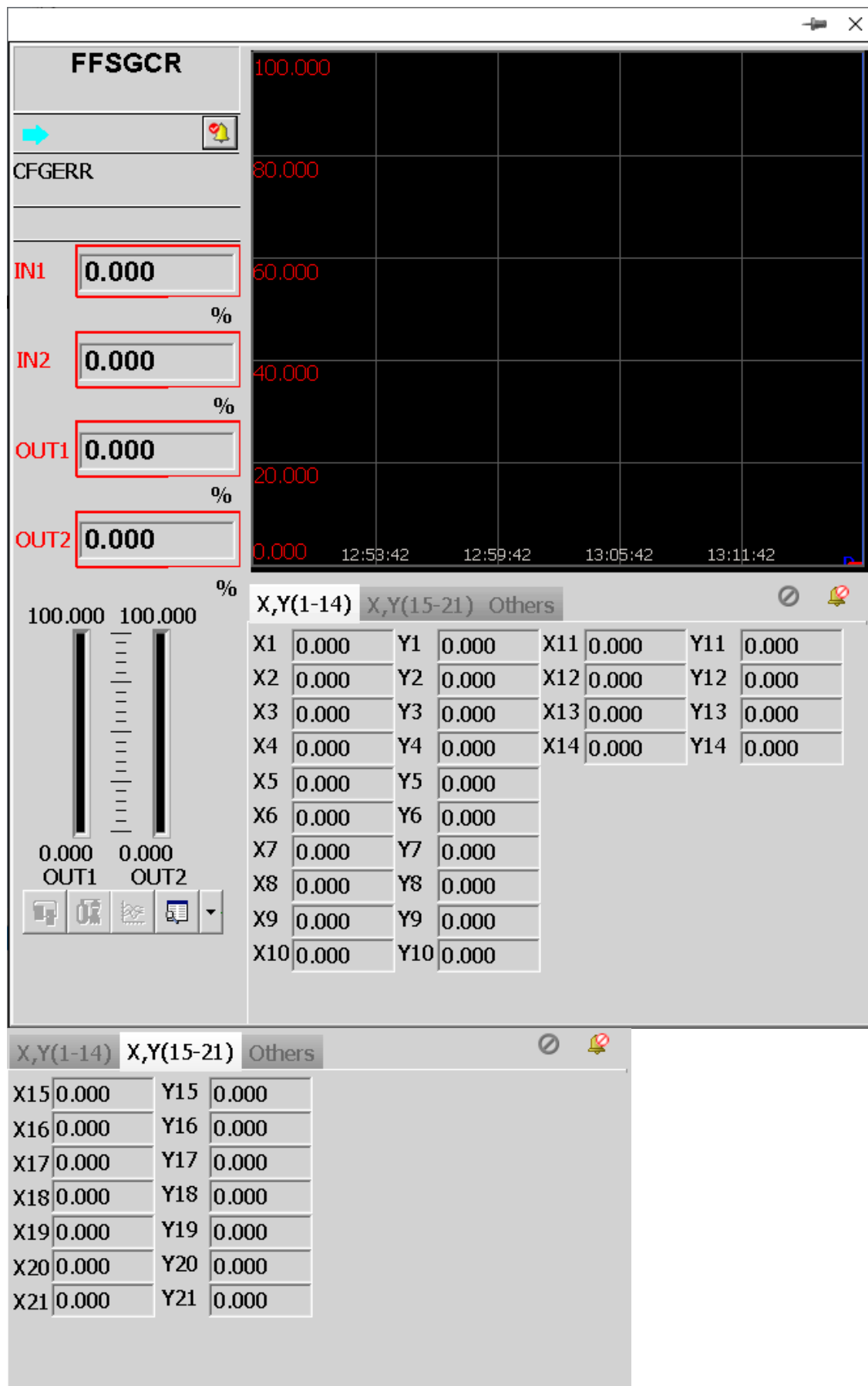


ATTENTION:

The curve coordinate parameters FFSGCR X1, X2...X21 and Y1, Y2...Y21 should be set as accurate value and downloaded after adding function block. Modification after the first download is not supported.

16.18.4 Panel Parameter

The function block panel of FFSGCR is shown as figure below.



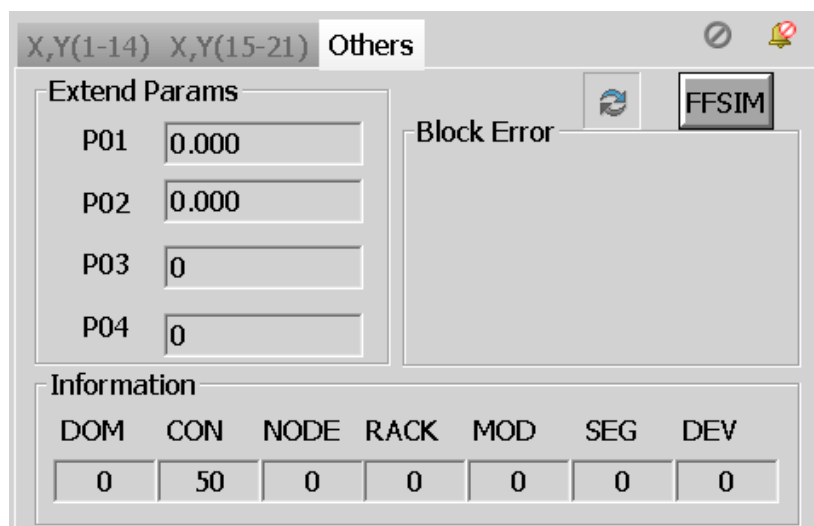


Figure 16.36 Panel of FFSGCR

The table below describes the FFSGCR panel parameters and those related parameters of FBD.

Table 16.49 FFSGCR Panel Parameters Instruction

Panel Parameter	FBD Parameter	Initial	Range
IN1	IN1	0.0	-
IN2	IN2	0.0	-
OUT1	OUT1	0.0	-
OUT2	OUT2	0.0	-
X1~X21	X1~X21	0.0	-
Y1~Y21	Y1~Y21	0.0	-

16.18.5 Flag

FFSGCR flag instruction is shown as below.

Table 16.50 Flag of FFSGCR

Flag	Alarm	Instruction
D0	OOS	Disable
D3	MAN	Manual
D4	AUTO	Auto
D8	FF_ALARM	FF Block Alarm
D27	CFGERR	Configuration Error
D28	HOLD	Hold

Table 16.50 Flag of FFSGCR (continued)

Flag	Alarm	Instruction
D29	ERR	Fault
D30	AOF	Suppress Alarm

16.19 FFSPPLIT

16.19.1 Overview

FFSPPLIT represents the field device input selection function block SPLIT, by which DCS can monitor and control the field device SPLIT.

FFSPPLIT can split one channel input signal into two-channel output signal based on their working ranges. It can be applied to field device controlled by two valves.

16.19.2 Parameter Description

Table 16.51 FFSPPLIT parameter description

Parameter Name			Description	Upload	Property	FF Parameter Name	Application Instruction
Basic Parameters	Operate Param	BAL_-TIM	Balanced Time	TRUE	Operation Parameter	HYSTVAL	When mode of function block or downstream function block switches, it is used for steady transition of output.
	Split Coordinate	X11	Setpoint Value of Output 1 Split L Point	TRUE	Operation Parameter	IN_ARRAY	Describe 2 split curves, [X11, Y11] and [X12, Y12] define channel1 split curve, [X21, Y21] and [X22, Y22] define channel2 split curve. Cross and overlap is forbidden when setting X axis. Details please refer to Algorithm.
		X12	Setpoint Value of Output 1 Split H Point	TRUE	Operation Parameter	IN_ARRAY	
		X21	Setpoint Value of Output 2 Split L Point	TRUE	Operation Parameter	IN_ARRAY	
		X22	Setpoint Value of Output 2 Split H Point	TRUE	Operation Parameter	IN_ARRAY	

Table 16.51 FFSPLIT parameter description (continued)

Parameter Name			Description	Upload	Property	FF Parameter Name	Application Instruction
		Y11	Output Value of Output 1 Split L Point	TRUE	Operation Parameter	OUT_ARRAY	
		Y12	Output Value of Output 1 Split H Point	TRUE	Operation Parameter	OUT_ARRAY	
		Y21	Output Value of Output 2 Split L Point	TRUE	Operation Parameter	OUT_ARRAY	
		Y22	Output Value of Output 2 Split H Point	TRUE	Operation Parameter	OUT_ARRAY	
	Actual Param	SV	Setpoint Value	TRUE	Operation Parameter	SP	-
		SV_STA	Setpoint value status. It can be viewed and configured by clicking "Settings" button.	TRUE	Operation Parameter	SP	-
	Scale Setting	MV1_SCH	MV1 Scale H Limit	TRUE	Configuration Parameter	OUT_1_RANGE	Output range. Have no influence for control algorithm.
		MV1_SCL	MV1 Scale H Limit	TRUE	Configuration Parameter	OUT_1_RANGE	
		MV2_SCH	MV2 Scale H Limit	TRUE	Configuration Parameter	OUT_2_RANGE	
		MV2_SCL	MV2 Scale H Limit	TRUE	Configuration Parameter	OUT_2_RANGE	
Extended Parameters	Input Param	BKIN1	Feedback IN1	-	Input Pin	BKCAL_IN_1	Connect BKOUT pin of downstream function block receiving MV1.
		BKIN-ERR1	Feedback IN1 Quality	-	Input Pin	-	When downstream function block con-

Table 16.51 FFSPLIT parameter description (continued)

Parameter Name			Description	Upload	Property	FF Parameter Name	Application Instruction
							necting MV1 is DCS function block, connect its BKOUTERR.
		BKI1_STA	Feedback IN1 status. It can be viewed and configured by clicking "Settings" button.	-	Input Pin	BKCAL_IN_1	-
		BKIN2	Feedback IN2	-	Input Pin	BKCAL_IN_2	Connect BKOUT pin of downstream function block receiving MV2.
		BKIN-ERR2	Feedback IN1 Quality	-	Input Pin	-	When downstream function block connecting MV2 is DCS function block, connect its BKOUTERR.
		BKI2_STA	Feedback IN2 status. It can be viewed and configured by clicking "Settings" button.	-	Input Pin	BKCAL_IN_2	-
		CSV	Cascade Input	-	Input Pin	CAS_IN	-
		CSV-ERR	Cascade Input Quality	-	Input Pin	-	-
		CSV_STA	Cascade input status. It can be viewed and configured by clicking "Settings" button.	-	Input Pin	CAS_IN	-
	Output Param	MV1	Operation Output Value1	-	Output Pin	OUT_1	-

Table 16.51 FFSPLIT parameter description (continued)

Parameter Name		Description	Upload	Property	FF Parameter Name	Application In-struction	
		MV1_ERR	Operation Output Value1 Quality	-	Output Pin	-	-
		MV1_STA	Operation Output Value1 status, it can be viewed by clicking “Settings” button.	-	Output Pin	OUT_1	-
		MV2	Operation Output Value2	-	Output Pin	OUT_2	-
		MV2_ERR	Operation Output Value2 Quality	-	Output Pin	-	-
		MV2_STA	Operation Output Value2 status, it can be viewed by clicking “Settings” button.	-	Output Pin	OUT_2	-
		BKOUT	Feedback Output Value	-	Output Pin	BKCAL_OUT	Connect BKIN pin of up-stream function block providing CSV.
		BKOUT_ERR	Feedback Output Status	-	Output Pin	-	When up-stream function block providing CSV is DCS function block, connect its BKIN pin.
		BKO_STA	Feedback output status, it can be viewed by clicking “Settings” button.	-	Output Pin	BKCAL_OUT	-
Alarm Param	BLCK_ERR	Block alarm, it can be viewed by clicking “Set-	-	Monitoring Parameter	BLOCK_ERR	-	

Table 16.51 FFSPLIT parameter description (continued)

Parameter Name			Description	Upload	Property	FF Parameter Name	Application Instruction
			tings" button.				
		FLAG	Flag	-	Monitoring Parameter	-	-
		AOF	Suppress Module Alarm	TRUE	Operation Parameter	-	-
	Actual Param	ST_-REV	Static Revision	-	Monitoring Parameter	ST_REV	-
		MAN-MV1	Manual Operate Output Value1	TRUE	Operation Parameter	-	MANMV1
		MAN-MV2	Manual Operate Output Value2	TRUE	Operation Parameter	-	MANMV2
	Operate Param	MODE_-ACT	Actual mode, it can be viewed by clicking "Settings" button.	-	Monitoring Parameter	MODE_BLK	-
		HYST-VAL	Output Lock Hysteresis	TRUE	Operation Parameter	HYSTVAL	Hysteresis of LOCKVAL
		MODE_-TRG	Target mode. It can be viewed and configured by clicking "Settings" button.	TRUE	Operation Parameter	MODE_BLK	-
		MODE_-PRM	Permit mode. It can be viewed and configured by clicking "Settings" button.	TRUE	Operation Parameter	MODE_BLK	-
		MODE_-NR	Normal mode. It can be viewed and configured by clicking "Settings" button.	TRUE	Operation Parameter	MODE_BLK	-

Table 16.51 FFSPLIT parameter description (continued)

Parameter Name			Description	Upload	Property	FF Parameter Name	Application Instruction
	Options Setting	LOCK-VAL	Output 1 lock options. It can be viewed and configured by clicking "Settings" button.	TRUE	Configuration Parameter	LOCKVAL	Work for channel1. Determine the MV1 output mode when CSV is larger than X12.
		STA_OPTS	Status options. It can be viewed and configured by clicking "Settings" button.	TRUE	Configuration Parameter	STATUS_OPTS	-
	Scale Setting	MV1_EU	MV1 Engineering Unit	TRUE	Configuration Parameter	OUT_1_RANGE	-
		MV1_DLEN	MV1 Decimal Digits	TRUE	Configuration Parameter	OUT_1_RANGE	-
		MV2_EU	MV2 Engineering Unit	TRUE	Configuration Parameter	OUT_2_RANGE	-
		MV2_DLEN	MV2 Decimal Digits	TRUE	Configuration Parameter	OUT_2_RANGE	-
		SV_SCH	SV Scale H Limit	TRUE	Configuration Parameter	-	-
		SV_SCL	SV Scale H Limit	TRUE	Configuration Parameter	-	-
		SV_EU	SV Engineering Unit	TRUE	Configuration Parameter	-	-
		SV_DLEN	SV Decimal Digits	TRUE	Configuration Parameter	-	-
	Extend Pin	P01	Extend Pin1	-	Extend Pin	Extend pin of actual configuration associated device function block	-

Table 16.51 FFSPLIT parameter description (continued)

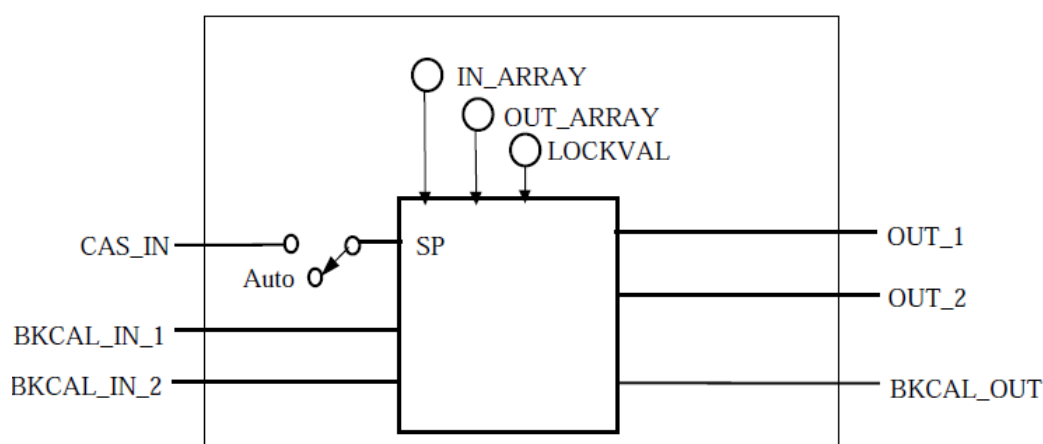
Parameter Name		Description	Upload	Property	FF Parameter Name	Application In-struction	
		P01_ STA	Extend Pin1 status, it can be viewed by clicking “Settings” button.	-	Extend Pin	Extend pin status of actual configuration associated device function block	-
		P02	Extend Pin2	-	Extend Pin	Extend pin of actual configuration associated device function block	-
		P02_ STA	Extend Pin2 status, it can be viewed by clicking “Settings” button.	-	Extend Pin	Extend pin status of actual configuration associated device function block	-
		P03	Extend Pin3	-	Extend Pin	Extend pin of actual configuration associated device function block	-
		P03_ STA	Extend Pin3 status, it can be viewed by clicking “Settings” button.	-	Extend Pin	Extend pin status of actual configuration associated device function block	-
		P04	Extend Pin4	-	Extend Pin	Extend pin of actual configuration associated device function block.	-
		P04_ STA	Extend Pin4 status, it can be viewed by clicking “Settings” button.	-	Extend Pin	Extend pin status parameter supported by device function block associating based on actual configuration.	-
	Simulation Function	SWSIM	Simulation switch	-	Extend Pin	-	When the controller is in debug mode and SWSIM is equal to ON, enters the simulation

Table 16.51 FFSPLIT parameter description (continued)

Parameter Name			Description	Upload	Property	FF Parameter Name	Application Instruction
							status. When SWSIM is equal to OFF, exits the simulation mode.

16.19.3 Instruction Details

Schematic of SPLIT

**Figure 16.37 Schematic of SPLIT**

Algorithm

- Split Calculation

The relationship of each output to the input may be defined by 2 lines, which are determined by 4 groups of Split Coordinates. Among them, [X11, Y11] and [X12, Y12] define the first split line, [X21, Y21] and [X22, Y22] define the second split line. The split points and directions of two output lines can be defined by setting different split coordinates, as shown in below.

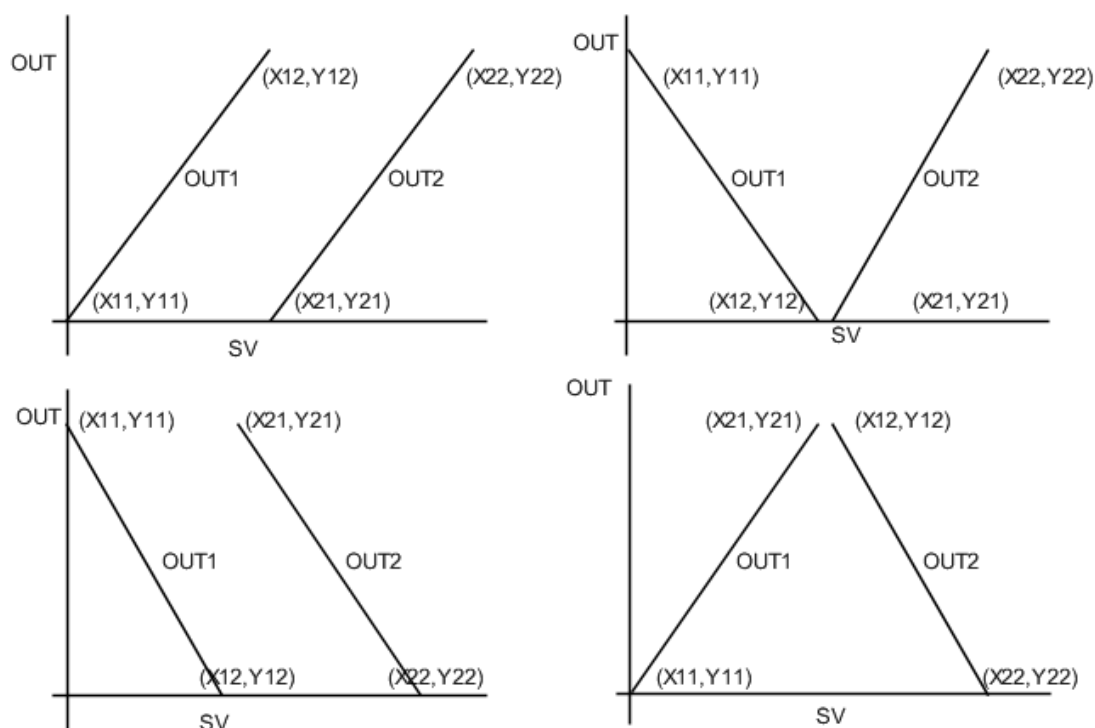


Figure 16.38 SPLIT Range and Sequence Operation

For Split Coordinate, when $X_{12} \leq X_{11}$, $X_{22} \leq X_{21}$, BLOCK_ERR generates alarm, and the block enters OOS mode.

- Over Limit Process for First Channel

When Input Value exceeds X_{12} , output of OUT1 can be set via LOCKVAL. If LOCKVAL is "LOCK", and $CSV > X_{12}$, MV1 outputs Y_{12} . If LOCKVAL is "NO LOCK", and $CSV > X_{12}$, MV1 outputs Y_{11} , perform output and hysteresis for the first channel.

$X \leq X_{12} - HYSTVAL$: MV1 may be determined by the calculated y value.

$X_{12} - HYSTVAL < X \leq X_{12}$: X enters hysteresis area and reaches X_{12} , MV1 may be determined by the calculated y value. X leaves hysteresis area is not X_{12} , MV1 outputs via LOCKVAL configuration.

$X > X_{12}$: MV1 outputs via LOCKVAL configuration.

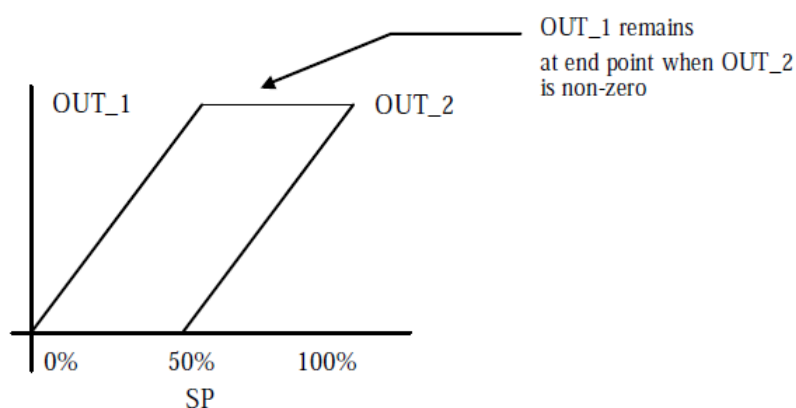


Figure 16.39 OUT with LOCKVAL "LOCK"

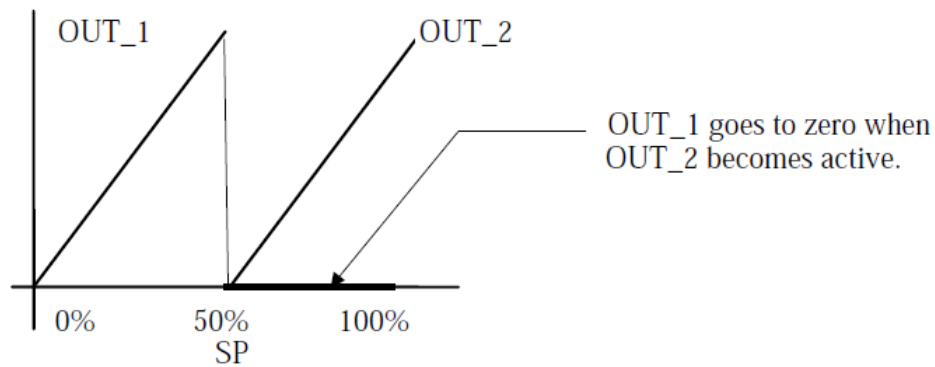


Figure 16.40 OUT with LOCKVAL “NO LOCK”

- Mode Non-reference Switch

When 2 function block modes of downstream switch, which means entering or leaving CAS mode, to secure the non-reference mode switch for whole control loop, FFSPLIT has following 2 methods based on status of 2 channels Feedback Input Pin.

When another downstream block is not in CAS mode, take the feedback value as Y of split curve, to calculate X of FFSPLIT feedback output value. Then notice upstream block via BKOUT pin, to achieve non-reference switch of the whole closed loop.

When another downstream block is in CAS mode, calculate the deviation value between feedback input value, and Y counted by current input value, and eliminate the difference in BAL_TIM via ramp action, to achieve steady transition from Feedback Output to Y.

- Supported Modes

OOS, IMAN, AUTO, CAS.

When the 2 output blocks of downstream are not in CAS mode, FFSPLIT enters IMAN mode.

Simulation Description

In the simulation status, the function block supports OOS, IMAN, AUTO and CAS modes.

- OOS mode

When MODE_TRG is equal to OOS, it enters OOS mode.

- IMAN mode

In non-OOS mode, When BKINERR1 is equal to ON, and BKINERR2 is equal to ON, it enters IMAN mode.

- AUTO mode

When MODE_TRG is equal to AUTO, it enters AUTO mode.

Or when MODE_TRG is equal to CAS, and CAS_IN_ERR is equal to ON, it enters AUTO mode.

- CAS mode

In non-OOS and non-IMAN mode, when MODE_TRG is equal to CAS, it enters CAS mode.

In the simulation status, the function block mode is switched and the output will be hopped.

16.19.4 Panel Parameter

The function block panel of FFSPLIT is shown as figure below.

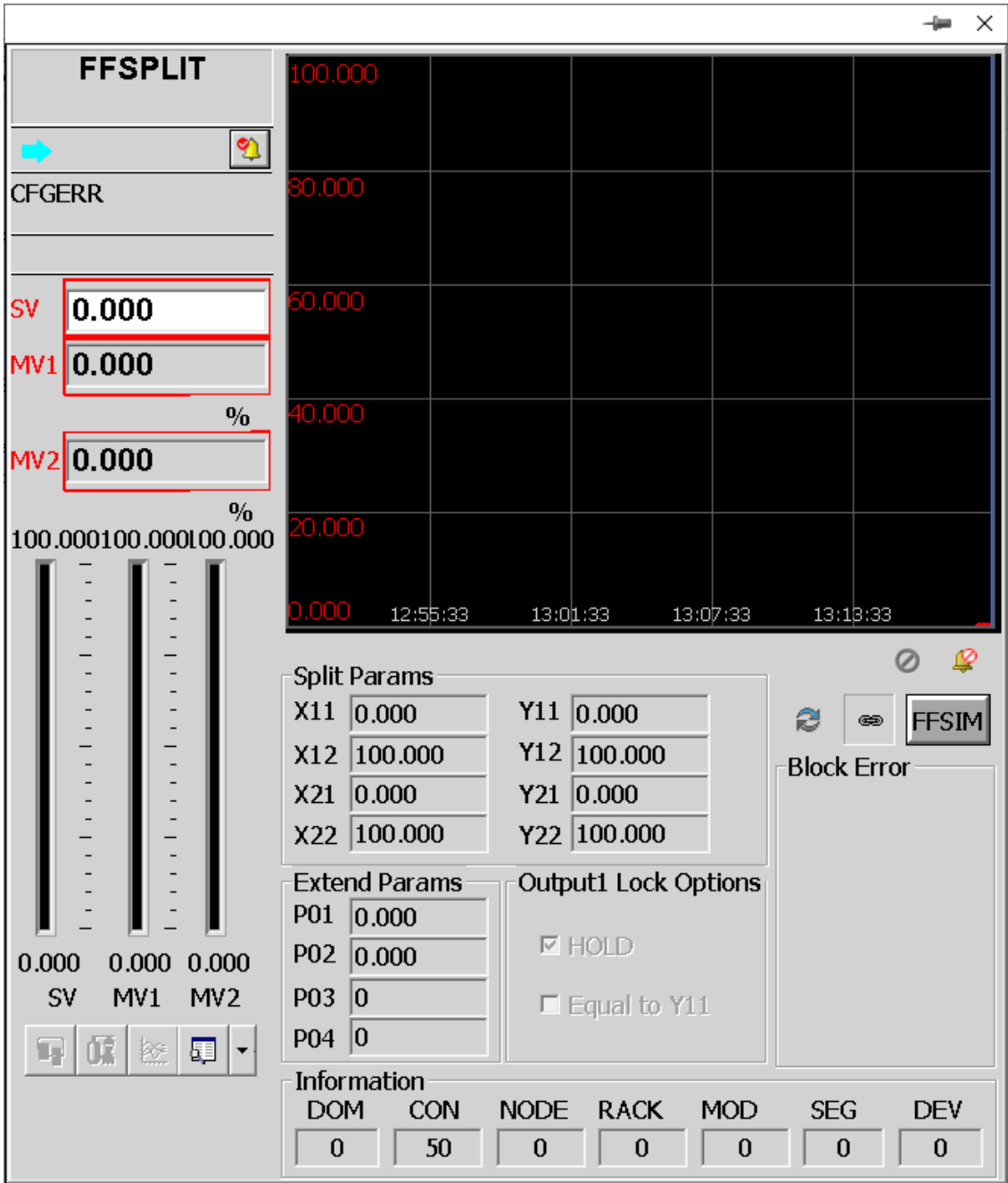


Figure 16.41 Preference Panel of FFSPLIT

Table 1 describes the FFSPLIT panel parameters and those related parameters of FBD.

Table 16.52 FFSPLIT Panel Parameters Instruction

Panel Parameter	FBD Parameter	Initial	Range
SV	SV	0.0	-
MV1	MV1	0.0	-
MV2	MV2	0.0	-
Split Params	X11	0.0	-
	X12	0.0	-
	X21	0.0	-
	X22	0.0	-
	Y11	0.0	-
	Y12	0.0	-
	Y21	0.0	-
	Y22	0.0	-

16.19.5 Flag

FFSPLIT flag instruction is shown as below.

Table 16.53 Flag of FFSPLIT

Flag	Alarm	Instruction
D0	OOS	Disable
D1	IMAN	Initialize Manually
D3	MAN	Manual
D4	AUTO	Auto
D5	CAS	Cascade
D8	FF_ALARM	FF Block Alarm
D25	SIMUL	Simulation
D27	CFGERR	Configuration Error
D28	HOLD	Hold
D29	ERR	Fault
D30	AOF	Suppress Alarm

17 Revision

Table 17.1 Revision History

Document Version	Applicable Software and Controller Versions	Remarks
V1.0 (20230301)	OMC High-performanceHMI V4.70.00.00	First release.
V1.1 (20230831)	OMC High-performanceHMI V5.10.00.00	<ul style="list-style-type: none"> Added BYPS_OPT parameter and its description in the PIDEX function block parameter table. Added SWUNCTN parameter and its description, and modified OUT_ERR parameter description in the FFAI function block. Added ENBKERR parameter and modified BKOUTERR parameter description in the FFAI function block. Modified OUT_ERR parameter description in the FFDI function block. Modified CRT_OPTS and STA_OPTS application descriptions, and modified ENALM and ENALM_EX parameter descriptions in the FFPID function block.