



**OMC**

**High-performanceHMI  
IO Tag  
User Manual**

**IM41S58-E  
20230831**

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# Symbol Definitions



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**WARNING:**

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

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**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.

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**ESD HAZARD:**

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

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**ATTENTION:**

Identifies information that requires special consideration.

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**TIP:**

Identifies advice or hints for users.

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# 1 Overview

Input and output signals includes regular IO and communication signals that remains as tags after being processed in the system. You can configure I/O tags in VFTAGBuilder, and reference the tags in FBD and ST programming software.

## 2 Tag of FCU711-S/FCU712-S/FCU731-S

Tags in this section refer to the I/O tags configured in FCU711-S/FCU712-S/FCU731-S.

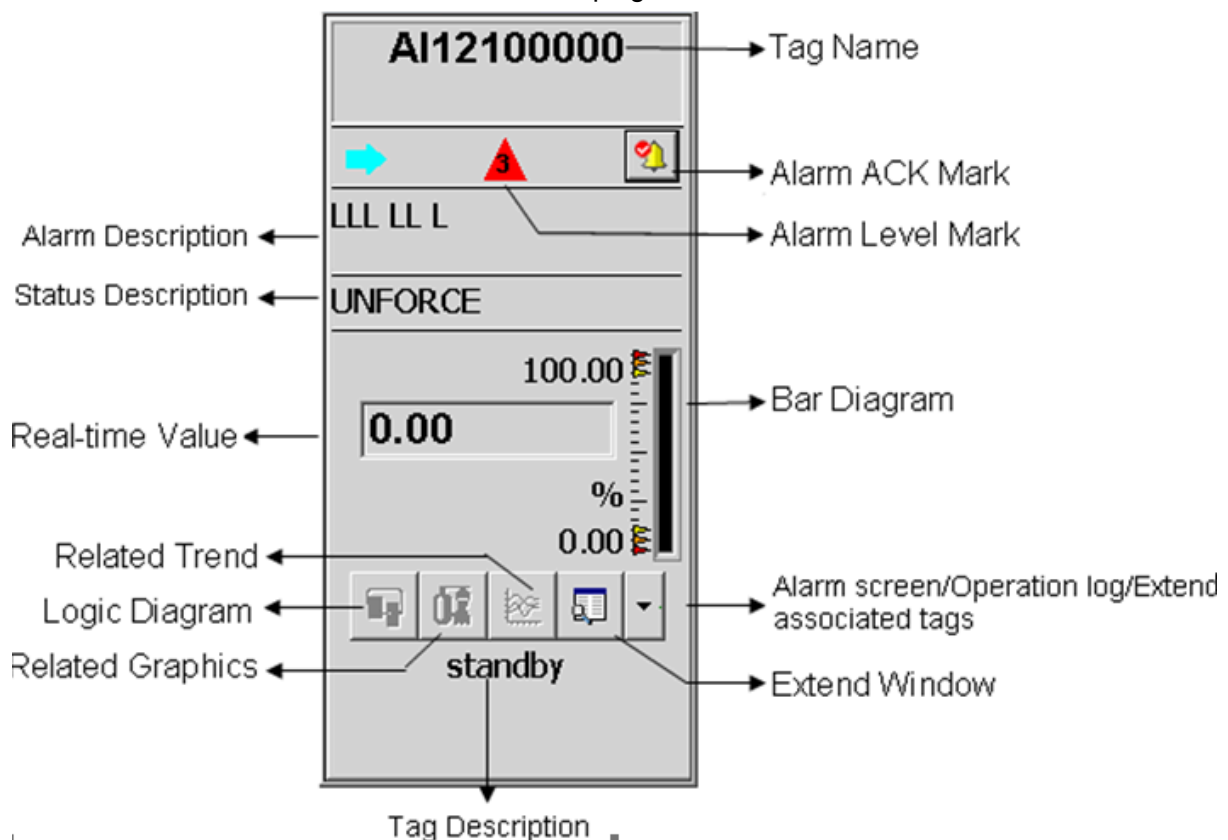
### 2.1 AI Tag

Signal of general AI input module, temperature signal input module (such as RTD, thermocouple and so on), pulse input module can be input to AI tag. The input signal is processed according to tag configuration and the actual value is got.

Communication AI signal can be input to AI tag and the actual value can be got directly or by conversion.

#### 2.1.1 Tag Panel

As shown in Figure 2.1, AI tag panel includes Tag Name, Alarm ACK Mark, Alarm Level Mark, Alarm Level, Real-time Value and Window Jumping Button.




**Figure 2.1 AI Tag Panel**

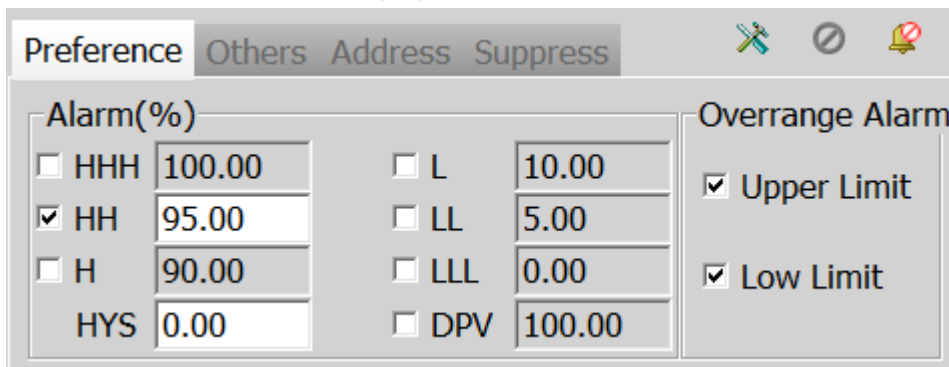
The display information in the panel is conformed according to system settings and the current status:



- Alarm level of the tag is conformed by real-time value of the tag and the alarm limit set in tag property. For example, real-time of the tag in the figure above is 0, alarm level of the tag is NEDV, L and LL.
- Decimal digits of the tag are conformed by the configuring in system configuration. By default, decimal digits are 2 bit.
- The mark and color of the tag alarm level is related to the configuring of “Global Default Settings > Alarm Priority” node in system structure configuration software.

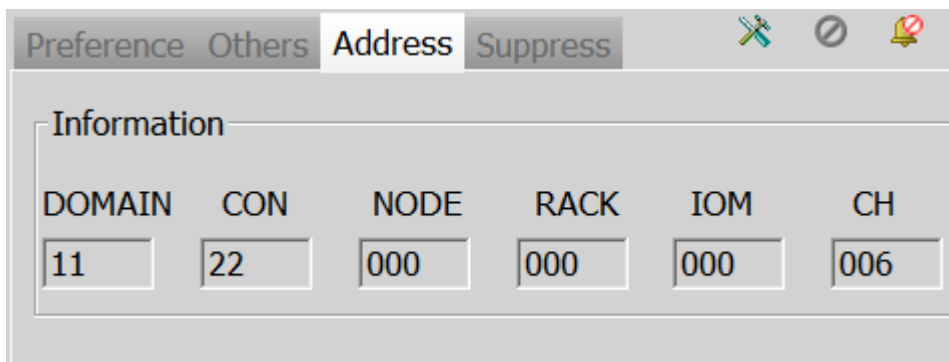
### AI Tag Extended Panel

The extended panel of AI tag includes the alarm information, the information of signal process, address information, suppress information and trend. Click  in AI tag panel to extend the AI panel as shown in the following figures.



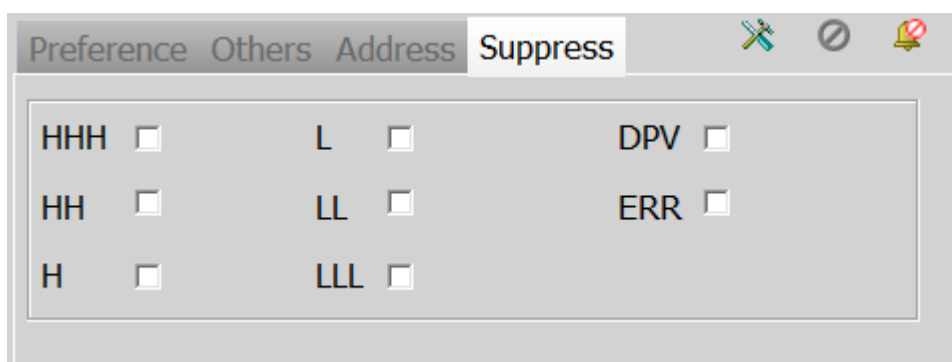
Alarm(%)		Overrange Alarm	
<input type="checkbox"/> HHH	100.00	<input type="checkbox"/> L	10.00
<input checked="" type="checkbox"/> HH	95.00	<input type="checkbox"/> LL	5.00
<input type="checkbox"/> H	90.00	<input type="checkbox"/> LLL	0.00
HYS	0.00	<input type="checkbox"/> DPV	100.00
		<input checked="" type="checkbox"/> Upper Limit	
		<input checked="" type="checkbox"/> Low Limit	

Figure 2.2 The extended panel of AI tag (Preference tab)



Information					
DOMAIN	CON	NODE	RACK	IOM	CH
11	22	000	000	000	006

Figure 2.3 The extended panel of AI tag (Address tab)



**Figure 2.4** The extended panel of AI tag (Suppress tab)

**Figure 2.5** The extended panel of AI tag (Others tab)

**Table 2.1** Parameter Description of AI panel

Parameter Name			Application Description
Alarm	Alarms	Enable	Enable status of each alarm.
		Limit	Set alarm limits
		DPV	The preset alarm value for PV change rate. A DPV rate alarm is generated when the absolute difference between PV values in two consecutive cycles exceeds the limit.
		Hysteresis	High/low limit alarm hysteresis value
	Overrange alarm limiting	Upper limit	Overrange upper limit alarm limiting (0-25%)
		Lower limit	Overrange lower limit alarm limiting (-25 -0%)
Settings	Signal	Low cut	Whether to cut off small signals. Tick to select the small signal cut-off and configure the cut-off range.
		Filter time	Filter time coefficient (s)
		Simulate	Whether to enable simulation. Select it to enter a simulate value.
		Raw	Value of RAWVAL
	Force	It is used to show the force status of the current tag, including FORCE and UN-FORCE. In the Force status, the real-time input box is in the white background with black words. In the Unforce status, the real-time input box in the gray background with black words.	
Address		It is used to display the domain address, station address, node address, rack address, module address and channel address of the tags.	
Suppress		When an alarm is selected under this tab, the corresponding alarm status will not be displayed on the panel when it occurs. Please refer to the "SUPPRESS" in the "Status Table" to view the suppression records. Only users with permission to access the alarm suppress panel can modify this parameter.	

## 2.1.2 AI Data List

**Table 2.2 FBD referenceable parameter**

Parameter Name	Data type	Description	Assignment	Default
FLAG	UDINT	Flag Code	Write Disable	0
PV	REAL	Procedure Variable Value If there's a float abnormal happened to the PV value, the PV will be set as the range low limit.	Write Disable	0.0
SWAM	BOOL	Force Switch OFF=Force, ON=Non-Force	Write Disable	ON
SIMIN	REAL	Simulation Input Value	Write Enable	0.0
SWSIM	BOOL	Simulation Input Switch ON=Simulation, OFF=Non-Simulation	Write Enable	OFF
SWOOS	BOOL	Tag Disable Switch ON=Disable, OFF=Enable	Write Enable	OFF
HHH	REAL	HHH Limit Alarm	Write Enable	100.0
HH	REAL	HH Limit Alarm	Write Enable	95.0
H	REAL	H Limit Alarm	Write Enable	90.0
L	REAL	L Limit Alarm	Write Enable	10.0
LL	REAL	LL Limit Alarm	Write Enable	5.0
LLL	REAL	LLL Limit Alarm	Write Enable	0.0
SCH	REAL	Range High Limit	Write Disable	100.0
SCL	REAL	Range Low Limit	Write Disable	0.0
LCUT	REAL	Mic-Signal Cut (%)	Write Enable	0.5
SWLCUT	BOOL	Optional Switch of Mic-Signal Cut ON=Cut, OFF=No Cut	Write Enable	OFF
TFLT	REAL	Filter Time Constant (S)	Write Enable	0.0
DPV	REAL	Setting Value of Change Rate Alarm	Write Enable	100.0
COMM_TON	REAL	Communication fault alarm generation delay (s) General tag: COMM_TON refers to the ERR alarm delay induced by channel fault (offline, short circuit, and more).	Write Enable	0

**Table 2.2 FBD referenceable parameter (continued)**

Parameter Name	Data type	Description	Assignment	Default
		Communication tag: COMM_TON refers to the ERR alarm delay induced by discontinuous communication between the channel and instrument.		
ERR	BOOL	Tag Status Flag(ON= Bad)	Write Disable	OFF
COMMCODE	USINT	Comm tag status flag	Write Disable	0
SAFEVAL	REAL	Fail-safe value	0.0	-
PRIMEPV	REAL	Original actual value Communication tag: invalid under the non-conversion mode	0.0	-
COMMASK	UDINT	Communication tag: Unsigned int code value (small end mode)	Write Disable	0

**Table 2.3 Debug parameter in VFTAGBuilder software**

Parameter Name	Data Type	Description	Default
Input Signal Parameter			
FLAG	UDINT	Flag Code	144
PV	REAL	Procedure Variable If there's a float abnormal happened to the PV value, the PV will be set as lower limit.	0.0
SWSIM	BOOL	Simulation Input Switch ON=Simulation, OFF=Non-Simulation	OFF
SIMIN	REAL	Simulation Input Value	0.0
SWAM	BOOL	Force Switch OFF=Force, ON=Non-Force	ON
SWOOS	BOOL	Tag Disable Switch ON=Disable, OFF=Enable	OFF
Config Parameter			
SCH	REAL	Range High Limit	100.0
SCL	REAL	Range Low Limit	0.0
RSCH	REAL	Input Originality Code High Limit	100.0
RSCL	REAL	Input Originality Code Low Limit	0.0

**Table 2.3 Debug parameter in VFTAGBuilder software (continued)**

Parameter Name	Data Type	Description	Default
MODE	USINT	Define for Signal Switch Type Bit: 1= Linear Switch 5= Linear Evolution Switch Else=No Switch	1
SWFORM	USINT	Communication Data Format Conversion Option: 0=No Conversion 1=Byte Conversion 2=Word Conversion 3=Word Internal Conversion	0
Adjust Parameter			
SWLCUT	BOOL	Optional Switch for Mic-Signal Cut ON=Enable, OFF=No Cut	OFF
LCUT	REAL	Mic-Signal Cuted Value(%)	0.5
TFLT	REAL	Filter Time Constant(S)	0.0
DPV	REAL	Setting Value for Change Rate Alarm(/Run Cycle)	100.0
Alarm Parameter			
HHH	REAL	3th High Limit Alarm	100.0
HH	REAL	HH Alarm	95.0
H	REAL	High Limit Alarm	90.0
L	REAL	Low Limit Alarm	10.0
LL	REAL	LL Alarm	5.0
LLL	REAL	3th Low Limit Alarm	0.0
HYS	REAL	High/Low Limit Alarm Hysteresis	0.0
HYS_OPT	USINT	H/L Limit Alarm Hysteresis Conversion Type (0=Actual Value, 1=Percentage)	0
HORLIM	REAL	Percent of Extend Range High Limit	10.0
LORLIM	REAL	Percent of Extend Range Low Limit	10.0
ENALM	UDINT	Itemize Alarm Enable	12
AOF	BOOL	Shield Alarm	OFF

**Table 2.3 Debug parameter in VFTAGBuilder software (continued)**

Parameter Name	Data Type	Description	Default
		ON=Don't Show Real-Time Alarm, OFF=Show Real-Time Alarm	
Sundries Parameter			
CHAN_EXIST	USINT	Channel Exist Flag 0 =No Exist, 255 =Exist	255
CHK_CODE	UINT	Channel Check Code	23130
TS	REAL	FB Operation Cycle	0.2
REALFAST	BOOL	Fast cycle schedule status (FCU711 doesn't support the parameter)	OFF
COMMCODE	USINT	Status Code for 4 Byte Communication Tag	0
ERR	BOOL	Tag Status Flag (ON =Bad)	ON
ERRVAL	USINT	(When no force and no simulation status) Tag Value Option When Tag Fault: 0=Keep, 1=Set Range High Limit, 2=Set Range Low Limit, 3=Set fault preset value, 4= Set proximity extended range limits	0
RAWVAL	REAL	Originality Input Value	0.0
PRIMEPV	REAL	Send Originality Value (Actual Value)	0.0
COMMASK	UDINT	Communication tag: Unsigned int code value (small end mode)	0

### 2.1.3 AI Flag Code

**Table 2.4 AI Flag code**

Flag code	Supervising assign	Explain
D0	Disable	Float Abnormal
D1	Enable (AOF)	Alarm Shielded (AOF)
D2	Disable	Exceed Range High Limit Alarm (ORH)
D3	Disable	Exceed Range Low Limit Alarm (ORL)
D4	Disable	Tag Fault (ERR)
D5	Disable	Force Status (FORCE)
D6	Enable (SWOOS)	Tag Disable (OOS)

**Table 2.4 AI Flag code (continued)**

Flag code	Supervising assign	Explain
D7	Enable (SWAM)	Non-Force Status (UNFORCE)
D8	Disable	Output High Limit Alarm (H)
D9	Disable	Output Low Limit Alarm(L)
D10	Disable	Output HH Alarm (HH)
D11	Disable	Output LL Alarm (LL)
D12	Disable	Output 3th High Limit Alarm (HHH)
D13	Disable	Output 3th Low Limit Alarm (LLL)
D14	Disable	Change Rate Overrun Alarm (DPV)
D15	Disable	AI Simulation Status Indication (SIMUL)

## 2.1.4 AI Multicast Data Structure

AI multicast data has six bytes, including quality code of two characters and real-time value of four characters.

**Table 2.5 AI multicast data structure**

Offset address	Parameter Name	Data Type	Description
00H	FLAG	UINT	AI Flag Code is UDINT type Multicast Low Two Byte of Flag Code
02H	PV	REAL	AI Real-Time Value

## 2.1.5 Signal send over

- Sample data linearly from -25% of span to 125% of span at most.
- Even if the measurement range of the module is more than or equal to -25%~125% of the span, sampling values in the range of -25%~125% of the span can be sent back because the maximum of the extended span can be set 25% and the minimum of the extended span can be set -25%.

- If the extended span range is less than  $\pm 25\%$ , linear sampling values are sent in the extended span range. If the sampling values are over the extended span range, the maximum or minimum of the extended span are sent back.
- The span range of thermocouple and thermal resistance is set by the measurement range of the sensor.

## 2.1.6 Input signal conversion

Input signal conversion of AI tag includes:

- No conversion

No conversion mode is only for communication tag, in which not convert the sent data, and output data in 2 types: output unsigned integer COMMASK equaling to communication value (controller FCU711-S doesn't have this function); or output float PV equaling to communication value

- Linear conversion

$PV = (\text{actual measurement code value} - \text{code value low limit}) / (\text{code value high limit} - \text{code value low limit}) * (\text{range high limit} - \text{range low limit}) + \text{range low limit}$

Convectional signals (type II, type III and -10V~10V, -20mA~20mA and so on)

Temperature signal (thermocouple, thermal resistance)

The actual temperature value is calculated in AI module according to measurement principle. Span range should be specified for signals in hardware configuration. For example, the span of thermocouple of E type is set 200~500°C. The high limit of the span is 500°C and the low limit of the span is 200°C in the hardware configuration. The span of actual value of E type thermocouple must be set 200°C~500°C in the tag configuration software.

- Sqrt

The input can be converted to actual value output by sqrt conversion.

Calculation formula:

$$PV = \sqrt{\frac{\text{actual measurement code value} - \text{code value low limit}}{\text{code value high limit} - \text{code value low limit}}} * (\text{range high limit} - \text{range low limit}) + \text{range low limit}$$

## 2.1.7 Communication data types

Communication signal configuration data types can reflect the mode applicated when getting communication data. 2-byte integer and 4-byte integer are "signed" or "unsigned". For example, 2-byte integer, the communication memory value is 0x8000. When signed, negative number can be obtained; when unsigned, positive number can be obtained.

## 2.1.8 Format conversion of communication signal



The data format is low bytes forward and high bytes backward. If data format of communication signal is different from system data format, corresponding conversion mode can be selected.

If communication data format is two bytes integer, "No conversion" or "Byte conversion" can be selected.

If communication data format is four bytes integer or four bytes float, "No conversion", "Byte conversion", "Word conversion" and "Conversion in word" can be selected.

For example,

**Table 2.6 format conversion of communication signal**

1th byte	2th byte	3th byte	4th byte	Conversion mode
Minimum	Hyp-low	Hyp-high	Highest	No Conversion
Highest	Hyp-high	Hyp-low	Minimum	Byte Conversion
Hyp-high	Highest	Minimum	Hyp-low	Word Conversion
Hyp-low	Minimum	Highest	Hyp-high	Word Internal Conversion

## 2.1.9 Small signal cutting

If the small signal cutting switch SWLCUT is ON, the small signal is cut. The small signal cutting value is set as percent. When percent of input signal is less than positive small signal cutting value, the small signal is cut and AI value is 0% of the span, equal to low limit of the span.

## 2.1.10 Forced process

In non-force status, AI input signal comes from AI module or simulation input, from which the current actual value is attained after a series of operation.

In force status, actual value PV of AI tag is set by users. In force status, high and low limit alarm, small signal cutting and over span process are same as in non-force status.

In FCU712-S, communication tag non-conversion mode has no force status.

## 2.1.11 Extended span limit process

Data send by AI module can be over 25% of the span at most. Data can be sampled linearly in the range of -25%~+125% at most. When data is over high or low limit of the extended span, high limit or low limit of the extended is sent back. The high and low limit of the extended span are set in the tag configuration software.

- When  $PV_{CALC} \geq SCH + (SCH - SCL) \times HORLIM / 100.0$ ,  $PV_{CALC} = SCH + (SCH - SCL) \times HORLIM / 100.0$
- When  $PV_{CALC} \leq SCL - (SCH - SCL) \times LORLIM / 100.0$ ,  $PV_{CALC} = SCL - (SCH - SCL) \times LORLIM / 100.0$

HORLIM and LORLIM are percent of high and low limit of the extended span. The maximum is 25% when it is configured.

If over-range occurs in non-forced status, ORL or ORH will be generated, and set ERR at the same time. In auto mode, output by fail-safe mode.

### 2.1.12 Filter function

$$FV(n) = \alpha \times FV(n-1) + (1-\alpha) \times PV(n)$$

$$\alpha = \frac{T_c}{T_c + T_s}$$

FV(n) is value of first-order filter,  $\alpha$  is filter smoothing coefficient,  $T_c$  is filter time constant,  $T_s$  is sampling time.

### 2.1.13 Single period change rate alarm

Judge single cycle change rate overrun for inputted AI signal.

When  $|inPV(n) - inPV(n-1)| \leq DPV$ : tag value is PV(n) when change rate of adjacent input values is not over the set rate limit DPV.

When  $|inPV(n) - inPV(n-1)| > DPV$ : PV(n) is equal to PV(n-1) when change rate of adjacent input values is not over the set rate limit DPV.

DPV is the most change value in single period when it is configured. inPV(n) and inPV(n-1) are data sent by AI module in two adjacent periods. PV(n) and PV(n-1) are tag value in two adjacent periods.

If input signal change values in two adjacent periods are over the most change value in running process, the output value in the last period is maintained and the single period change rate alarm is set. When the alarm is generated, if PV difference of the two new adjacent periods are less than or equal to DPV, the jump reaches new balance position and alarm is eliminated.

### 2.1.14 Alarm process

- Fault alarm  
When the module or communication is faulty, AI tag fault alarm ERR is displayed (In the status of controller debugging, ERR alarm is not generated). FBD can reference parameter, tag status sign ERR=ON.

- **Over range alarm**  
When over max/min limits, alarm is set in alarm enable and PV is over max/min of extended span, over range alarm flag is set in the quality code. FBD can reference parameter, tag status sign ERR=ON.
- **Change rate of single period over limit alarm**  
When change rate over limit alarm is set in alarm enable and change rate of single period of PV is over limit, corresponding alarm flag is set in quality code.
- **High/Low alarm**  
HHH, HH, high, low, LL, LLL limit of PV can be processed by the tag. Each alarm can has hysteresis function.
- **Alarm shield**  
If the function of tag alarm shield is set, corresponding alarm will only be recorded but not displayed in real time.
- **Alarm enable**  
In alarms above, each alarm in high and low limit alarm, over span alarm and rate alarm can be set enable or disable separately. Alarm limit reversal alarm and tag fault alarm always work. When an alarm is generated, corresponding flag is set in quality code.
- **Delay alarm**  
When the heterogeneous communication module (COM741) loses communication connection with its I/O modules (including 485 communication channel disconnects, communication timeout and data package verification error), it issues delay alarm.  
When module lost (insert and extract COM741), inconsistent module types (configuration is inconsistent with the actual I/O) and module major fault appear on its I/O device, the delay alarm will occur immediately.

## 2.1.15 Fault setting

In status of non-force and non-simulation, tag values are from AI module. When data sent by AI module is suspicious, tag value is maintained. When data sent by AI module is bad, tag value is output according to configuration setting, which includes maintain, set span high limit and set span low limit.

Details of fault safety, refer to "Fail-safe".

## 2.2 AO Tag

Analog operated in control strategy is output to AO module by AO tag to control field executor.

### 2.2.1 Tag Panel

The panel of AO tag is basically the same as the panel of AI tag. Please refer to "Tag Panel", no more details here.

## 2.2.2 AO Data List

**Table 2.7 FBD referenceable parameter**

Parameter Name	Data Type	Description	Assign Value	Default
FLAG	UDINT	Flag Code	Write Disable	0
IN	REAL	Input Real-time Value You should use "Tag Name. IN" parameter when assigning values to DO tag. If the output involves in logical calculation, the form should be "Tag Name .OUT".	Write Enable	0.0
TV	REAL	Tracking Input Value	Write Enable	0.0
OUT	REAL	Real-Time Value Output If there's a float abnormal happened to the OUT value, the OUT will be set as the value of previous period or 0.	Write Disable	0.0
BKOUT	REAL	Inversion Calculated Value	Write Disable	0.0
SWAM	BOOL	Force Switch OFF=Force, ON=Non-Force	Write Enable	OFF
SWTR	BOOL	Tracking Input Switch ON=Tracking, OFF=No Tracking	Write Enable	OFF
SWOOS	BOOL	Tag Disable Switch ON=Disable, OFF=Normal	Write Enable	OFF
SCH	REAL	Range High Limit	Write Disable	100.0
SCL	REAL	Range Low Limit	Write Disable	0.0
HOLIM	REAL	Amplitude Limiting of Output High Limit	Write Enable	100.0
LOLIM	REAL	Amplitude Limiting of Output Low Limit	Write Enable	0.0
COMMCODE	USINT	Status Code of 4 Byte Communication Tag	Write Enable	0
BKOUTERR	BOOL	Inversion Calculation Output Status	Write Disable	ON

**Table 2.7 FBD referenceable parameter (continued)**

Parameter Name	Data Type	Description	Assign Value	Default
COMMASK	UDINT	Send communication original code value, and it is used to output communication data.	Write Enable	0

**Table 2.8 Debug parameter of tag config software**

Parameter Name	Data Type	Description	Default
Output Signal Parameter			
FLAG	UDINT	Flag Code	24
IN	REAL	Real-Time Input	0.0
TV	REAL	Tracking Input Value	0.0
OUT	REAL	Real-Time Value Output	0.0
BKOUT	REAL	Inversion Calculation Value	0.0
SWAM	BOOL	Force Switch ON=Non-Force, OFF=Force	OFF
SWTR	BOOL	Tracking Input Switch ON=Tracking, OFF=No Tracking	OFF
SWOOS	BOOL	Tag Disable Switch ON=Disable, OFF=Normal	OFF
Config Parameter			
SCH	REAL	Range High Limit	100.0
SCL	REAL	Range Low Limit	0.0
RSCH	REAL	Output Originality Code High Limit	100.0
RSCL	REAL	Output Originality Code Low Limit	0.0
ATC	BOOL	Positive and Negative Output Optional Switch: ON=Negative Output, OFF=Positive Output	OFF
SWFORM	BOOL	Communication Data Format Conversion Option 0=No Conversion 1=Byte Conversion 2=Word Conversion 3=Word Internal Conversion	0
ENSAFEOP	BOOL	Output enable of force manual status ON: enable	OFF

**Table 2.8 Debug parameter of tag config software (continued)**

Parameter Name	Data Type	Description	Default
		OFF: disable	
Alarm Parameter			
HOLIM	REAL	Amplitude Limiting Value of Output High Limit	100.0
LOLIM	REAL	Amplitude Limiting Value of Output Low Limit	0.0
HORLIM	REAL	Output Extend Range High Limit	0.0
LORLIM	REAL	Output Extend Range Low Limit	0.0
ENALM	UDINT	Itemize Alarm Enable	0
ACK	BOOL	Confirm Recovery from Fault	OFF
AOF	BOOL	Shield Alarm	OFF
Sundries Parameter			
CHAN_EXIST	USINT	Channel Exist Flag 0 =No Exist, 255 =Exist	255
CHK_CODE	UINT	Channel Check Code	42405
TS	REAL	FB Operation Cycle	0.2
COMMCODE	USINT	Status Code of 4 Byte Communication Tag	0
BKOUTERR	BOOL	Inversion Calculation Output Status	ON
SWSAFESET	BOOL	Fail-safe function ON= Enable, OFF= Disable	OFF
SAFEVAL	REAL	Fail-safe value	0.0
COMMASK	UDINT	Send communication original code value	0

## 2.2.3 AO Flag Code

**Table 2.9 AO flag code**

Flag code	Supervising Assign	Explain
D0	Disable	Retain
D1	Disable (OOP)	AO channel external channel fault (OOP)
D2	Disable	Retain

**Table 2.9 AO flag code (continued)**

Flag code	Supervising Assign	Explain
D3	Disable	Fault Safe Mode (SAFESTA)
D4	Disable	Tag Error(ERR)
D5	Disable	Force Mode(FORCE)
D6	Enable (SWOOS)	Tag Disable (OOS)
D7	Enable (SWAM)	No Force Mode (UNFORCE)
D8	Disable	Output Amplitude Limiting Alarm of High Limit (H)
D9	Disable	Output Amplitude Limiting Alarm of Low Limit (L)
D10	Disable	Tracking Mode (TR)
D11	Enable (AOF)	Shield Alarm (AOF)
D12	Disable	Alarm for Exceed Range High Limit (ORH)
D13	Disable	Alarm for Exceed Range Low Limit (ORL)
D14	Disable	Float Abnormal
D15	Disable	Retain

## 2.2.4 AO Multicast Data Structure

AO multicast data has six bytes, including quality code of two bytes and AO real-time value of four bytes.

**Table 2.10 structure of multicasting data**

Offset address	Parameter Name	Data Type	Description
00H	FLAG	UINT	AO Flag Code is Type UDINT, Only Multicast Lower 2 Byte of Flag Code
01H	OUT	REAL	AO Real-Time Value

## 2.2.5 Validity check of parameters

Check whether configuration data is right. The output low limit set should be less than the output high limit when tags are configured. Otherwise, low limit is equal to high limit.

When the output limit is more than the high limit of the extended span, the output limit can be set high limit of the extended span at most.

When the output limit is less than the low limit of the extended span, the output limit can be set low limit of the extended span at least.

## 2.2.6 Conversion type (controller FCU711-S doesn't have the function)

The configuration is for communication tag. Output AO output value after converted by high/low limits of output original code in linear conversion mode. In no conversion mode, output unsigned integer COMMASK directly.

## 2.2.7 Communication signal format conversion

The data format is low bytes forward and high bytes backward. If data format of communication signal is different from system data format, corresponding conversion mode can be selected.

If communication data format is integer of two bytes, "No conversion" or "Byte conversion" can be selected.

If communication data format is integer of four bytes or float of four bytes, "No conversion", "Byte conversion", "Word conversion" and "Conversion in word" can be selected.

For example,

**Table 2.11 format conversion of communication signal**

1th byte	2th byte	3th byte	4th byte	Conversion mode
Minimum	Deuto-low	Deuto-high	Highest	Non-conversion
Highest	Deuto-high	Deuto-low	Minimum	Byte Conversion
Deuto-high	Highest	Minimum	Deuto-low	Word Conversion
Deuto-low	Minimum	Highest	Deuto-high	Word Internal Conversion

## 2.2.8 Output track function

When SWTR is ON, output of AO module tracks TV value and marks track status. When the field device is in handheld status, it can be connected with TV by readback AI signal of device position in order that output of AO tag can track actual position of field device.

The priority of track status is sub-status of non-force status and lower than the force status.

## 2.2.9 Output limit



The output value is set between maximum output a minimum output.

If output value of AO is more than maximum output, the output value is restricted to the maximum output and the maximum output limit flag is set.

If output value of AO is less than minimum output, the output value is restricted to the minimum output and the minimum output limit flag is set.

If high limit is larger or equal to low limit, the output value is limited no matter in force status or non-force status.

Otherwise, limit is invalid, and report CFGERR configuration error, while extended range limit is still valid.

## 2.2.10 Output inversion calculation

Inversion calculation output value BKOUT is equal to input value which is acquired byf reverse calculate currently AO block output value OUT:  $BKOUT = OUT - Bterm$ . When AO block is in force status, think it is in open loop status. BKOUT linked inversion calculation value of previous block, and the output of previous block track this inversion calculation input value.

BKOUTERR should link BKINERR of previous block. When AO is OOS, trackin, force, fault sage status, BKOUTERR equal ON, and can make previous control block turn into IMAN status by BKOUTERR.

## 2.2.11 Force status process

When SWAM is OFF, it is in force status and output OUT is set manually not according to input IN.

When SWAM is ON, it is in non-force status, output OUT is attained from input IN after process. In FCU712, communication tag non-conversion mode has no force status.

## 2.2.12 Positive output/negative output

For general tags and communication tags as below:

- 4-byte float and the data is percentage.
- 4-byte integer (signed / unsigned)
- 2-byte integer (signed / unsigned)

When positive output, output value of AO module = dimensionless output value of AO tag.

When negative output, the output value of AO module = dimensionless output value which is AO tag range high limit subtraction OUT value.

For communication tags, when they are 4-byte float and actual value output, no matter positive output or negative output, output is equal to actual value, while it still limits the output.

## 2.2.13 Output with extended span

Output of AO signal supports extended span and maximum is 25%. High and low limit of the extended span can be configured.

## 2.2.14 Alarm process

- **Fault alarm**  
When the module or communication is faulty, tag fault alarm ERR is displayed (In the status of controller debugging, ERR alarm is not generated).
- **Output H/L Limit Alarm**  
When the output is over max./min. of output, the output will be limited and corresponding maximum output /minimum output alarm flag is set. Maximum output/minimum output limit alarm can be shielded separately but the limit function can be shielded. The function is available in force or non-force status.
- **Over span alarm**  
When the input value is out of the range of extended span, over span alarm is generated.
- **Alarm shield**  
If the function of tag alarm shield is set, corresponding alarm will only be recorded and not displayed in real time.
- **Alarm enable**  
High limit/low limit alarm and over span alarm can be enabled or disabled separately. The tag fault alarm always works. When the alarm is generated, corresponding flag will be set in the quality code.

## 2.2.15 Fault safety status

If the controller is in non-debugging status and the channel which the tag corresponds to is configured under "Output according to the preset value", AO tag will be in fault safety status automatically, the tag value displays the fault safety value and SAFESTA after the controller disconnection with AO module for five minutes. The tag is in "Fault safety status" displayed in the bar "Fault safety list" in the system status list of supervision. In the status, the tag value can't be modified.

If communication between controller and AO module restores or AO channel connection restores, AO tag exits fail-safe status automatically.

When AO channel is disconnected or in short circuit, AO tag Flag is set as OOP (open loop) status.

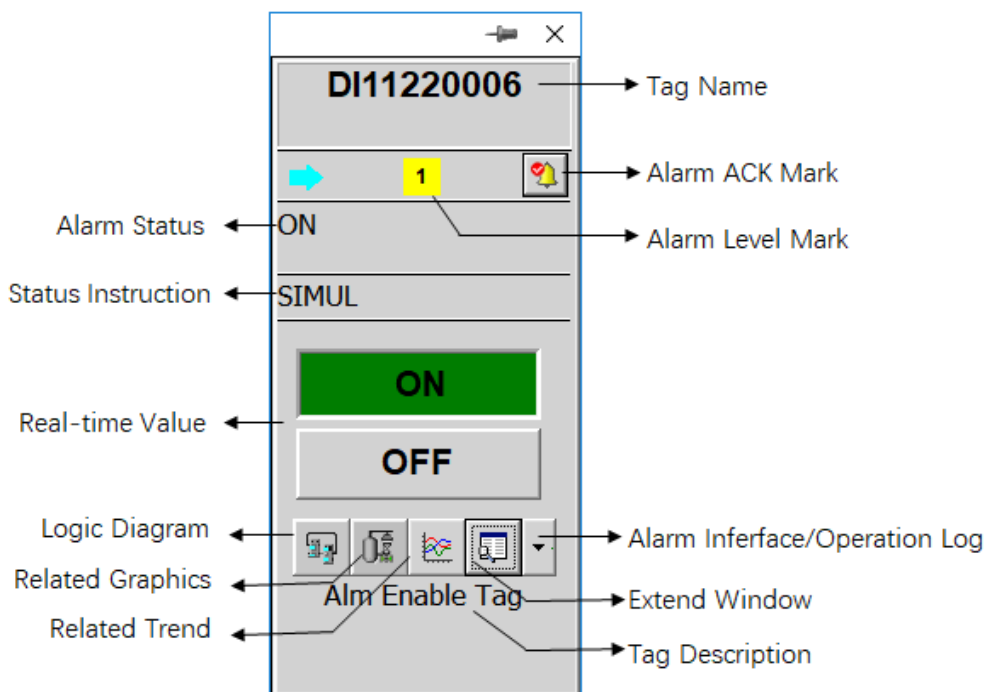
Please refer to "Fail-safe" for details.

## 2.3 DI Tag

DI gets field signal from digital input module. The digital of the tag is got after corresponding process according to the configuration.

### 2.3.1 Tag Panel


As shown in Figure 2.6, DI tag panel includes Tag Name, Alarm ACK Mark, ON/OFF Mark, Status Instruction, Force Instruction, Tag Status and Window Jumping Button.



**Figure 2.6 DI Tag Panel**

The color of ON/OFF is conformed by “Global Default Settings” in system structure configuration.

### DI Extended Panel

The extended panel of DI tag includes the alarm information, the setting information of signal process, address information, suppress information, and trend screen. Click  in the tag panel to extend the panel as shown in the following figures.

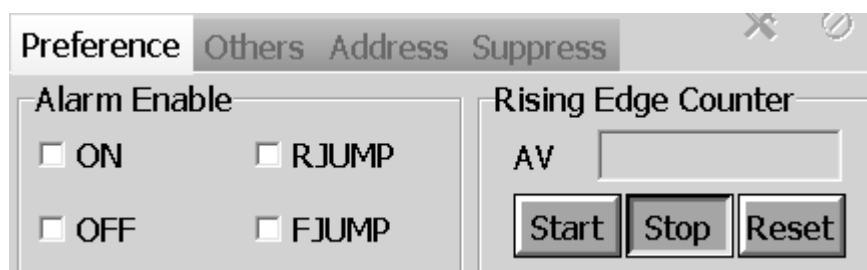


Figure 2.7 The extended panel of DI tag (Preference tab)

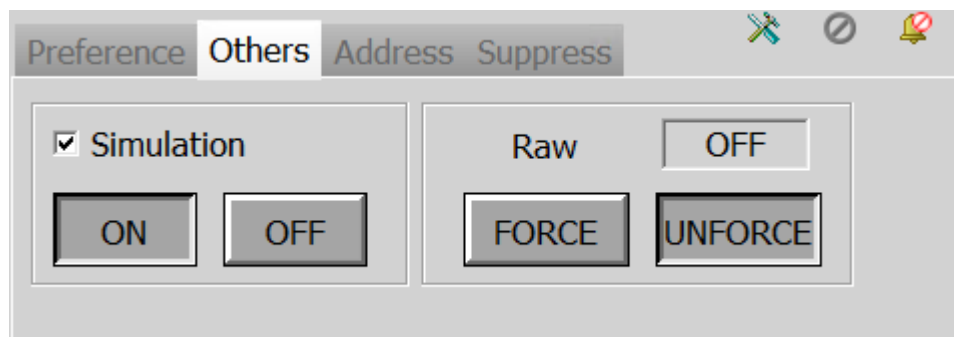


Figure 2.8 The extended panel of DI tag (Others tab)

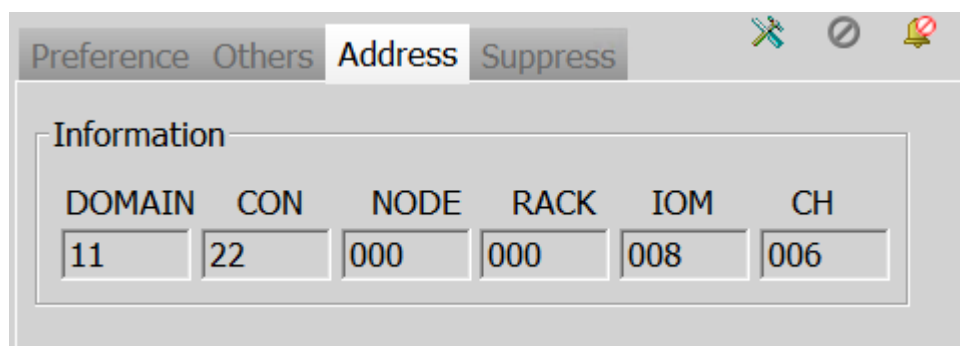


Figure 2.9 The extended panel of DI tag (Address tab)

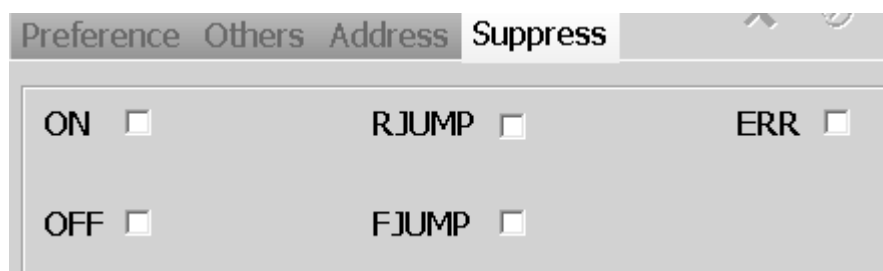


Figure 2.10 The extended panel of DI tag (Suppress tab)

Table 2.12 Panel Parameter Description

Panel Parameter Name			Application Description
Preference	Alarm	Enable	The enable condition of each type of alarms
		RJUMP	Enable: positive jump alarm. Disable/enable (optional) Disable: RJUMP alarm in the suppression status
		FJUMP	Enable: negative jump alarm. Disable/enable (optional)

**Table 2.12 Panel Parameter Description (continued)**

Panel Parameter Name			Application Description
			Disable: FJUJP alarm in the suppression status
	Rising Edge Counter	AV	The accumulation of the rising edge
		Start/stop	Switch of the rising edge count accumulation
		Reset	The reset switch of the rising edge count accumulation
Others	Simulation		Simulation input value
	ON/OFF		In simulation status, tag value equals this value
	RAW		Value of RAWVAL
	FORCE/UNFORCE		Force switch, OFF = force, ON = unforce
Address			It is used to display the tag domain address, station address, node address, rack address, module address and channel number.
Suppress			When an alarm is selected under this tab, the corresponding alarm status will not be displayed on the panel when it occurs. Please refer to the "SUPPRESS" in the "Status Table" to view the suppression records. Only users with permission to access the alarm suppress panel can modify this parameter.

## 2.3.2 DI Data List

**Table 2.13 referenceable parameter of FBD**

Parameter Name	Data Type	Description	Assignment	Default
FLAG	UDINT	Flag Code	Write Disable	0
PV	BOOL	Procedure Variable	Write Disable	OFF
AV	UDINT	Accumulation Value of Rise Edge	Write Disable	0
SWSIM	BOOL	Simulation Input Switch ON=Simulation, OFF=Non-Simulation	Write Enable	OFF
SIMIN	BOOL	Simulation Input	Write Enable	OFF
SWAM	BOOL	Force Switch OFF=Force, ON=Non-Force	Write Disable	ON
SWOOS	BOOL	Tag Disable Switch ON=Disable, OFF=Enable	Write Enable	OFF
AVRST	BOOL	Reset Switch of Rise Accumulation	Write Enable	OFF

**Table 2.13 referenceable parameter of FBD (continued)**

Parameter Name	Data Type	Description	Assignment	Default
		ON=Reset, OFF=Non-Reset		
AVSTRT	BOOL	Start Switch of Rise Accumulation ON=Start, OFF=Keep	Write Enable	OFF
ERR	BOOL	DI Tag Status Flag	Write Disable	OFF

**Table 2.14 debug parameter list for tag config software**

Parameter Name	Data Type	Description	Default
Input Signal Parameter			
FLAG	UDINT	Flag Code	4
PV	BOOL	Procedure Variable	OFF
AV	UDINT	Output Value of up Jump Accumulation	0
SWSIM	BOOL	Switch of Simulation Input	OFF
SIMIN	BOOL	Simulation Input Value	OFF
SWAM	BOOL	Force Switch (ON=Unforced, OFF=Force)	ON
SWOOS	BOOL	Tag Disable Switch (ON=Disable, OFF=Enable)	OFF
Config Parameter			
IVO	BOOL	Input NOT Option (ON=Negate, OFF=Nunegate)	OFF
Up Jump Accumulation Parameter			
AVRST	BOOL	Reset Switch of up Jump Accumulation (Reset AV When up Jump)	OFF
AVSTRT	BOOL	Start Switch of Up Jump Accumulation (ON=Start, OFF=Stop)	OFF
Alarm Parameter			
ENALM	UDINT	Itemiae Alarm Enable D8: ON Status Alarm; D9: OFF Status Alarm D10: Up Jump Alarm; D11: Down Jump Alarm	0
AOF	BOOL	Alarm Shield	OFF

**Table 2.14 debug parameter list for tag config software (continued)**

Parameter Name	Data Type	Description	Default
Sundries Parameter			
CHAN_EXIST	SINT	Channel Flag (0=No Exist, 255=Exist)	255
CHK_CODE	INT	Channel Check Code	21930
ERR	BOOL	Tag Status Flag (ON=Bad)	OFF
ERRVAL	USINT	(when unforced and non-simulation status) Tag Value Option When Tag Fault: 0=Hold, 1=Set ON, 2=Set OFF	0
RAWVAL	BOOL	Input originality value	OFF
PRIMEPV	BOOL	Up send originality value	OFF

### 2.3.3 DI Flag Code

**Table 2.15 DI flag code**

Flag code	Supervising assign	Explain
D0	Disable	Retain
D1	Disable	Retain
D2	Enable (SWAM)	Unforced Status (UNFORCE)
D3	Disable	Dithering Alarm (FLICK)
D4	Disable	Tag Malfunction Alarm(ERR)
D5	Disable	Force Status (FORCE)
D6	enable(SWOOS)	Tag Disable (OOS)
D7	Disable	Simulation Input(SIMUL)
D8	Disable	ON Status Alarm (ON)
D9	Disable	OFF Status Alarm (OFF)
D10	Disable	Up Jump Alarm(RJUMP)
D11	Disable	Down Jump Alarm (FJUMP)
D12	Enable (AOF)	Alarm Shield (AOF)

**Table 2.15 DI flag code (continued)**

Flag code	Supervising assign	Explain
D13~D14	Disable	Retain
D15	Disable	Tag Real-Time Value

## 2.3.4 DI Multicast Data Structure

DI multicast data is quality code with two bytes and the highest bit is real-time value.

**Table 2.16 DI multicast data structure**

Offset address	Parameter Name	Data Type	Description
00H	FLAG	UINT	Flag cod, please refer to Table 2.15 for definition.

## 2.3.5 Select output source

Simulation input is available for DI tag.

When the simulation input switch SWSIM is ON, the input signal is from SIMIN. SIMIN can be set manually in the panel or FBD debugging interface or from other function blocks.

When SWSIM is OFF, input signal is from corresponding DI module. Original status of input is recorded in RAWAL parameters no matter input signal are from simulation input or DI module.

## 2.3.6 Negate DI input

When IVO is ON, negate raw value RAWVAL but RAWVAL is not changed; When IVO is OFF, output the original status of DI without processing.




---

**TIP:**

In the status of force, negating is unavailable.

---

## 2.3.7 Process in force status

When SWAM is OFF, it is in force status. In this case, DI output value is set manually by operators, not according to the value sent by I/O module.

## 2.3.8 DI accumulator of rising



DI tag can count positive jumps of input digital. If the rising edge accumulation switch AVSTRT is ON, AV is added by 1 when a positive jump is checked. If the rising edge accumulation switch AVSTRT is OFF, rising accumulation is stopped.

If rising edge accumulation is reset, i.e., rising edge of AVRST occurs, accumulated value AV is set 0.

### 2.3.9 Alarm processing

- Fault alarm

When the module or communication is faulty, tag fault alarm ERR is displayed (ERR alarm is not generated in the status of controller debugging).

- Status alarm

If ON status alarm is enabled, when DI tag value is ON, the tag is in the status of ON alarm and ON status alarm bit of corresponding quality code is set 1; When DI is changed from ON to OFF, the tag is in normal status and ON status alarm bit of corresponding quality code is set 0.

If OFF status alarm is enabled, when DI tag value is OFF, the tag is in the status of OFF alarm and OFF status alarm bit of corresponding quality code is set 1; When DI is changed from OFF to ON, the tag is in normal status and OFF status alarm of corresponding quality code is set 0.

- Jump alarm

If positive jump alarm is enabled, when DI jumps from OFF to ON, positive jump alarm is generated (RJUMP).

If negative jump alarm is enabled, when DI jumps from ON to OFF, negative jump alarm is generated (FJUMP).

- Alarm shield

When the function of tag alarm shield is set, corresponding alarms are only recorded but not displayed in real time.

### 2.3.10 Set in fault status

If the status of non-force and non-simulation is selected, i.e., tag value is from DI module, when data sent by DI module is suspicious, tag value is maintained and dithering alarm is marked.

When data sent by DI module, tag value is set according to configuration. Tag value can be set Maintain, ON and OFF.

## 2.4 DO Tag

Digital signal operated in control strategy is output to DO module by DO tag to indicate or control field executor.

## 2.4.1 Tag Panel

The panel of DO tag is basically the same as the panel of DI tag. Please refer to "Tag Panel", no more details here.

## 2.4.2 DO Data List

**Table 2.17 Referenceable parameter of FBD (DO)**

Parameter Name	Data Type	Description	Assign Value	Default
FLAG	UDINT	Flag Code	Write Disable	0
IN	BOOL	Input Real-time Value You should use "Tag Name. IN" parameter when assigning values to DO tag. If the output involves in logical calculation, the form should be "Tag Name .OUT".	Write Enable	OFF
TV	BOOL	Tracking Input Value	Write Enable	OFF
OUT	BOOL	Output Real-Time Value	Write Disable	OFF
BKOUT	BOOL	Inversion Calculation Value	Write Disable	OFF
SWAM	BOOL	Force Switch OFF=Force, ON=Unforced	Write Disable	OFF
SWTR	BOOL	Tracking Switch ON=Tracking, OFF=No Tracking	Write Enable	OFF
SWOOS	BOOL	Tag Disable Switch ON=Disable, OFF=No Disable	Write Enable	OFF
BKOUTERR	BOOL	Inversion Calculation Output Status	Write Disable	ON

**Table 2.18 debug parameter of tag config software**

Parameter Name	Data Type	Description	Default
Parameter of Output Signal			
FLAG	UDINT	Flag Code	4
IN	BOOL	Input Real-Time Value	OFF

**Table 2.18 debug parameter of tag config software (continued)**

Parameter Name	Data Type	Description	Default
TV	BOOL	Tracking Input Value	OFF
OUT	BOOL	Output Real-Time Value	OFF
BKOUT	BOOL	Inversion Calculation Value	OFF
SWAM	BOOL	Force Switch (ON=Unforced, OFF=Force)	ON
SWTR	BOOL	Tracking Switch (ON=Tracking, OFF=No Tracking)	OFF
SWOOS	BOOL	Tag Disable Switch (ON=Disable, OFF=Enable)	OFF
Config Parameter			
IVO	BOOL	Output NOT Option (ON=Negate, OFF=Un-Negate)	OFF
Alarm Parameter			
ENALM	UDINT	Itemize Alarm Enable D8:ON Status Alarm; D9:Offstatus Alarm	0
ACK	BOOL	Confirm Recovery from Failure	OFF
AOF	BOOL	Alarm Shield ON=Don't Show Real-Time Alarm; OFF=Show Real-Time Alarm	OFF
Sundries Parameter			
CHAN_EXIST	SINT	Channel Exist Flag (0=Non-Exist, 255=Exist)	255
CHK_CODE	INT	Channel Check Code	43605
BKOUTERR	BOOL	Inversion Calculation Output Status	ON
SWSAFESET	BOOL	Fail-safe function ON= Enable, OFF= Disable	OFF
SAFEVAL	BOOL	Fail-safe value	OFF

### 2.4.3 DO Flag Code

**Table 2.19 DO flag code list**

Flag code	Supervising assign	Description
D0	Disable	Retain
D1	Disable	Retain
D2	Enable (SWAM)	Unforced Status (UNFORCE)
D3	Disable	Failure Safe Status(SAFESTA)
D4	Disable	Tag Failure Alarm(ERR)
D5	Disable	Force Status(FORCE)
D6	Enable (SWOOS)	Tag Disable(OOS)
D7	Disable	Rerain
D8	Disable	ON Status Alarm (ON)
D9	Disable	OFF status Alarm(OFF)
D10	Disable	Tracking Status (TR)
D11	Enable (AOF)	Shield Alarm(AOF)
D12~D14	Disable	Retain
D15	Disable	Real-Time Output Value

## 2.4.4 DO Multicast Data Structure

DO multicast data is quality code with two bytes.

**Table 2.20 DO multicast data structure**

Offset address	Parameter Name	Data Type	Description
06H	FLAG	UDINT	Flag code, please refer to "Table 2.19" or definition.

## 2.4.5 Negate

When IVO is ON, value of OUT parameter is sent to DO module after negating.

**TIP:**

When Negate is set in force status, value set manually is output to DO module after negating

## 2.4.6 Process in force status

When SWAM is OFF, the tag is in force status and the flag of force in quality code is set. DO output is not updated according to the input parameter IN but can be set manually.

When SWAM is ON, the function block is in non-force status. DO output is updated by the input parameter IN processed.

## 2.4.7 Output track

When SWTR is ON, output OUT tracks input value of TV. When the field device is to be maintained and it is set handheld, DO output tracks status of the field device by inputting DI measure point and setting SWTR ON.

The priority of track status is sub-status of non-force status and lowers than force status.

## 2.4.8 Output inversion calculation

DO processing is in the end of control scenario generally. BKOUT is equal to IN value which corresponding OUT of currently DO, and it is joined with BKIN of fore function block to notify whether fore module is open loop status. When DO block is in the force status, output value of fore module track that inversion calculation input value.

When DO are OOS, tracking, force, failure safe status, make fore control module into IMAN status by BKOUTERR.

## 2.4.9 Alarm process

- Fault Alarm

When the module or communication is faulty, tag fault alarm ERR is displayed (If the option is not set in the status of controller debugging, ERR alarm is generated).

- Status Alarm

If ON status alarm is enabled, when DO tag value is ON, the function block is in the status of ON alarm and ON status alarm bit of corresponding quality code is set 1; When DO is changed from ON to OFF, the function block is in normal status and ON status alarm bit of corresponding quality code is set 0.

If OFF status alarm is enabled, when DO tag value is OFF, the function block is in the status of OFF alarm and OFF status alarm bit of corresponding quality code is set 1; When DO is changed from OFF to ON, the function block is in normal status and OFF status alarm of corresponding quality code is set 0.

- Alarm shield

If the function of tag alarm shield is set, corresponding alarm will only be recorded but not displayed in real time.

## 2.4.10 Fault safety status

If the controller is in non-debugging status and the channel which the tag corresponds to is configured under "Output according to the preset value", DO tag will be in fault safety status automatically, the tag value displays the fault safety value and SAFESTA after the controller disconnection with DO module for five minutes. The tag is in "Fault safety status" displayed in the bar "Fault safety list" in the system status list of supervision. In the status, the tag value can't be modified.

If communication between controller and DO module restores, DO tag exits fail-safe status automatically.

Please refer to "Fail-safe".

## 2.5 Fail-safe

The system has powerful functions of fault self-test and processing. The fault diagnosis can reach channel level directly and the troubleshooting is set when configuring.

### 2.5.1 Troubleshooting

- AI tag:

When AI tag fails (module failure, channel failure or communication failure) and fail-safe is enabled, according to the configuration of fail-safe, AI tag outputs can be set as: hold, set upper limit and lower limit of the measuring range, set the preset value of faults and proximity extended range limits.

- Selects "Hold" and enters fault mode, then PV value of AI holds the value of last cycle.
- Selects "Set upper limit of the measuring range" and enters fault mode, then PV value of AI will be set as the upper limit of the measuring range.
- Selects "Set lower limit of the measuring range" and enters fault mode, then PV value of AI will be set as the lower limit of the measuring range.

- Selects “Set the preset value of faults” and enters fault mode, then PV value of AI will be set as the preset value of faults.
- Selects “Set proximity extended range limits” and enters fault mode, if the sent original code is smaller than the lower limit of the extended measuring range, PV value of AI will be set as the lower limit of the extended measuring range. If it is greater than the upper limit of the extended measuring range, PV value of AI will be set as the upper limit of the extended measuring range. If it enters fault mode due to module lost while the value is held within the normal measuring range, PV value of AI tags will be set as the lower limit of the extended measuring range.
- For DI  
In VFIOBuilder, Hold, ON or OFF can be selected in troubleshooting.
- For AO  
In hardware configuration software, “Hold” and “Output the preset value” can be selected from the channel fail-safe mode.
- For DO  
In hardware configuration software, “Hold” and “Output the preset value” can be selected from the channel fail-safe mode.

Different faults have different processing modes. The fault types can be listed as below:

- Fault in channel level of I/O module
- Fault in module level of I/O module
- Fault in communication communication between I/O module and controller.

### **Fault in channel level of I/O module**

Fault in channel level of I/O module means only one channel of the module fails (like disconnection and short circuit).

When this kind of fault occurs, the solution is shown as below:

- AI tag: troubleshoot immediately, generate ERR alarm and output fault value.
- DI tag: troubleshoot immediately, generate ERR alarm and output fault value.
- AO tag: delay for 8 seconds and enter the fault safety status, generate the ERR alarm and output holding or output the pre-setting value.
- DO tag: delay for 8 seconds and enter the fault safety status, generate the ERR alarm and output holding or output the pre-setting value.

### **Fault in module level of I/O module**

Fault in module level of I/O module includes module lost, model difference, configuration difference and severe fault

When the Fault in module level of I/O module occurs, the tag troubleshooting is shown below:

- AI tag: troubleshoot after delay for 8 seconds, generate ERR alarm and output fault value.
- DI tag: troubleshoot after delay for 8 seconds, generate ERR alarm and output fault value.
- AO tag: delay for 8 seconds and enter the fault safety status, generate the ERR alarm and output holding or output the pre-setting value.
- DO tag: delay for 8 seconds and enter the fault safety status, generate the ERR alarm and output holding or output the pre-setting value.

### **Fault in the communication between I/O module and controller**

After the communication between the AO/DO module and the controller is broken for 5 seconds. the module will enter the fault safety status and output holding or output pre-setting value according to the configuration.

The reasons of the communication breaking include L-BUS communication fault between I/O module and the controller or remote nodes, the E-BUS communication fault between the controller and remote nodes, and the fault in remote nodes.

In the operation mode, if communication of the controller with AO/DO module is broken.

- When the communication is broken for less than 5 seconds: AO/DO module will hold the output during the breaking time, and output the program calculation value as soon as the communication is normal.
- When the communication breaking time is between 5 and 8 seconds: AO/DO module will hold the output value firstly and then output the fault safety value after 5 seconds during the breaking time, and output the program calculation value as soon as the communication is normal.
- When the communication breaking time is greater than 8 seconds: AO/DO module will hold the output value firstly, output the fault safety value after 5 seconds, enter the fault safety status and output the fault safety value after 8 seconds. When the communication is normal, the AO/DO tag will exit the fault safety status automatically. If the upriver is connected to loop or handholder, then it will enter the MAN mode and output the fault safety value. If the upriver connection does not exist, then output program calculation value immediately.

The fault safety value mentioned above includes output holding and output the pre-setting value these two modes.

## **2.5.2 Output specifications of controller in different start modes**

### **Start modes of controller**

According to different start conditions, there are 3 start modes as below:



- Cold Startup
- Instantaneous Power-off
- Hot Startup

### **Cold Startup**

Definition: the controller restarts in the case of which the controller is power-off for 5 seconds or power-off protecting battery is useless.

In the latter case, the system needs to load configuration again.

If the power-off protecting battery works well in the cold restarting mode, then the controller will read back the output value of I/O module within 8 seconds after restart. When it is over, the output specification of the controller is shown below:

- If the AO tag is under non-Force mode before power-failure, controller will output the read-back value when the upriver of the AO tag is connected to the controlling function block. When there is no connection, then output the program calculating value.
- When AO tag is under the force mode before power-off, then the controller will output the read-back value.
- When DO tag is under non-force mode before power-failure, then output the program calculating value.
- When DO tag is under the force mode before power-off, then the controller will output the read-back value.

### **Instantaneous Power-off**

Definition: controller restart when the power-off time is less than 5 seconds and the power self-test is normal.

The power-off protecting battery is normal and data stays still around the instantaneous power-off point, the controller will read back the output of I/O module after start for 8 seconds. When it is over, the output specification of the controller is shown below.

- When the upriver of the AO tag is connected to the controlling function block and the AO tag is under non-Force mode before power-off, if it is set to the manual-back mode, controller will output the read-back value; if it is set to automatical back mode, then output the program calculating value.
- When AO tag is under the force mode before power-off, then the controller will output the read-back value.

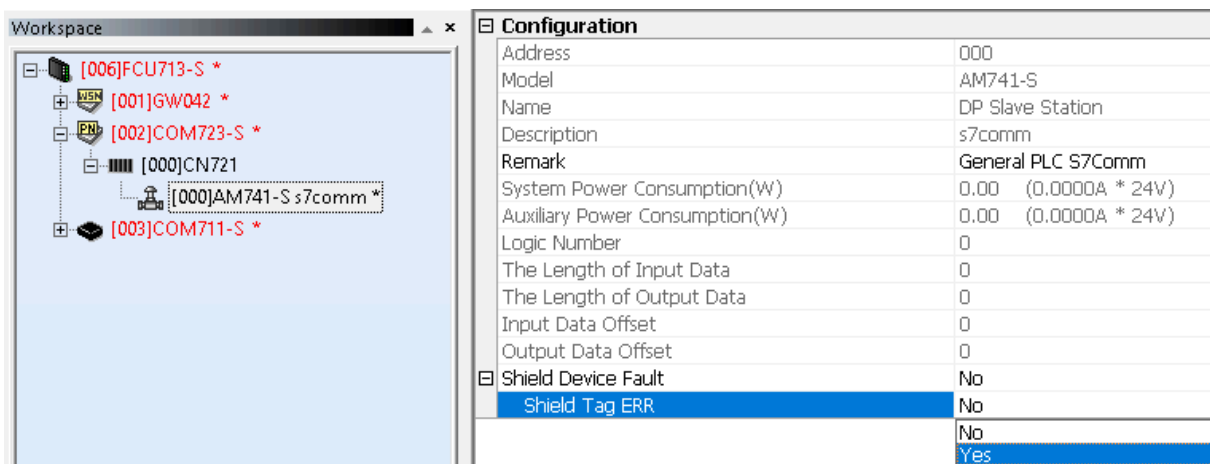
- When DO tag is under non-force mode before power-off, then output the program calculating value.
- When DO tag is under the force mode before power-off, then the controller will output the read-back value.

## Hot Startup

Definition: the controller restart in the condition of non-power-off which is caused by resetting. The data inside controller will keep fixedness during hot-startup. After restart, controller continues to calculating and output according to status of before reset, thus ensure the control continuity and stability.

## 2.5.3 Shielding Communication Tag Faults

In the VFIOBuilder software interface, after selecting the communication slave module, you can shield the fault of a single slave device or shield ERR alarm of the tag. Take the slave device fault blocking setting of AM741-S as an example to introduce the fault blocking function, as shown in Table 2.21.



**Figure 2.11 Shielding slave device fault configuration interface**

See Table 2.21 for the illustration of device fault shielding and tag ERR shielding function.

**Table 2.21 Description of device fault and tag ERR shielding effect**

Shielding Device Fault	Shielding Device Tag ERR	Description of Fault Shielding Effect
Yes	-	<ul style="list-style-type: none"> <li>• All alarms of tags (PVH, PVL, ORH, ORL, ERR, etc.) will be shielded.</li> <li>• ERR alarm of this communication tag will not displayed on the process alarm interface</li> </ul>

**Table 2.21 Description of device fault and tag ERR shielding effect (continued)**

Shielding Device Fault	Shielding Device Tag ERR	Description of Fault Shielding Effect
		<ul style="list-style-type: none"> <li>Whether the network communication of master and slave is normal or not, tags are in the fail-safe status, no shielding status is displayed on the tag panel, and the alarm column displays NR (Normal). When AO is connected to PID function block, PID function block tag enters IMAN status</li> </ul>
No	Yes	<ul style="list-style-type: none"> <li>The process alarm interface displays other alarms from the tag</li> <li>No ERR alarm from this tag is displayed</li> <li>If the master and slave communication fails, the tag enters the fail-safe status</li> <li>If the communication between master and slave is normal, no shielding status is displayed on the tag panel, and the status bar displays NR (Normal)</li> </ul>
No	No	Alarm status is displayed based on "Alarm Process" of various tags

## 3 Tag of FCU713-S/FCU714-S

The tags described in this section include I/O tags generated by the regular modules under the FCU713-S/FCU714-S controller, regular I/O tags generated by I/O modules (UIO811, UIO831) and communication tags generated by modules under APL switch.

### 3.1 Analog Input Tag (AI)

Signal of general AI input module, temperature signal input module (such as RTD, thermocouple and so on), pulse input module can be input to AI tag. The input signal is processed according to tag configuration and the actual value is got.

Analog input processing tag AI receives the input signals of normal AI, RTD, thermocouple, pulse, and performs input function processing according to the tag configuration parameters, and provides signal interlocking, control, alarm and other monitoring functions.

Analog input processing tag AI can also receive communication signal input (including Modbus RTU, Modbus TCP, PROFIBUS, PROFINET, and EtherNet / IP), which can be converted or AI can directly obtain engineering quantities.

#### 3.1.1 Tag Panel

After installing the HPHMI plugin, the AI tag panel will be as shown in Figure 3.29.

If HPHMI plugin is not installed, AI tag panel will be the same as the AI panel of FCU712-S. AI tag panel mainly includes the following content:

- Bar graph, it is used to display the real time values, alarm limit, interlock values and so on.
- Alarm bar, it is used to display the tag information such as NR and ERR.
- Status bar: it is used to display the status of tags, including IOP, ORL, ORH, HWF and FORCE status.
- Real-time value type: display the current tag status, including simulation and fail-safe.

#### Alarm bar/real-time values/status bar description

The alarm bar, real-time values and status bar of AI tag panel display different values as per the external situation and module status.

- Normal AI tags (they are in the unforce status and the fail-safe value setting is disabled)  
As per the request of NAMUR, if the set value of ORL alarm is 3.8mA and the set value of the ORH alarm is 20.5mA.

AI Panel			System Diagnosis	Potential Cause
ERR	Sam- pling value	IOP	Channel fails.	Signal breaks or short circuit. Channel faults but the sampled value is within the normal sampling range from 0 to 24mA.
		ORL	Channel is normal.	Signal range is (2~3.8) mA
		ORH	Channel is normal.	Signal range is (20.5~24)mA
		HWF	Module fails.	AI module fails
			Module lost.	The controller module lost communication with AI modules.

- Normal AI tags (they are in the unforce status and the fail-safe value setting is enabled)  
As per the request of NAMUR, if the set value of ORL alarm is 3.8mA and the set value of the ORH alarm is 20.5mA.


AI Panel				System Diag- nosis	Poterntial	
Alarm Bar	Real-time Value	Status Bar	Indication Bar			
ERR	Substitu- tion	IOP	SV	Channel fails.	Signal breaks, short circuit. Channel faults but the sampled value is within the normal sampling range from 0 to 24mA	
		ORL		Channel is nor- mal.	Signal range is (2~3.8) mA	
		ORH		Channel is nor- mal.	Signal range is (20.5~24)mA	
		-		Channel is nor- mal.	Signal range is (3.8~20.5)mA	
		HWF		Module fails	AI module fails	
				Module is lost	The controller module lost communi- cation with AI modules.	

- Normal AI tags (they are in the force status)

AI Panel				System Diag- nosis	Potential Cause
Alarm Bar	Real-time Value	Status Bar	Indication Bar		
NR	Forced Values	IOP	SI	Channel fails.	Signal breaks. Signal range is (0~2) mA

AI Panel				System Diagnosis	Potential Cause
Alarm Bar	Real-time Value	Status Bar	Indication Bar		
					Signal is over the maximum limit of range
		ORL		Channel is normal.	Signal range is (2~3.8) mA
		ORH		Channel is normal.	Signal range is (>20.5mA , which is the maximum limit of the signal detection)
		-		Channel is normal.	Signal range is (3.8~20.5) mA
		HWF		Channel fails.	Hardware fault of AI channel and the signal detection is in the range of (3.8~20.5)mA
				Channel fails.	AI module fails
				Module is lost,	The controller module lost communication with AI modules.

### Extended panel of AI Tag

The extended panel of AI tag includes the alarm information, the setting information of signal process, interlock information and trend screen. Click  in AI tag panel to extend the AI panel as shown in Figure 3.1 and Figure 3.4.

Under the FCU713-S/FCU714-S controller, the AI signal generated by the AI714-H module with channel HART enabled will display HART parameters on its extended panel. Only the enabled PV/SV/TV/FV in the channel will be displayed, as shown in Figure 3.5.

Alarm Config Interlock Trend

PV Alarm(kg)

Enable	Limits	TON(s)	TOFF(s)	SUP
<input type="checkbox"/> HHH	100.00	0.0	0.0	<input type="checkbox"/>
<input type="checkbox"/> HH	95.00	0.0	0.0	<input type="checkbox"/>
<input type="checkbox"/> H	90.00	0.0	0.0	<input type="checkbox"/>
<input type="checkbox"/> L	10.00	0.0	0.0	<input type="checkbox"/>
<input type="checkbox"/> LL	5.00	0.0	0.0	<input type="checkbox"/>
<input type="checkbox"/> LLL	0.00	0.0	0.0	<input type="checkbox"/>
<input type="checkbox"/> PRIN	100.00	0.0	0.0	<input type="checkbox"/>
<input type="checkbox"/> NRIN	100.00	0.0	0.0	<input type="checkbox"/>
HYS	0.00	TDPV	60.0	

Overrange Alarm

☒ MAX ☒ MIN

Figure 3.1 The extended panel of AI tag (alarm page)

Alarm Config Interlock Trend

Information

DOMAIN	CON	NODE	RACK	IOM	CH
12	8	0	0	0	0

Signal Processing

☐ Low Cut 0.500 %

Filter Time 0.0 s

Fault Safety Setting

☒ Enable

☒ Hold ☐ Span Max ☐ Span Min

☐ Near Extended Range Limit

☐ Substitute 0.00

Desirable Operating Range(%)

☐ Enable OPR\_L 40.00 OPR\_H 60.00

Force

Simulate(%)

☐ Simulate 0.00

Figure 3.2 The extended panel of AI tag (setting page)

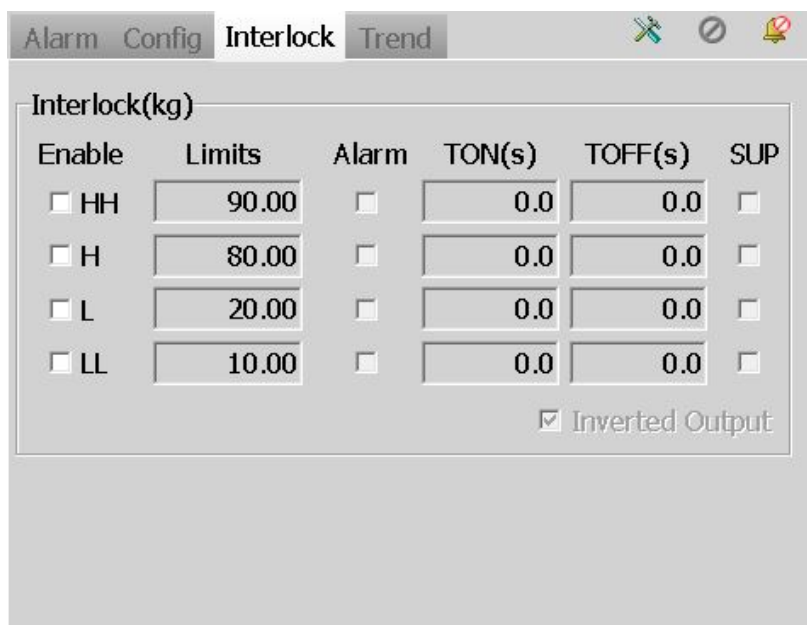


Figure 3.3 The extended panel of AI tag (interlock page)

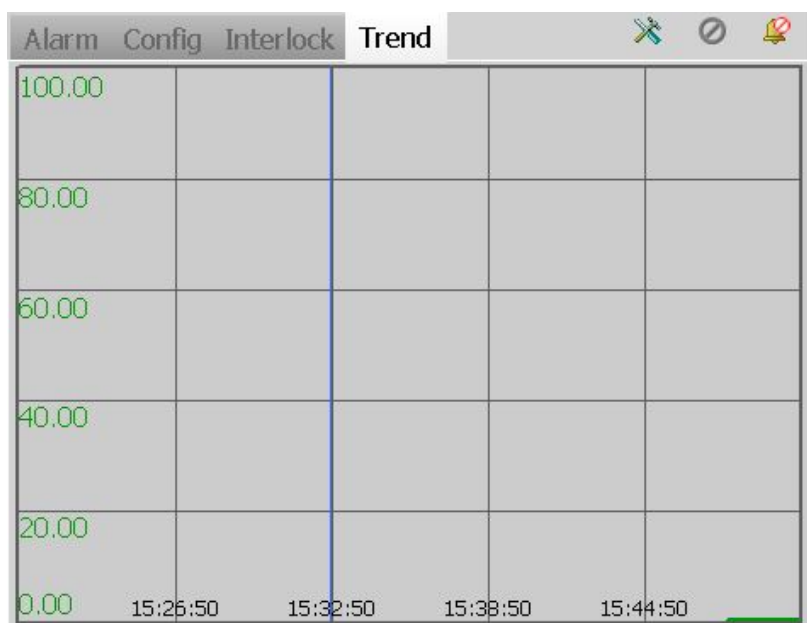


Figure 3.4 The extended panel of AI tag (Trend page)

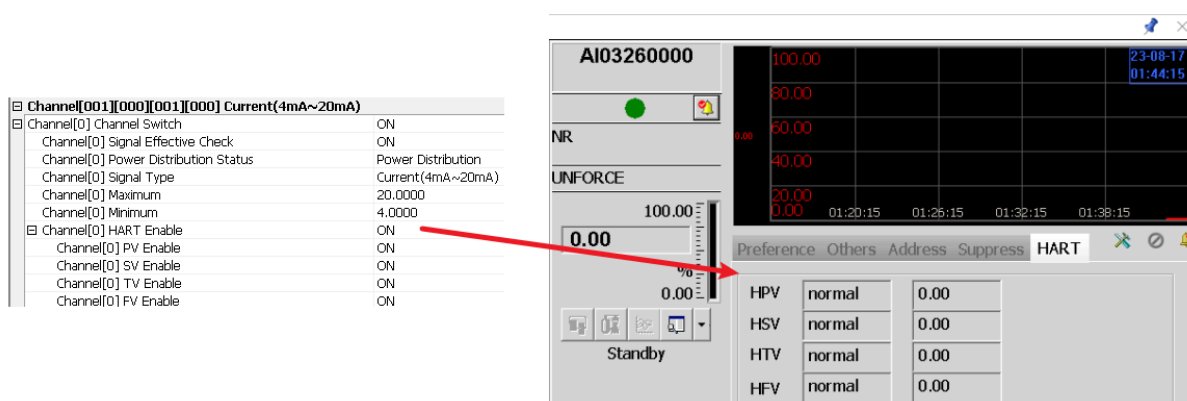


Figure 3.5 The extended panel of AI tag (HART)



## Other parameters

Description of other parameters on AI panel is shown in the table below.

**Table 3.1 Parameter Description of AI panel**

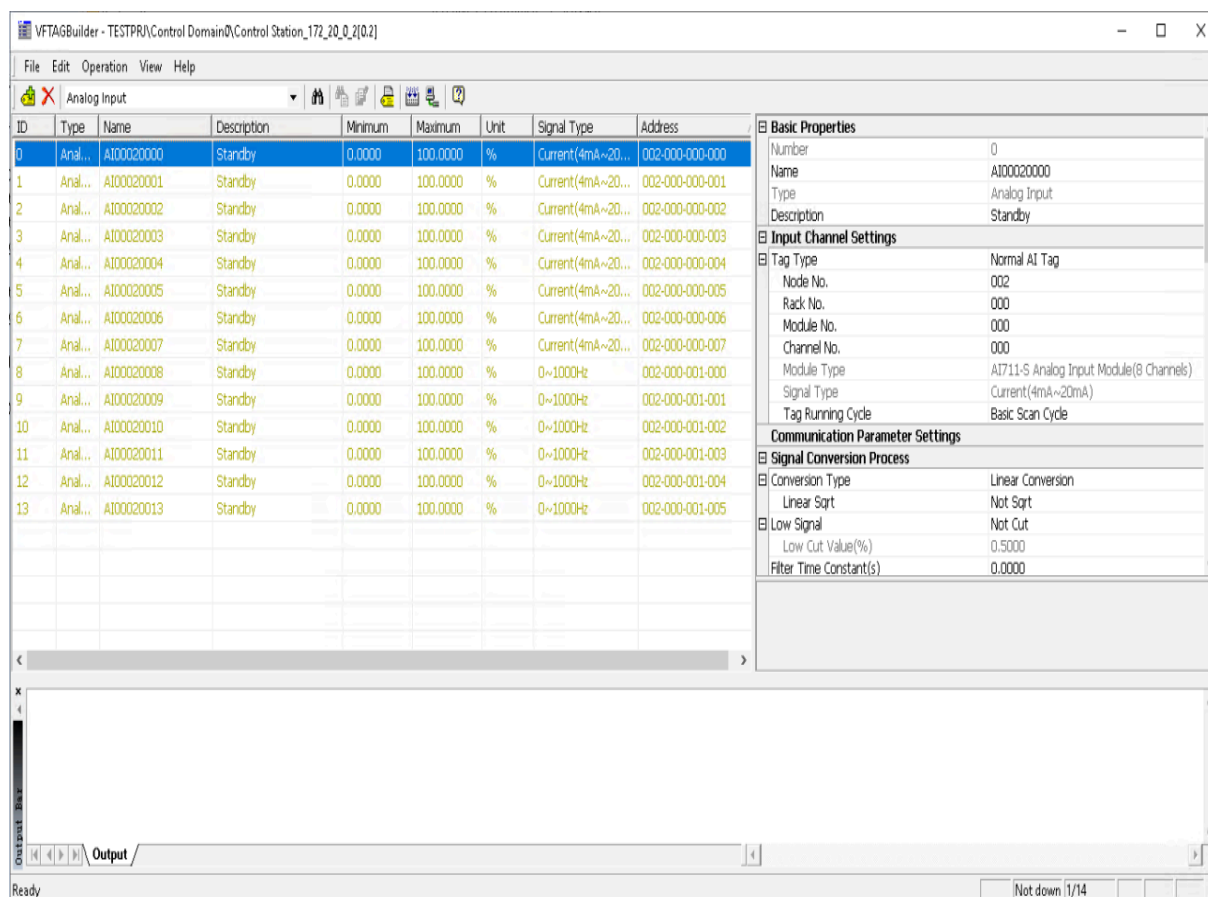
Parameter Name			Application Description
Alarm	PV alarm	Enable	Enable status of each alarm.
		Limit	Set alarm limit
		TON	Alarm triggering delay, unit (s)
		TOFF	Elimination delay of each alarm. Alarm elimination delay, unit (s)
		Suppress	Suppression conditions of each alarm
		Hysteresis	High/low limit alarm hysteresis value
		Rate test cycle	Unit (s)
	Overrange alarm limiting	Upper limit	Overrange upper limit alarm limiting (0-25%)
		Lower limit	Overrange lower limit alarm limiting (-25 -0%)
Settings	Address	It is used to display the domain address, station address, node address, rack address, module address and channel address of the tags.	
	Signal	Small signal cut-off	Whether to cut off small signals. Tick to select the small signal cut-off and configure the cut-off range.
		Filter time	Filter time coefficient (s)
	Fault setting	Enable	Whether to enable fault-safe value setting function
		After enabling the fault preset, you can preset fault values including hold, preset values, set the upper and lower limit of the measuring range and set proximity extended range.	
	Desirable operational area	Enable	Enable the desirable operational area
		Lower limit	The lower limit of the desirable operational area
		Upper limit	The upper limit of the desirable operational area
	Force	It is used to show the force status of the current tag, including FORCE and UN-FORCE. In the Force status, the real-time input box is in the white background with black words. In the Unforce status, the real-time input box in the grey background with black words.	
	Simulation	simulation	Simulation input switch.

**Table 3.1 Parameter Description of AI panel (continued)**

Parameter Name			Application Description
Interlock	Interlock	Enable	The enabling status of interlock
		Amplitude limiting	Interlock limiting setting, full range (%)
		Alarm	Enable interlock triggers alarm
		TON	Interlock triggering delay (s)
		TOFF	Interlock elimination delay (s)
		Suppress	The suppression condition of each alarm type
	Output negation		Interlock output negation :negate: OFF interlock; Not to negate: ON interlock
HART	HPV		When the AI714 module has its channel HART function and PV parameter enabled, this parameter's status and value will be displayed on the tag panel.
	HSV		When the AI714 module has its channel HART function and SV parameter enabled, this parameter's status and value will be displayed on the tag panel.
	HTV		When the AI714 module has its channel HART function and TV parameter enabled, this parameter's status and value will be displayed on the tag panel.
	HFV		When the AI714 module has its channel HART function and HV parameter enabled, this parameter's status and value will be displayed on the tag panel.

### 3.1.2 Tag Configuration

In VFTAGBuilder, you can select “Analog Input” to configure AI tag property as shown in the figure below.



**Figure 3.6 AI configuration interface**

The property of AI tags are configured at the right side of the interface above and the property description is shown in the table below.

**Table 3.2 AI Tag Property Table**

Category	Setting Item	Parameter Description and Value Range	Type
Basic Properties	Number	Determined when the tag is added, and can't be modified.	-
	Name	Tag name can be modified manually. The maximum length is 24 characters, supporting numbers, English letters, "_" and "-". Also, starting with a number or a letter.	-
	Type	Analog Input (can't be modified)	-
	Description	Tag instruction, and can be input manually. The maximum length is 64 characters.	STRING
Input Channel Setting (Normal AI tags)	Tag Type	Normal AI Tag	USINT
	Node No.	[0~31 ] input manually	USINT
	Rack No.	[0~3] (input manually)	USINT

**Table 3.2 AI Tag Property Table (continued)**

Category	Setting Item	Parameter Description and Value Range	Type
	Module No.	[0~15] (input manually)	USINT
	Channel No.	[0~31] (input manually)	USINT
	Module Type	Correspond to the hardware configuration(it's not allowed to be modified)	-
	Signal Type	Correspond to the hardware configuration(it's not allowed to be modified)	-
	Tag Running Cycle	Fast Cycle/ Basic Scan Cycle (optional)	-
	APL Tag	Whether the specified tag is an APL tag or not, which is determined by the module type in the hardware configuration.	
Input Channel Setting (communication tags)	Tag Type	Communication AI Tag	USINT
	Communication Node No.	Appoint the communication node NO. [(0~31] of the tag	USINT
	Communication Rack No.	Appoint the communication rack NO. [0~3] of the tag	USINT
	Slave Station Address	Appoint the slave address [0~255] of the tag	USINT
	Data Block No.	Appoint the data block NO. [0~63] of the tag	USINT
	The Offset Address of the Tag in the Data Block	Appoint Offset address [0~511] of the slave station in the Data Block	USINT
	Data Type	2-Byte Integer (signed/unsigned)/ 4-Byte Integer (signed/unsigned)/ 4-Byte Float	-
	Signal Properties	Actual Value/Percentage(It is available only when data type is 4-Byte Float)	-
	Status Code Location	Status Code Ahead/ Status Code Behind/ No status Code For FCU713-S/FCU714-S controllers, Status Code Location of an communication AI tag can also be set as one of the following options: "Status Code Ahead (Fault Setting ERR)", "Status Code Behind (Fault Setting ERR)", "Status Code Ahead (Fault (Include Uncertain) Setting ERR)", or "Status Code Behind (Fault (Include Uncertain) Setting ERR)". The configuration and values of the status code will affect the fault alarm state. Please refer to Note 1 for details.	-

**Table 3.2 AI Tag Property Table (continued)**

Category	Setting Item	Parameter Description and Value Range	Type
	Data Format	No Conversion/Byte Conversion/Word conversion / Word Internal Conversion	-
Signal Conversion Process	Conversion Type	Linear Conversion/No Conversion (optional)	USINT
	Linear Sqrt	Not Sqrt/Sqrt (optional)	-
	Low Signal	Not Cut/Cut(optional)	BOOL
	Low Cut Value (%)	It can be modified when Small Signal is set as "Cut"	REAL
	Filter Time Constant (s)	Input values manually	REAL
Desirable Operation Area	Desirable Operating Range Enable	Enable/Disable	BOOL
	Desirable Operating Range High Limit	Input the upper limit of the operation area and the default is 60. This is a project value.	REAL
	Desirable Operating Range Low Limit	Input the lower limit of the operation area and the default is 40. This is a project value.	REAL
Output Range Settings	Span Maximum	Input values manually	REAL
	Span Minimum	Input values manually	REAL
	High Overrange Limit (%)	Input values manually[0.25]	REAL
	Low Overrange Limit (%)	Input values manually[0,25]	REAL
	High Overrange Alarm	Enable/disable	BOOL
	Alarm High Overrange TON(s)	Refer to alarm delay instruction.	REAL
	Alarm High Overrange TOFF(s)	Refer to alarm delay instruction.	REAL
	Low Overrange Alarm	Enable/Disable	BOOL
	Alarm Low Overrange TON (s)	Refer to alarm delay instruction.	REAL
	Alarm Low Overrange TOFF (s)	Refer to alarm delay instruction.	REAL
	Unit	%, Pa, etc. (optional)	EU-TYPE

**Table 3.2 AI Tag Property Table (continued)**

Category	Setting Item	Parameter Description and Value Range	Type
Input Original Code Settings	Input original code maximum limit	Only adapt to communication tags.	REAL
	Input original code minimum limit	Only adapt to communication tags.	REAL
Alarm Settings	HHH Limit Alarm	Disable/Enable (optional)	BOOL
	HHH Limit Alarm Priority	Select the alarm level from drop-down menu, options including log, low, medium, high, emergent and alarm level 5.	USINT
	HHH Limit Alarm Value	Input HHH alarm value manually.	REAL
	Alarm HHH TON (s)	Refer to alarm delay instruction.	REAL
	Alarm HHH TOFF (s)	Refer to alarm delay instruction.	REAL
	HH Limit Alarm	Disable/Enable (optional)	BOOL
	HH Limit Alarm Priority	Select the alarm level from drop-down menu.	USINT
	HH Limit Alarm Value	Input the alarm value manually	REAL
	Alarm HH TON (s)	Refer to alarm delay instruction.	REAL
	Alarm HH TOFF (s)	Refer to alarm delay instruction.	REAL
	H Limit Alarm	Disable/Enable (optional)	BOOL
	H Limit Alarm Value	Input H alarm value manually	USINT
	H Limit Alarm Priority	Select the alarm level from drop-down menu.	REAL
	Alarm H TON (s)	Refer to alarm delay instruction.	REAL
	Alarm H TOFF (s)	Refer to alarm delay instruction.	REAL
	L Limit Alarm	Disable/Enable (optional)	BOOL
	L Limit Alarm Priority	Select the alarm level from drop-down menu.	USINT
	L Limit Alarm Value	Input Lower alarm value manually	REAL
	Alarm L TON (s)	Refer to alarm delay instruction.	REAL
	Alarm L TOFF (s)	Refer to alarm delay instruction.	REAL
	LL Limit Alarm	Disable/Enable (optional)	BOOL

**Table 3.2 AI Tag Property Table (continued)**

Category	Setting Item	Parameter Description and Value Range	Type
	LL Limit Alarm Priority	Select the alarm level from drop-down menu.	USINT
	LL Limit Alarm Value	Input LL alarm value manually	REAL
	Alarm LL TON (s)	Refer to alarm delay instruction.	REAL
	Alarm LL TOFF (s)	Refer to alarm delay instruction.	REAL
	LLL Limit Alarm	Disable/Enable (optional)	BOOL
	LLL Limit Alarm Priority	Select the alarm level from drop-down menu.	USINT
	LLL Limit Alarm Value	Input LLL alarm value manually	REAL
	Alarm LLL TON (s)	Refer to alarm delay instruction.	REAL
	Alarm LLL TOFF (s)	Refer to alarm delay instruction.	REAL
	H/L Limit Alarm Hysteresis	Input values manually	REAL
	Positive Rate Alarm	Disable/ Enable (optional)	BOOL
	Positive Rate Alarm Priority	Select the alarm level from drop-down menu.	USINT
	Positive Rate Limit	Manual Input Alarm Value.	REAL
	Alarm DPVH TON (s)	Refer to alarm delay instruction.	REAL
	Alarm DPVH TOFF (s)	Refer to alarm delay instruction.	REAL
	Negative Rate Alarm	Disable/ Enable (optional)	BOOL
	Negative Rate Alarm Priority	Select the alarm level from drop-down menu.	USINT
	Negative Rate Limit	Input values manually	REAL
	Alarm DPVL TON (s)	Refer to alarm delay instruction.	REAL
	Alarm DPVL TOFF (s)	Refer to alarm delay instruction.	REAL
	Change Rate Alarm	Disable/ Enable (optional)	BOOL
	Change Rate Alarm Priority	Select the alarm level from drop-down menu.	USINT

**Table 3.2 AI Tag Property Table (continued)**

Category	Setting Item	Parameter Description and Value Range	Type
	Change Rate Alarm Value	Input values manually	REAL
	Rate Alarm Detection Cycle	It is used to determine the test cycle of the positive/negative rate alarm. Unit is second.	REAL
	Interlock HH Limit Alarm	Disable/ Enable (optional)	BOOL
	Interlock HH Limit Alarm Priority	Select the alarm level from drop-down menu.	USINT
	Interlock HH Limit	Input values manually	REAL
	Interlock HH TON (s)	Refer to alarm delay instruction.	REAL
	Interlock HH TOFF (s)	Refer to alarm delay instruction.	REAL
	Interlock H limit alarm	Disable/ Enable (optional)	BOOL
	Interlock H limit alarm Priority	Select the alarm level from drop-down menu.	USINT
	Interlock H Limit	Input values manually	REAL
	Interlock H TON (s)	Refer to alarm delay instruction.	REAL
	Interlock H TOFF (s)	Refer to alarm delay instruction.	REAL
	Interlock L Limit Alarm	Disable/ Enable (optional)	BOOL
	Interlock L Limit Alarm Priority	Select the alarm level from drop-down menu.	USINT
	Interlock L Limit	Input values manually	REAL
	Interlock L TON (s)	Refer to alarm delay instruction.	REAL
	Interlock L TOFF (s)	Refer to alarm delay instruction.	REAL
	Interlock LL Limit Alarm	Disable/ Enable (optional)	BOOL
	Interlock LL Limit Alarm Priority	Select the alarm level from drop-down menu.	USINT
	Interlock LL Limit	Input values manually	REAL
	Interlock LL TON (s)	Refer to alarm delay instruction.	REAL
	Interlock LL TOFF (s)	Refer to alarm delay instruction.	REAL
	Fault Alarm Priority	Select the alarm level from drop-down menu.	USINT

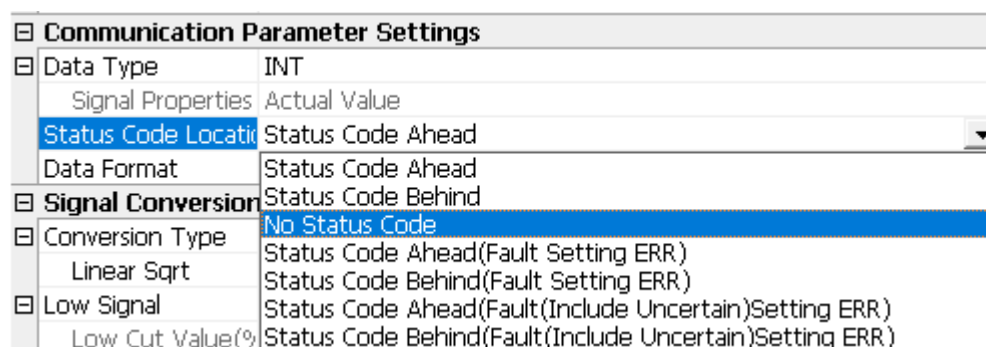


**Table 3.2 AI Tag Property Table (continued)**

Category	Setting Item	Parameter Description and Value Range	Type
Communication Fault Alarm	Communication Fault Alarm TON (s)	After 485 communication fault occur among communication tags, the alarm will be generated until this value expires.	REAL
Interlock Output Setting	Interlock HH Output Enable	Disable/Enable	BOOL
	Interlock H Output Enable	Disable/Enable	BOOL
	Interlock L Limit Output Enable	Disable/Enable	BOOL
	Interlock LL Output Enable	Disable/Enable	BOOL
	Interlock Output Negate Options	Negate or not	BOOL
Tag Fault Processing	Fault Safety Switch	Disable/Enable	BOOL
	Fault Safety Processing	Hold/Set Span Maximum/Set Span Minimum(optional)/Set Substitute Value/Set proximity extended range limit	USINT
Cold Start SWAM Mode Configuration		Hold/Force/Unforce	USINT
Supervision Settings	Tag Group	Tag Group 0~31 (optional)	USINT
	Tag Level	Tag Level 0~9 (optional)	USINT
	Default Decimal Digits	(0~5) optional	USINT
	Panel	AI tag can set the panel as custom panel or system original panel.	-
	The recent history section	Not display\2 minutes\10 minutes\30 minutes\1 hour\2 hours\4 hours\8 hours\12 hours\24 hours	USINT

**Note 1**

The configuration of the "Status Code Position" for communication tags is shown in the figure below.



**Figure 3.7 Status code position**

- "Status Code Ahead (Fault Setting ERR)" or "Status Code Behind (Fault Setting ERR)":
  - If the two highest bits of the status code value (COMMCODE) are 00, it will set an ERR alarm (AI.ERR=ON).
  - If the two highest bits of the status code value (COMMCODE) are 01, 10, or 11, no ERR alarm will be generated.
- "Status Code Ahead (Fault (Include Uncertain) Setting ERR)" or "Status Code Behind (Fault (Include Uncertain) Setting ERR)":
  - If the two highest bits of the status code value (COMMCODE) are 00 or 01, it will set an ERR alarm.
  - If the two highest bits of the status code value (COMMCODE) are 10 or 11, no alarm will be generated.
- "Status Code Ahead", "Status Code Behind", or "No Status Code", only changes in the two highest bits of the status code value (COMMCODE) will not cause an ERR alarm.

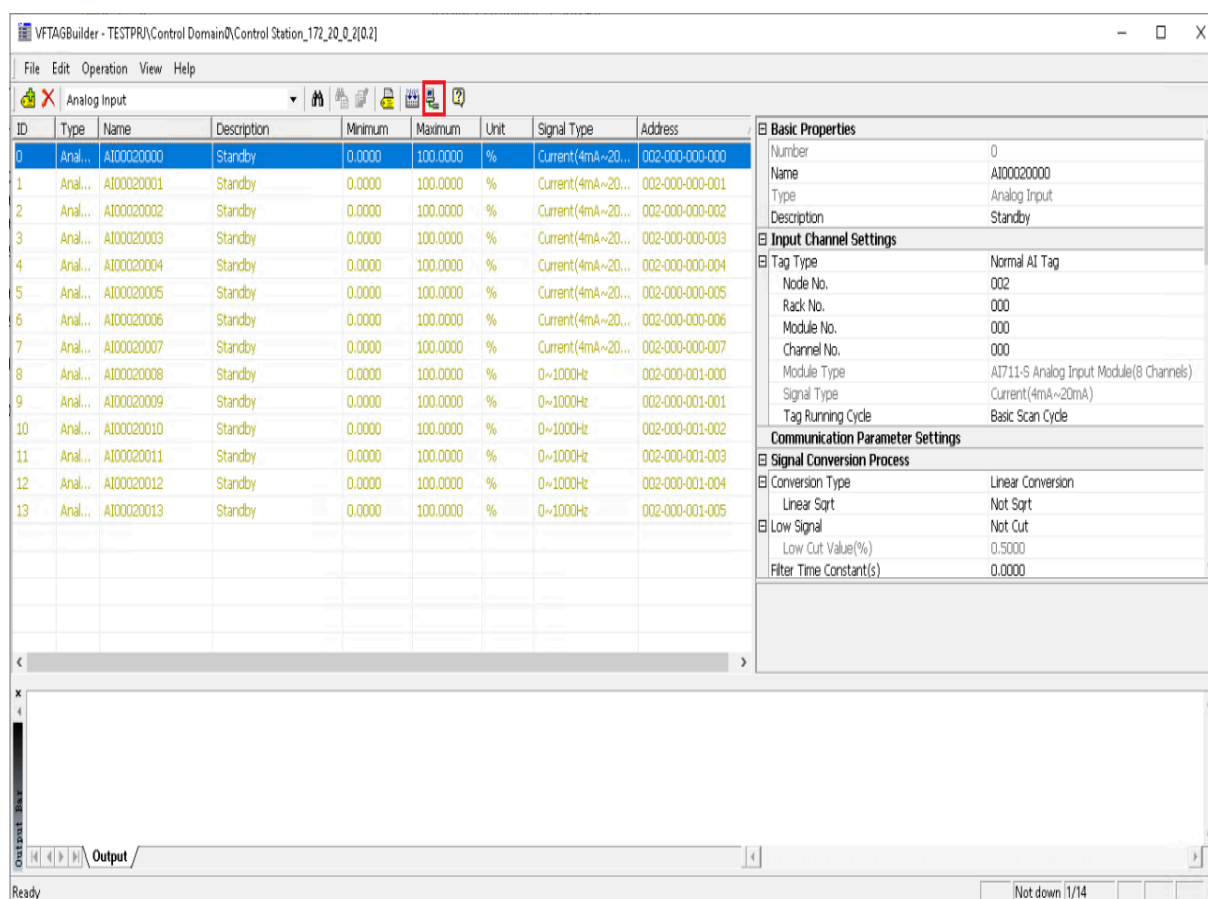


**TIP:**

ERR alarms generated based on the values of the status code will not update the ERR status according to the fault alarm generation/clear delay of the communication tags.

### 3.1.3 Tag Debugging Parameters

In VFTAGBuilder, click the debug button to enter the online debugging mode of tags as shown in the figure below.



**Figure 3.8 An example of tag debugging**

Parameters of AI tags and their meanings are listed in the table below.

**Table 3.3 Debugging parameter list of tag configuration software**

Parameter Name		Type	Description
Input Signal Parameters	FLAG	UDINT	Flag Code
	PV	REAL	Process Variable Value
	SWSIM	BOOL	Simulation Input Switch ON=Simulation, OFF=Non-Simulation
	SIMIN	REAL	Simulation Input Value
	SWAM	BOOL	Force Switch OFF=Force, ON=Unforce
	SWOOS	BOOL	Switch of out of service ON=Disable, OFF=Enable
Configuration Parameters	SCH	REAL	Span maximum
	SCL	REAL	Span minimum

**Table 3.3 Debugging parameter list of tag configuration software (continued)**

Parameter Name		Type	Description
	RSCH	REAL	Input Original code maximum, communication tags take effect.
	RSCL	REAL	Input Original code minimum, communication tags take effect.
	MODE	USINT	Signal conversion type
	SWFORM	USINT	Communication Data Format Conversion Option: 0=No Conversion 1=Byte Conversion 2=Word Conversion 3=Word Internal Conversion
	IVO	BOOL	Invert the interlock output
Adjustion Parameters	SWLCUT	BOOL	Low cut selection ON=Enable, OFF=No Cut
	LCUT	REAL	Low cut Value (% FS)
	TFLT	REAL	Filter Time Constant (s)
Desirable Operation Area Parameters	OPR_EN	BOOL	Desirable operating area enable
	OPR_H	REAL	Desirable operating area upper limit
	OPR_L	REAL	Desirable operating area lower limit
	OPR_EI	REAL	Desirable operating area deviation value (%FS)
Alarm Parameters	HHH	REAL	HHH Limiting of Alarm
	HHH_TON	REAL	HHH Limit Alarm Delay
	HHH_TOFF	REAL	HHH Limit Alarm Elimination Delay
	HH	REAL	HH Limiting of Alarm
	HH_TON	REAL	HH Limit Alarm Delay
	HH_TOFF	REAL	HH Limit Alarm Elimination Delay
	H	REAL	H Limiting of Alarm
	H_TON	REAL	H Limit Alarm Delay
	H_TOFF	REAL	H Limit Alarm Elimination Delay
	L	REAL	L Limiting of Alarm

**Table 3.3 Debugging parameter list of tag configuration software (continued)**

Parameter Name	Type	Description
L_TON	REAL	L Limit Alarm Delay
L_TOFF	REAL	L Limit Alarm Elimination Delay
LL	REAL	LL Limiting of Alarm
LL_TON	REAL	LL Limit Alarm Delay
LL_TOFF	REAL	LL Limit Alarm Elimination Delay
LLL	REAL	LLL Limit of Alarm
LLL_TON	REAL	LLL Limit Alarm Delay
LLL_TOFF	REAL	LLL Limit Alarm Elimination Delay
HYS	REAL	H/L limit alarm hysteresis value
TPV	REAL	Positive/negative rate alarm test cycle
PR_LIM	REAL	Positive/negative rate alarm limit
PR_TON	REAL	Positive rate alarm delay
PR_TOFF	REAL	Positive rate alarm elimination delay
NR_LIM	REAL	Negative rate alarm limit
DPVL_TON	REAL	Negative rate alarm delay
DPVL_TOFF	REAL	Negative rate alarm elimination delay
DPV	REAL	Change Rate alarm value
LHH_LIM	REAL	Interlock HH Enable
IHH_TON	REAL	Interlock HH Limit Alarm Delay
IHH_TOFF	REAL	Interlock HH Limit Alarm Elimination Delay
IH_LIM	REAL	Interlock H Enable
IH_TON	REAL	Interlock H Limit Alarm Delay
IH_TOFF	REAL	Interlock H Limit Alarm Elimination Delay
IL_LIM	REAL	Interlock L Enable
IH_TON	REAL	Interlock L Limit Alarm Delay

**Table 3.3 Debugging parameter list of tag configuration software (continued)**

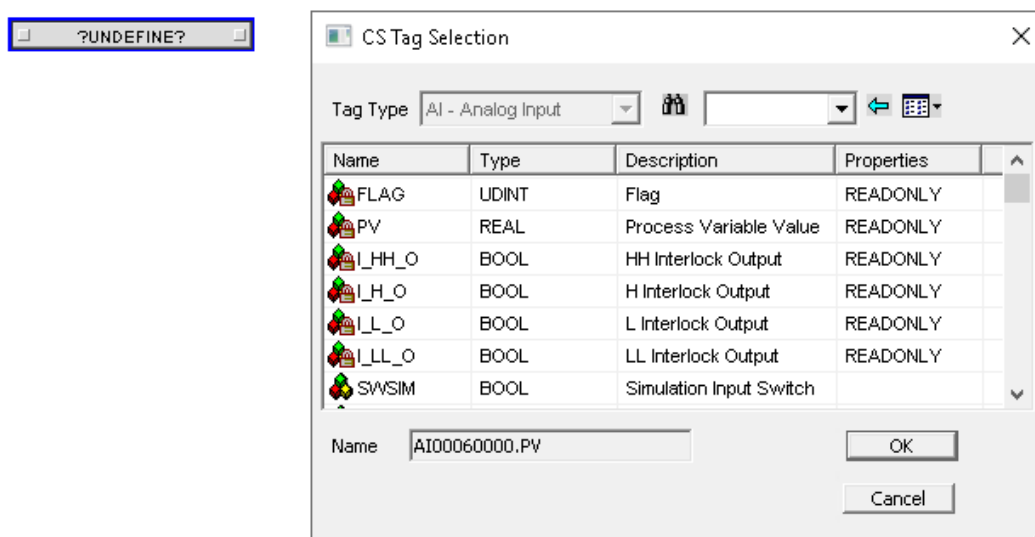
Parameter Name		Type	Description
	IH_TOFF	REAL	Interlock L Limit Alarm Elimination Delay
	IL_LIM	REAL	Interlock LL Enable
	IL_TON	REAL	Interlock LL Limit Alarm Delay
	IL_TOFF	REAL	Interlock LL Limit Alarm Elimination Delay
	ILL_LIM	REAL	Interlock LL Limit
	ILL_TON	REAL	Interlock LL Limit Alarm Generation Delay
	ILL_TOFF	REAL	Interlock LL Limit Alarm Elimination Delay
	COMM_TON	REAL	Communication fault alarm delay
	HORLIM	REAL	High overrange limit
	LORLIM	REAL	Low overrange limit
	HOR_TON	REAL	Overrange maximum alarm delay
	HOR_TOFF	REAL	Overrange maximum alarm elimination delay
	LOR_TON	REAL	Overrange minimum alarm delay
	LOR_TOFF	REAL	Overrange minimum alarm elimination delay
	ENALM	UDINT	Subentry Alarm Enable
	AOF	BOOL	Shield Alarm ON=doesn't display the real-time alarm; OFF=displays the real-time alarm
Interlock Output Parameters	IHH_EN	BOOL	Interlock HH limit
	IH_EN	BOOL	Interlock H limit
	IL_EN	BOOL	Interlock L limit
	ILL_EN	BOOL	Interlock LL limit
Other Parameters	CHAN_-EXIST	USINT	Channel Exists Tag 0 =No Exist, 255 =Exist
	CHK_CODE	UINT	Channel Check Code
	REALFAST	BOOL	Fast cycle schedule
	COMMCODE	USINT	Status Code for 4 Byte Communication Tag

**Table 3.3 Debugging parameter list of tag configuration software (continued)**

Parameter Name		Type	Description
	ERR	BOOL	Tag Status Flag (ON =Bad)
	ERR_R	BOOL	Hardware Status Flag (ON=Bad)
	ENERRVAL	BOOL	Fault safety switch
	ERRVAL	USINT	Tag value is set When Tag Fault occurs: 0=Keep, 1=Set Range High Limit, 2=Set Range Low Limit, 3=Set Substitute Value, 4=Set Proximity Extended Range Limit
	SAFEVAL	REAL	Substitute value Fault preset value
	RAWVAL	REAL	Normal tags: module sending flag code; Communication tags: floating point flag code
	PRIMEPV	REAL	Original engineering value Communication tag: it is invalid in the no conversion mode
	COMMASK	UDINT	Communication tag: Unsigned int code value (small endian mode)
	COLD_OPT	USINT	Cold start manual/auto mode: Hold/Force/Unforce
	T_PEAK	UINT	Recent history section (0=Not Show, 1=2min, 2=10min, 3=30min, 4=1h, 5=2h, 6=4h, 7=8h, 8=12h, 9=24h)

### 3.1.4 Refereceable Parameters for Custom Programs

In the custom application configuration, by specifying the tags and selecting the corresponding auxiliary parameters, the relevant variables or states can be directly referenced in the custom application, as shown in the figure below.



**Figure 3.9** An example of calling AI tags in custom programs

Parameters AI tags able to call in custom programs and their property are listed in the table below.

**Table 3.4** Parameters Custom Programs able to call (AI)

Parameter Name		Type	Initial Value	Description
Output Pins	PV	REAL	0	Process Variable Value
	ERR	BOOL	OFF	Analog Input Status Flag:ON=Bad When fault occurs, ERR =ON. When it is in the forced status, ERR=OFF.
	COMMASK	UDINT	0	Communication Tag Original Code Value
	ERR_R	BOOL	OFF	Hardware Status Flag:ON=Bad
	I_HH_O	BOOL	ON	HH Interlock Output
	I_H_O	BOOL	ON	H Interlock Output
	I_LL_O	BOOL	ON	LL Interlock Output
	I_L_O	BOOL	ON	L Interlock Output
Monitoring parameters	OPR_EI	REAL	0	Desirable Operating Range Deviation Value
	SWAM	BOOL	ON	Force Switch:OFF=Force,ON=Unforce
	SWLCUT	BOOL	OFF	Low Cut Switch:ON=cut
	SWOOS	BOOL	OFF	Switch of Out of Service:ON=Disable,OFF=Enable
	SWSIM	BOOL	OFF	Simulation Input Switch:ON=Simulation Input,OFF=Module Input



**Table 3.4 Parameters Custom Programs able to call (AI) (continued)**

Parameter Name		Type	Initial Value	Description
	AOF	BOOL	OFF	Shield Alarm
	PRIMEPV	REAL	0	Deliver Original Value (Actual Value)
	FLAG	UDINT	0	Flag
	COMMCODE	USINT	0	Comm Tag Status Flag
Operation Parameters	HHH	REAL	100	Alarm HHH Limit
	HHH_TON	REAL	0	Alarm HHH TON(s)
	HHH_TOFF	REAL	0	Alarm HHH TOFF(s)
	HH	REAL	95	Alarm HH Limit
	HH_TON	REAL	0	Alarm HH TON(s)
	HH_TOFF	REAL	0	Alarm HH TOFF(s)
	H	REAL	90	Alarm H Limit
	H_TON	REAL	0	Alarm H TON(s)
	H_TOFF	REAL	0	Alarm H TOFF(s)
	L	REAL	10	Alarm L Limit
	L_TON	REAL	0	Alarm L TON(s)
	L_TOFF	REAL	0	Alarm L TOFF(s)
	LL	REAL	5	Alarm LL Limit
	LL_TON	REAL	0	Alarm LL TON(s)
	LL_TOFF	REAL	0	Alarm LL TOFF(s)
	LLL	REAL	0	Alarm LLL Limit
	LLL_TON	REAL	0	Alarm LLL TON(s)
	LLL_TOFF	REAL	0	Alarm LLL TOFF(s)
	TPV	REAL	60	Rate Alarm Detection Cycle(s)
	PR_LIM	REAL	5	Positive Rate Limit
	PR_TON	REAL	0	Alarm DPVH TON(s)

**Table 3.4 Parameters Custom Programs able to call (AI) (continued)**

Parameter Name	Type	Initial Value	Description
PR_TOFF	REAL	0	Alarm DPVH TOFF(s)
NR_LIM	REAL	5	Negative Rate Limit
NR_TON	REAL	0	Alarm DPVL TON(s)
NR_TOFF	REAL	0	Alarm DPVL TOFF(s)
IHH_EN	BOOL	OFF	Interlock HH Output Enable
IHH_LIM	REAL	90	Interlock HH Limit
IHH_TON	REAL	0	Interlock HH TON(s)
IHH_TOFF	REAL	0	Interlock HH TOFF(s)
IH_EN	BOOL	OFF	Interlock H Output Enable
IH_LIM	REAL	85	Interlock H Limit
IH_TON	REAL	0	Interlock H TON(s)
IH_TOFF	REAL	0	Interlock H TOFF(s)
IL_EN	BOOL	OFF	Interlock L Output Enable
IL_LIM	REAL	10	Interlock L Limit
IL_TON	REAL	0	Interlock L TON(s)
IL_TOFF	REAL	0	Interlock L TOFF(s)
ILL_EN	BOOL	OFF	Interlock LL Output Enable
ILL_LIM	REAL	5	Interlock LL Limit
ILL_TON	REAL	0	Interlock LL TON(s)
ILL_TOFF	REAL	0	Interlock LL TOFF(s)
OPR_EN	BOOL	OFF	Desirable Operating Range Enable
OPR_H	REAL	60	Desirable Operating Range High Limit
OPR_L	REAL	40	Desirable Operating Range Low Limit
HYS	REAL	2	H/L Limit Alarm Hysteresis
TFLT	REAL	5	Filter Time Coefficient(s)

**Table 3.4 Parameters Custom Programs able to call (AI) (continued)**

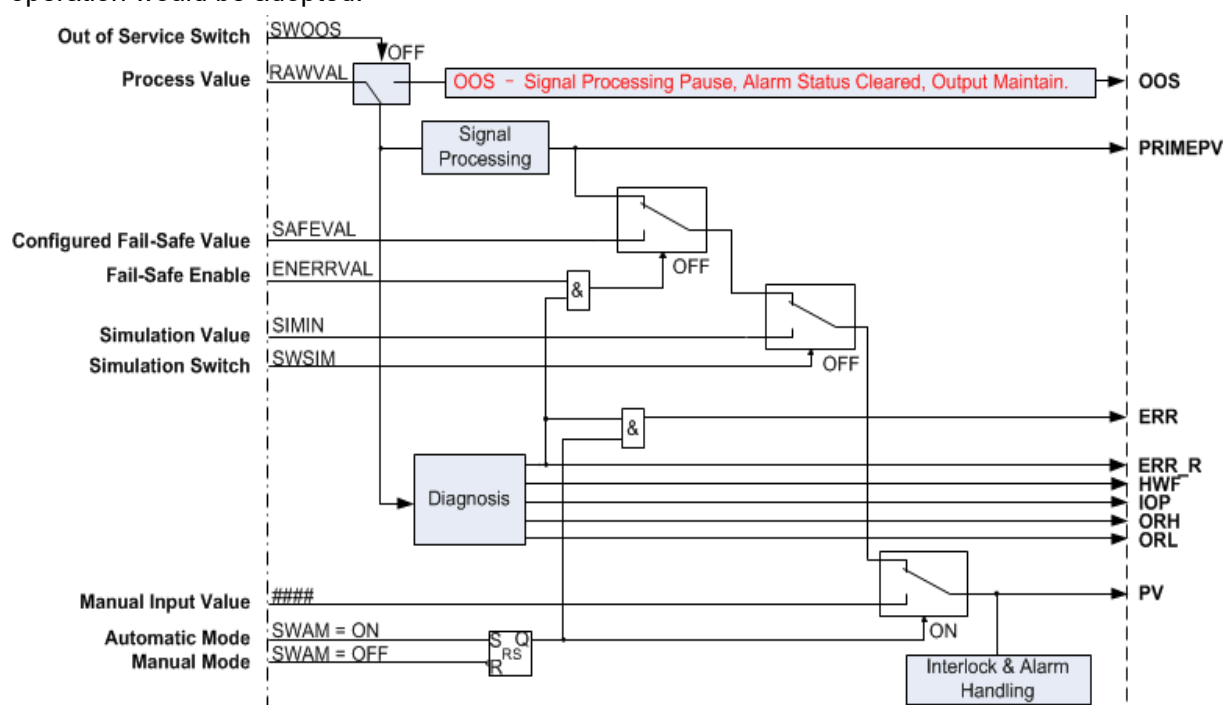
Parameter Name		Type	Initial Value	Description
	DPV	REAL	0	Change Rate Alarm Setting Value
	SIMIN	REAL	0	Simulation Input Value
	LCUT	REAL	0.5	Low Cut Value (%)
	ENERRVAL	BOOL	ON	Fault Safety Switch:ON=Enable,OFF=Disable
	SAFEVAL	REAL	0	Substitute Value
	T_PEAK	UINT	0	Recent History (0=Not Show, 1=2min, 2=10min, 3=30min, 4=1h, 5=2h, 6=4h, 7=8h, 8=12h, 9=24h)
	COMM_TON	REAL	0	Communication Fail Alarm TON(s)
Alarm Pa- rameters	ENALM	UDINT	0	Alarm Enable
Configu- ration Pa- rameters	SCH	REAL	100	Actual Value Maximum
	SCL	REAL	0	Actual Value Minimum
	EU	EU- TYPE	0	Engineer Unit
	NODE_SN	USINT	0	Node No.
	BUS_SN	USINT	0	Rack No.
	MODULE_SN	USINT	0	Module No.
	CHAN_SN	USINT	0	Channel No.
	TAG_TYPE	USINT	0	Tag Type
	DB_OFFSET	UINT	0	Data Block No.
	TAG_OFFSET	UINT	0	The Offset Address of the Tag in the Data Block
	DLEN	USINT	3	Decimal Digits Length[0,5]
	RSCH	REAL	100	Input Original Code Maximum When Communicat- ing Tag
	RSCL	REAL	0	Input Original Code Minimum When Communicat- ing Tag
	HORLIM	REAL	25	High Overrange Limit
	LORLIM	REAL	25	Low Overrange Limit

**Table 3.4 Parameters Custom Programs able to call (AI) (continued)**

Parameter Name	Type	Initial Value	Description
HOR_TON	REAL	0	High Overrange Limit Alarm TON(s)
HOR_TOFF	REAL	0	High Overrange Limit Alarm TOFF(s)
LOR_TON	REAL	0	Low Overrange Limit Alarm TON(s)
LOR_TOFF	REAL	0	Low Overrange Limit Alarm TOFF(s)
IVO	BOOL	ON	Interlock Negate Options:ON=Negate, OFF=Not to negate
COLD_OPT	USINT	0	Cold Start SWAM Mode Options: 0=Hold,1=Force,2=Unforce

### 3.1.5 Normal Tag Function

When the configuration item “input channel setting/tag type” is “normal AI tag”, the normal tag operation would be adopted.

**Figure 3.10 Functional graph of AI normal tags**

#### AI measuring value and status

IO tags processing supports a measuring range from -25% to 125%. If it is over 125%, the system will take it as 125% by default. If it is under -25%, the system will take it as -25%.

The settable range of the over-range limit varies according to the measurement range of the hardware module. For the specific settable range, please refer to the IO module manual.

The status of AI module include module failure and channel failure. Fault in level of channel is displayed as IOP while fault in level of module is HWF.

Temperature signal (thermal resistance, thermocouple)

AI module such as RTD or thermocouple calculates the actual temperature as per the measuring principle. However when configuring hardware, signals should also be assigned a specific measuring range. For example, the range of E thermocouple is from -200°C to 900°C, which means, as per the project application requirement, the maximum measuring range should set as 500°C during the hardware configuration process while the minimum measuring range should be set as 200°C. In VFTAGBuilder, the actual measuring range of E thermocouple must be set as from 200°C to 500°C accordingly.

### Measuring Range Conversion

Normal tags allow linear conversion and linear square conversion:

Linear conversion  $PV = (\text{actual measured signal} - \text{the lower limit of the signal}) / (\text{the upper limit of the signal} - \text{the lower limit of the signal}) \times (\text{the upper limit of the range} - \text{the lower limit of the range}) + \text{the lower limit of the range}$

Sqrt The input can be converted to actual value output by sqrt conversion. Calculation formula:

$$PRIMEPV = \sqrt{\frac{\text{Measured Signal} - A \text{ Min}}{A \text{ Max} - A \text{ Min}}} * (B \text{ Max} - B \text{ Min}) + B \text{ Min}$$

, in which A represents Signal Span while B represents Measuring Range.

### Signal Processing

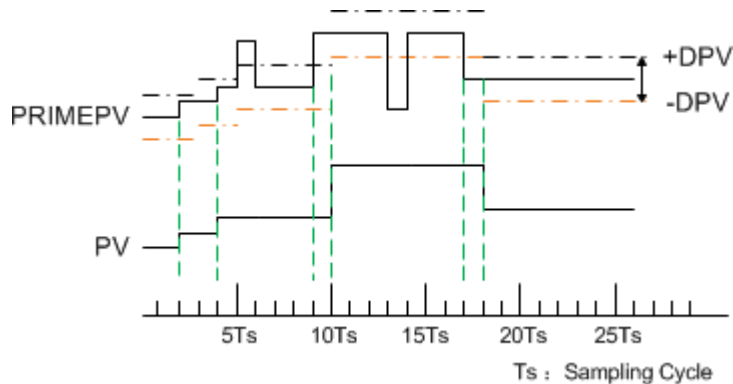
AI tags support signal processing functions including small signal cutting, single period change rate alarm and filter.

**Small signal cutting** If the small signal cutting switch SWLCUT is ON, the small signal is cut. The small signal cutting value is set as percent. When percent of input signal is less than positive small signal cutting value, the small signal is cut and AI value is 0% of the span, equal to low limit of the span.

**Single period change rate alarm** Judge single cycle change rate overrun for inputted AI signal.

- When  $|PRIMEPV(n) - PRIMEPV(n-1)| \leq DPV$ : tag value is PV (n) when change rate of adjacent input values is not over the set rate limit DPV.
- When  $|PRIMEPV(n) - PRIMEPV(n-1)| > DPV$ : PV (n) is equal to PV(n-1) when change rate of adjacent input values is not over the set rate limit DPV.

DPV is the most change value in single period when it is configured. PRIMEPV(n) and PRIMEPV(n-1) are data sent by AI module in two adjacent periods. PV(n) and PV(n-1) are tag value in two adjacent periods. If input signal change values in two adjacent periods are over the most change value in running process, the output value in the last period is maintained and the single period change rate alarm is set. When the alarm is generated, if PV difference of the two new adjacent periods are less than or equal to DPV, the jump reaches new balance position and alarm is eliminated.



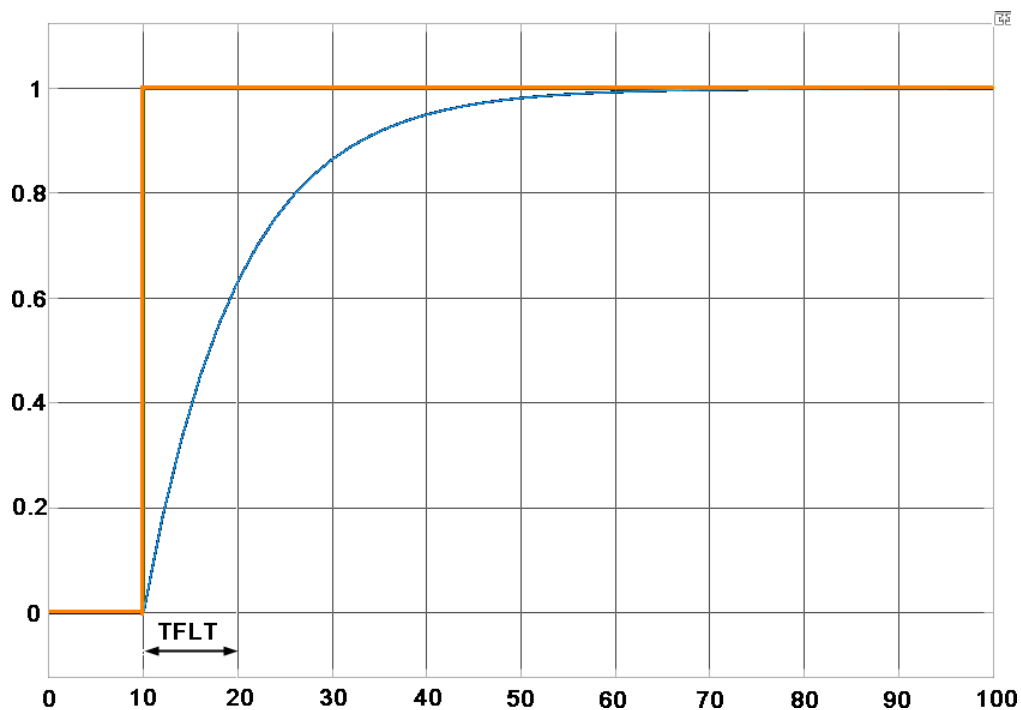
### Filter function

Apply the first order hysteresis filter to the input AI signals, which can resist high-frequency and low –frequency disturbance, remove the great random disturbance or a large margin jump disturbance resulting from distortion due to the bad reliability of the transmitter in field. Its expression is as follows:  $FV(n) = \alpha \times FV(n-1) + (1 - \alpha) \times PV(n)$

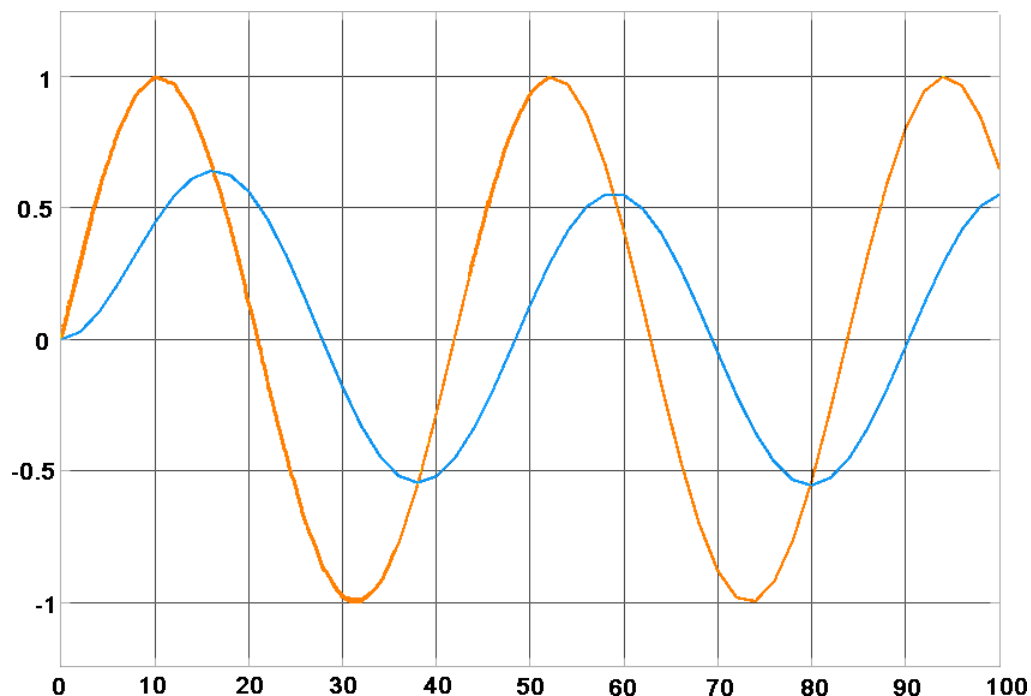
$$\alpha = \frac{T_c}{T_c + T_s}$$

FV (n) is value of first-order filter,  $\alpha$  is filter smoothing coefficient,  $T_c$  is filter time constant,  $T_s$  is sampling time.

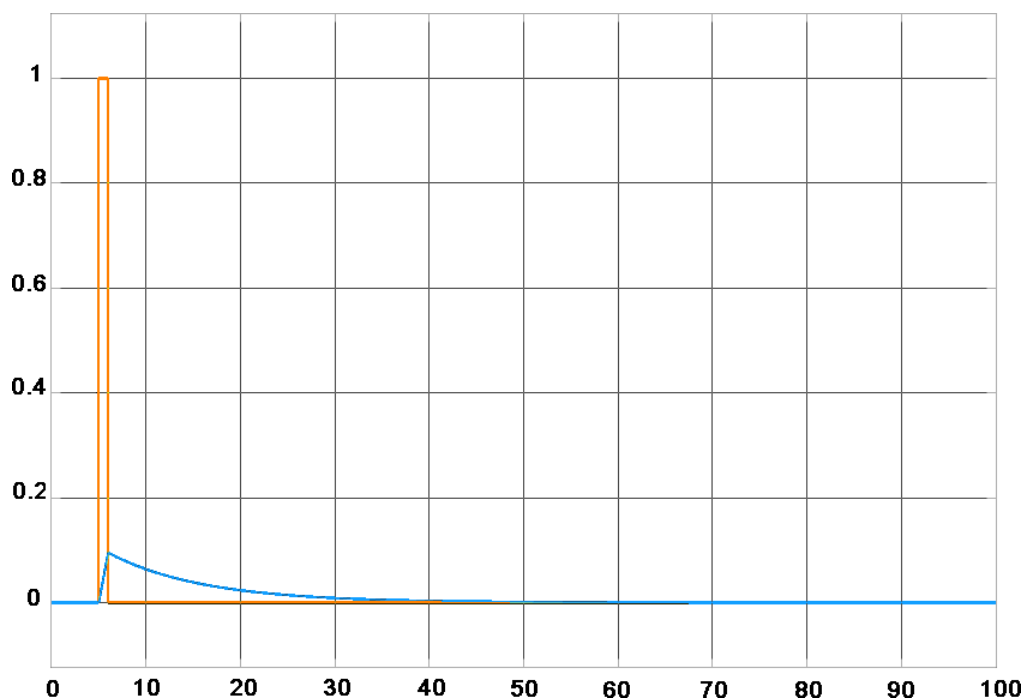
The figure below shows the effect of the step signal before and after the filtering process. The orange line is the initial signal (not filtered) while the blue line is the filtered signal.



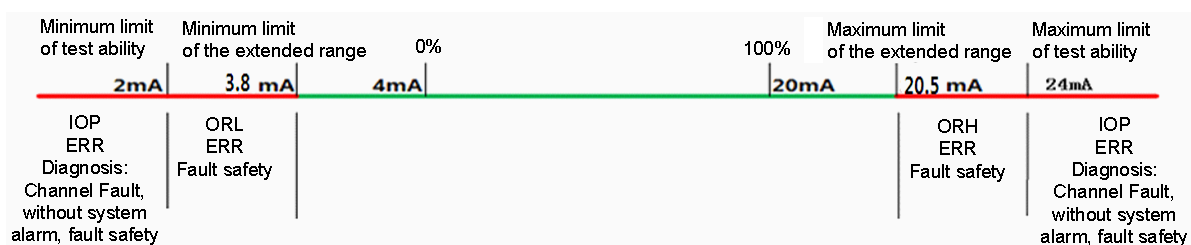
The figure below shows the effect of the sine signal before and after the filtering process. The orange line is the initial signal (not filtered) while the blue line is the filtered signal. From the figure below, the peak value becomes lower as TFLT goes up.



The figure below shows under the disturbance of the spike, the effect of the signal before and after the filtering process. The orange line is the initial signal (not filtered) while the blue line is the filtered one.



### Fault and overrange processing



**Figure 3.11 AI tag fault and overrange processing**

Input signals, panel output and fault output information of module in different status are shown in the table below.

Module State	Input Signal	Panel Alarm	Panel State	Fault Output	Remarks
Module Fault <sup>Note1</sup>	-	ERR	HWF	ERR=ON ERR_R=ON	Note1:The module is pulled out, hardware fault and controller communication fault
Module Normal Channel Fault <sup>Note2</sup>	-	ERR	IOP	ERR=ON ERR_R=ON	Note2: channel is open circuit or short circuit.
Module Normal Channel Normal	Over range maximum- Note3	ERR	ORH	ERR=ON ERR_R=ON	Note3:it can be enabled and TON and TOFF will occur. For details, see "Alarm Process" section.



Module State	Input Signal	Panel Alarm	Panel State	Fault Output	Remarks
	Over range minimum	ERR	ORL	ERR=ON ERR_R=ON	-
	Within the range	NR	/	ERR=OFF ERR_R=OFF	-

When the controller is in debug mode, clear the alarm and status information in the AI bit number, that is, ERR = OFF, ERR\_R = OFF.

About the activation and deactivation of the debugging mode of the controller, please refer to the "Controller" chapter of the *Hardware Configuration Software User Manual* for detailed instructions.

### Fail-safe processing

When the AI input signal is in a fault state (module fault, channel fault, or communication fault) and fail-safe processing is enabled, the AI tag output is set according to the fail-safe configuration according to the configuration, and the values can be: hold, set range upper limit, set range lower limit, set the fault preset value and set the adjacent extended range limit (see table below).

Fail-safe Switch	Fault Value Setting	PV
Enable	Hold	Hold
	Set Maximum limit of range	Maximum limit of range
	Set Minimum limit of range	Minimum limit of range
	Et Fault Preset Value	Fault Preset Value
	Set proximity extended range limit	Maximum or minimum limit of extended range
Disable	-	Sampling values

### Simulation Input

When the simulation input switch SWSIM = ON, the AI tag output takes the value of the simulation input variable SIMIN (allowing the program to assign values).

### Force processing

In force status, actual value PV of AI tag is set by users. In force status, high and low limit alarm, small signal cutting and over span process are the same as themselves in unforce status.

In force status, if ERR alarm will be cleared, fault output ERR=OFF, but the output ERR\_R is consistent with the current module status.

## Alarm processing

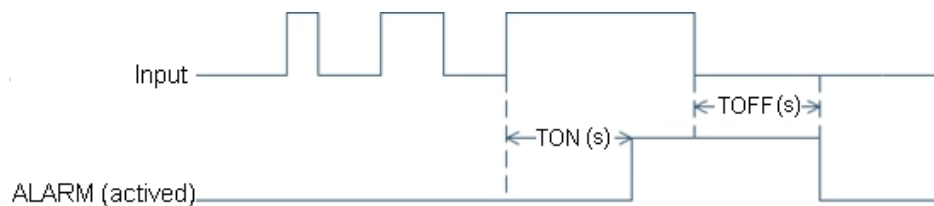
Table 3.5 shows the alarm items and parameters of AI tags.

**Table 3.5 AI tag alarm item and parameter instruction**

Alarm Item	Hysteresis	Alarm Delay Generation	Alarm Delay Elimination	Remarks
HHH	HYS	HHH_TON	HHH_TOFF	HHH alarm
HH		HH_TON	HH_TOFF	HH alarm
H		H_TON	H_TOFF	H alarm
L		L_TON	L_TOFF	L alarm
LL		LL_TON	LL_TOFF	LL alarm
LLL		LLL_TON	LL_TOFF	LLL alarm
DPV	/	/	/	Single cycle rate alarm
PR_LIM		PR_TON	PR_TOFF	Positive rate alarm
NR_LIM		NR_TON	NR_TOFF	Negative rate alarm
IHH_LIM		IHH_TON	IHH_TOFF	Interlock HH alarm
IH_LIM		IH_TON	IH_TOFF	Interlock H alarm
IL_LIM		IL_TON	IL_TOFF	Interlock L alarm
ILL_LIM		ILL_TON	ILL_TOFF	Interlock LL alarm

- Alarm delay

AI tags all support alarm delay function and the process is shown below:



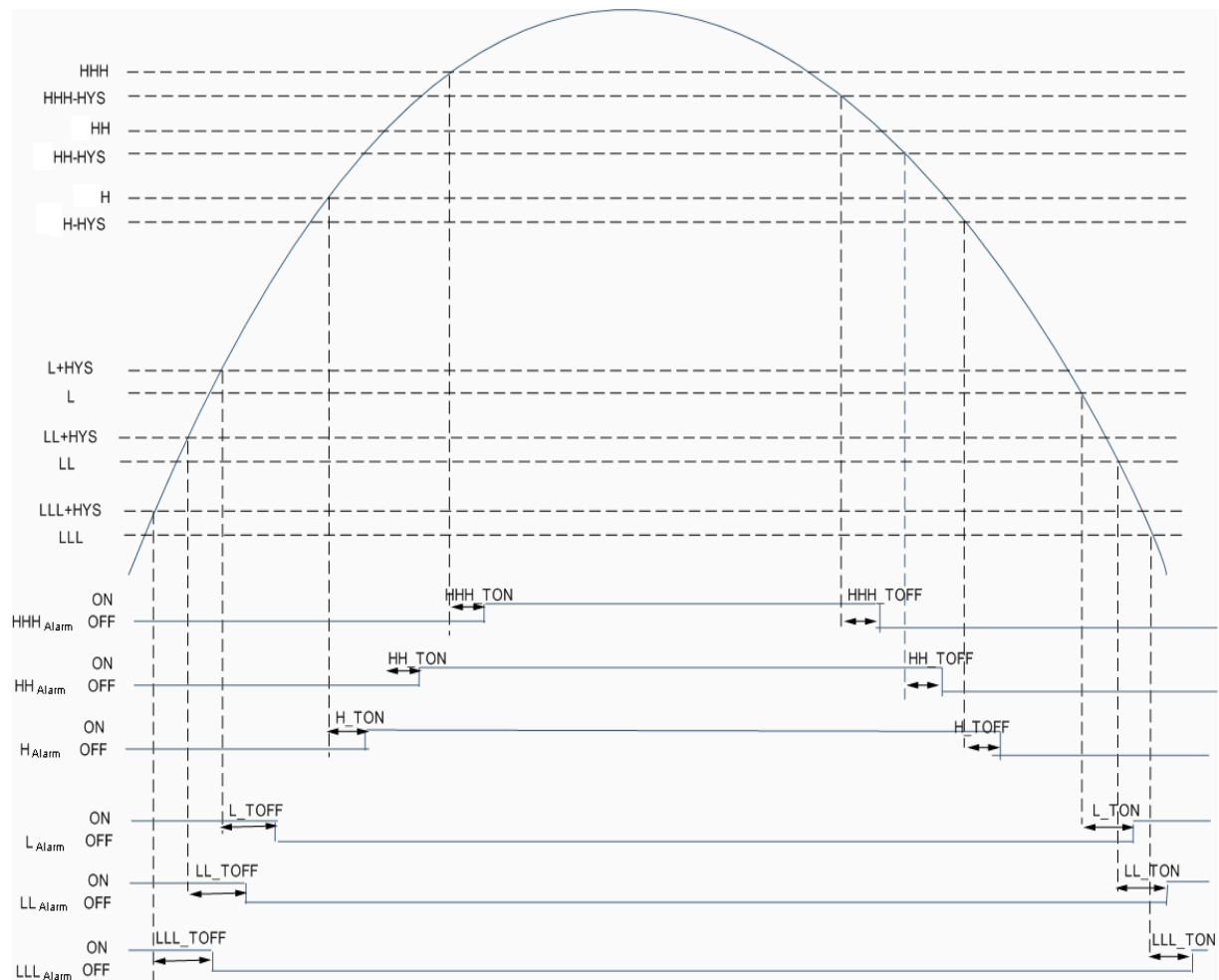
**Table 3.6 AI tag alarm and alarm clear delay**

Tag Type	ERR Alarm Delay/Alarm Clear Delay	Overrange Alarm Delay/Alarm Clear Delay
General AI tags	For ERR alarm induced by channel fault (offline, short circuit), alarm status display is delayed. When alarm is cleared and the delay time is met, the status is not displayed. During ERR alarm, PV is processed according to the fail-safe value, while RAW is updated though.	Alarm status display is delayed when the tag has overrange alarm. When the alarm is cleared and the delay time is met, the status is not displayed.
Communication AI tags	Delay alarm is induced by communication fault (including 485 line fault, communication timeout, and data package parity error). When the alarm is cleared and the delay time is met, the status is not displayed.	

When the slave IO devices has the following fault, alarm is immediately generated. Fault includes: module lost (reinsert COM741), inconsistent alarm type, and module major fault.

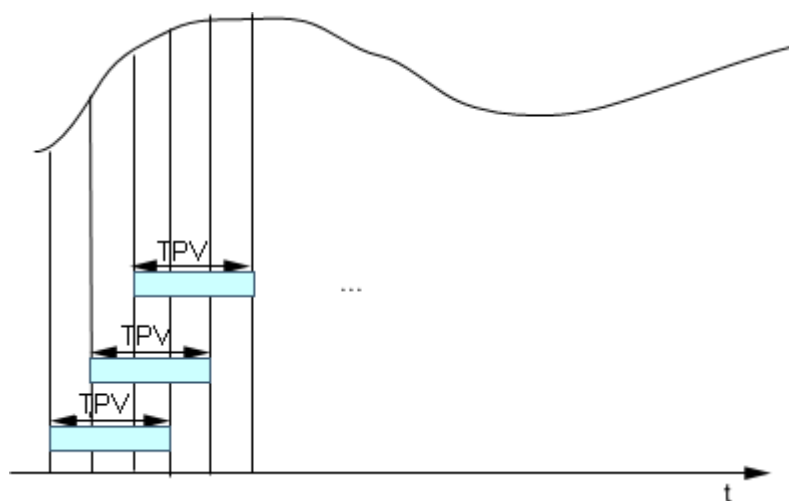
- High/Low alarm

AI tags apply alarm processing on PV, including HHH, HH, H, L, LL and LLL alarm. They also have hysteresis and alarm delay functions. For details, refer to the figure below.



In the figure above, HYS is H/L limit alarm hysteresis value, and  $HYS > 0$ . HYS should be meet  $HHH-HH > HYS$ ,  $HH-H > HYS$ ,  $L-LL > HYS$  and  $LL-LLL > HYS$  when it is applied.

- Single cycle rate alarm: refer to “signal process” section.
- Rate alarm



AI tags will figure out whether or not the change of PV is beyond the limit during the

- If PV's increase is more than PR\_LIM during TPV, PR\_LIM alarm will occur.
- If PV's decrease is more than NR\_LIM during TPV, NR\_LIM alarm will occur.
- Interlock Alarm: AI tags execute HH, H, L, LL interlock alarm and output process on PV. Its triggering condition is as the same as the H and L alarm. For alarm enable and output processing, refer to "Interlock Processing" section.
- Alarm shield  
If the function of tag alarm shield is set, corresponding alarm will only be recorded but not displayed in real time.
- Alarm enable  
Each alarm shown in Table 3.5 can be enabled or disabled individually. The general tag fault alarm ERR always works.

### Interlock Processing

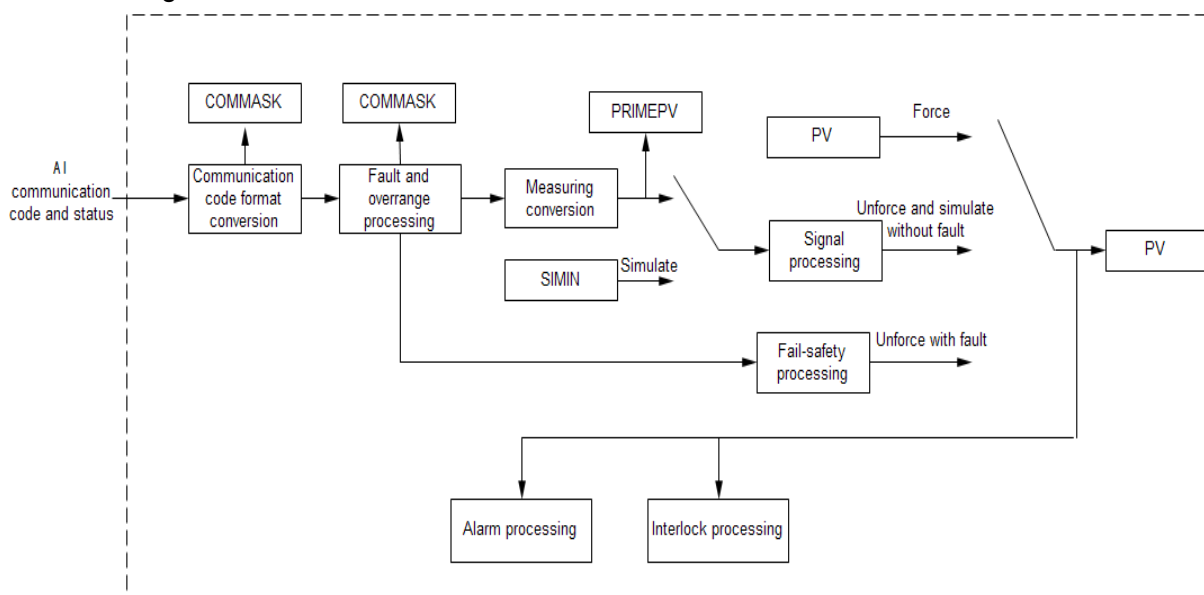
AI tags support interlock output enabling and interlock alarm.enabling. The interlock output enabling is prior to the interlock alarm enabling. The relationship is shown in the table below.

Interlock Item	Interlock Output Enable	Interlock Alarm Enable	Interlock Output	Interlock Alarm
IHH_LIM	Disable	/	Invalid	Invalid
IH_LIM	Disable	/	Invalid	Invalid
IL_LIM	Disable	/	Invalid	Invalid
ILL_LIM	Disable	/	Invalid	Invalid
IHH_LIM	Enable	Disable	Valid	Invalid
IH_LIM	Enable	Disable	Valid	Invalid
IL_LIM	Enable	Disable	Valid	Invalid
ILL_LIM	Enable	Disable	Valid	Invalid
IHH_LIM	Enable	Enable	Valid	Valid
IH_LIM	Enable	Enable	Valid	Valid
IL_LIM	Enable	Enable	Valid	Valid
ILL_LIM	Enable	Enable	Valid	Valid

Interlock output has negation settings. When it is checked, ON is triggered; when it is unchecked, OFF is triggered.

### 3.1.6 Communication Tag Function

When the configuration item “Input channel setting/tag type” is “Communication AI tag”, please refer to the figure below.



**Figure 3.12 Functional graph of AI communication tags**

Compared with the normal tags, a communication format conversion is added into the processing. As to the processing methods of AI communication tags, except for the measuring range conversion, other processing methods are as the same as the normal AI tags.

#### Format Conversion of Communication Code

The data format of the system is the low byte at front, followed with the high byte. If the data format of the communication tags is different from that, an appropriate format should be considered to convert to.

If the communication data format is a 2-byte integer (with or without symbols), “not to convert” or “byte conversion” is optional.

If the communication data format is a 4-byte integer (with or without symbols) or a 4-byte floating number, “no conversion”, “byte conversion”, “conversion”, “word conversion” or “word internal conversion” is optional.

For example:

**Table 3.7 Format conversion of communication code**

First Byte	Second Byte	Third Byte	Fourth Byte	Conversion Method
Lowest	Second lowest	Second highest	Highest	No conversion
Highest	Second highest	Second lowest	Lowest	Byte conversion

**Table 3.7 Format conversion of communication code (continued)**

First Byte	Second Byte	Third Byte	Fourth Byte	Conversion Method
Second highest	Highest	Lowest	Second lowest	Word conversion
Second lowest	Lowest	Highest	Second highest	Word internal conversion

## Measuring Range Conversion

Communication tags allow linear conversion, linear square conversion and no conversion. The conversion is related to the input original code maximum and minimum of the communication tags.

The input original code maximum and minimum are configured in the tag property as shown in the figure below.

Input Original Code Settings	
Input Original Code Maximum	100.0000
Input Original Code Minimum	0.0000

- Linear conversion

$$\text{PRIMEPV} = (\text{code value} - \text{input original code minimum limit}) / (\text{input original code maximum limit} - \text{input original code minimum limit}) \times (\text{measuring range maximum limit} - \text{measuring range minimum limit}) + \text{measuring range minimum limit}$$

- Sqrt

The input can be converted to actual value output by sqrt conversion. Calculation formula:

$$\text{PRIMEPV} = \sqrt{\frac{\text{Code Value} - A \text{ Min}}{A \text{ Max} - A \text{ Min}}} * (B \text{ Max} - B \text{ Min}) + B \text{ Min}$$

, in which A represents Input

Original Code while B represents Measuring Range.

- No conversion

$$\text{PRIMEPV} = \text{COMMASK}$$

## Communication data type

Communication signal configuration data types can reflect the mode applied when getting communication data. 2-byte integer and 4-byte integer are “signed” or “unsigned”. For example, 2-byte integer, the communication memory value is 0x8000. When signed, negative number can be obtained; when unsigned, positive number can be obtained.

## Fault alarm of communication tag

Communication tags add communication fault alarm delay parameter COMM\_TON.

When the associated instruments have alarms due to communication break, time out, data package error, ERR alarm will occur until the delay time of COMM\_TON expires. Meanwhile, the state of communication tag will set as IOP.

When module lost, severe fault or type mismatch occur, ERR is generated immediately.

Meanwhile, the status of communication tags will be set as HWF.



**TIP:**

**Communication fault alarm can be enabled or disabled. When ERR alarm is disabled, if fault occurs, communication tags won't undertake fail-safe processing. The output is ERR=OFF.**

## Shielding Communication Tag Fault

In the VFIOBuilder software interface, after selecting the communication slave module, you can shield the fault of a single slave device or shield ERR alarm of the tag. For details, refer to "Shielding Communication Tag Faults".

### 3.1.7 Flag

**Table 3.8 AI Flag Code List**

Flag code	Monitor Assignment	Explain	Type
D0	Disable	Run Fault	Alarm, floating exception
D1	Enable(AOF)	Shield Alarm(AOF)	Status
D2	Disable	Overrange Maximum Alarm(ORH)	Status
D3	Disable	Overrange Minimum Alarm(ORL)	Status
D4	Disable	Fault(ERR)	Alarm
D5	Disable	Force(FORCE)	Status
D6	Enable(SWOOS)	Disable(OOS)	Status
D8	Disable	H Limit Alarm(H)	Alarm
D9	Disable	L Limit Alarm(L)	Alarm
D10	Disable	HH Limit Alarm(HH)	Alarm
D11	Disable	LL Limit Alarm(LL)	Alarm
D12	Disable	HHH Limit Alarm(HHH)	Alarm
D13	Disable	LLL Limit Alarm(LLL)	Alarm



**Table 3.8 AI Flag Code List (continued)**

Flag code	Monitor Assignment	Explain	Type
D14	Disable	Change Rate Over Limit Alarm(DPV)	Alarm
D15	Disable	Simulation (SIMUL)	Status
D16	Disable	Positive Rate Alarm(PRIN)	Alarm
D17	Disable	Negative Rate Alarm(NRIN)	Alarm
D18	Disable	Configuration Error(CFGERR)	Alarm
D20	Disable	Hardware Fail(HWF)	Status
D23	Disable	Interlock HH Limit Alarm(I_HH)	Alarm
D24	Disable	Interlock LL Limit Alarm(I_LL)	Alarm
D25	Disable	Interlock H Limit Alarm(I_H)	Alarm
D26	Disable	Interlock L Limit Alarm(I_L)	Alarm
D27	Disable	Broken Line or Short Circuit Alarm(IOP)	Status

## 3.2 Analog Output Tag (AO)

The control variables are processed by the AO tags and they are output to the AO module, therefore controlling the on-site execution devices. AO tags could be converted to the communication tags to output (Modbus RTU, Modbus TCP, PROFIBUS, PROFINET and Ether Net/IP).

### 3.2.1 Tag Panel

The panel of AO tag is shown below.

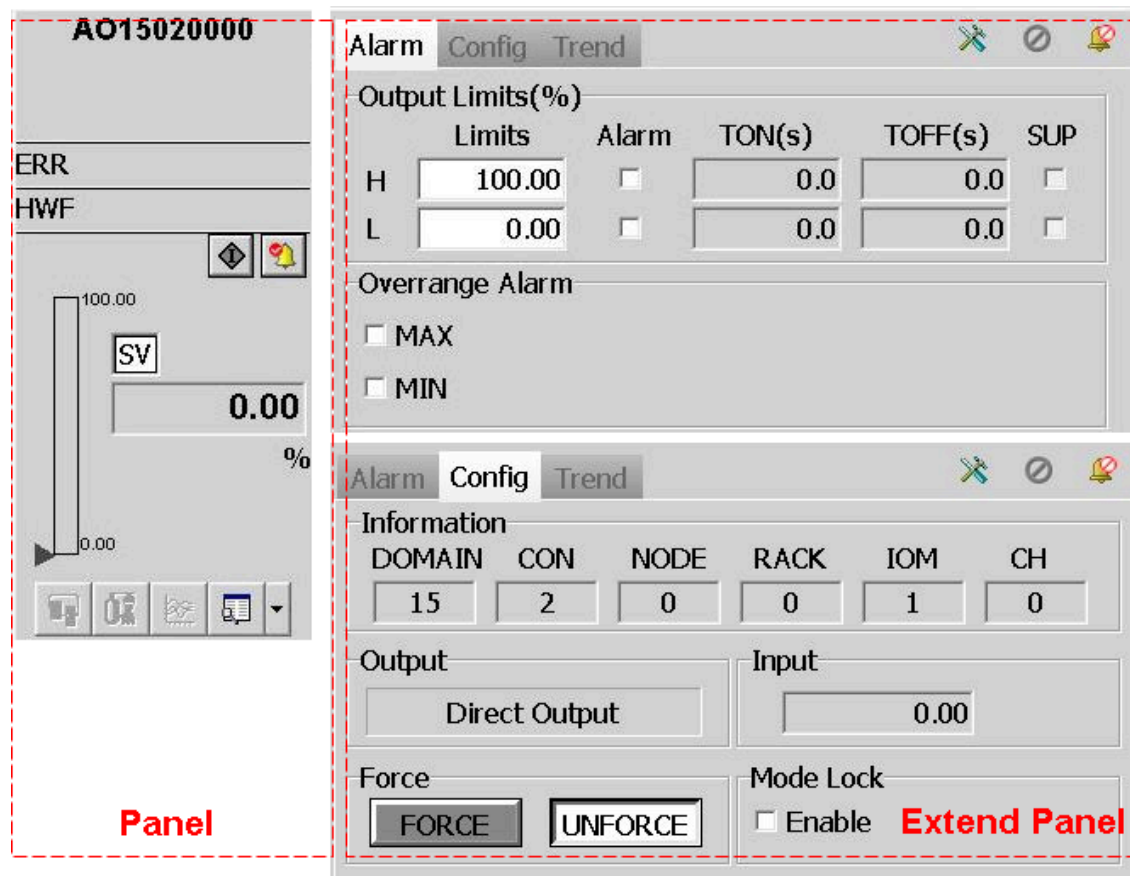


Figure 3.13 AO Tag Expansion Panel

Under the FCU713-S/FCU714-S controller, the AO signal generated by the AO714-H module with channel HART enabled will display HART parameters on its extended panel. Only the enabled PV/SV/TV/FV in the channel will be displayed, as shown in Figure 3.14.

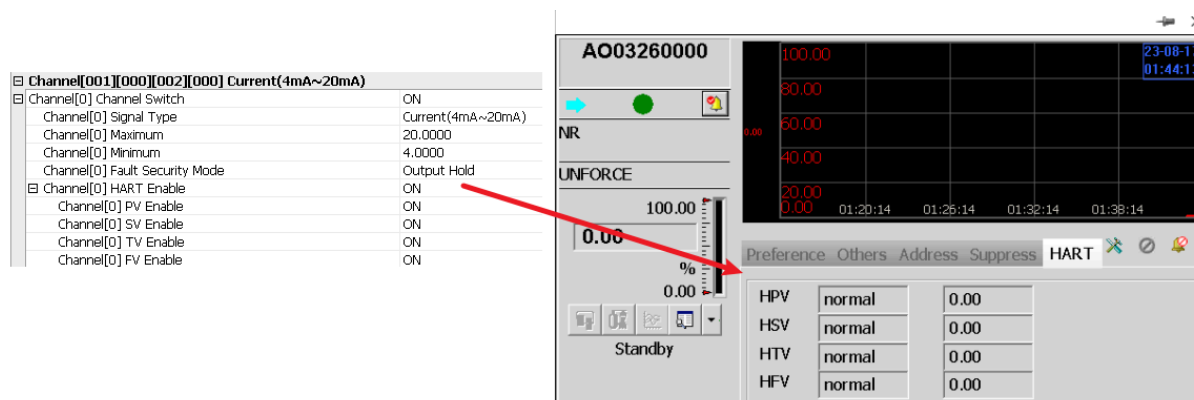


Figure 3.14 The extended panel of AO tag (HART)

### Alarm bar/real-time value/status bar instruction

When the fault is communication break and the panel status bar displays HWF, in the monitor screen, in “hardware fault list” in the system status list you can see the AO tags in the fault status.

When the fault is AO in the open circuit and panel status bar displays OOP, in the monitor screen, in "AO circuit fault list" in the system status list you can see the AO tags in the fault status.

**Table 3.9 AO tag troubleshooting**

AO Panel			System Diag- nostics	Abnormity
Alarm bar	Realtime value	Status bar		
ERR	Fail-safe value	HWF	Module fault	AO module fault
			Module lost	Controller lost communication with AO module
		OOP	Channel fault	AO is in the open circuit or in the short circuit

### Other parameter instruction on the panel

Description of other parameters of AO tag panel is shown in the table below.

For details of the icons in the panel, refer to "Bar Graph".

**Table 3.10 Panel Parameter Description**

Panel Parameter Name			Application Description
Alarm	Output ampli- tude limiting	Limit	Output amplitude limiting. Values should be taken within the overrange limitings (%).
		Alarm	Alarm enabling options
		TON	Alarm triggering delay (s) is valid when alarm is enabled.
		TOFF	Alarm eliminating delay (s) is valid when alarm is enabled.
		Suppress	Alarm suppression is enabled. When suppression is selected, the corresponding alarm will only record it but not prompt.
	Overrange alarm limit	Upper limit	Overrange upper limit alarm. Disable/enable (optional), corresponding to ORH.
		Lower limit	Overrange lower limit alarm. Disable/enable (optional), corresponding to ORL.
Settings	Address	It is used to display the domain address, station address, node address, rack address, module address and channel number.	
	Direct/re- verse output	Direct/reverse out- put	Direct (output=OUT)/reverse output (output=measuring range maximum-OUT), corresponding to parameters ATC.
	Input	Input value	Input manually, corresponding to IN.

**Table 3.10 Panel Parameter Description (continued)**

Panel Parameter Name			Application Description
	Force	FORCE/UN-FORCE	Force switch, corresponding to SWAM.
	Mode lock	Enable	Mode lock: OFF=unlock, ON=lock, corresponding to LOCK.
HART	HPV		When the AO714 module has its channel HART function and PV parameter enabled, this parameter's status and value will be displayed on the tag panel.
	HSV		When the AO714 module has its channel HART function and SV parameter enabled, this parameter's status and value will be displayed on the tag panel.
	HTV		When the AO714 module has its channel HART function and TV parameter enabled, this parameter's status and value will be displayed on the tag panel.
	HFV		When the AO714 module has its channel HART function and HV parameter enabled, this parameter's status and value will be displayed on the tag panel.

### 3.2.2 Tag Table Management

In the tag configuration software, you can configure AO tags according to the table below.

The screenshot shows the VFTAGBuilder software interface. The main window displays a table of AO tags with columns for ID, Type, Name, Description, Minimum, Maximum, Unit, Signal Type, and Address. The right sidebar shows the configuration settings for the selected tag, including Basic Properties, Output Channel Settings, Communication Parameter Settings, Signal Conversion Process, and Tag Output Setting of Fault Status.

ID	Type	Name	Description	Minimum	Maximum	Unit	Signal Type	Address
10000	Anal...	A000060000	Standby	0.0000	100.0000	%	Current(4mA~20...	003-000-000-000
10001	Anal...	A000060001	Standby	0.0000	100.0000	%	Current(4mA~20...	003-000-000-001
10002	Anal...	A000060002	Standby	0.0000	100.0000	%	Current(4mA~20...	003-000-000-002
10003	Anal...	A000060003	Standby	0.0000	100.0000	%	Current(4mA~20...	003-000-000-003
10004	Anal...	A000060004	Standby	0.0000	100.0000	%	Current(4mA~20...	003-000-000-004
10005	Anal...	A000060005	Standby	0.0000	100.0000	%	Current(4mA~20...	003-000-000-005
10006	Anal...	A000060006	Standby	0.0000	100.0000	%	Current(4mA~20...	003-000-000-006
10007	Anal...	A000060007	Standby	0.0000	100.0000	%	Current(4mA~20...	003-000-000-007
10008	Anal...	A000060008	Standby	0.0000	100.0000	%	Current(4mA~20...	003-000-001-000
10009	Anal...	A000060009	Standby	0.0000	100.0000	%	Current(4mA~20...	003-000-001-001
10010	Anal...	A000060010	Standby	0.0000	100.0000	%	Current(4mA~20...	003-000-001-002
10011	Anal...	A000060011	Standby	0.0000	100.0000	%	Current(4mA~20...	003-000-001-003
10012	Anal...	A000060012	Standby	0.0000	100.0000	%	Current(4mA~20...	003-000-001-004
10013	Anal...	A000060013	Standby	0.0000	100.0000	%	Current(4mA~20...	003-000-001-005
10014	Anal...	A000060014	Standby	0.0000	100.0000	%	Current(4mA~20...	003-000-001-006
10015	Anal...	A000060015	Standby	0.0000	100.0000	%	Current(4mA~20...	003-000-001-007
10016	Anal...	A000060016	Standby	0.0000	100.0000	%	Current(4mA~20...	003-000-001-008
10017	Anal...	A000060017	Standby	0.0000	100.0000	%	Current(4mA~20...	003-000-001-009

**Basic Properties**

- Number: 0
- Name: A000060000
- Type: Analog Output
- Description: Standby

**Output Channel Settings**

- Tag Type: Normal AO Tag
- Node No.: 003
- Rack No.: 000
- Module No.: 000
- Channel No.: 000
- Module Type: AO711-S Current Output Module(8 Channels)
- Signal Type: Current(4mA~20mA)
- Tag Running Cycle: Basic Scan Cycle
- APL Tag: No

**Communication Parameter Settings**

- Signal Conversion Process
- Conversion Type: Linear Conversion
- Positive/Negative Output Selection: Positive Output

**Tag Output Setting of Fault Status**

- Tag Output Enable of Fault Status: Disable

**Figure 3.15 AO configuration interface**

Property of AO tags is configured at the right side of the interface shown above and the configuration description is shown in the table below.

**Table 3.11 AO Tag Property Table**

Category	Setting Item	Properties	Type
Basic Properties	Number	Determined when the tag is added and can't be modified.	USINT
	Name	Can be modified manually.	STRING
	Type	Analog Output(can't be modified)	-
	Description	Tag instruction and can be input manually.	STRING
Output Channel Settings (Normal AO tags)	Tag Type	Normal AO Tag	USINT
	Node No.	[0~31 ] input manually	USINT
	Rack No.	[0~3] (input manually)	USINT
	Module No.	[0~15] (input manually)	USINT
	Channel No.	[0~31] (input manually)	USINT
	Module Type	Consistent with the hardware configuration (cannot be modified)	-
	Signal Type	Consistent with the hardware configuration (cannot be modified)	-
	Tag Running Cycle	Fast Cycle/ Basic Scan Cycle (optional)	-
Output Channel Settings (Communication AO tags)	Tag Type	Communication AO Tag	USINT
	Communication Node No.	Appoint the communication node No. [0~31] of the tag	USINT
	Communication Rack No.	Appoint the communication rack No. [0~3] of the tag	USINT
	Slave Station Address	Appoint the slave station address [0~255] of the tag	USINT
	Data Block No.	Appoint the data block No. [0~63] of the tag	USINT
	The Offset Address of the Tag in the Data Block	Appoint the offset address [0~255] of the tag in the data block	USINT
Communication Parameter Settings (When tag type is Communication AO Tag)	Data Type	2 Byte Integer (signed/unsigned) / 4 Byte Integer (signed/unsigned) / 4 Byte Float	-
	Signal Properties	Actual Value/Percentage(It is available only when data type is 4 Byte Float)	-
	Status Code Location	Status Code Ahead/ Status Code Behind/ No status Code	-

**Table 3.11 AO Tag Property Table (continued)**

Category	Setting Item	Properties	Type
		For FCU713-S/FCU714-S controllers, Status Code Location of an communication AO tag can also be set as one of the following options: "Status Code Ahead (Fault Setting ERR)", "Status Code Behind (Fault Setting ERR)", "Status Code Ahead (Fault (Include Uncertain) Setting ERR)", or "Status Code Behind (Fault (Include Uncertain) Setting ERR)". The configuration and values of the status code will affect the fault alarm state. Please refer to Note 1 for details.	
	Data Format	No Conversion/Byte Conversion/Word conversion / Word Internal Conversion	-
Signal Conversion Process	Conversion Type	Linear Conversion/ No Conversion	USINT
	Direct /Reverse Output Selection	Direct Output/Reverse Output (optional)	BOOL
Output Range Settings	Span Maximum	Input values manually	REAL
	Span Minimum	Input values manually	REAL
	High Overrange Limit (%)	Input values manually	REAL
	Low Overrange Limit (%)	Input values manually	REAL
	High Overrange Alarm	Enable/Disable (optional)	BOOL
	Alarm High Overrange TON(s)	Input values manually	REAL
	Alarm High Overrange TOFF(s)	Input values manually	REAL
	Low Overrange Alarm	Enable/Disable (optional)	BOOL
	Alarm Low Overrange TON (s)	Input values manually	REAL
	Alarm Low Overrange TOFF (s)	Input values manually	REAL
	Unit	%, Pa, etc(optional)	EU-TYPE
Output Original Code Settings	Output Original Code Maximum	Input values manually	REAL

**Table 3.11 AO Tag Property Table (continued)**

Category	Setting Item	Properties	Type
	Output Original Code Minimum	Input values manually	REAL
Alarm Settings	Output H Limit Alarm	Disable/Enable (optional)	BOOL
	Output H Limit Alarm Priority	Select the alarm level from drop-down menu. The optional alarm levels are configured in the global settings.	USINT
	Output H Limit value	Input values manually	REAL
	Output H Alarm TON (s)	Input values manually	REAL
	Output H Alarm TOFF (s)	Input values manually	REAL
	Output L Limit Alarm	Disable/Enable (optional)	BOOL
	Output L Limit Alarm Priority	Select the alarm level from drop-down menu. The optional alarm levels are configured in the global settings.	USINT
	Output L Limit value	Input values manually	REAL
	Output L Alarm TON (s)	Input values manually	REAL
	Output L Alarm TOFF (s)	Input values manually	REAL
	Interlock Track Alarm	Disable/enable (optional)	BOOL
	Interlock Track Alarm Priority	Select the alarm level form the drop-down menu. The optional alarm levels are configured in the global settings.	USINT
	Fault Alarm	Enable	BOOL
	Fault Alarm Priority	Select the alarm level from drop-down menu. The optional alarm levels are configured in the global settings.	USINT
	Configuration Error Alarm	Enable	BOOL
	Configuration Error Alarm Priority	Select the alarm level from drop-down menu. The optional alarm levels are configured in the global settings.	USINT
Communication Fail Alarm	Communication Fault Alarm TOFF (s)	Input values manually	REAL

**Table 3.11 AO Tag Property Table (continued)**

Category	Setting Item	Properties	Type
Cold Start SWAM Mode Configuration	Cold start SWAM mode configuration	Hold/Force/Unforce (optional)	-
Supervision Settings	Tag Group	Tag Group 0~31 (optional)	STRING
	Tag Level	Tag level 0~9 (optional)	USINT
	Decimal Digits	0~5 (optional)	USINT
	Panel	AO tag can set the panel as custom panel or system original panel.	-
	Recent History	Not to display/2 minutes/ 10minutes/ 30minutes/1 hour/ hours/2 hours/4 hours/8 hours/12 hours/24 hours (optional)	UINT
	Interlock Tag	Input the name manually	STRING

### 3.2.3 Tag Debugging Parameters

In VFExplorer, click “tag debug” to enter the online debugging mode as shown in Figure 3.9. Parameters of AO tags to debug and their description are shown in the table below.

**Table 3.12 Tag Configuration Software Debugging Parameter List**

Parameter Name	Type	Description
Output signal parameter	FLAG	UDINT Flag Code
	IN	REAL Input Real-Time Value
	TV	REAL Track Input Value
	OUT	REAL Output Real-Time Value
	BKOUT	REAL Back Calculation Value
	SWAM	BOOL Force Switch OFF=Force, ON=Unforce
	SWTR	BOOL Tracking Input Switch ON=Tracking, OFF=No Tracking
	SWOOS	BOOL Switch of Out of Service ON=Disable, OFF=Normal



**Table 3.12 Tag Configuration Software Debugging Parameter List (continued)**

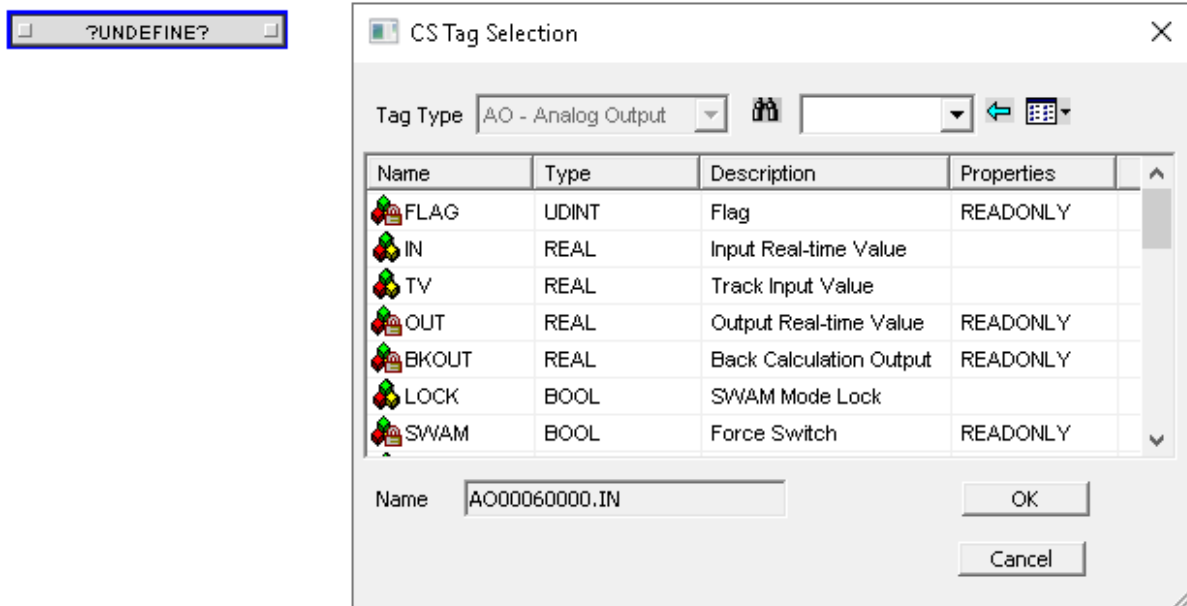
Parameter Name		Type	Description
Configuration parameter	SCH	REAL	Span maximum
	SCL	REAL	Span minimum
	RSCH	REAL	Output original code maximum In the case for the communication tags, it is decided by users.
	RSCL	REAL	Output original code minimum In the case for the communication tags, it is decided by users.
	ATC	BOOL	Direct/Reverse output switch ON=negative output, OFF=positive output
	SWFORM	USINT	Communication data format conversion selection 0=not to convert, 1=byte conversion, 2=word conversion. 3=word internal conversion
Alarm Parameter	HOLIM	REAL	Output H limit value
	HO_TON	REAL	Output H limit alarm delay
	HO_TOFF	REAL	Output H limit alarm elimination delay
	LOLIM	REAL	Output L limit amplitude limiting value
	LO_TON	REAL	Output L limit alarm delay
	LO_TOFF	REAL	Output L limit alarm elimination delay
	HORLIM	REAL	High Overrange Limit
	HOR_TON	REAL	High Overrange alarm delay
	HOR_TOFF	REAL	High Overrange alarm elimination delay
	LORLIM	REAL	Low overrange limit
	LOR_TON	REAL	Low overrange alarm delay
	LOR_TOFF	REAL	Low overrange alarm elimination delay
	COMM_TON	REAL	Communication fail alarm delay
	ENALM	UDINT	Alarm enabled
	AOF	BOOL	Shield Alarm

**Table 3.12 Tag Configuration Software Debugging Parameter List (continued)**

Parameter Name		Type	Description
Other Parameters	CHAN_EXIST	USINT	Channel exist or not: 0= not exist, 255=exist
	CHK_CODE	UINT	Channel check code
	REALFAST	BOOL	Fast cycle schedule
	COMMCODE	USINT	Status code of the 4-byte communication tag
	BKOUTERR	BOOL	Back calculation output status
	SWSAFESET	BOOL	Fault safety function ON=enable, OFF=not to enable
	SAFEVAL	REAL	Fault safety value
	COMMASK	UDINT	No convert communication tag send value
	COLD_OPT	USINT	Cold start SWAM mode
	T_PEAK	UINT	Recent history (0=Not Show, 1=2min, 2=10min, 3=30min, 4=1h, 5=2h, 6=4h, 7=8h, 8=12h, 9=24h)

### 3.2.4 Refereceable Parameters for Custom Programs

In custom programs, users can call data and apply them on AO tags as shown in the figure below.

**Figure 3.16 An example of calling AO tags in custom programs**

Parameters of AO tags to call in custom programs and their property are shown in the table below.

**Table 3.13 Parameters Custom Programs able to call (AO)**

Parameter Name		Type	Default Value	Description
Input pins	IN	REAL	0	Input Value
	TV	REAL	0	Track Input Value
	COMMASK	UDINT	0	Communication Tag Original Code Value
Output pins	OUT	REAL	0	Actual Value Unit Output Value
	BKOUT	REAL	0	Back Calculation Output
	BKOUTERR	BOOL	OFF	Back Calculation Output Status
Monitoring parameters	LOCK	BOOL	OFF	Mode Lock:OFF=UnLock,ON=Lock When lock=on, force and unforce cannot be switched mutually.
	SWAM	BOOL	OFF	Force Switch:OFF=Force,ON=Unforce
	SWTR	BOOL	OFF	Track Switch:OFF=Not Track,ON=Track
	SWOOS	BOOL	OFF	Switch of Out of Service:ON=Disable,OFF=Enable
	ACK	BOOL	OFF	Output Readback Track Alarm Confirm
	AOF	BOOL	OFF	Shield Alarm
	FLAG	UDINT	0	Flag
	COMMCODE	USINT	0	Comm Tag Status Flag
Operational Parameters	HOLIM	REAL	100	Output H Limit Value
	HO_TON	REAL	0	Output H Alarm TON(s)
	HO_TOFF	REAL	0	Output H Alarm TOFF(s)
	LOLIM	REAL	0	Output L Limit Value
	LO_TON	REAL	0	Output L Alarm TON(s)
	LO_TOFF	REAL	0	Output L Alarm TOFF(s)
	T_PEAK	UINT	0	Recent History (0=Not Show, 1=2min, 2=10min, 3=30min, 4=1h, 5=2h, 6=4h, 7=8h, 8=12h, 9=24h)

**Table 3.13 Parameters Custom Programs able to call (AO) (continued)**

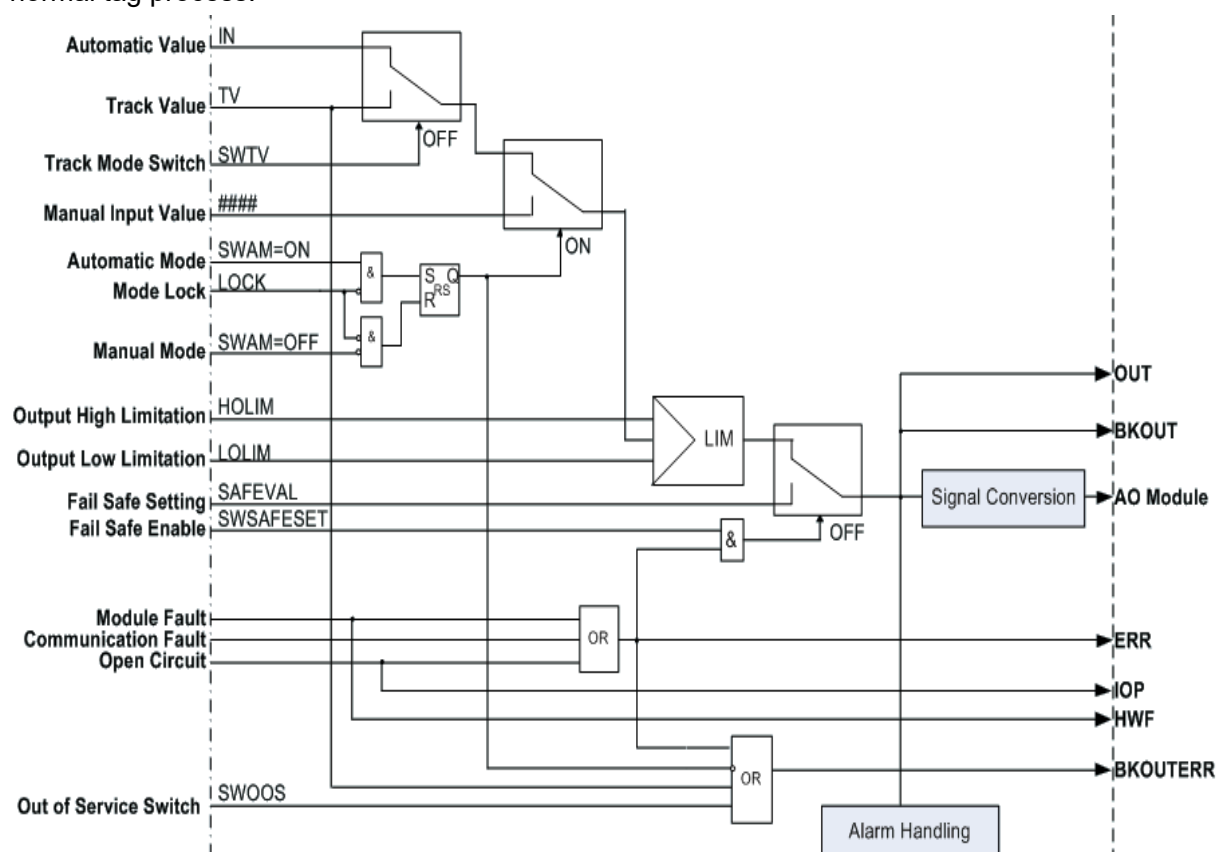
Parameter Name		Type	Default Value	Description
Alarm Parameters	COMM_TON	REAL	0	Communication Fail Alarm TON(s)
	ENALM	UDINT	0	Alarm Enable
Configuration parameters	SCH	REAL	100	Actual Value Maximum
	SCL	REAL	0	Actual Value Minimum
	EU	EUTYPE	0	Actual Value Unit
	ATC	BOOL	OFF	Direct/Reverse Output Selection:ON=Reverse Output,OFF=Direct Output
	NODE_SN	USINT	0	Node No.
	BUS_SN	USINT	0	Rack No.
	MODULE_SN	USINT	0	Module No.
	CHAN_SN	USINT	0	Channel No.
	TAG_TYPE	USINT	0	Tag Type
	DB_OFFSET	UINT	0	Data Block No.
	TAG_OFFSET	UINT	0	The Offset Address of the Tag in the Data Block
	DLEN	USINT	3	Decimal Digits Length[0,5]
	RSCH	REAL	100	Output Original Code Maximum
	RSCL	REAL	0	Output Original Code Minimum
	HORLIM	REAL	25	High Overrange Limit
	LORLIM	REAL	25	Low Overrange Limit
	HOR_TON	REAL	0	High Overrange Limit Alarm TON(s)
	HOR_TOFF	REAL	0	High Overrange Limit Alarm TOFF(s)
	LOR_TON	REAL	0	Low Overrange Limit Alarm TON(s)
	LOR_TOFF	REAL	0	Low Overrange Limit Alarm TOFF(s)
	SIGNALMODE	USINT	0	Signal Conversion Type

**Table 3.13 Parameters Custom Programs able to call (AO) (continued)**

Parameter Name	Type	Default Value	Description
COLD_OPT	USINT	0	Cold Start SWAM Mode Options: 0=Hold, 1=Force, 2=Unforce

### 3.2.5 Normal Tag Function

When the configuration item “input channel settings/tag type” is “normal AO tag”, you can execute normal tag process.

**Figure 3.17 AO Function Graph**

#### Parameter Validity Check

Check whether configuration data is right. The output low limit set should be less than the output high limit when tags are configured. Otherwise, low limit is equal to high limit.

When the output limit is more than the high limit of the extended span, the output limit can be set high limit of the extended span at most.

When the output limit is less than the low limit of the extended span, the output limit can be set low limit of the extended span at least.

#### Signal Conversion

The system supports the positive and negative output conversion of AO signals.

- As for positive output, the output value of AO module= the OUT value of AO tags through non-dimensionalized process.
- As for negative output, the output value of AO module=maximum limit of measuring range of AO tags-the OUT value through non-dimensionalized process.

### **Output tracking function**

- When SWTR = ON, AO output comes from the tracking input (TV).
- TV input is assigned by custom program.
- In the tracking state, BKOUTERR = ON (AO output BKOUT is connected to the upper-level function block BKIN, which can avoid the output jump when the tracking state is cancelled)

### **Extended range output**

AO signal output supports the extended measuring range up to a further 25%. The maximum and minimum limit can be configured

### **Output amplitude limiting**

- Output upper amplitude limit (HOLIM), lower amplitude limit (LOLIM), upper and lower limit settings need to be set within the extended range limits.
- When the upper and lower amplitude limits are not set or set incorrectly, then the extended range limits are valid.
- When the upper and lower amplitude limits or extended range limits function, set the output amplitude limiting flag.
- When the upper limit is set lower than the lower limit, the limit is invalid, and the CFGERR configuration error is reported. In this case, the extended range limit is valid.

### **Output inversion calculation**

In order to achieve switch with control function blocks in the upstream without any disturbance, AO tag offers inversion calculation output, which is connected to the inversion calculation input in the upstream.

Inversion calculation output BKOUT equals the current AO tag output. According to the needs of the control logic, by judging the current working state of the AO tags, the output of the upstream function block can track BKOUT.

It is recommended that when the AO tag is in the state of OOS, tracking, forcing, amplitude limiting and fail-safe, its upstream function block output tracks BKOUT.

## Force status processing

When SWAM = OFF, it enters the forced state, AO output OUT comes from the panel forced input.

In forced state, BKOUTERR = ON (AO output BKOUT is connected to the upper-level function block BKIN, which can avoid the output jump when the tracking state is cancelled)

When the mode lock (LOCK) is set to ON, the forced / unforced status cannot be switched between them.

## Alarm Process

- Fault alarm

When the module itself fails, communication fails or channel breaks, the sign "ERR" will be displayed (it isn't displayed when the controller in the debugging state).

- Output maximum/minimum amplitude limiting alarm

When the output is greater than the preset output maximum or minimum limit, it will limit the amplitude and set the alarm signs of the corresponding output maximum limit or minimum limit. The alarm of output maximum/minimum amplitude limiting can be shielded individually but limiting function cannot be shielded. When the maximum limit is greater than or equal to the minimum limit, forced and non-forced state both have this function.

- Alarm shield

If the function of tag alarm shield is set, corresponding alarm will only be recorded and not displayed in real time.

- Alarm enable

High limit/low limit alarm and over span alarm can be enabled or disabled separately. The tag fault alarm always works. When the alarm is generated, corresponding flag will be set in the quality code.

- Alarm Delay

Each alarm item of AO tags has an alarm delay function, and its processing is described in the description of AI alarm delay.

**Table 3.14 AO tag alarm and alarm clear delay**

Tag Type	ERR Alarm Delay/Alarm Clear Delay	Overrange Alarm Delay/Alarm Clear Delay
General AO tags	For ERR alarm induced by channel fault (offline, short circuit), alarm status display is delayed (delay time: COM-M_TON+8). When alarm is cleared and the delay time	Alarm status display is delayed when the tag has overrange alarm. When the alarm is cleared and the delay time is met, the status is not displayed.

**Table 3.14 AO tag alarm and alarm clear delay (continued)**

Tag Type	ERR Alarm Delay/Alarm Clear Delay	Overrange Alarm Delay/Alarm Clear Delay
	<p>(COMM_TOFF) is met, the status is not displayed.</p> <p>During ERR alarm, OUT is not updated to the output cache area, while RAW is updated though.</p> <p>When ERR alarm is cleared, update the PV according to the real input value.</p>	
Communication AO tags	<p>Delay alarm is induced by communication fault (including 485 line fault, communication timeout, and data package parity error), and its delay time is COMM_TON. When the alarm is cleared and the delay time (COMM_TOFF) is met, the status is not displayed.</p> <p>During ERR alarm is delayed, real-time OUT value is updated to the output cache area.</p> <p>When the ERR alarm is generated, calculate OUT according to the set mode, but it is not updated to the output cache area.</p> <p>When the ERR alarm is cleared, update PV based on the real input value.</p> <p>If ERR alarm is disabled, calculate OUT and update to the output cache area according to the set mode.</p>	

When the slave IO devices has the following fault, alarm is immediately generated. Fault includes: module lost (reinsert COM741), inconsistent alarm type, and module major fault.

### Fail-safe process

When the controller is in debug mode, no fail-safe processing is performed.



**Table 3.15 Fail-safe descriptions**

Module Status	Panel Display	System Diagnosis	Fault Output	Notes
Module Fault	ERR, HWF	Module Fault	BKOUTERR=ON	This fault is generally caused by the module being unplugged, module hardware failure, or communication failure with the controller.
Channel Open Circuit	ERR, OOP	Channel Fault	BKOUTERR=ON	This fault is generally caused by channel disconnection or short circuit.

When a tag enters fail-safe state, the real-time output value of the tag is different according to the settings, as shown in the figure below.

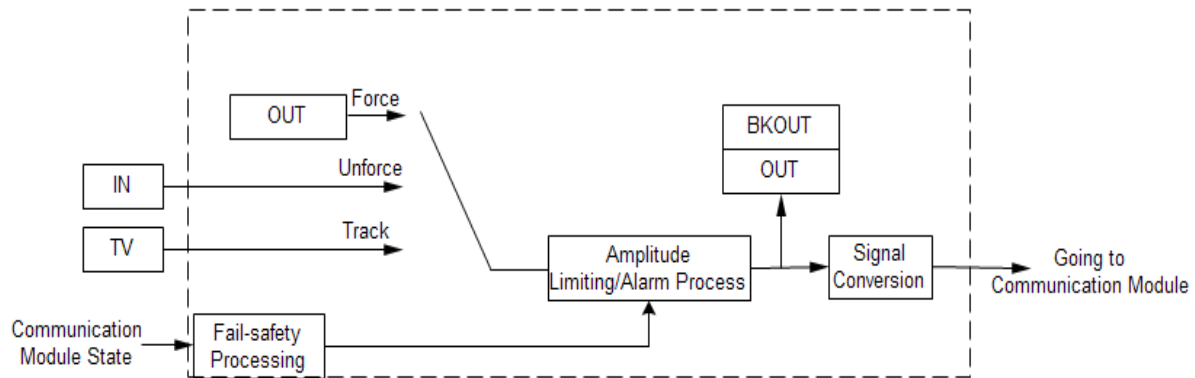
[-] Channel[000][000][001][000] Current(4mA~20mA)	
[-] Channel[0] Channel Switch	ON
Channel[0] Signal Type	Current(4mA~20mA)
Channel[0] Maximum	20.0000
Channel[0] Minimum	4.0000
Channel[0] Fault Security Mode	Hold
[+] Channel[000][000][001][001] Current(4mA~20mA)	Hold
[+] Channel[000][000][001][002] Current(4mA~20mA)	Preset Value

**Figure 3.18 Output in fail-safe state**

- If set to "Preset Value", the OUT equals the "Fault Status Set Value".
- If set to "Hold", the OUT is held.

### 3.2.6 The Functional Description of Communication Tag's Linear Conversion

This section mainly introduces the processing method High-performanceHMI software executes when AO tag is a communication tag and "Signal conversion processing" is configured as "Linear conversion".



**Figure 3.19 Linear conversion of AO communication tags**

AO's processing of communication tags is basically as the same as normal IO tags, and the differences are explained as follows.

### Fault alarm processing

- When alarms occur due to signal break, overtime or data package error, the ERR alarm will be generated after COMM\_TON delay.
- When the communication lost, severe fault or mismatching occurs, the ERR alarm will be generated immediately and meanwhile the state of communication tags are set to HWF.



#### ATTENTION:

Fault alarm of communication tags can be enabled or disabled. When ERR alarm is disabled, if a fault occurs, the communication tag will not execute fail-safe processing and it will output ERR=OFF.

### Shielding Communication Tag Fault

In the VFIOBuilder software interface, after selecting the communication slave module, you can shield the fault of a single slave device or shield ERR alarm of the tag. For details, refer to "Shielding Communication Tag Faults".

### Signal Conversion

- As for 4-byte real actual value: flag code=OUT
- As for 4-byte real percentage value, 2-byte UINT, 2-byte INT, 4-byte UDINT, 4-byte DINT:
  - If "positive output" is selected, code flag= $(\text{OUT}-\text{SCL})/(\text{SCH}-\text{SCL}) * (\text{RSCH}-\text{RSCL}) + \text{RSCL}$
  - ,If "negative output" is selected, code flag= $(1-(\text{OUT}-\text{SCL})/(\text{SCH}-\text{SCL})) * (\text{RSCH}-\text{RSCL}) + \text{RSCL}$

### Communication signal format conversion

as for executing communication signal format conversion on the flag code, the data format inside the system is the low byte comes in front while the high byte in the back. If data format of communication signal is different from system data format, corresponding conversion mode can be selected.

If communication data format is integer of two bytes, "No conversion" or "Byte conversion" can be selected.

If communication data format is 4-byte integer or 4-byte real, "No conversion", "Byte conversion", "Word conversion" and "Conversion in word" can be selected.

For example:

**Table 3.16 Communication Signal Format Conversion**

1th byte	2th byte	3th byte	4th byte	Conversion mode
Minimum	Deuto-low	Deuto-high	Highest	Non-conversion
Highest	Deuto-high	Deuto-low	Minimum	Byte Conversion
Deuto-high	Highest	Minimum	Deuto-low	Word Conversion
Deuto-low	Minimum	Highest	Deuto-high	Word Internal Conversion

### 3.2.7 Flag

**Table 3.17 AO flag code**

Flag code	Monitor Assignment	Explain	Type
D1	Disable(OOP)	AO Channel Exterior Fault(OOP)	Status
D4	Disable	Fault(ERR)	Alarm
D5	Disable	FORCE(FORCE)	Status
D6	Enable(SWOOS)	Disable(OOS)	Status
D8	Disable	Output H Limit Alarm(OUTH)	Alarm
D9	Disable	Output L Limit Alarm(OUTL)	Alarm
D10	Disable	Track(TR)	Alarm
D11	Enable(AOF)	Shield Alarm(AOF)	Status
D12	Disable	Overrange Maximum Alarm (ORH)	Status
D13	Disable	Overrange Minimum Alarm (ORL )	Status
D14	Disable	Configuration Error (CFGERR)	Alarm

**Table 3.17 AO flag code (continued)**

Flag code	Monitor Assignment	Explain	Type
D15	Disable	Run Fault(REVSCL)	Alarm
D16	Disable	Hardware Fail(HWF)	Status
D17	Disable	Interlock Track (LTR)	Alarm

## 3.3 Digital Input Tag (DI)

The digital input processing tag DI receives the input signal of the normal DI input module, performs input function processing according to the tag configuration parameters, and provides signal interlocking, control, alarm and other monitoring functions.

DI gets field signal from digital input module. The digital of the tag is got after corresponding process according to the configuration. DI tags also can process the communication signal input (including Modbus RTU, Modbus TCP, PROFIBUS, PROFINET and EtherNet/IP), convert them or directly gain the actual values.

### 3.3.1 Tag Panel

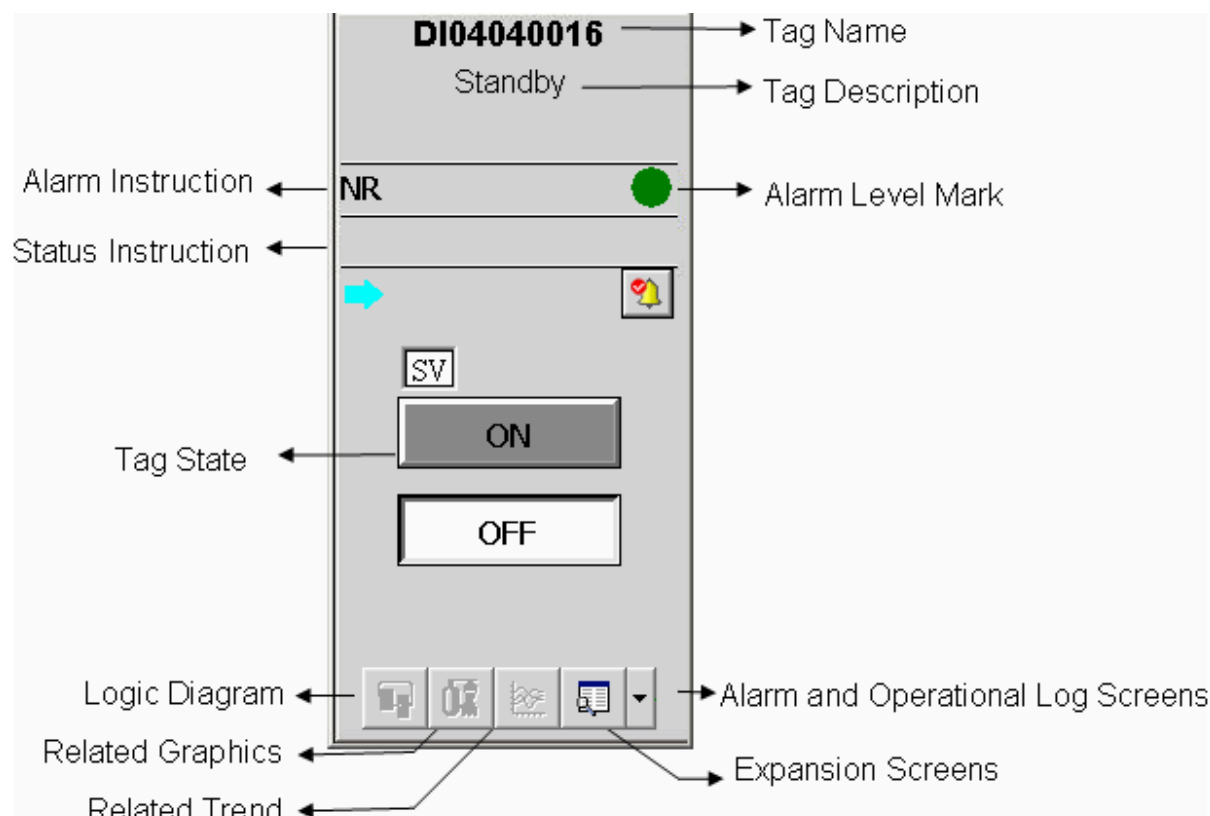
As shown in Figure 2.6, DI tag panel of the system includes the functions below:

Alarm illustration, it is used to display the alarm information of the function block tags, such as NR, ERR and so on.

Status illustration, it is used to display tag function block status, including HWF or IOP states.

Tag status: it displays real-time data and SV/SI marker. If it is SV, the current real-time value is fail-safe substitute value while SI means the current real-time value is forced value. In addition, ON/OFF turns white as it is selected while turns gray as it is not selected. The colors of ON/OFF are not affected by the global settings or that in tag list.

As shown in Figure 2.6, the AI tag panel of the system includes tag name, ACK marker, alarm level marker, alarm level, real-time value and page-turning button.



**Figure 3.20 DI Tag Panel**

### Alarm bar/real-time values/status bar description

The alarm bar, real-time values and status bar of DI tag panel display different values as per the external situation and module status.

DI (in the unforce status (SWAM=ON) and the fail-safe is disabled(ENERRVAL=OFF))

**Table 3.18 Display exception of DI panel**

DI Panel				
Alarm Bar	Real-time Value	Status Bar	System Diagnosis	Exception
ERR	Sampling value	HWF	Module fault	DI module fault
			Module lost	Controller module lost communication with DI module
		IOP	Channel fault	Channel break or short circuit

DI (in the unforce status (SWAM=ON) and the fail-safe is enabled (ENERRVAL=ON) )

DI Panel					
Alarm Bar	Real-time Value	Indication Bar	Status Bar	System Diagnosis	Exception
ERR	Substitute	SV	HWF	Module fault	DI module fault
				Module lost	Controller module lost communication with DI module
			IOP	Channel fault	Channel break or short circuit

DI (in the status of force (SWAM=OFF))

DI Panel					
Alarm Bar	Real-time Value	Status Bar	Indication Bar	System Diagnosis	Exception
NR	Forced value	SI	HWF	Module fault	DI module fault
				Module lost	Controller module lost communication with DI module
			IOP	Channel fault	Channel break or short circuit

### Description of other parameters on DI panel

Click "Expansion screens" button in Figure 3.24 to show the expansion panel in the figure below.

Enable	TON(s)	TOFF(s)	SUP
<input type="checkbox"/> ON	0.0	0.0	<input type="checkbox"/>
<input type="checkbox"/> OFF	0.0	0.0	<input type="checkbox"/>
<input type="checkbox"/> RJUMP			<input type="checkbox"/>
<input type="checkbox"/> FJUMP			<input type="checkbox"/>

The screenshot shows the 'Config' tab of the DI Tag Expansion Panel. At the top, there are three tabs: 'Alarm', 'Config', and 'Trend'. Below the tabs is a grid of six input fields: DOMAIN (15), CON (2), NODE (0), RACK (0), IOM (2), and CH (0). The main area is divided into four sections: 'Rising Edge Counter' with an 'AV' field (0) and 'Start', 'Stop', 'Reset' buttons; 'Fault Safety Setting' with 'Enable' (checked), 'Hold' (selected), and 'Substitute' (ON/OFF) options; 'Force' with 'FORCE' and 'UNFORCE' buttons; and 'Simulation' with 'Simulate' and 'OFF' buttons.

**Figure 3.21 DI Tag Expansion Panel**

Description of other parameters of DI tag panel is shown in the table below.

**Table 3.19 Panel Parameter Description**

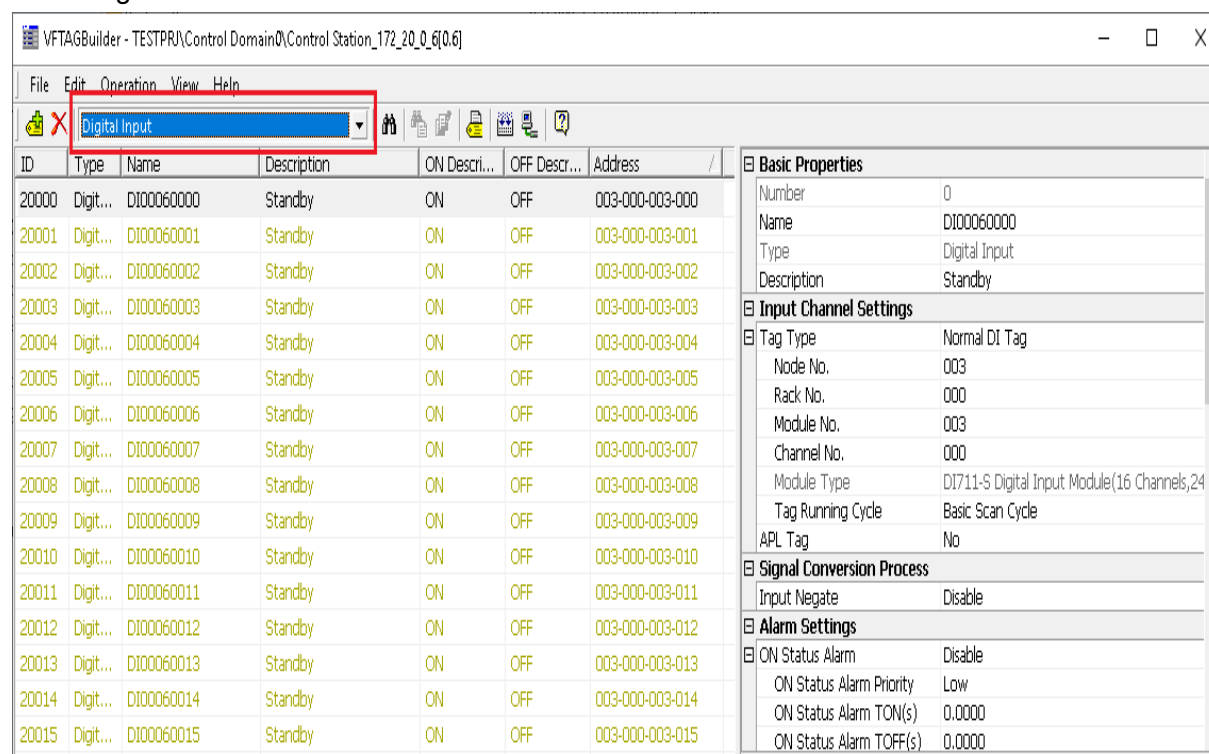
Panel Parameter Name			Application Description
Alarm	Alarm	Enable	The enable condition of each type of alarms
		TON	Each type of alarms delay
		TOFF	The elimination delay of each type of alarms
		Suppress	The suppression condition of each type of alarms
		Rising edge jump	Enable: positive jump alarm. Disable/enable (optional) Suppression: RJUMP alarm in the suppression status
		Falling edge jump	Enable: negative jump alarm. Disable/enable (optional) Suppression: FJUMP alarm in the suppression status
Settings	Address	It is used to display the tag domain address, station address, node address, rack address, module address and channel number.	
	Rising edge count	Accumulation value	The accumulation of the rising edge
		Start/stop	Switch of the rising edge count accumulation: ON=start, OFF=stop.
		Reset	The reset switch of the rising edge count accumulation: ON=reset.
	Fault value setting	Enable	Fault safety value setting enable switch: ON=enable, OFF=disable
		Hold/ON/OFF	Fault value setting: 0=hold, 1=ON, 2=OFF

**Table 3.19 Panel Parameter Description (continued)**

Panel Parameter Name			Application Description
	Force	FORCE/UN-FORCE	Force switch, OFF = force, ON = unforce
	Simulation	Simulation	Simulation input value

### 3.3.2 Tag Table Management

In VFTAGBuilder, you can select “Digital Input” to start configuring the property of DI tags according to the table below.

**Figure 3.22 DI configuration interface**

Property of DI tags is configured at the right side of the interface shown above and the configuration description is shown in the table below.

**Table 3.20 DI Tag Property Table**

Category	Setting Item	Properties	Type
Basic Properties	Number	Determined when a tag is added and can't be modified.	USINT
	Name	Can be modified manually.	STRING
	Type	Digital Input ( can't be modified)	-



**Table 3.20 DI Tag Property Table (continued)**

Category	Setting Item	Properties	Type
	Description	Tag instruction and can be input manually	STRING
Input Channel Settings(when tag type is Normal DI Tag)	Tag Type	Normal DI Tag	USINT
	Node No.	[0~31 ] input manually	USINT
	Rack No	[0~3] (input manually)	USINT
	Module No.	[0~15] (input manually)	USINT
	Channel No.	[0~31] (input manually)	USINT
	Module Type	Accord with the hardware configuration (it's not allowed to be modified.)	-
	Tag Running Cycle	Fast Cycle/ Basic Scan Cycle (optional)	-
Input Channel Settings (when tag type is Communication DI Tag)	Tag Type	Communication DI Tag	USINT
	Communication No.	Appoint the communication node No. [0~31] of the tag	USINT
	Communication Rack No.	Appoint the communication rack No. [ 0~3] of the tag	USINT
	Slave Station Address	Appoint the slave station address [0~255] of the tag	USINT
	Data Block No.	Appoint the data block No. [0~63] of the tag	USINT
	The Offset Address of the Tag in the Data Block	Appoint the offset address of the tag in the data block	USINT
Signal Conversion Process	Input Negate	Disable/Enable	BOOL
Alarm Settings	ON Status Alarm	Disable/Enable (optional)	BOOL
	ON Status Alarm Priority	Select the alarm level from drop-down menu. The optional alarm levels are configured in the global settings.	USINT
	ON Status Alarm TON (s)	Input values manually	REAL
	ON Status Alarm TOFF (s)	Input values manually	REAL
	OFF Status Alarm	Disable/Enable (optional)	BOOL
	OFF Status Alarm Priority	Select the alarm level from drop-down menu. The optional alarm levels are configured in the global settings.	USINT

**Table 3.20 DI Tag Property Table (continued)**

Category	Setting Item	Properties	Type
	OFF Status Alarm TON (s)	Input values manually	REAL
	OFF Status Alarm TOFF (s)	Input values manually	REAL
	Positive Transition – sensing Alarm	Disable/Enable (optional)	BOOL
	Positive Transition – sensing Alarm Priority	Select the alarm level from drop-down menu. The optional alarm levels are configured in the global settings.	USINT
	Negative Jump Alarm	Disable/Enable (optional)	BOOL
	Negative Jump Alarm Priority	Select the alarm level from drop-down menu. The optional alarm levels are configured in the global settings.	USINT
	Fault alarm	Enable	BOOL
	Fault Alarm Priority	Select the alarm level from drop-down menu. The optional alarm levels are configured in the global settings.	USINT
Tag Fault Processing	Fault Safety Switch	Enable/Disable	REAL
	Fault Processing	Hold/Set ON/Set OFF(optional)	USINT
Communication Fail Alarm	Communication Fail Alarm TON (s)	Input values manually	BOOL
Cold start SWAM mode configuration	Cold start SWAM mode configuration	Hold/Force/Unforce	USINT
Supervision Settings	Tag Group	Tag Grouping 0~31 (optional)	USINT
	Tag Level	Tag level 0~9 (optional)	USINT
	Alarm Level	level 0(Low)~31(High) (optional)	-
	ON Description	Input ON status description	STRING
	OFF Description	Input OFF status description	STRING
	Color Configuration	Configure ON/OFF color on the tag panel. Select "Custom Configuration" to configure the ON/OFF color of tag panel in ON/OFF color selection area of monitor. Select "Global Default Configuration" and	BOOL

**Table 3.20 DI Tag Property Table (continued)**

Category	Setting Item	Properties	Type
		the ON/OFF color on panel of monitor will be displayed in the color configuration in system structure configuration software.	
	Panel	DI tag can set the panel as custom panel or system original panel.	STRING
SOE Settings (When tag type is Normal DI Tag)	SOE Tag	No/Yes (optional)	STRING
	SOE Description	When SOE Tag is "Yes", input characters within 64	
	SOE Device Group	When SOE Tag is "Yes", input characters within 24	

### 3.3.3 Tag Debugging Parameters

In VFExplorer, click “tag debug” to enter the online debugging mode as shown in Figure 3.8. Parameters of DI tags to debug and their description are shown in the table below.

**Table 3.21 Tag Configuration Software Debugging Parameters**

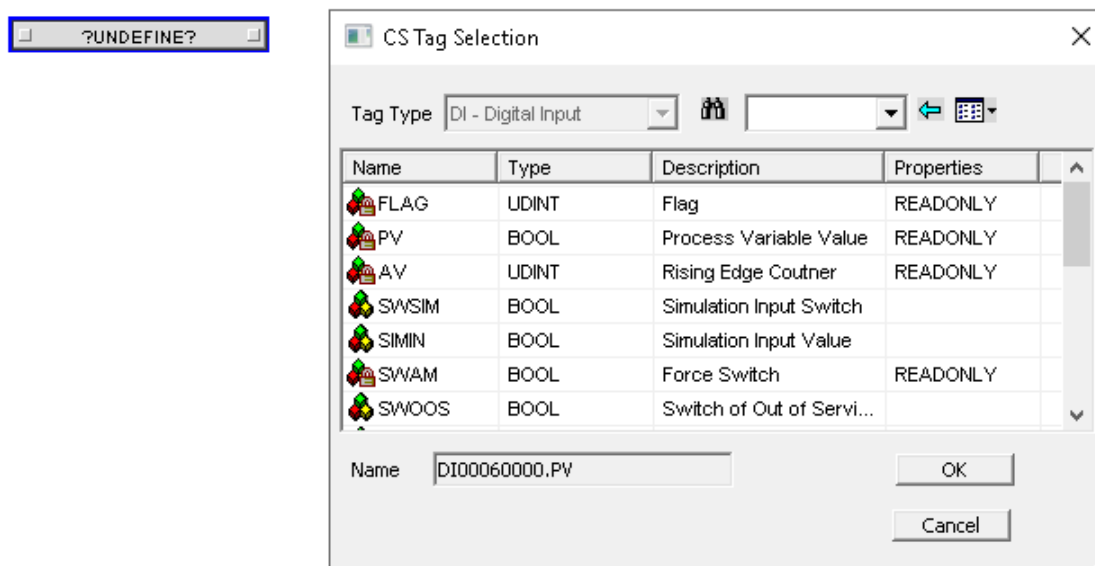
Parameter Name	Type	Description
Input Signal Parameter		
FLAG	UDINT	Flag
PV	BOOL	Process Variable Value
AV	UDINT	Rising Edge Counter
SWSIM	BOOL	Simulation Input Switch
SIMIN	BOOL	Simulation Input Value
SWAM	BOOL	Force Switch (ON=Unforced, OFF=Force)
SWOOS	BOOL	Switch of Out of Service (ON=Disable, OFF=Enable)
Config Parameter		
IVO	BOOL	Input Negate (ON=Negate, OFF=Nonnegate)
Up Jump Accumulation Parameter		
AVRST	BOOL	Reset Command

**Table 3.21 Tag Configuration Software Debugging Parameters (continued)**

Parameter Name	Type	Description
		(Reset AV When up Jump)
AVSTRT	BOOL	Start/Stop Command (ON=Start, OFF=Stop)
Alarm Parameter		
ENALM	UDINT	Alarm Enabled D8: ON Status Alarm; D9: OFF Status Alarm D10: Up Jump Alarm; D11: Down Jump Alarm
AOF	BOOL	Shield Alarm
Other Parameters		
CHAN_EXIST	SINT	Channel Exists Tag (0=No Exist, 255=Exist)
CHK_CODE	INT	Channel Check Code
ERR	BOOL	Tag Status Flag (ON=Bad)
ERRVAL	USINT	(when unforced and non-simulation status) Tag Value Selection When Fault: 0=Hold, 1=Set ON, 2=Set OFF
RAWVAL	BOOL	Field Original Value

### 3.3.4 Refereceable Parameters for Custom Programs

In the custom application configuration, by specifying the tag and selecting the corresponding auxiliary parameters, the relevant variables or states can be directly referenced in the custom application, as shown in the following figure.



**Figure 3.23** An example of calling DI tags in custom programs

Parameters of DI tags to call in custom programs and their property are shown in the table below.

**Table 3.22** Parameters Custom Programs able to call (DI)

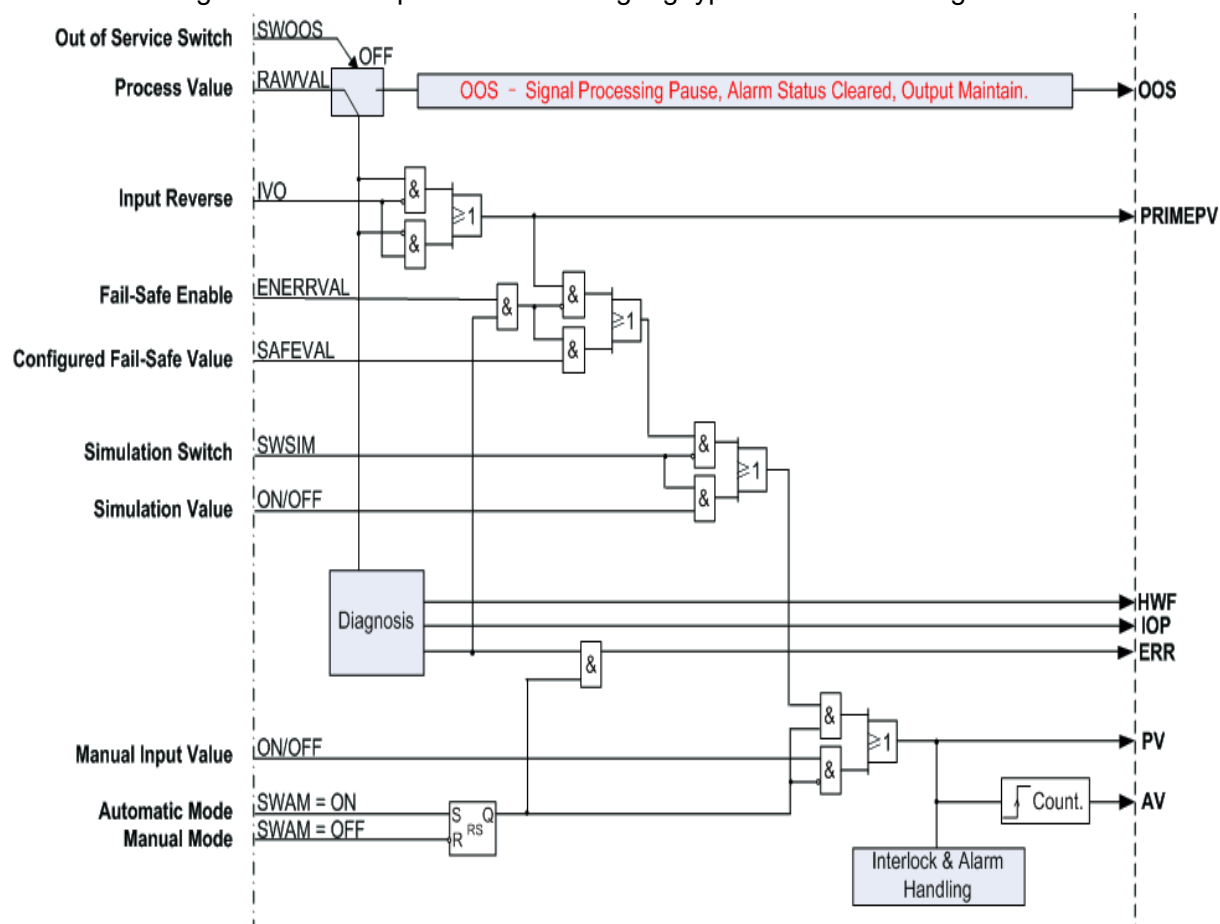
Parameter Name		Type	Initial Value	Description
Output Pins	PV	BOOL	OFF	Process Variable Value
	ERR	BOOL	OFF	Status Flag:ON=Bad(Forced Status OFF When Bad)
	ERR_R	BOOL	OFF	Hardware Status Flag:ON=Bad (Forced Status ON When Bad)
	AV	UDINT	0	Rising Edge Counts Cumulation
Monitoring parameters	SWAM	BOOL	ON	Force Switch:OFF=Force,ON=Unforce
	SWSIM	BOOL	OFF	Simulation Input Switch:ON=Simulation Input,OFF=Module Input
	SWOOS	BOOL	OFF	Switch of Out of Service:ON=Disable,OFF=Enable
	FLAG	UDINT	0	Flag
Operational Parameters	ON_TON	REAL	0	ON Status Alarm TON(s)
	ON_TOFF	REAL	0	ON Status Alarm TOFF(s)
	OFF_TON	REAL	0	OFF Status Alarm TON(s)
	OFF_TOFF	REAL	0	OFF Status Alarm TOFF(s)

**Table 3.22 Parameters Custom Programs able to call (DI) (continued)**

Parameter Name		Type	Initial Value	Description
	AVRST	BOOL	OFF	Rising Edge Counts Cumulation Reset Switch:ON=Reset
	AVSTRT	BOOL	OFF	Rising Edge Counts Cumulation Start Switch:ON=Start
	SIMIN	BOOL	OFF	Simulation Input Value
	COMM_ - TON	REAL	0	Communication Fail Alarm TON(s)
Alarm Para- meters	ENALM	UDINT	0	Alarm Enable

### 3.3.5 Normal Tag Function

When the configuration item “input channel setting/tag type” is “Normal DI tag”

**Figure 3.24 DI function diagram**

OOS

When the input signal is in the unused state, the OOS switch can be used to avoid further processing of the input signal. The tag cannot be operated on if in the OOS state, the corresponding alarm item is neither triggered nor recorded, and the tag state remains (program can be called).

### DI Input Inversion

When IVO = ON, the input DI original value RAWVAL is reversed, but the value of RAWVAL is not changed; when IVO = OFF, the input DI original value will not be processed and output directly.



**TIP:**

**In the force status, inversion is invalid.**

### Fail-safe Processing

When DI detects an input signal failure, it sets the signal to a safe value if the fail-safe process is effective.

Input fault status includes module fault, communication fault, channel fault (NAMUR type input), etc. The security value ERRVAL can be configured and configured, including:

ENERRVAL	ERRVAL	PV
ON	Hold	Hold
	Set ON	Set ON
	Set OFF	Set OFF
OFF	-	Sample values

### Simulation Input

DI supports simulation input.

After the input signal is inversed, the module output can be from the real-time input or the simulated input (SIMIN), you can select one mode through the simulated input switch SWSIM. SIMIN can be set manually from the panel or from the FBD debugging interface, or from other function blocks. The simulation input does not affect the state of the original value output RAWVAL.

### Process in force status

When SWAM is OFF, it enters the force status. In this case, DI output directly is directly taken from the input of the operator panel.

### Accumulator of rising

DI tag can count positive jumps of input digital. If the rising edge accumulation switch AVSTRT is ON, AV is added by 1 when a positive jump is checked. If the rising edge accumulation switch AVSTRT is OFF, rising accumulation is stopped.

When the rising edge of AVRST command is received by DI tag, AV will be reset.



---

**TIP:**

**In the forced, simulated and fail-safe status, the rising edge accumulation and signal alarm are the same as the normal state.**

---

### Alarm processing

- Fault alarm

When the system detects input module fault, channel fault (open and short, NAMUR type input) or communication fault. Set fault alarm ON (ERR and ERR\_R), where ERR remains OFF when the signal is in the forced status.

Note: ERR alarm is not generated in the controller debugging state.

- Status alarm

The DI tag supports the alarm of the ON / OFF status of the input signal.

- Jump alarm

The DI tag supports independent setting of positive transition (RJUMP) or negative transition alarm (FJUMP) of the input signal.

- Alarm Suppress

When the alarm suppression option is selected, the corresponding alarm item is only recorded without real-time alarm prompt.

- Communication tag fault alarm

The fault alarm function of DI communication tags is similar as that for AI communication tags. For details, see "Communication Tag Function".

- Alarm delay

The DI tag has a signal alarm delay function. For descriptions of ERR alarm delay and alarm clear delay functions of general and communication tags, refer to .

### 3.3.6 Flag



**Table 3.23 DI flag code**

Flag code	Monitor Assignment	Explain	Type
D3	Disable	Flick Alarm(FLICK)	Status
D4	Disable	Fault(ERR)	Alarm
D5	Disable	FORCE(FORCE)	Status
D6	Enable(SWOOS)	Disable(OOS)	Status
D7	Disable	Simulation (SIMUL)	Status
D8	Disable	ON Status Alarm(ON)	Alarm
D9	Disable	OFF Status Alarm(OFF)	Alarm
D10	Disable	Positive Jump Alarm(RJUMP)	Alarm
D11	Disable	Negative Jump Alarm(FJUMP)	Alarm
D12	Enable(AOF)	Shield Alarm(AOF)	Status
D17	Disable	Hardware Fail (HWF)	Status
D18	Disable	Broken Line or Short Circuit Alarm(IOP)	Status

## 3.4 Digital Output Tag (DO)

The switch control output is output to the DO module via the DO tags, which in turn controls on-site devices such as switch valves and motors. The output of the DO tags can also be converted into a communication signal output (Modbus RTU, Modbus TCP, PROFIBUS, PROFINET, EtherNet/IP).

### 3.4.1 Tag Panel

The panel of DO tag is basically the same as the panel of DI tag. Please refer to "Figure 2.6", no more details here.

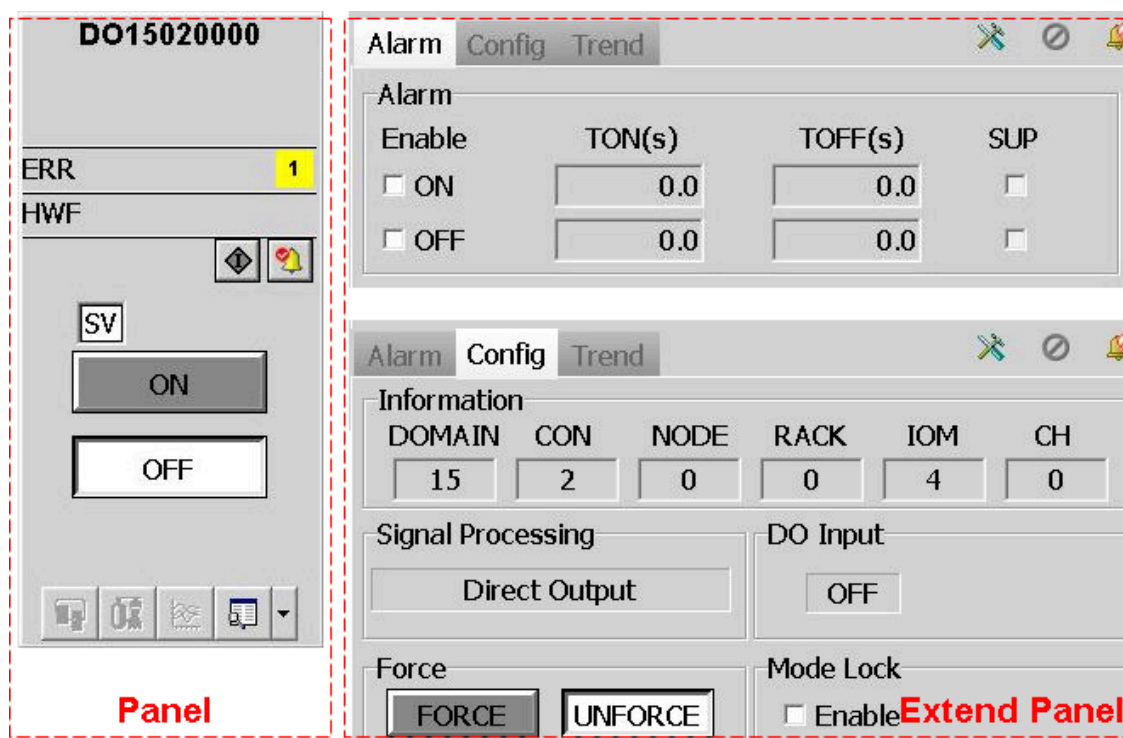


Figure 3.25 DO Tag Expansion Panel

### Alarm bar/real-time value/status bar instruction

The alarm bar, real-time value and status bar of DO panel will display different values as per the external environment and the module status.

When the fault is communication break and the panel status bar displays HWF, in the monitor screen, in “hardware fault list” in the system status list you can see the DO tags in the fault status. When the fault is DO in the open circuit and panel status bar displays OOP, in the monitor screen, in “DO circuit fault list” in the system status list you can see the DO tags in the fault status.

Table 3.24 DO panel display abnormality

DO Panel			System Diag-nostics	Abnormity
Alarm bar	Realtime value	Status bar		
ERR	Fail-safe value	HWF	Module fault	AO module fault
			Module lost	Controller lost communication with AO module
		OOP	Channel fault	AO is in the open circuit or in the short circuit

### Other parameter instruction on panel

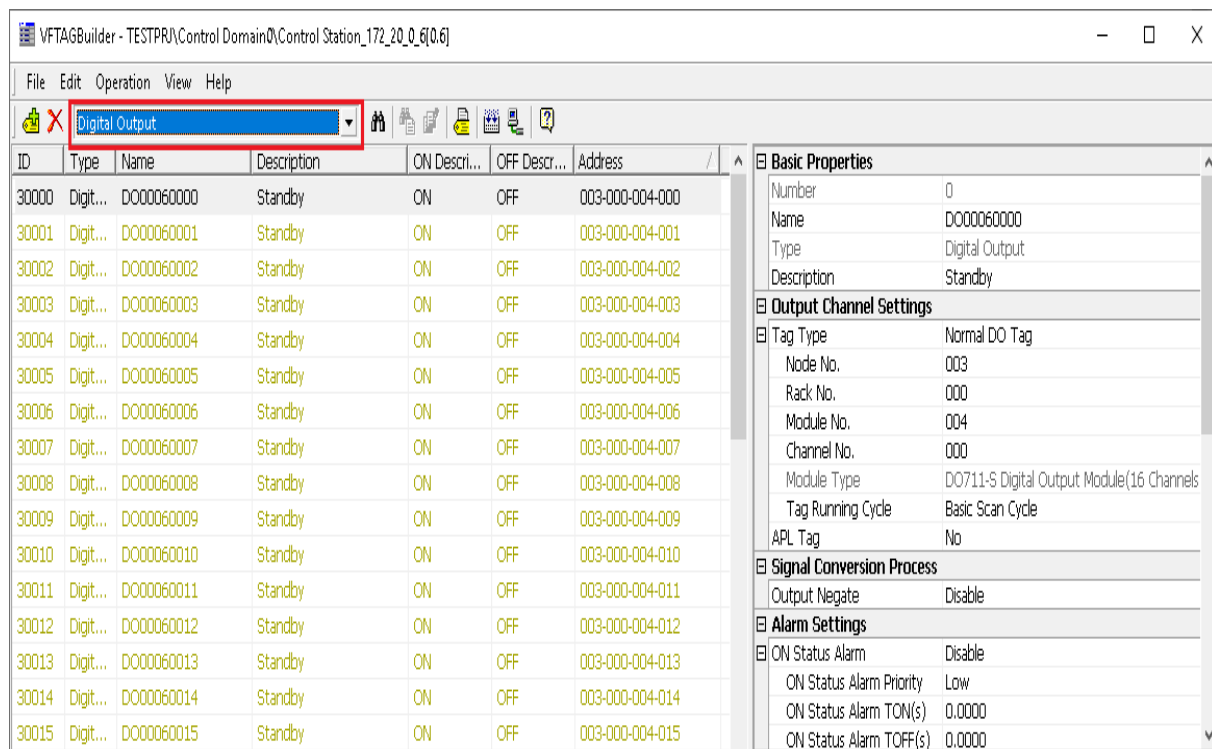
For details of the icons in the panel, refer to "Icon Description".

**Table 3.25 Panel Parameter Description**

Panel Parameter Name			Application Description
Alarm	Alarm	Enable	Whether or not to enable alarm
		TON	Alarm delay time
		TOFF	Alarm elimination delay time
		Suppression	The suppression condition of alarms
settings	Address	It is used to display the tag domain address, station address, node address, rack address, module address and the channel number.	
	Signal	Direct output	Output
	DO input	OFF	Program command input (OFF=close, ON=open)
	Force	FORCE/UNFORCE	Force switch, OFF = force, ON = unforce
	Mode lock	Enable	Mode lock (ON=lock., OFF=unlock)

### 3.4.2 Tag Table Management

In VFTAGBuilder, you can select "Digital Output" to configure the property of DO tags according to the figure below.



**Figure 3.26 DO configuration interface**

Property of DO tags is configured at the right side of the interface shown above and the configuration description is shown in the table below.

**Table 3.26 DO Tag Property Table**

Category	Setting Item	Properties	Type
Basic Properties	Number	Determined when a tag is added and can't be modified here.	-
	Name	Can be modified manually.	-
	Type	DO (It can't be modified)	-
	Description	Tag instruction and can be input manually	STRING
Output Channel Settings(when tag type is Normal DO Tag)	Tag Type	Normal DO Tag	USINT
	Node No.	[0~31 ] input manually	USINT
	Rack No.	[0~3] (input manually)	USINT
	Module No.	[0~15] (input manually)	USINT
	Channel No.	[0~31] (input manually)	USINT
	Module Type	Accord with the hardware configuration	-
	Tag Running Cycle	Fast Cycle/ Basic Scan Cycle (optional)	-

**Table 3.26 DO Tag Property Table (continued)**

Category	Setting Item	Properties	Type
Output Channel Setting (when tag type is Communication DO Tag)	Tag Type	Communication DO tag (Optional)	USINT
	Communication No.	Appoint the communication node No.[ 0~31] of the tag	USINT
	Communication Rack No.	Appoint the communication rack No. [0~3] of the tag	USINT
	Slave Station Address	Appoint the slave station address [0~255] of the tag	USINT
	Data Block No.	Appoint the data block No. [0~63] of the tag	USINT
	The Offset Address of the Tag in the Data Block	Appoint the offset address of the tag in the data block	USINT
Signal Conversion Process	Output Negate	Disable/Enable (optional)	-
Alarm Settings	ON Status Alarm	Disable/Enable (optional)	BOOL
	ON Status Alarm Priority	Select the alarm level from drop-down menu. The optional alarm levels are configured in the global settings.	USINT
	ON Status Alarm-TON (s)	Input values manually	REAL
	ON Status Alarm TOFF (s)	Input values manually	REAL
	OFF Status Alarm	Disable/Enable (optional)	BOOL
	OFF Status Alarm Priority	Select the alarm level from drop-down menu. The optional alarm levels are configured in the global settings.	USINT
	OFF Status Alarm TON (s)	Input values manually	REAL
	OFF Status Alarm TOFF (s)	Input values manually	REAL
	Interlock track alarm	Disable/Enable (optional)	BOOL
	Interlock track alarm priority	Select the alarm level from drop-down menu. The optional alarm levels are configured in the global settings.	USINT
	Fault alarm	Enable	BOOL

**Table 3.26 DO Tag Property Table (continued)**

Category	Setting Item	Properties	Type
	Fault Alarm Priority	Select the alarm level from drop-down menu. The optional alarm levels are configured in the global settings.	USINT
Communication Fail Alarm	Communication Fail Alarm TON (s)	Input values manually	REAL
Cold Start SWAM Mode	Cold Start SWAM Mode	Hold/Force/Unforce	-
Supervision Settings	Tag Group	Tag Grouping 0~31 (optional)	USINT
	Tag Level	Tag level 0~9 (optional)	USINT
	Panel	DO tag can set the panel as custom panel or system original panel.	-
	ON Description	ON status description	-
	OFF Description	OFF status description	STRING
	Interlock tag	Input names manually	STRING
SOE Settings (When the tag type is Normal DO Tag)	SOE Tag	No/Yes (optional)	STRING
	SOE Description	When SOE Tag is "Yes", input characters within 64	BOOL
	SOE Device Group	When SOE Tag is "Yes", input characters within 24	STRING

### 3.4.3 Tag Debugging Parameters

In VFExplorer, click "tag debug" to enter the online debugging mode as shown in "Figure 3.8".

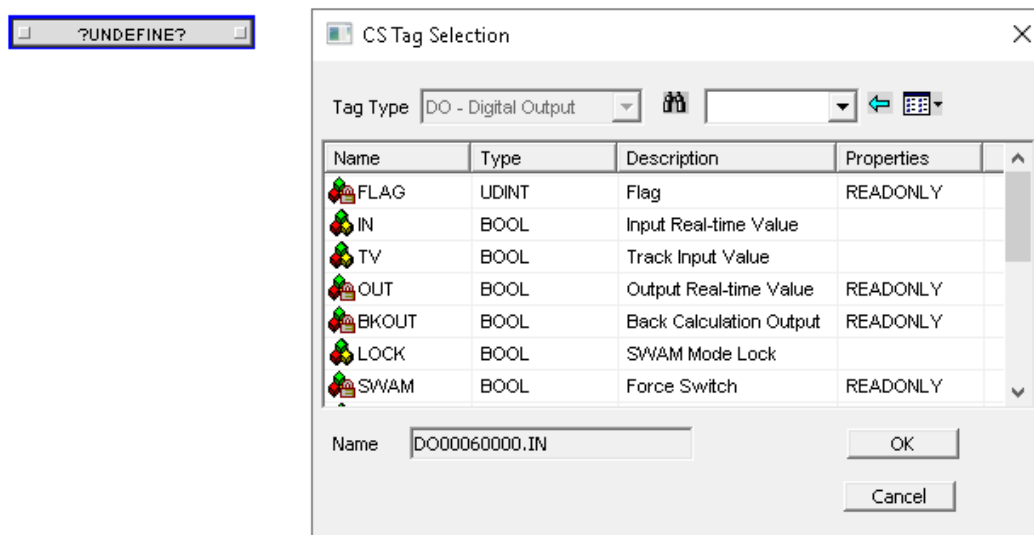
Parameters of DO tags to debug and their description are shown in the table below.

Parameter Name		Type	Description
Parameter of Output Signals	FLAG	UDINT	Flag
	IN	BOOL	Input Real-Time Value
	TV	BOOL	Track Input Value
	OUT	BOOL	Output Real-Time Value
	BKOUT	BOOL	Back Calculation Value

Parameter Name		Type	Description
	SWAM	BOOL	Force Switch (ON=Unforced, OFF=Force)
	SWTR	BOOL	Track Switch (ON=Tracking, OFF=No Tracking)
	SWOOS	BOOL	Switch of Out of Service (ON=Disable, OFF=Enable)
Configuration Parameters	IVO	BOOL	Input negate (ON=Negate, OFF=Un-Negate)
Alarm Parameters	ON_TON	REAL	ON status alarm delay
	ON_TOFF	REAL	ON status alarm elimination delay
	OFF_TON	REAL	OFF status alarm delay
	OFF_TOFF	REAL	OFF status alarm elimination delay
	COMM_TON	REAL	Communication fail alarm delay
	ENALM	UDINT	Alarm Enabled D8:ON Status Alarm; D9:Offstatus Alarm
	AOF	BOOL	Shield Alarm ON=Don't Show Real-Time Alarm; OFF=Show Real-Time Alarm
Other Parameters	CHAN_EXIST	SINT	Channel Exists Tag (0=Non-Exist, 255=Exist)
	CHK_CODE	INT	Channel Check Code
	REALFAST	BOOL	Fast Cycle Schedule
	BKOUTERR	BOOL	Back Calculation Output Status
	SWSAFESET	BOOL	Fail-safe function ON= Enable, OFF= Disable
	SAFEVAL	BOOL	Fail safety value
	COLD_OPT	USINT	Cold start SWAM mode

### 3.4.4 Refereceable Parameters for Custom Programs

In custom programs, users can call data and apply them on DO tags as shown in the figure below.



**Figure 3.27** An example of calling DO tags in custom programs

Parameters of DO tags to call in custom programs and their property are shown in the table below.

**Table 3.27** Parameters Custom Programs able to call (DO)

Parameter Name		Type	Initial Value	Description
Input pins	IN	BOOL	OFF	Input Value
	TV	BOOL	OFF	Tracking Input Value
Output pins	OUT	BOOL	OFF	Output Value
	BKOUT	BOOL	OFF	Feedback value output
	BKOUTERR	BOOL	OFF	Inversion Calculation Output Status
Monitoring parameters	Lock	BOOL	OFF	Mode lock: OFF=Unlock, ON=lock. When lock=on, you cannot switch modes.
	SWAM	BOOL	OFF	Force Switch OFF=Force, ON=Unforced
	SWOOS	BOOL	OFF	Tag Disable Switch ON=Disable, OFF=No Disable
	SWTR	BOOL	OFF	Tracking Switch ON=Tracking, OFF=No Tracking
	ACK	BOOL	OFF	Output origin track alarm confirmation
	AOF	BOOL	OFF	Shield Alarm

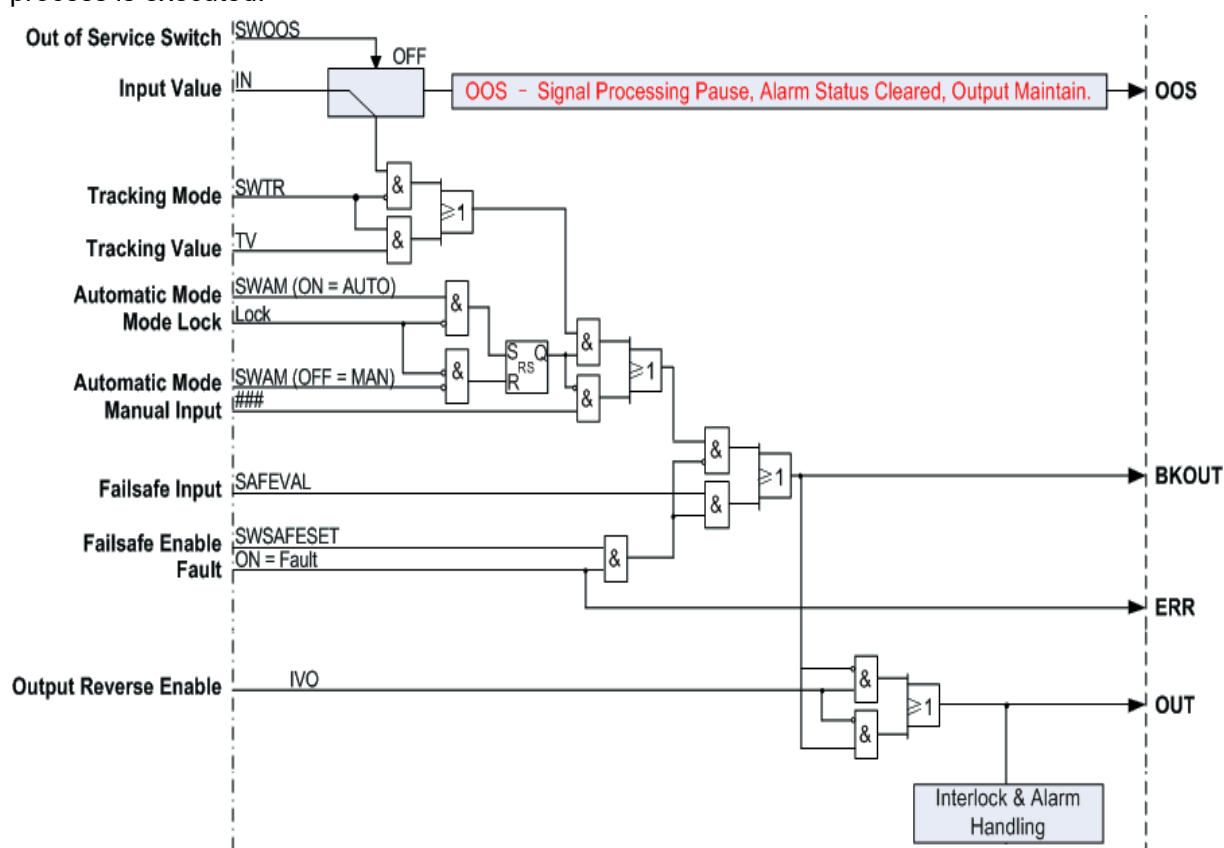


**Table 3.27 Parameters Custom Programs able to call (DO) (continued)**

Parameter Name		Type	Initial Value	Description
	FLAG	UDINT	0	Flag code
Operational Parameters	ON_TON	REAL	0	ON status alarm delay (s)
	ON_TOFF	REAL	0	ON status alarm elimination delay (s)
	OFF_TON	REAL	0	OFF status alarm delay (s)
	OFF_TOFF	REAL	0	OFF status alarm elimination delay (s)
	COMM_TON	REAL	0	Communication fault alarm delay (s)
Alarm Parameters	ENALM	UDINT	0	Enable alarm

### 3.4.5 Normal tag Function

When the configuration item “input channel setting/ tag type” is “Normal DO Tag”, the normal tag process is executed.

**Figure 3.28 DO function diagram**

**OOS**

When the output signal is in the unused state, the OOS switch can be used to avoid further processing of the output signal. The tag cannot be operated on in the OOS state, the corresponding alarm item is neither triggered nor recorded, and the tag status is remained (program can be referenced).

### Output track

When SWTR = ON, the output OUT tracks the TV input value. When the on-site equipment needs to be repaired and set to hardware consoler, it can be introduced into the TV through a DI measuring point and SWTR = ON, so that the DO tag output tracks the status of the on-site equipment.

### Force status processing

If SWAM = OFF, it means to enter the forced state and set the forced flag in the quality code. At this time, the DO tag output will not be updated with the input parameter IN and can be set manually.

If SWAM = ON, it means that it is in an unforced state. At this time, after the input parameter IN is processed, the DO output is updated.

### Fail-safe

The system diagnoses the output signal and the communication status as the FAULT input DO tags. The output of the DO tag will be output in the optional safe status in the FAULT status. This function can be disabled.

### Negation Process

When IVO=ON is satisfied, it will send the OUT parameter to the DO module after the negation process.



---

**TIP:**

**When Negate is set in force status, value set manually is output to DO module after negating.**

---

### Output Inversion Calculation

In some control modes (such as OOS, force, track, and fail-safe states), the output of the DO tag has nothing to do with the corresponding input (IN) state. In order to avoid control mode switching (the above state and normal control mode) directly leading to the change of the output. the DO

tag provides the output inversion calculation function. The value inversed (BKOUT) is equal to the input (IN) value corresponding to the current output (OUT) and is used as the BKIN input value of the upstream function block of DO. When DO tag is in the status of OOS, track, force, fail-safe, it can make the upstream control module enter IMAN status by BKOUTERR and set its output to the output inversion calculation of DO by BKIN.

### Alarm processing

The DO tag provides an output status alarm function. Both the generation and elimination of status alarms provide delay options to avoid the repetitive alarms due to signal jitter. For descriptions of ERR alarm delay and alarm clear delay functions of general and communication tags, refer to "Alarm Process".

### Communication Tag Fault Alarm

The fault alarm function of DO communication tags is similar to that for AI communication tags. For details, see "Fault alarm of communication tag".

## 3.4.6 DO Flag

**Table 3.28 DO flag list**

Flag	Monitor assignment	Illustration	Type
D4	Disable	Fault (ERR)	Alarm
D5	Disable	Force (FORCE)	Status
D6	Allow (SWOOS)	Disable (OOS)	Status
D8	Disable	ON status alarm (ON)	Alarm
D9	Disable	OFFstatus alarm (OFF)	Alarm
D10	Disable	Track (TR)	Alarm
D11	Allow (AOF)	Shield Alarm (AOF)	Status
D16	Disable	Hardware fault (HWF)	Status
D17	-	Interlock track (LTR)	Alarm

## 3.5 Monitoring Panel Description

IO tag panel includes tag information, alarm information, real time values and so on as shown in the figures below.

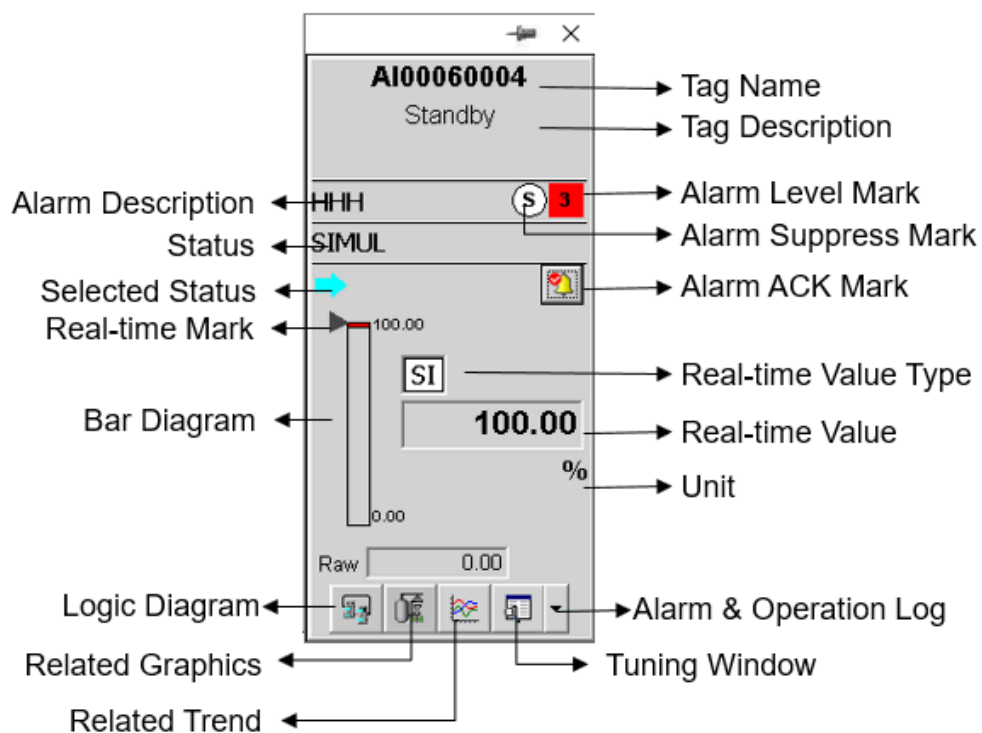


Figure 3.29 AI tag panel

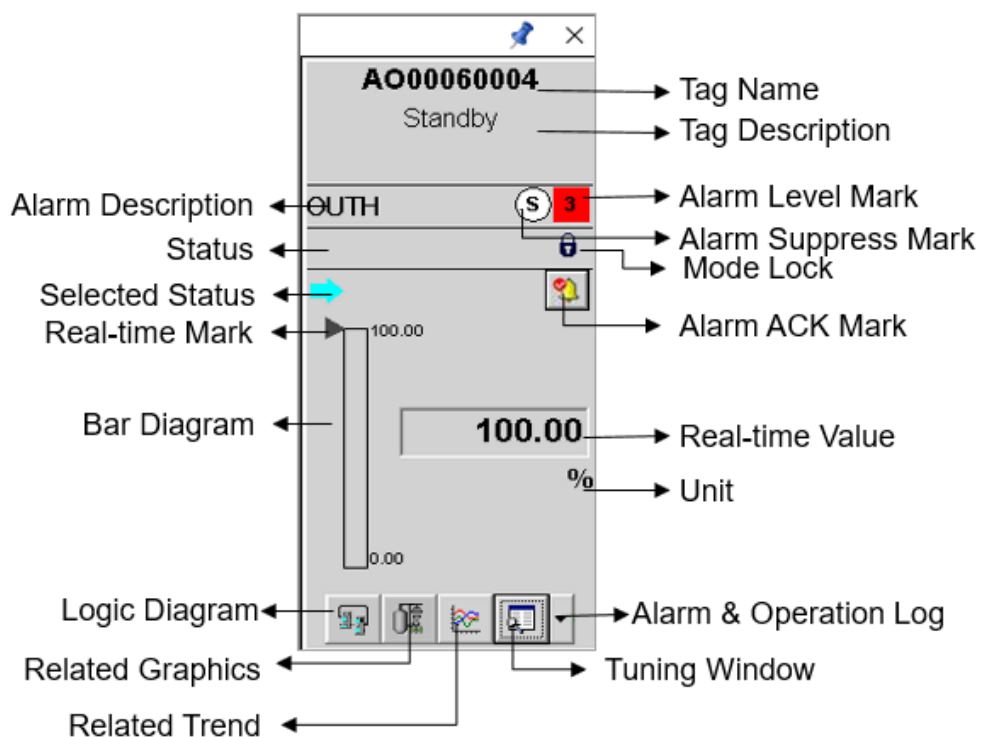
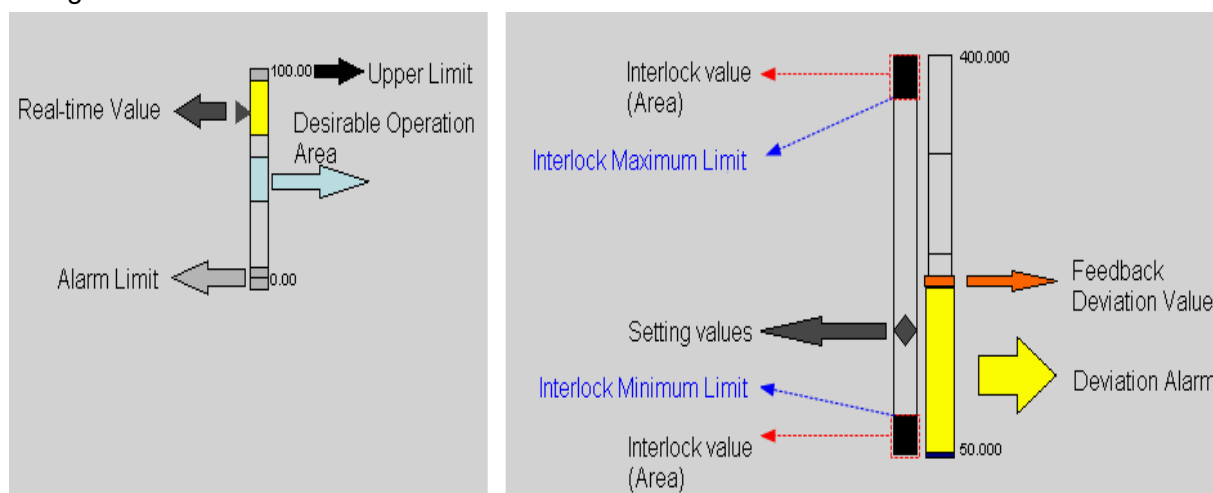


Figure 3.30 AO tag panel

### 3.5.1 Bar Graph

The bar graph includes the real time values, alarm limit, interlock values and so on as shown in the figure below.














**Figure 3.31 A Bar Graph Case (The left one is AIEX bar graph and the right one is PIDBX bar graph)**

- If the “Desirable operation area” is enabled (i.e. OPR\_EN=ON), the ideal operating area will be displayed.
- After “T\_PEAK” is set, the trend of the latest history segment will be displayed in the tag panel.
- After the display of the interlock area is enabled (function block with interlock function and SHOWCAS=ON being established), the interlock value will be displayed in the tag panel.
- After the feedback deviation value (i.e. SHOWMF=ON) is enabled, the feedback deviation value will be displayed in the tag panel.

### 3.5.2 Icon Description

Different icons on the panel indicate the status of different function blocks and the description is shown in the table below.

Icon	Function	Description
	Alarm Suppress Status Indication	When the alarm suppression is selected, this icon will be displayed. When no alarm suppression is selected, this icon will be not displayed.
	Real-time Value Type	<ul style="list-style-type: none"> <li>• SL: the current value is a force or simulation value. The panel displays simulation status, such as SIMUL.</li> <li>• SV: the current value is a fail-safe value. The panel displays fault status, such as HWF.</li> </ul>

Icon	Function	Description
	Mode Lock Indication	<ul style="list-style-type: none"> <li>Some tags have this status, such as AO or DO tags.</li> <li>When the mode lock is enabled, this icon will be displayed. In this case you are not able to click FORCE and UNFORCE buttons on the panel. It is noted that the operational authorization is set on the panel authorization software. For details, please refer to <i>User Access Software User Manual</i>.</li> <li>When the mode lock is not enabled, this icon will be not displayed and FORCE or UNFORCE buttons are available.</li> </ul>
	Interlock Indication	<p>When it is not interlocked or bypassed,  will be displayed.</p> <p>When it is interlocked and not bypassed,  will be displayed.</p> <p>When it is not interlocked or bypassed,  will be displayed.</p> <p>When it is interlocked and bypassed,  will be displayed.</p>
	Interlock of Allow Signals	<p>HVFC/HVFO/MOT panel have another interlock button representing the allow signal.</p> <p>When the signal is not allowed and bypassed,  will be displayed.</p> <p>When the signal is allowed and not bypassed,  will be displayed.</p> <p>When the signal is not allowed but bypassed,  will be displayed.</p> <p>When the signal is allowed and bypassed,  will be displayed.</p>

### 3.5.3 Other Functions

- Override Settings

When buttons such as mode switch button are locked therefore no operation is permitted, if you choose to enable overriding, these buttons will get operation permissions.

The operation permission of the override button is set in the panel authority software. For detailed operations, please refer to *User Access Software User Manual*.

- Alarm Suppression Settings

When an alarm is selected to be suppressed, the alarm information will be shielded.

- Alarm delay setting

TON (TOFF) is the alarm generation (elimination) delay, which represents the time delay from the alarm occurrence (disappearance) to the display of alarm occurrence (disappearance). The alarm delay has one decimal place.

## 4 Revision

**Table 4.1 Revision history**

Document Version	Applicable Product Version	Remarks
V1.0	OMC High-performanceHMI V4.70.00.00	First release.
V1.1	OMC High-performanceHMI V5.10.00.00	<ul style="list-style-type: none"><li>• Added "COMMCODE" to the AI tag parameter list under the FCU712-S controller.</li><li>• Added descriptions for HART parameters when FCU714 is used.</li></ul>