

FF Interface Module

AM712

User manual

IM23H49-E

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
Symbol Definition	
	WARNING: Indicates information that a potentially hazardous situation which, if not avoided, could result in serious injury or death.
	RISK OF ELECTRICAL SHOCK: Indicates information that Potential shock hazard where HAZARDOUS LIVE voltages greater than 30V RMS, 42.4V peak, or 60V DC may be accessible.
	ESD HAZARD: Indicates information that Danger of an electro-static discharge to which equipment may be sensitive. Observe precautions for handling electrostatic sensitive devices
	ATTENTION: Identifies information that requires special consideration.
	TIP: Identifies advice or hints for the user.

Table of Contents

FF Interface Module AM712	1
Section 1 Overview.....	1
Section 2 Specifications	3
Section 3 Usage.....	4
3.1 Module Unit Structure	4
3.2 Indicator LEDs	5
3.2.1 Indicator LEDs of AM712.....	5
3.2.2 Indicator LEDs of MB734-S	5
3.3 Wiring	5
Section 4 Application	7
4.1 Segment Components.....	7
4.1.1 FF Power Conditioner	7
4.1.2 FF Junction Box and Spur Module	8
4.1.3 FF Cable	9
4.1.4 FF Device.....	9
4.1.5 FF Surge Protector (Selectable).....	10
4.2 Segment Wiring Example	10
4.2.1 AM712-S Segment Wiring Example	10
4.2.2 AM712-P Segment Wiring Example	11
4.3 Terminal Resistor Setting.....	12
4.4 Notes	13
4.5 Troubleshooting	13
4.6 Segment Design.....	13
4.7 Segment Constraint.....	15
4.7.1 Distance Constraint	15
4.7.2 Power Consumption and Voltage Attenuation	16
4.7.3 Communication Process (Macrocycle)	17
Section 5 FF Configuration Application	18
Section 6 Revision.....	19

FF Interface Module AM712

Section 1 Overview

Fieldbus H1 interface module AM712 provides the communication interface for the fieldbus devices conforming to the FF standards and ECS-700 or i-OMC system.

In the network, AM712 is in the layer of I/O modules, and connects the Fieldbus devices with system via L-BUS. One control station can commission maximum 64 pairs or 64 non-redundant AM712 modules.

AM712 can acquire the real-time input (output) data of FF device and send them to the controller, to achieve the centralized control for FF device. AM712 supports demoting control to the field device to achieve decentralized control. It also supports standard FF function blocks and manages all block parameters of field devices via the FF configuration software and SAMS device management software.

AM712 has 2 kinds of models: AM712-P and AM712-S. AM712-P integrates FF power conditioner and external FF power conditioner is not necessary; AM712-S integrates no FF power conditioner and external FF power conditioner is necessary.

FF H1 interface module unit (module unit in short below) is made up of AM712 and fieldbus H1 interface module base MB734-S.

The position of AM712 in ECS-700 is shown in Figure 1-1.

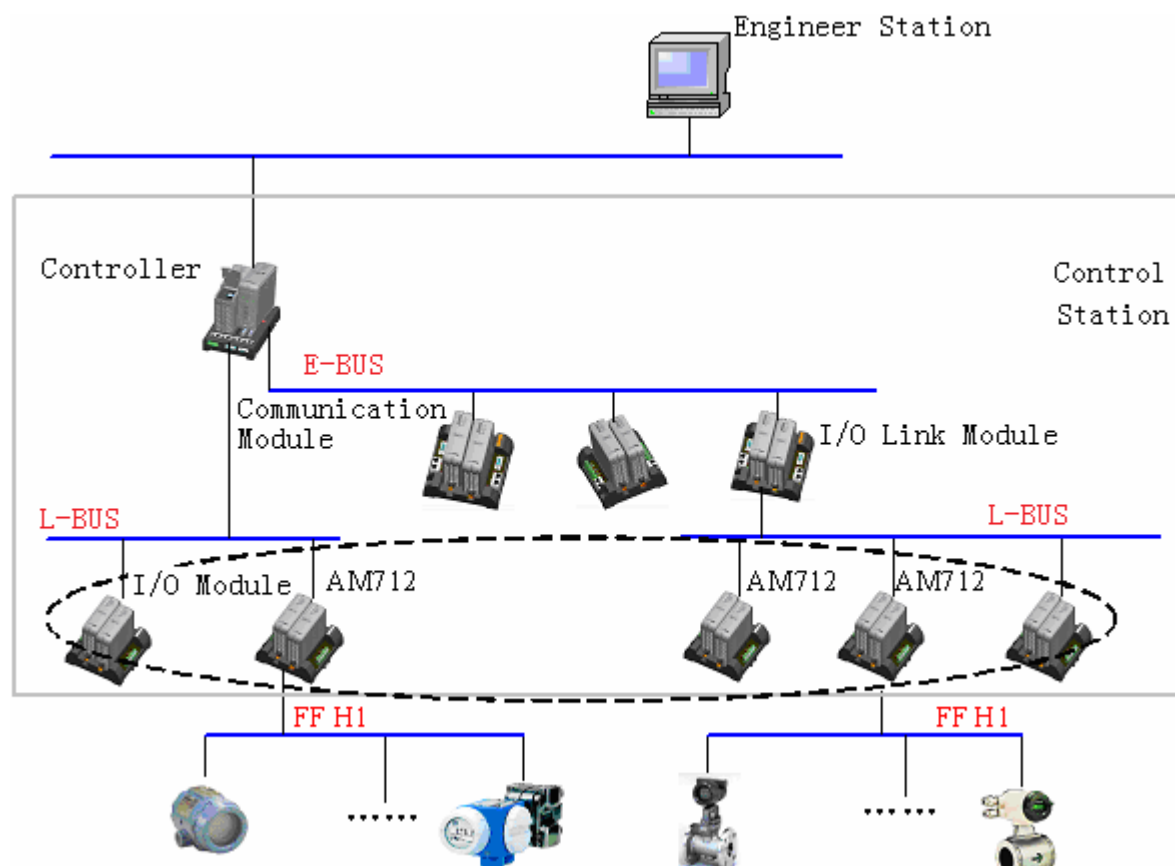


Figure 1-1 AM712 in ECS-700 system

The features of AM712 are shown below:

- Support 2 independent Fieldbus H1 Segments.
- Support module redundancy.
- Support module hot swapping.
- Support all Filebus H1 devices certified by Fieldbus Foundation.
- Support whole segment download for FF configuration.
- Support alarm and communication diagnosis.
- Support data retention with Nonvolatile memory

Section 2 Specifications

Table 2-1 Specifications

Parameter	Specifications
FF H1 Segment Connection	2 Segments
FF H1 Device Maximum Connection for Single Segment	16 FF Devices
FF H1 Segment Wire Maximum Length	1900m (Include Spur Length)
Redundant Recovery Time	<10s
Power Supply/ Explosion-protection	Bus Power Supply/ Intrinsically Safe Explosion-protection
Input and Output Connection Supported by Segment	50
Input Tags Supported by AM712	80
Output Tags Supported by AM712	40
Local I/O Communication Rate	1Mbps
FF H1 Communication Rate	31.25Kbps
Rack Power Rated Voltage	24V
Power Consumption	AM712-S: 0.6W AM712-P: 6.5W ¹
FF H1 Rated Voltage (Only for AM712-P)	24V
FF H1 Maximum Current Output (Only for AM712-P)	350mA
IP Protection Level	IP30



Attention:

1: As Fieldbus H1 devices are powered by AM712-P, the power consumption of AM712-P is influenced by the current of H1 segments. The consumption of a module is 6.5 W, when AM712-P configures redundantly and current of each H1 segment is 200 mA (about 8~12 Fieldbus devices).

Section 3 Usage

3.1 Module Unit Structure

FF H1 interface module unit consists of the module AM712 and the base MB734-S. Appearance of the unit structure is shown in Figure 3-1.

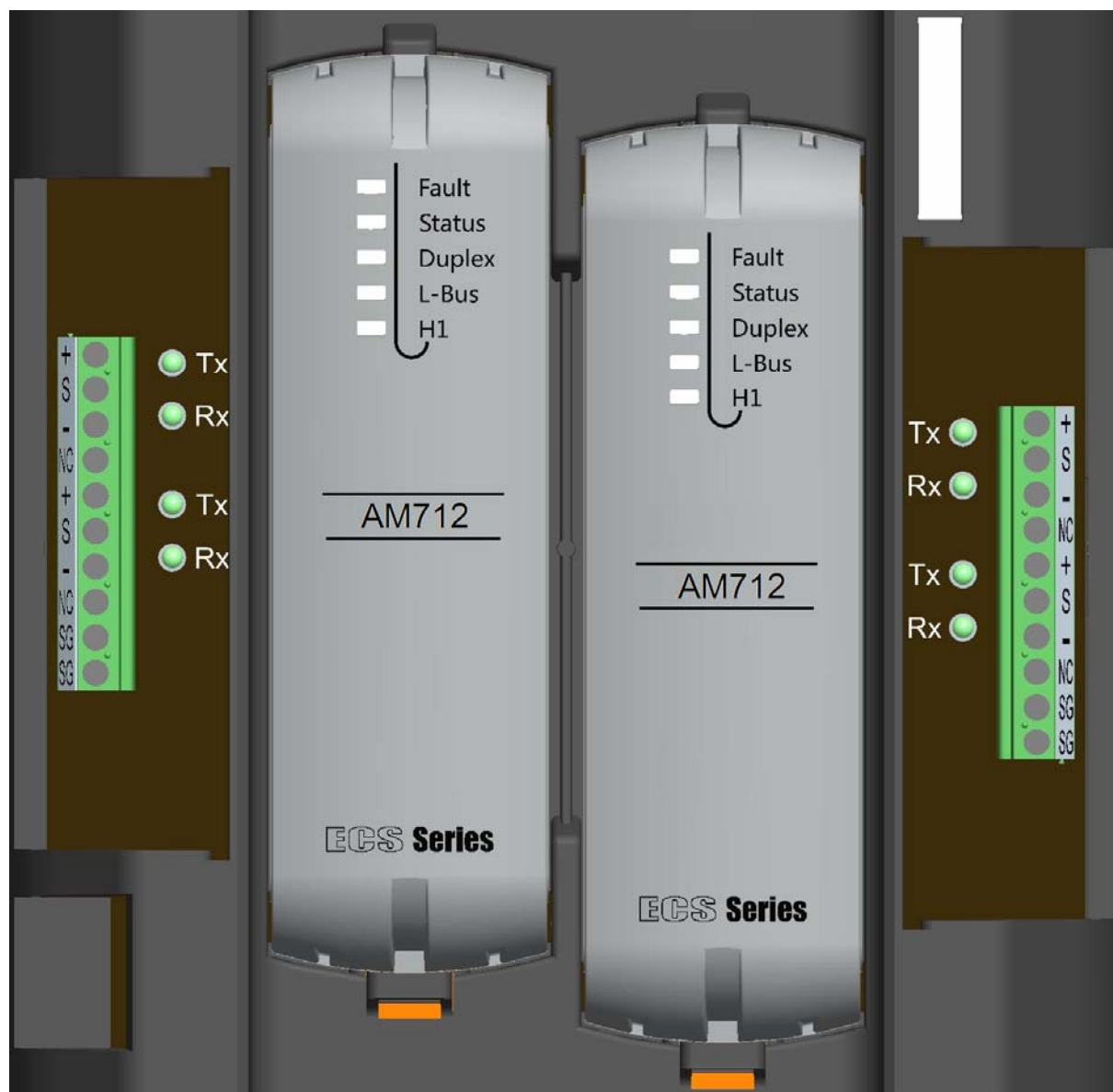


Figure 3-1 Appearance of FF H1 interface module unit

Compare the module units of AM712-P and AM712-S, main differences are shown below:

- The power conditioner of segment is integrated in AM712-P module unit. The instruction

of power supply please refers to FF Power .

- The terminal resistor is integrated in AM712-P module unit. The configuration of terminal resistor please refers to Terminal Resistor Setting.
- AM712-P module unit can supply power for devices in bus.

3.2 Indicator LEDs

3.2.1 Indicator LEDs of AM712

Table 3-1 Indicator LEDs of AM712

LED	Normal	Abnormal	Instruction for Abnormal
Fault	OFF	ON	Serious Fault
		Flash	——
Status	ON	OFF	Module Not Powered
		Flash in 2s	Module Cold Started
		Flash in 400ms	Configurasion Error
Duplex	ON		Work Module
	OFF		Standby Module
L-Bus	ON	OFF	Both L-BUS Channels Fault
		Flash	Address Conflict on L-BUS
H1	ON	OFF	Both H1 Segments Fault
		Flash	One of H1 Segments Fault

3.2.2 Indicator LEDs of MB734-S

Table 3-2 Indicator LEDs of MB734-S

LED	Normal	Abnormal	Instruction for Abnormal
Tx	Flash	OFF	No H1 Signal is Sending
Rx	Flash	OFF	No H1 Signal is Receiving

3.3 Wiring

In redundant mode, a pair of redundant AM712 can be installed in the FF interface module base MB734-S. In non-redundant mode, only one AM712 can be installed in MB734-S.

There are 10 terminals in each side of the base, as shown in Figure 3-1. The corresponding terminals on left and right are connected directly in the base and the user can wire on left, right or

both sides as required. There are 4 indicator LEDs between the terminals and module slots in both sides. The indicator LEDs will work when AM712 is plugged in the slot of this side.

The instruction of terminal and indicator light are shown in Figure 3-2. The terminal instruction is shown in Table 3-3.

Table 3-3 Terminal instruction

Left Terminals		Instruction	Right Terminals	
No.	Sign		Sign	No.
1	+	Positive of Segment0	+	1
2	S	Shield of Segment0	S	2
3	-	Negative of Segment0	-	3
4	NC	Not Connect	NC	4
5	+	Positive of Segment1	+	5
6	S	Shield of Segment1	S	6
7	-	Negative of Segment1	-	7
8	NC	Not Connect	NC	8
9	SG	Grounding Terminal of Shield	SG	9
10	SG	Grounding Terminal of Shield	SG	10

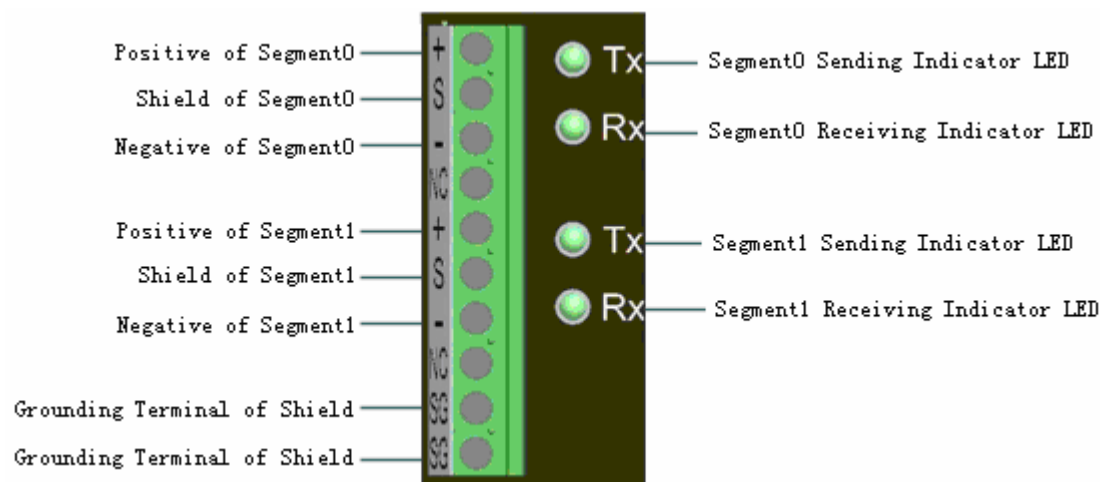


Figure 3-2 Terminals instruction (left side)

Section 4 Application

4.1 Segment Components

As shown in Figure 4-1, the components of FF segment include the H1 interface module, power conditioner, spur module (wire module), surge protector, FF cable, terminator and device, etc.

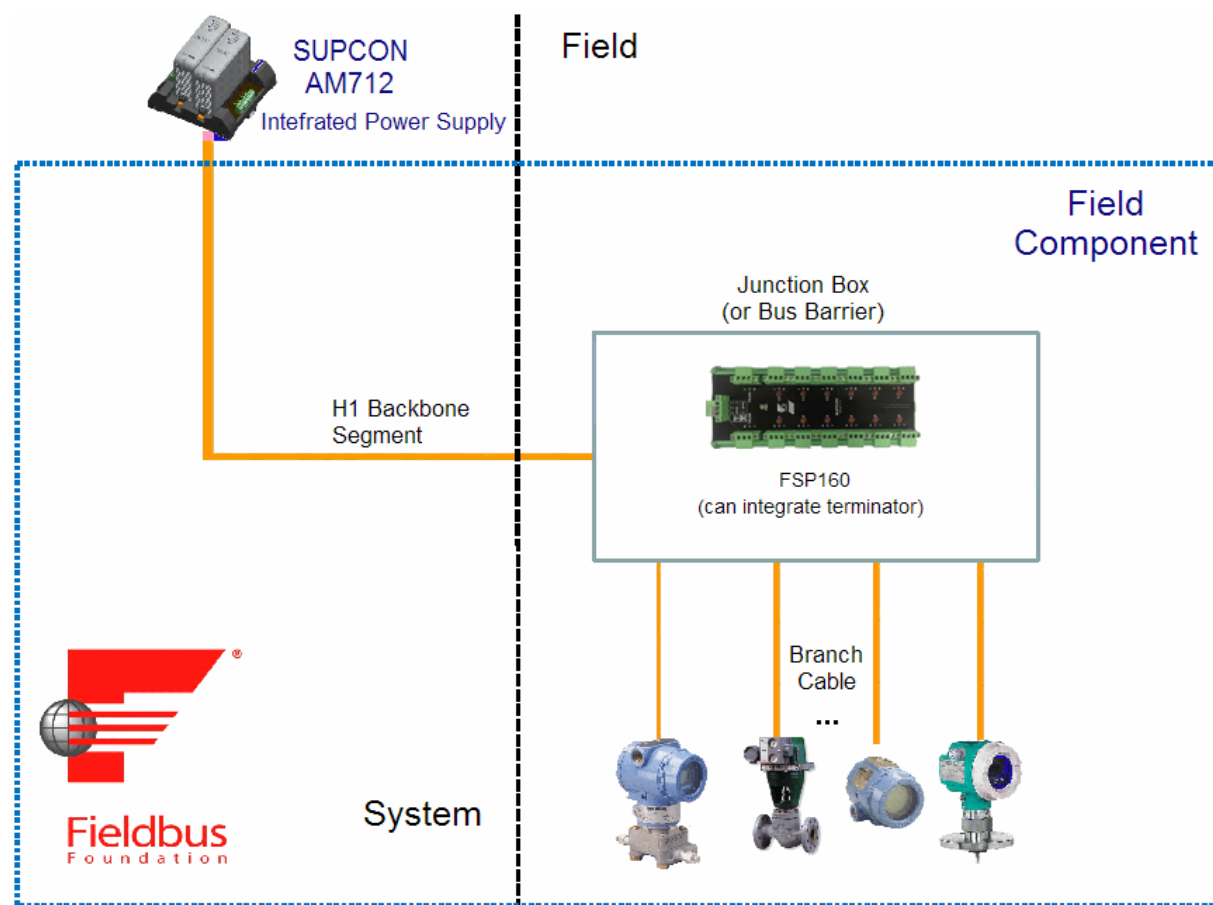


Figure 4-1 FF H1 Components

4.1.1 FF Power Conditioner



Attention:

AM712-P module has integrated FF power conditioner, so external power conditioners are not permitted when configuring AM712-P module.

The H1 fieldbus can achieve the power supply for several field devices and bidirectional digital communication on the same shield twisted pair cable. The fieldbus H1 interface module is used to

achieve the bidirectional communication with the field devices. The power supply of fieldbus devices are achieved by FF power conditioner. FF conditioner is necessary on each segment and set as redundancy generally.

4.1.2 FF Junction Box and Spur Module

The foundation recommends that the wiring of spurs and trunk should be completed in the junction box. All cable heads should be connected in an individual terminal. There should be no 2 cable heads connect the same terminal. The junction box can apply pluggable terminal, whose wiring specification is (12~24) AWG.

The junction box should be weather-proof, and the proof level should not be less than IP65. The junction box should also be anticorrosion. The material for junction box can be duralumin, stainless steel and fibre-glass reinforced plastic as required. The cable interface can apply cable sealed joint or fast connector. All spurs of junction box should integrate the function of short circuit protection. SUPCON[®] Fieldbus spur protection module has the function of short-circuit protection, which can avoid the influence of whole segment caused by short-circuit accident of spur and keep normal working of segment.

For the junction box in explosion-protection area, different explosion-protection scheme can be selected according to the fact. For Zone 1/0 (or Division 1), the spur of junction box should be certified by intrinsically safe explosion-protection, like the EEx ia IIC. For Zone 2 (or Division 2), the spur of junction box should be certified by limited non-sparking explosion-protection, i.e. EEx nL IIC. Although the devices in explosion isolated field not support hot-operation, few users are still used to do it. Thus, the spur of junction box should be certified by increased safety explosion-protection, i.e. EEx e IIC T4, which is applied in Zone 1/2 (or Division 1/2).

The spur module in the junction box, also called wiring module (MEGABLOCK), should support standard DIN rail installation, and the spur module should have independent function of short circuit protection. The short circuit of one spur will not influence other spurs of the whole segment. The spur module can have 4, 6, 8, 10 or 12 spurs, including 2 trunk terminals, one for system trunk wiring and the other for outside, to meet the requirements of user.

The common models of wiring modules include SUPCON FSP120, FSP160, etc.

The segment terminator with integration can be selected in wiring module, which has “T” type marker. Each spur has power indicator which shows that power supply of the spur is normal.

At the same time, it is required that the shell of wiring box should has the function of protection grounding, which can connects with field ground piles, which is close to wiring box, or metallic shell of cable bridge.

**Attention:**

The shield of each spur should connect to wiring module independently and can't touch each other or the shell of wiring box.

4.1.3 FF Cable

The shield twisted pair cable of FF bus should conform to the FF physical layer standards of IEC. The classical specifications of FF bus cable are shown below:

- Cable Specifications: 18 AWG (0.8mm²)
- Shield: 90% covered
- Weakness: 3db/km when 39kHz
- Maximum capacitance: 150pF/m
- Property Impedance: 100 (when 1.25 kbit/s)

This cable is also called A cable. When using it, the cable length of each H1 segment can reach 1900m (including the backbone and spur cables). The distributed resistance of the cable is 44Ω/km. FF bus cable can apply special cover color to be distinguished from other signal wires. FF bus cable can apply the multi-core cable, in which each twisted pair cable is shield individually. FF bus cable can also apply the embedded cable.

The cable specifications and transmission distance are shown below:

Cable Type	Cable Model	Transmission Rate	Max Transmission Distance
A Shield Twisted Pair	#18AWG	H1 31.25Kbps	1900m
	#22AWG	H2 1Mbps	750m
	#22AWG	H2 2.5Mbps	500m
B Shield Several Twisted Pairs	#22AWG	H1 31.25Kbps	1200m
C No Shield Twisted Pair	#22AWG	H1 31.25Kbps	400m
D Multi-core Shield Cable	#16AWG	H1 31.25Kbps	200m

Figure 4-2 FF Cable Specifications

**Attention:**

As for the item which is built newly, it must choose A-kind cable.

4.1.4 FF Device

The system supports all FF devices certified by Fieldbus Foundation. These FF devices must have

corresponding DD (device description) files can be downloaded from the website of the manufacturer. The mainstream FF device manufacturers include ABB, EMERSON, HONEYWELL, YOKOGAWA, ENDRESS+HAUSER and SMAR, etc.



Figure 4-3 FF Devices

4.1.5 FF Surge Protector (Selectable)

The surge protection for segment should be provided in the thunder-prone area or near the large device of inductive load, to prevent the anti-surge device from the obvious filed signal weakness. FF surge protection can belong to SUPCON® or be the third-party device.

4.2 Segment Wiring Example

4.2.1 AM712-S Segment Wiring Example

In Figure 4-4, set AM712-S segment linked to MTL9189 power conditioner(FF 8 segments power) as an example to show the FF H1 segment wiring. Figure 4-4 is only an example, and the wiring can be varied as required.

If there is redundant HOST interface in FF power supply selected, in other words, the power supply is redundant with AM712-S wiring, redundant HOST interface should be linked to the other terminal in MB734-S.

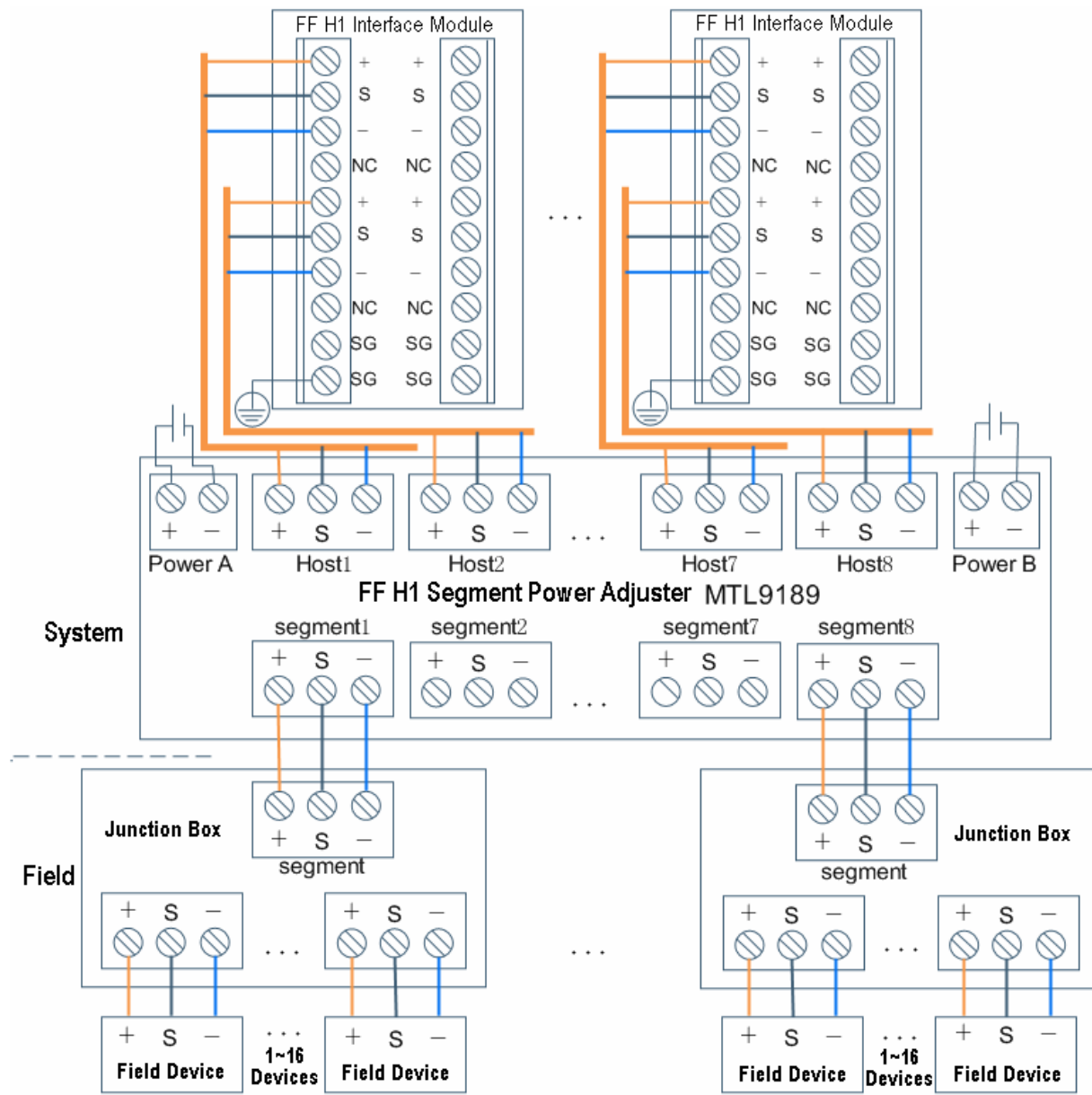


Figure 4-4 AM712-S Segment Wiring



Attention:

When the wiring between FF H1 segment power supply and the AM712-S are redundant, make sure the polarity connection of bus and terminal is correct. Misconnection will lead to power short circuit.

4.2.2 AM712-P Segment Wiring Example

In Figure 4-5, AM712-P integrates FF power conditioner, so that AM712-P can link to field wiring module directly through bus cable.

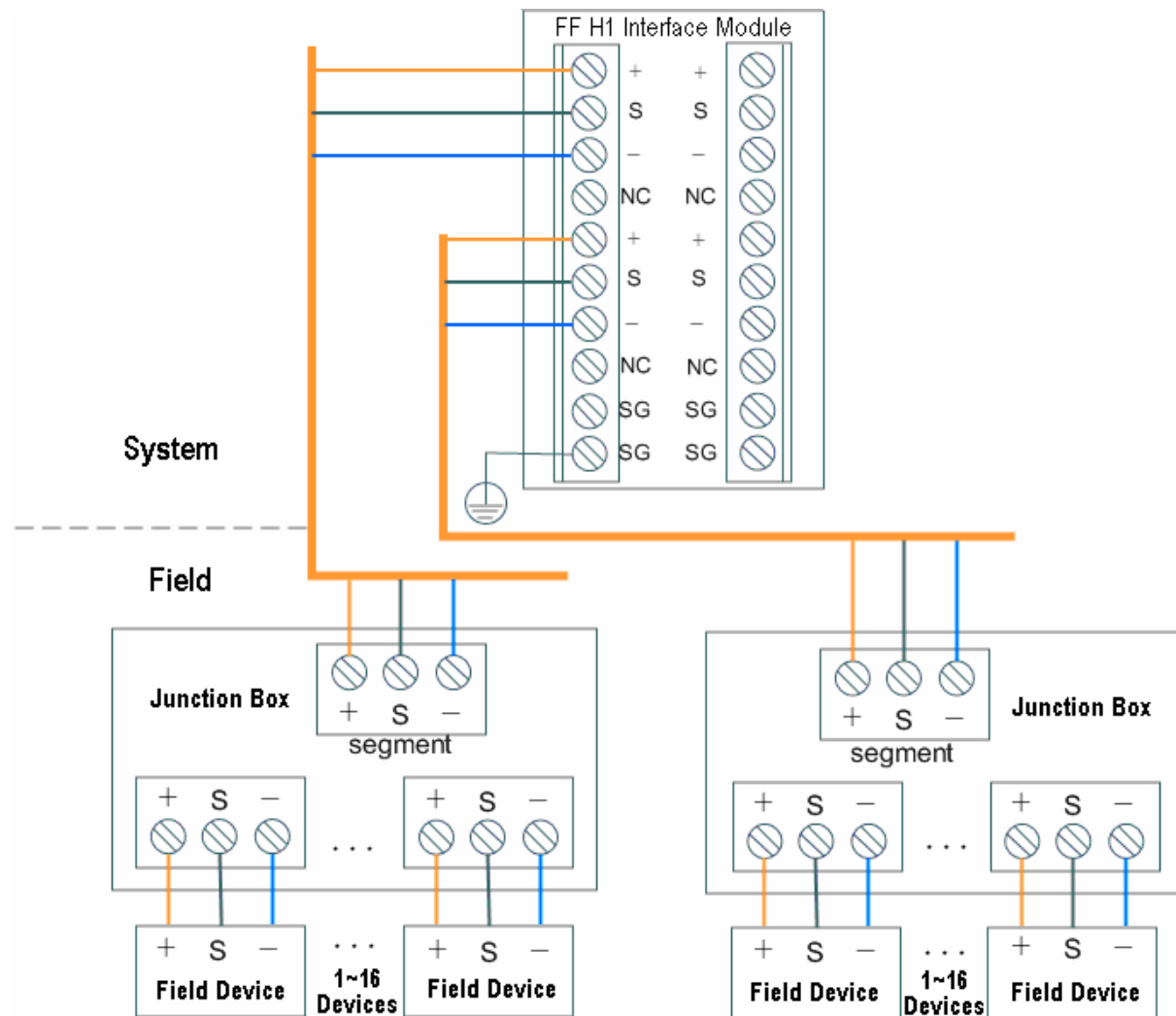


Figure 4-5 AM712-P Segment Wiring

4.3 Terminal Resistor Setting

As project required, both sides of FF bus should install a terminal resistor (terminator) to eliminate the echo of high frequency signal. In system side, terminal resistor integrates in FF power conditioner; in field side, it integrates in wiring module (MEGABLOCK) .



Attentions:

- Each module of AM712-P has integrated terminal resistor.
- The integrated terminal resistor of FSP160 has installed in the bus when factory setting and needs confirmation on site.

4.4 Notes

- The shield wire of FF should be grounded on the single point of system, and should connect the shield port of MB734-S terminal.
- The FF device should be grounded nearby in the field, and the cable shield layer should be suspended.
- Make sure the module, base, rack and cabinet are in the same protection ground.
- MB734-S is redundant base and the AM712 should be set as redundant in configuration. Otherwise, a slight fault will appear.
- The application of AM712-S and AM712-P in the software is the same completely.

4.5 Troubleshooting

- If all LEDs are off, the power connection has fault, please check it.
- If the indicator LED “Fault” is on, there is a hardware fault. Please replace the module and re-download the configuration.
- If the indicator LED “Status” is flashing in frequency of 400ms, at least one channel of segment configuration mismatch with hardware configuration.
- If the indicator LED “Status” is flashing in frequency of 2s, the module is in the status of cold startup.
- If the indicator LED “L-Bus” is off, both channels of L-BUS have fault. Please check them.
- If the indicator LED “L-Bus” is flashing, the L-BUS is in the status of address conflict.
- If the indicator LED “H1” is off, both H1 segments have fault. Please check the H1 segments and the wiring of the filedbus devices.
- If the indicator LED “H1” is flashing, one H1 segment has fault. Please check the H1 segments and the wiring of the filed devices.
- If the indicator LED “Status” in one side is on and the other side is flash, when AM712 works redundantly and the configuration is downloaded correctly, please check whether FF configuration software has configured AM712 in non-redundant mode.
- If the indicator LED “Tx” and “Rx” in the one side of MB734-S base are normal but in the other side, the indicator light “Tx” is off and the indicator light “Rx” is on, when AM712 works redundantly, please check the terminal resistor on site.

4.6 Segment Design

1. **Device Function:** select the FF device with the correct control function block.
2. **Device Position:** it should satisfy the requirements of technique design (include

determining the dangerous place). The segment should be designed after determining the device position.

3. **Technique Control Requirements:** include selecting the measurement and control, etc. The complicate control requirements should also be considered, such as the serial control and split control etc.
4. **Stability Requirements:** the control strategy is in transducer, valve localizer or controller, the control loop number of the same segment and the key valve number (refer to the valve levels), etc.

Importance levels of valve are shown below:

Level1

The failure of level1 valve will lead to the whole system fault and cause the shut-down of whole devices or other unavoidable loss over million dollars. This kind of fault can apply general valve fault mode.

Design Requirements: the valve and related measuring devices (transducer) of level1 should connect the same H1 network of level1 control. If the service is independent, the segment can have a valve and related transducer of level1. If the service is associated, it can have 2 valves and related transducers of level1. “**Association**” refers to that either valve can close the same device (such as the flow of fired heater). Follow notes below to make sure the interoperability:

- All field devices of level1 in the loop are provided by one manufacturer.
- The interoperability of host connectors and all field devices of level1 in the loop should be tested independently.
- In the life span of network, the versions of devices and connectors should be compatible.

Level2

The failure of level2 valve will lead to the whole system fault and cause the shut-down of whole devices or other unavoidable loss over million dollars. But the process dynamic time of level2 valve allows the fast recovery from fault status. It could be fast fixing the fault or applying manual control. The related container material and energy capacity, location and the operability of the valve also should be considered. The difference between level1 valve and level2 valve are their operability for single fault.

Design Requirements: the valve and related measuring devices (transducer) of level2 should connect the same H1 network for control. If the service is independent, the segment can have a valve and related transducer of level2. If the service is associated, it can have 2 valves of level1, or one valve of level2 and one valve of level3 and their related transducers. “**Association**” refers to that either valve can close the same device (such as the flow of fired heater). Follow notes below to make sure the interoperability:

- All field devices of level2 in the loop are provided by one manufacturer.

- The interoperability of host connectors and all field devices of level2 in the loop should be tested independently.
- In the life span of network, the versions of devices and connectors should be compatible.

Level3

The failure of level3 valve will not lead to the whole devices shut-down or serious loss. The level3 valve can switch to the fault position and operator is no need to apply any instant measures.

Design Requirements: the level3 valve can locate in the same segment with 3 level3 valves or 1 level2 valve at most. The network containing level3 control can apply products from several (certified) manufacturers, including the measurement device. The design paper of segment should mark the importance level and note observably that not any accessories should be added in the segment.

4.7 Segment Constraint

4.7.1 Distance Constraint

Except the intrinsically safe explosion-protection (it has individual limits), when applying the fieldbus A cable, the total length of backbone and branch should be less than 1900m. The length of branch is recommended as follow:

Table 4-1 The length of branch

Communication Device No. In Segment	Max Length of Branch Cable
15~18	60m
13~14	90m
1~12	120m

For the segment certified by the intrinsically safe Entity, the cable length of backbone and branch should not exceed the recommended values above, and user should check computation of the total capacitance and inductance by the intrinsically safe certified parameter.

For the segment certified by the intrinsically safe FISCO, the cable length of backbone and branch should not exceed 1000m, and the length of branch should not exceed 30m.

The calculation example is shown below:

Whole Length of Segment=Backbone + All Branches

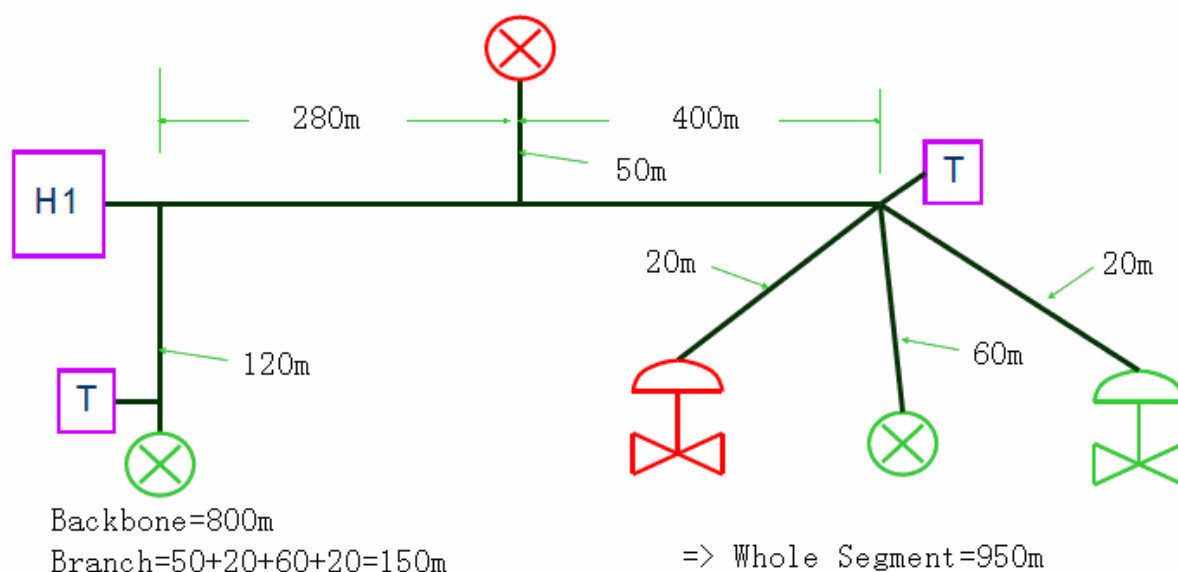
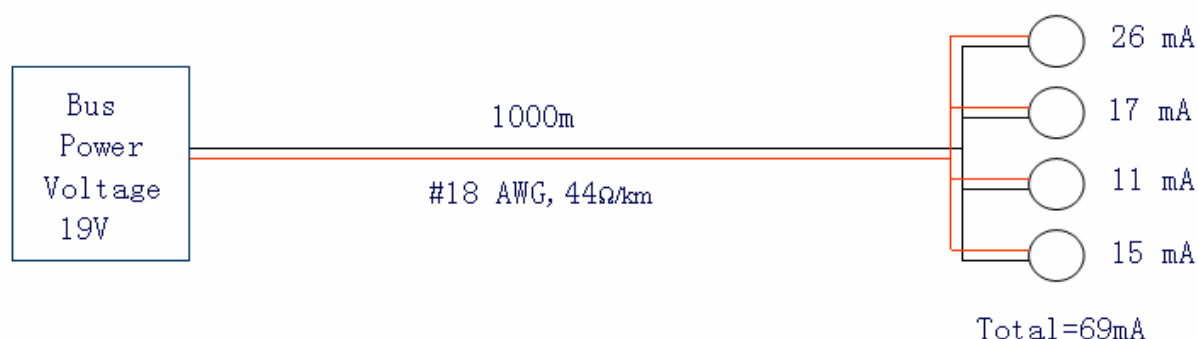


Figure 4-6 FF H1 segment wiring

4.7.2 Power Consumption and Voltage Attenuation

The segment load checking computation can confirm the maximum field devices actually connected and the length of cable in the segment. FF power unit refers to the devices powering the H1 segment, such as the FF power supply, repeater, intrinsically safe power (Entity or FISCO) etc, which have the powering function individually, i.e. output voltage and current. The larger the output current is, the more field devices can be supported. The higher the output voltage is, the longer the segment cable can be supported.

The standards of FF stipulate that the current consumption of field device should be less than 10mA, while the maximum is not stipulated. The current consumption of mainstream FF device is (10~30) mA and exact power consumption target is shown in instrument manual. When a branch is short circuit, the protection circuit will consume certain extra current, like about (40~60) mA. The checking computation of load current can confirm whether the output current of FF power unit is larger than the sum of field device current consumption and the protection current of at least one branch.



$$\text{Voltage Calculation} = 19 - (1000 \times 44 / 1000 \times 69 / 1000)$$

$$\text{Voltage Calculation} = 19 - 3.036$$

$$\text{Voltage Calculation} = 15.964\text{V}$$

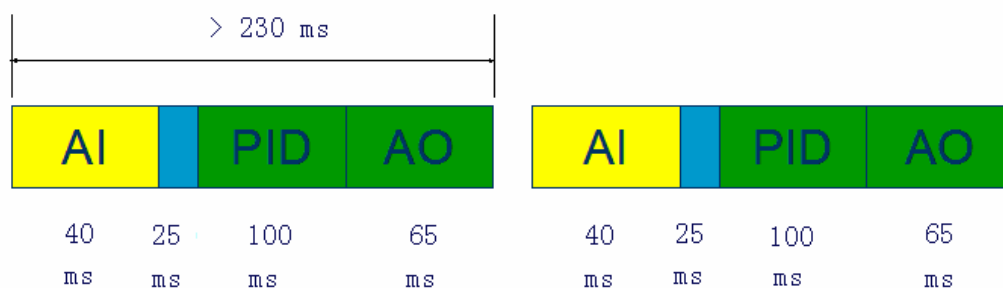
Figure 4-7 Segment voltage calculation

According to the FF standard, the work voltage of field device is (9~23) VDC. As the cable has distributed resistance (for example, the loop resistance of fieldbus A cable is 44Ω/km), the segment load current will have voltage drop on the cable unavoidably. So the load voltage equals to the output voltage of FF power unit minus the pressure drop of segment load current on cable. The checking computation for load voltage is used to confirm that the load voltage cannot be less than 9 VDC. The calculation of voltage pressure drop is shown in Figure 4-7.

4.7.3 Communication Process (Macrocycle)

The segment "LAS" should execute the periodic and non-periodic data communication schedule simultaneously, and generally 60% time should be for non-periodic data communication time. The time of macrocycle is determined by the execution time and number of function block.

The example of calculating macrocycle time is shown below:



The macrocycle time of segment should be 230ms.

Figure 4-8 Segment macrocycle calculation

Besides, the limit of system for the number of function block called by each segment, or the limit for VCR number of each segment, will limit the number of device connected.

Section 5 FF Configuration Application

Please refer to the *FF Software Configuration User Manual*.

Section 6 Revision

Table 6-1 Retrofit list of the version

Document Version	Applicable Product Version	Remarks
V1.0(20131022)	AM712-12.11.00 and later version MB734-S-12.00.00 and later version	
V1.1 (20121207)	AM712-S V12.11.00 and later version MB734-S V12.00.00 and later version	
V1.2 (20160627)	AM712-S V12.11.00 and later version, AM712-P V10.10.00 and later version, MB734-S V13.00.00 and later version	<ul style="list-style-type: none"> ● Add AM712-P and project application. ● Add instruction about base selection and function difference of AM712-P and AM712-S module in the chapter “Module Unit Structure”.
V1.3 (20191105)	AM712-S V12.11.00 - V21.15.00 AM712-P V10.10.00 / V10.11.00 MB734-S V13.00.00 and later version	Delete former the instruction about “Segment Components”, modify some description and figures of the module. Add Code