HollySys MACS Hardware Specifications

FM Series

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Part I System Features

HOLLiAS-MACS realizes field control. With advanced FieldBus and international standard protocols, it can communicate with instruments and modules of other makers. FM modules realize field data collection; RASC processes hundreds of control loops at millisecond rate; the upper monitor system based on Ethernet provides easy-to-use HMI; it is capable of storing all important historical data and providing production data analysis reports.

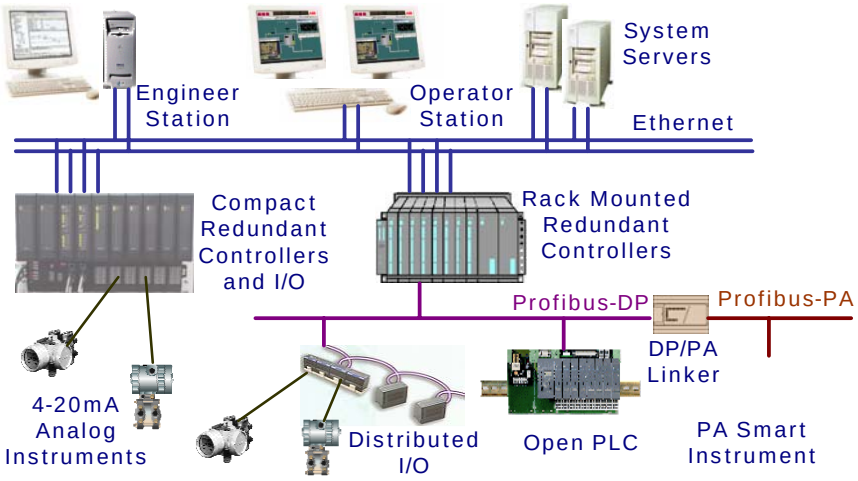


Figure 1-1 System Architecture

Advanced Technology

Provide Management-Control Integrated Solution on the Uniform Platform

MACS connects perfectly with enterprise management system. Real-time information system, installed at the enterprise management network, receives real-time data from MACS through OPC, provides real-time data display, report printout, and trend report. It can directly connect with HollySys-ERP. Software configuration adopts modularization.

Standard Client/Server Architecture

Redundant system server stores all real-time data, operating records, events and logs. Operator station, engineer station, advanced control station, analysis station and field control station constitute client ends of different functions. This client/server architecture decentralizes functions and risks, and integrates management.

Advanced FieldBus technology

HOLLYSYS has FieldBus technology with full intellectual property, and has independently developed physical layer and link layer of master and slave station. The advantages are as follows:

- Connecting with other manufactures' PLC, like Siemens, VIPA, GE etc;
- Connecting with Profibus-PA intelligent transducer or performer through coupler or connector;
- Integrated or distributed installation;
- Independent MACS software and I/O equipments;

- Standard and integratable I/O modules.

Support OPC Data Processing

OPC standardizes interfaces between different equipments and application programs.

HOLLiAS products support OPC data interfaces, which enable the data exchange with other control systems, MIS networks, ERP and PLC.

Open System

Open Network

- Redundant 100Mbps Ethernet (TCP/IP) at the enterprise management level;
- Redundant 100Mbps Ethernet (TCP/IP) at the system management level;
- Redundant 10/100Mbps Ethernet at the control layer to connect with field control station controller through interchanger/concentrator and communicate with other DCS/computer systems.
- At the FieldBus layer, connecting with I/O modules and PLC through 12Mbps Profibus-DP, providing standard RS-485, RS-232, ModBUS to connect with other PLC and intelligent instruments.
- FF, CAN, HART.

Open Operating System

It adopts WINDOWS NT/2000 and provides ODBC and OPC interfaces.

It adopts sophisticated real-time multi-task operating system, RASC controller software consolidated in the semiconductor disk and real-time data are stored in the SRAM with back-up battery.

Internet Connection

HOLLiAS-MACS can function as Web Server and the control system can provide Internet access and remote functions such as remote production alarm and failure diagnosis.

Open Hardware Architecture

Different manufactures' cards can be connected inside the MACS controller FieldBus network through GSD file.

Easy to Use

Standard Configuration Software

- IEC1131-3, providing SFC, FBD, LD, ST, IL and CFC;
- User defined function block (UDFB);
- Powerful control configuration: batch processing, PID loop, complex loop, logic loop, hybrid loop, advanced control calculation and special recipe control;
- Rich diagram configuration;
- Report configuration and Excel exchangeable;
- Historical record analysis and processing, log processing, alarm record report and event analysis;
- System self-diagnosis and fault alarm

Convenient Data Transfer Tool

Combination of input and output enables easy data transfer.

System Simulation, Download and Data Read-back

- Off-line and independent simulation for broken point setting, monitor variation, single-step execution, flow display control etc.
- Download database by "point", control solution by "page", database downloaded to the controller;
- Data read-back function.

Convenient System Installation

- Module signal process and I/O connection consist of two separate components; signal line component change is not necessary in case of module replacement;
- Field module power supply and net wire are on the base; modules can be easily connected;
- Standard rail mounting.

System Reliability

System Hardware Reliability

- Low consumption, fanless, small rack mouning, micro-core and high reliability real-time operating system; IEC61131-3, Profibus-DP, FF (H1), CAN, DeviceNet and ModBUS; hot swap and double-channel 100Mbps Ethernet;
- Smaller modular structure (8 analog points, 16 digital points) for I/O processing unit, one A/D converter for each channel, distributed risks.
- Extra control loop module, including 4-channel AI, 2-channel AO, 6-channel DI, 2-channel DO, realize 2-channel PID control, serial control, compensation control and quick response loop;
- Over-voltage and over-current protection at signal interfaces;
- Hot swap;
- Connecting modules and bases with EURO-connector;
- Small modular and industrial design, applying to the environment of –45℃~85℃;
- Highly reliable power supply specially designed for DCS.

System Software Reliability

- Windows NT operating system for operator station, QNX for control station;
- Rich self-diagnosis display information;
- Network communication protocol and interface drive program adopt international standard protocols such as TCP/IP AND Profibus-DP.
- Support Internet.

System Redundancy Ensures High Reliability

- Redundant operator station;

- Redundant 100M Ethernet;
- Redundant controller;
- Redundant I/O modules;
- Redundant power supply.

Failure Monitor and Transfer

- Detecting failure of DCS equipment and primary/standby modules switch and network;
- Alarm record for each failure and its recovery;
- System redundant at every layer, including the central server, management network, system network, field control station controller and I/O modules. Controller and I/O modules have diagnostic function to ensure normal operation in case of failure.

Powerful Processing Capacity

High-speed Network

- 100Mbps;
- Field signal processing: Profibus-DP rate up to 12Mbps.

High Configuration Capacity

- Operator station≤20;
- Physical I/O configuration capacity ≤10000;
- Control loop number≤1024;
- Max configuration capacity of each field control station:
  -I/O modules of each station: ≤127;
  -I/O points of each station: 127 ×16;
  -Analog control loop of each station: ≤128 (recommended);
  -Typical motor digital control loop of each station: ≤256 (recommended).

Real-time Response

System response time

- From inputing change to displaying the change＜collection cycle+1S
- From entering to output change＜1S
- Event sequence record resolution≤1mS
- Loop control cycle min 50mS
- Quick loop control cycle 10ms
- Logic control cycle min 5mS

Screen display time

- Picture display completing time≤sampling cycle1S;
- Dynamic data updating time≤sampling cycle 1S.Powerful Hardware Processing Capacity System graphics resolution: 1600×1280 (or above), response time≤1s, data updating time≤1s;
- System server can select high-performance industrial computer or specialized server (optional);
  Operator station and engineer station: CPU > Pentium III, main frequency > 800MHz, EMS memory >

128M, HD > 20G, monitor resolution1600×1280 industrial level IPC; Multiple field control stations, each processing over 1152 physical I/O points and up to 256 control loops;

- Controller: CPU > Pentium II CPU, 32M EMS memory, 2M SRAM;
- Intelligent I/O signal processing units;
- AI processing: One A/D converter for each module, 16-bit resolution;
- Signal processing accuracy: big signal≤0.1%, small signal≤0.2%, flexible detection cycle with min of 50ms;
- AO processing: one 12-bit D/A converter, accuracy≥0.2%;
- DI/DO processing: SOE resolution 1ms, debouncing for all digital inputs;

Expandability and Maintainability

Expandability

MACS mainly applies to large-scale distributed control system. The system has engineer station, operator station, printer service station, field control station, and communication control station and system server. MACS also applies to small and medium-sized systems, where engineer station and printer service station can be combined with operator station. And one operator station can be equipped with several CRT display.

Maintainability

All off-line configuration tools are designed and programmed objects-oriented.

Database: A large database for tools and interfaces maintenance.

Economy

- Larger capacity for each control station, and fewer number of control stations;
- Higher reliability and smaller damage rate;
- Distributed I/O modules on site, and less amount of signal cables and construction cost;
- Multiple solutions and software configuration to save engineering cycle and cost;
- Less investment in case of system extending and modification;
- Maintenance service for HollySys modules with low charge;
- Professional instruction system and powerful simulation system;
- Perfect connection with advanced control system to integrate management and control;
- Comprehensive training to help user comprehend system configuration and maintenance;
- Multi-media monitor system and auto-paging system improve efficiency.

Part II MACS FM Hardware Specifications

Chapter 1 MACS FM Hardware Overview

Architecture

FM hardware system is a controller and distributed I/O system developed by Hollysys based on Fieldbus technology. System architecture consists of controller, power supply, distributed I/O, terminal modules, and cabinets.

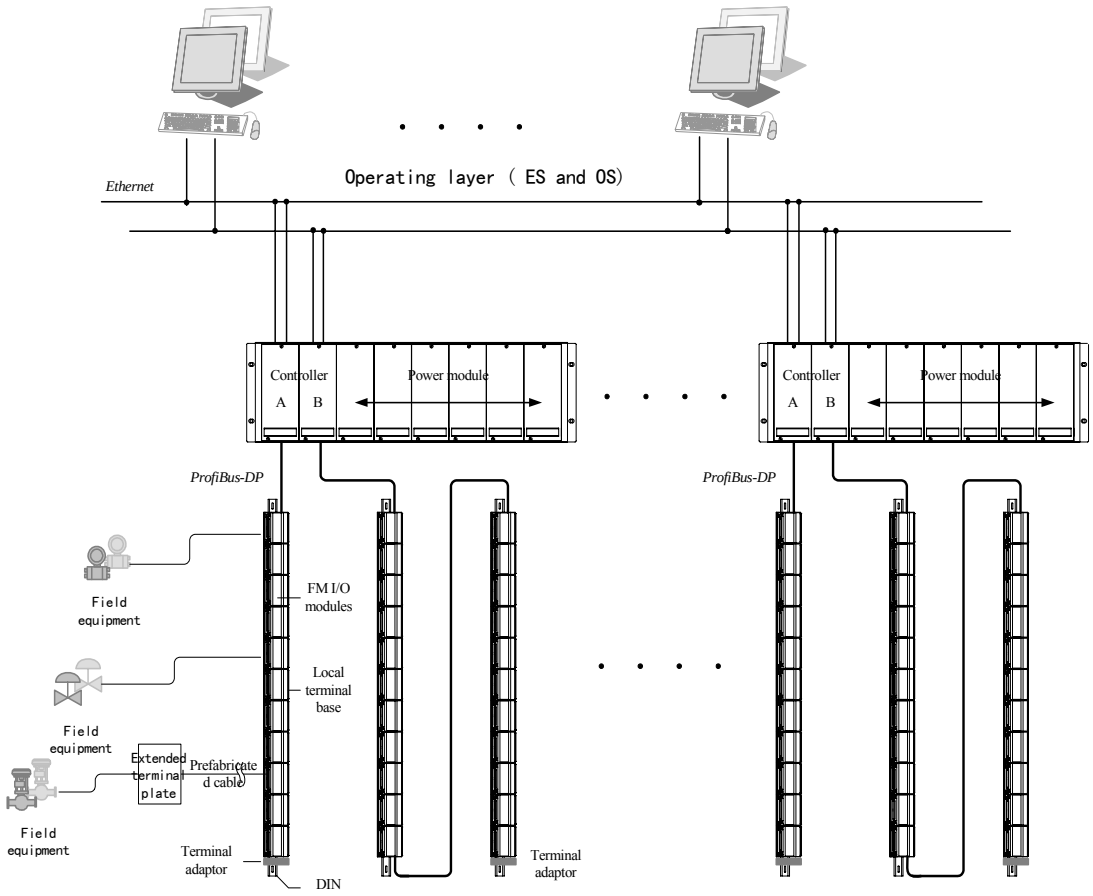


Figure 2-1 FM Hardware System Architecture

Controller & I/O Modules

FM controller has redundant switch circuit and error self-check circuit. It adopts embedded fanless design and features low power consumption (7.5W@24VDC). Its real-time multi-task operation system provides fast scan cycle and open structure, and combines network communication, data processing, continuous control, discrete control, sequence control, and batch control.

Each I/O unit communicates with the controller with PROFIBUS-DP.

Both controller and I/O modules support hot swap.

Power Supply Modules

FM power supply modules are AC/DC converter that realizes the conversion from 220VAC to 24VDC and/or 48VDC. They supply power for the controller, I/O modules, and other field equipments. They can either work independently or redundantly.

Communication Network

System network (SNET): real-time communication network connecting engineer station/operator station with field control station; industrial Ethernet redundant network, IEEE802.3 and IEEE802.3u standard, based on TCP/IP and real-time industrial Ethernet protocols, baud rate 10/100Mbps, transmission medium 5-type non-shielded twisted-pair cable with RJ45 connector.

Control network (CNET): internal network in field control station for communication between I/O modules and the controller; PROFIBUS-DP, IEC61158 international standard (JB/T10308.3-2001 standard, and EN50170 European standard), max baud rate 500Kbps, transmission medium shielded twisted-pair cable.

SNET and CNET realize independent data collection and equipment control functions, effectively isolating industrial automation system and IT system.

Hardware Equipment

Controller Rack

Model	Name	Specifications
FM301	Controller rack	2 controller, 6 power supply
FM305	Controller rack	2 controller, 2 power supply

Controller

Model	Name	Specifications
FM801	Controller	Embedded x86 processor; 100MHz

Power Supply Module

Model	Name	Specifications
FM910	24V power supply	24V±10%; 180W@Max
FM920	48V power supply	48V±10%; 150W@Max
FM931	16-channel DI query power distribution board	16-channel 24V±10%/48V±10%

Communication Module

Model	Name	Terminal Base
FM1201*	DP repeater	FM1303
FM192A-TR	Terminal adapter	—

* **DP repeater can also adopt SIEMENS *6ES7-972-0AA01-0XA0.***

Terminal Base

Model	Name	Terminal Base
FM131A	Standard terminal base	40-bit double-line connection terminal

I/O Module

Model	Name	Specifications
FM143	8-channel RTD AI module	50～383.02Ω
FM143A	8-channel RTD AI module	0~316.54Ω
FM147	8-channel thermocouple AI module	-5~78.125mV
FM148A	8-channel thermo AI module	0~10V; 0~20mA
FM148E	8-channel (channel isolation) AI module	0~10V; 0~20mA
FM148R	8-channel (channel redundancy) AI module	0~5V; 0~20mA
FM151A	8-channel AI/AO module	4~20mA
FM152A	6-channel (channel redundancy) AI/AO module	4~20mA
FM161D	16-channel contact DI module	24VDC
FM161D-48	16-channel contact DI module	48VDC
FM161D-SOE	16-channel contact SOE input module	24VDC
FM161D-48-SOE	16-channel contact SOE input module	48VDC
FM161E-48-SOE	15-channel (hard time-setting) SOE input module	48VDC
FM162	8-channel pulse input module	0~10K Hz
FM171	16-channel relay DO module	Passive normal open contact
FM171B	16-channel transistor DO module	Photoelectric coupling

Cabinet

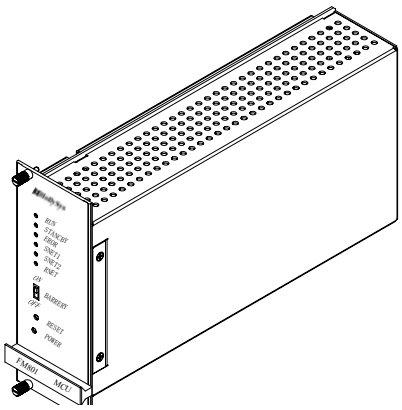
Model	Name	I/O Capacity	Dimensions (mm) （W×H×D）
FP040	Controller cabinet	66	807×2175×652
FP041	Expansion cabinet	84	807×2175×652
FP033	Expansion cabinet	66	807×2175×652
FP035	Power distribution cabinet	—	807×2175×652
FP036	Server cabinet	—	807×2175×852
FP038	Relay cabinet	—	807×2175×652

Chapter 2 FM Module Specification

Controller Module FM801/FM803

Features

- **Embedded x86 compatible processor**
- **1MB SRAM, backup battery**
- **Flash solid disc**
- **Redundancy configuration**
- **Double-redundancy industrial Ehternet interface**
- **Built-in Profibus-DP master interface**
- **Hot swap**
- **Rail mounting**



Model	Hardware configuration
FM801	Embedded x86 compatible processor, 100MHz 16MB DRAM, 1MB SRAM, 8M solid state disc
FM803	Embedded x86 compatible processor, 266MHz 16MB DRAM, 1MB SRAM, 16M solid state disc

Overview

Controllers are the core devices inside the field control station, see figure 2-2 for the diagram.

CNET realizes I/O module data collection, processing, operation and exchange through Profibus-DP; SNET uploads all data from field control station to system server through redundant industrial Ethernet interface; configuration commands from engineer/operator station are downloaded to the controller through SNET.

Data exchange network (RNET) completes data backup between main/backup controllers.

Static data storage (SRAM) saves real-time data with battery protection.

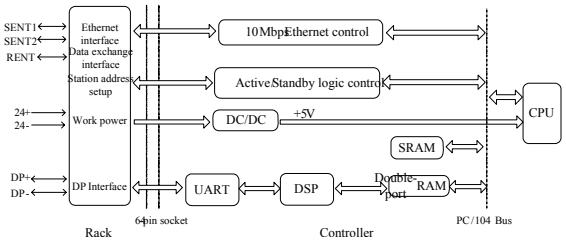


Figure 2-2 Diagram

Instruction

Status Indication and Operation Setup

See figure 2-3 for front view and table 1 for LED indicator and operation setup details.

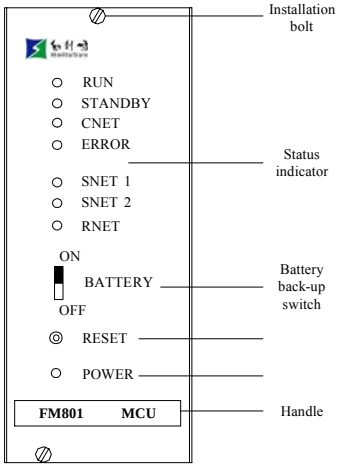


Figure 2-3 Front View

Table 1 LED Indicator and Operation Setup

LED Indicator	Description
POWER (Green)	On: controller power-on; Off: controller power-off;
RUN (Green)	On: controller in active operation; Flash: controller in standby operation; Off: controller off-line;
STANDBY (Yellow)	On: in standby operation; Off: in active operation;
ERROR (Red)	On: controller error; Flash: no database;
SNET1 (Yellow)	On: SNET (Ethernet) data exchange normal; Off: no SNET (Ethernet) data exchange, communication error;
SNET2 (Yellow)	On: SNET (Ethernet) data exchange normal; Off: no SNET (Ethernet) data exchange, communication error;
CNET (Yellow)	On: active, controlling CNET, communication with I/O modules normal; Off: standby, no control over CNET;
RNET (Yellow)	On: (Ethernet) data exchange normal; Off: (Ethernet) data exchange error;
Operation Setup	**Description**
RESET	Reset button
BATTERY	Data retain battery ON: controller in power-off protection; OFF: controller off power-off protection.

Redundancy Configuration

The following should be noted:

1. No. of master and slave stations must be the same.
2. Station No. setup must be done when power-off.

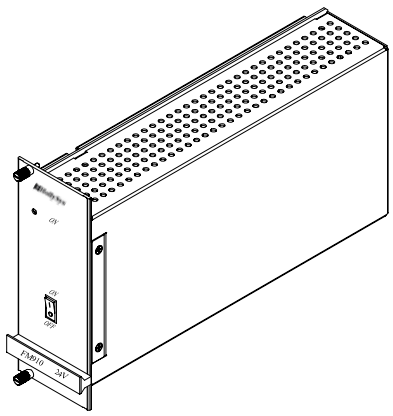
Specifications

Model	FM801	FM803
Hardware configuration		
CPU	Embedded x86 compatible processor 100MHz	Embedded x86 compatible processor 266MHz
DRAM	16MB	
SRAM	1MB	
SSD (solid state disc)	8MB	16MB
Communication		
SNET	Redundant industrial Ethernet, baud rate 10Mbps	
CNET	Profibus-DP field bus, baud rate 500kbps	
Power supply		
Power voltage	24VDC±5%	
Power consumption （Max）	10W@24VDC	15W@24VDC
Working environment		
Working temperature	0℃~45℃	
Working humidity	5~90% relative humidity, non-condensing	
Storage temperature	-15℃~65℃	
Storage humidity	5~95% relative humidity, non-condensing	
Physical features		
Dimension	71.12mm × 177.8mm × 305mm (W×H×D)	
Installation	Installed on rail and fixed with bolts	

Power Supply Module FM910/FM920

Features

- **Input voltage：220VAC**
- **Output voltage：24VDC(FM910)/48VDC(FM920)**
- **Rating power：180W@Max**
- **Equalization redundancy**
- **Output protection**
- **Power alarm output**
- **Rail mounting**



Model	Name	Input voltage	Output voltage	Rating power
FM910	24VDC power supply	220VAC (-15%~+10%) 50Hz±1Hz	24VDC±5%	180W@ MAX
FM920	48VDC power supply			150W@ MAX
FM931	DI query power distribution board	24VDC±5% / 48VDC±5%	24VDC±5% / 48VDC±5%	—

Overview

FM910/FM920 realizes the conversion from 220VAC to 24VDC and/or 48 VDC, and provides power for controllers and I/O modules. See figure 2-4 for its diagram. FM910/FM920 also works with multi-channel power distribution template, and provides 24VDC/48VDC query power for DI modules. FM910/FM920 can work independently or redundantly.

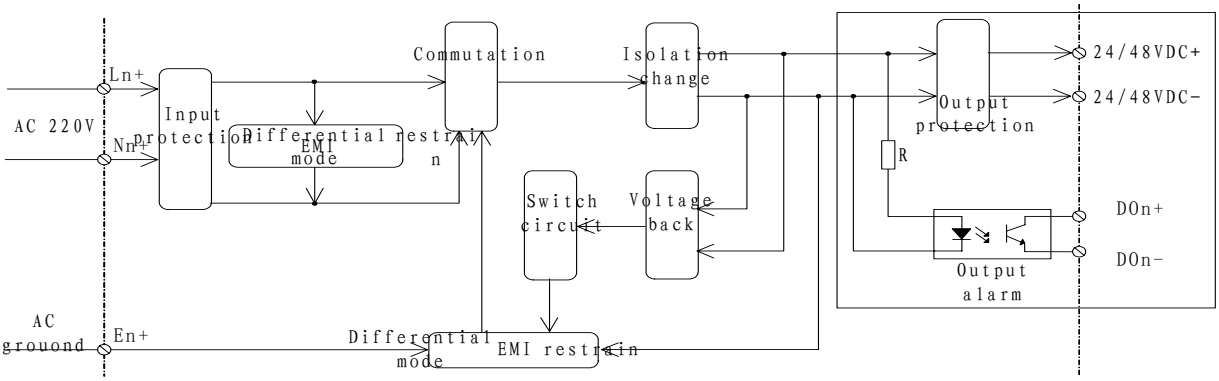


Figure 2-4 Diagram

Instruction

See figure 2-5 for its front view.

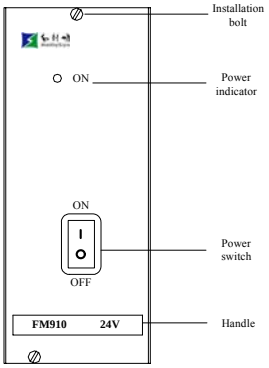


Figure 2-5 Front View

LED Indicator

The LED indicator（ON）shows the current working status when power-on. Light on indicates normal 24/48VDC output; off or abnormal shows zero or abnormal power output.

Shunt Redundancy

Double redundancy and shunt operation improve system reliability, enables power supply non-disturbed switch or online replacement in 1+1 mode.

Shunt Equalization

Under shunt running, power module error will not affect power output. Other power modules will reequalize load and realize power supply non-disturbed switch or online replacement.

Power Distribution Template

FM931 distributes 1-channel VDC input into 16-channel VDC output, as shown in Figure 2-6.

The output channel can work as short-circuit protection and indicator lights. Light on (Red) indicates

error in the corresponding channel.

The power distribution template is fixed on the backboard of controller rack (FM301), distributing 1-channel 24VDC/48VDC query power from FM910/FM920 into 16-channel 24VDC/48VDC for field 24V/48V DI modules (such as FM161D and FM161D-48, the following description takes FM161D as an example). See Figure2-7.

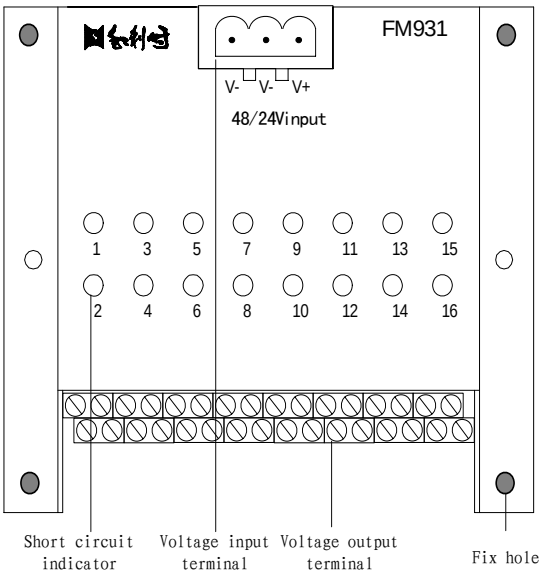


Figure 2-6 FM931

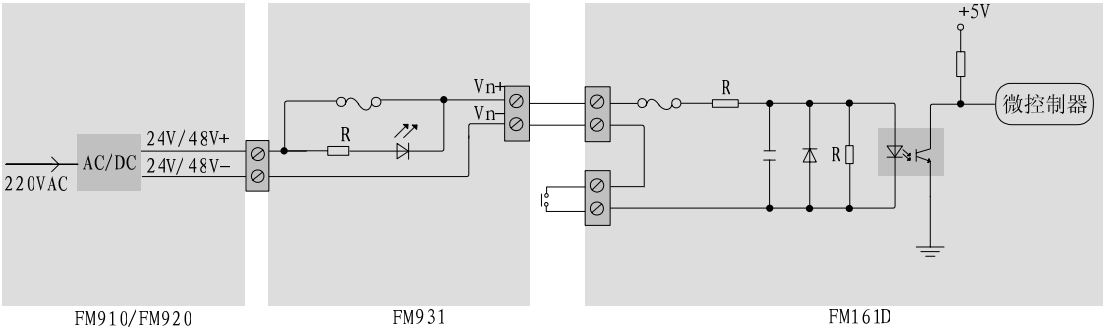


Figure 2-7 Diagram（n=1~16）

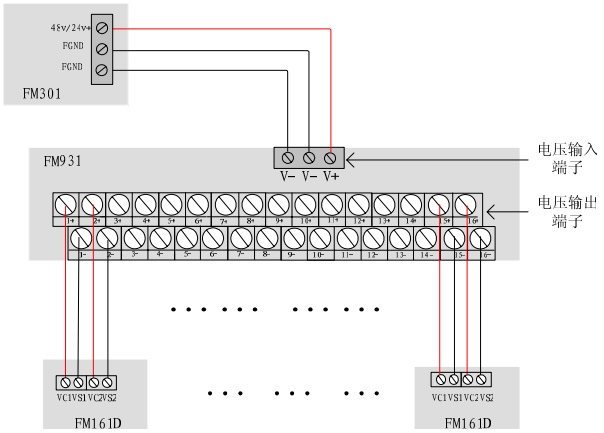


Figure 2-8 Wiring

Wiring is shown in Figure 2-8. Voltage input terminals "48V/24V+", "48V/24V-" and "48V/24V-" connect with output terminals of power supply in shunt redundancy; voltage output terminals "n+" and "n-" （n=1~16）connect with the positive and negative ends of DI module query power.

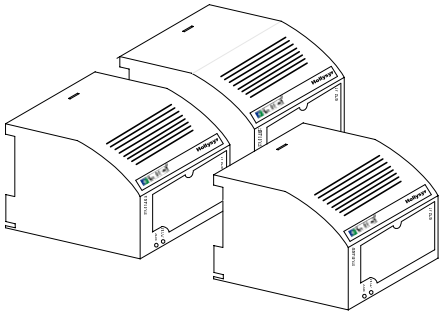
Specifications

Model	FM910 24VDC power supply	FM920 48VDC power supply	FM931 Query power distribution template	
Input feature				
AC input voltage	220VAC（-15%~ +10%），50Hz±1Hz		**DC input voltage**	24 / 48VDC±5%（1 channel）
Surge restrain capacity	Max. 3000V@1.2μs±30%			
Input insulation	Endurance1500V@1min，creepage less than 20mA			
Output feature				
DC output voltage	24VDC±5%	48VDC±5%	24 / 48VDC±5%（16 channels）	
Rating output power	180W, 300CFM air volume; 150W, natural radiation	150W, 300CFM air volume; 110W, natural radiation	—	
Output wave voltage	<250mV		—	
Output insulation	Endurance 1500V@1 min，creepage less than 20mA		—	
Protection				
Input/output isolation	Endurance 3000V@1 min，creepage less than 20mA		—	
Short-circuit protection	No damage in short circuit within 10 seconds		100mA (Auto-resumed)	
Working environment				
Working temperature	0℃~45℃			
Working humidity	5~90% relative humidity, non-condensing			
Storage temperature	-15℃~65℃			
Storage humidity	5~95% relative humidity, non-condensing			
Physical feature				
Dimension	71.12mm × 177.8mm × 305mm (W×H×D)		—	
Installation	Mounted on rack and fixed with bolt		Fixed with bolt	

8-Channel Analog Input Module FM148A/FM148E/FM148R

Features

- **8-channel current/voltage input**
- **Redundant current/voltage input（FM148R）**
- **Inter-channel isolation (FM148E)**
- **Two-wire/four-wire connection（FM148A/R）**
- **Built-in Profibus-DP slave interface**



- **Current overload proof, 24VDC reverse proof**
- **Hardware watchdog**
- **Hot swap**
- **Real-time status display**

Model	Input channel	Signal range	
FM148A	8 (Two/four-wire)	**Voltage**	0～5V; 0～10V
		Current	0～10mA; 0～20mA; 4～20mA
FM148E (Channel isolated）	8 (Four-wire)	**Voltage**	0～5V; 0～10V
		Current	0～10mA; 0～20mA; 4～20mA
FM148R (Channel redundancy）	8 (Two/four-wire)	**Voltage**	0～5V
		Current	0～10mA; 0～20mA; 4～20mA

Overview

See figure 2-9 for the diagram of FM148 AI modules.

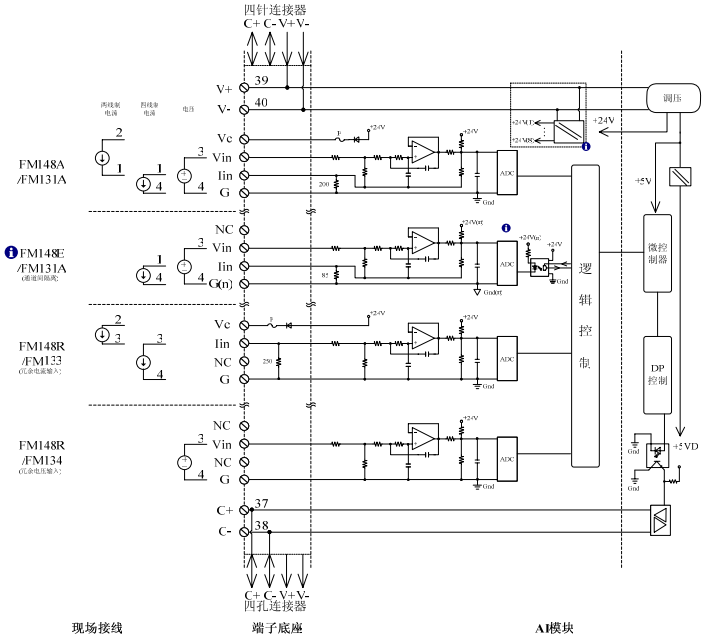


Figure 2-9 AI Modules Diagram

Instruction：

V+ and V- stand for the positive and negative ends of 24VDC power supply; C and C- stand for the positive and negative signals of communication;

Vc stands for external power supply +24V output; G stands for system grounding;

Vin stands for voltage signal input end; Iin stands for current signal input end；

NC stands for spare terminals (the same below)

LED Indicator

The LED indicator (RDY and COM) shows the working and communication status when power-on. See table 2 for descriptions.

Table 2 LED Indicator Descriptions

RDY	COM	Meaning
On	On	Normal;
Flash	Off	To be initialized, communication not established or error;
Off	Off	Module power-off or damaged.

Terminal Definition

Connecting terminals are shown in Figure 2-10 and terminal definitions in Table 3.

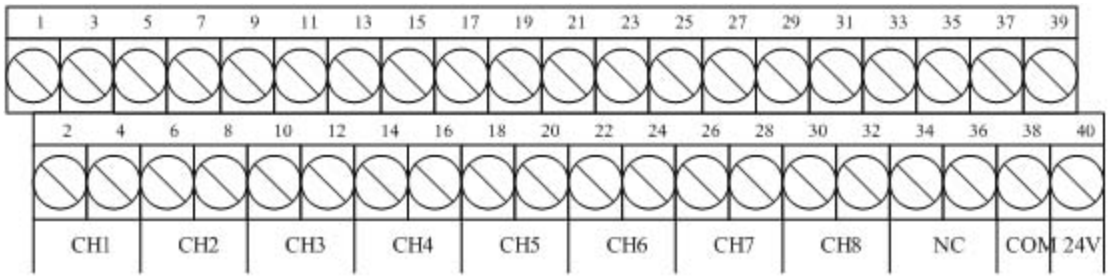


Figure 2-10 Connecting Terminals

Table 3 Terminal Definitions

No.		Model		
Channel No.	**Terminal No.**	**FM148A**	**FM148E**	**FM148R**
1	1	Iin 1	Iin 1	NC
	2	Vc 1	NC	Vc 1/ NC
	3	Vin 1	Vin 1	Iin 1/ Vin 1
	4	G 1	G 1	G1
……	……	……	……	……
8	29	Iin 8	Iin 8	NC
	30	Vc 8	NC	Vc 8/ NC
	31	Vin 8	Vin 8	Iin 8/ Vin 8
	32	G 8	G 8	G8
NC	33~36	NC		
COM	37	C+		
	38	C-		
24V	39	V+		
	40	V-		

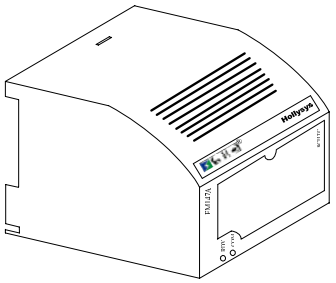
Specifications

Model		FM148A	FM148E	FM148R
Input features				
Channel number		8		
Range	Voltage	0～5V; 0～10V		0～5V
	Current	0～20mA; 0～10mA; 4～20mA		
Conversion accuracy		0.1%@25℃，F.S.	0.1%@25℃，F.S.（0～10V/0～20mA） 0.2%@25℃，F.S.（0～5V/0～10mA）	0.1%@25℃，F.S.
Dead zone range		Below 50mV or 0.25mA		
CMMRR		Better than 90dB		
NMMRR		Better than 40dB	Better than 60dB	
Current sampling resistance		200Ω	85Ω	250Ω
Sampling rate		10 times/second		
Temperature drift		±50ppm/℃	±100ppm/℃	±50ppm/℃
Isolation				
Channels isolated		—	500Vrms	—
Communication and system isolated		500Vrms	1000Vrms	500Vrms
Communication				
Protocol		ProfiBus-DP protocol		
Baud rate		500Kbps/ 93.75Kbps/ 45.45Kbps/ 31.25Kbps/ 19.2Kbps/ 9.6Kbps		
Power supply				
Voltage		24VDC±5%		
Power consumption（Max）		6W@24VDC（8-channel, external power supply, 20mA）	3W@24VDC	6W@24VDC（8-channel, external power supply, 20mA）
Working environment				
Working temperature		0℃~45℃		
Working humidity		5~90% relative humidity, non-condensing		
Storage temperature		-15℃~65℃		
Storage humidity		5~95% relative humidity, non-condensing		
Physical features				
Dimension		114mm×63mm×101mm (W×H×D)		
Installation		Installed on DIN35 rail		Works with FM133/FM134; Mounted on DIN35
Key position		3		
Protection degree		IP40		

8-Channel Thermocouple Analog Input ModuleFM147A

Features

- **8-channel thermocouple or millivoltage signal input**
- **Burnout detection, software filtration**
- **Built-in Profibus-DP slave interface**
- **24VDC reverse proof, signal channel voltage overload proof**
- **Hardware watchdog, Hot swap**
- **Real-time status display**



Model	Input channel	Signal range
FM147A	8	-5～+75mV
		-5～+35mV
		0～+78.125mV
		0～+39.0625mV

Overview

TC module works with terminal base, processes thermocouple millivoltage and millivoltage input signals from the field.

FM147A connects with thermocouple primary temperature measuring components J, K, N, E, S, B, R and T, to process field temperature signals. As its signal measuring scope can reach -5mV, temperatures below 0 can also be sampled. See figure 2-11 for diagram of FM147A.

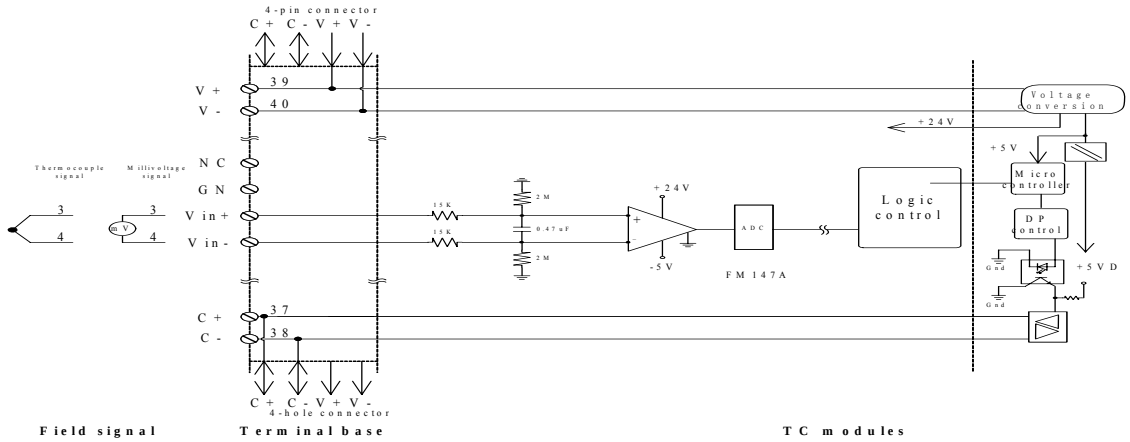


Figure 2-11 TC Module Diagram

Instruction：

V+ and V - stand for the positive and negative ends of 24VDC power supply;

C+ and C- stand for the positive and negative signals of communication;

Vin+ and Vin- stand for the positive and negative ends of field thermocouple millivoltage signal input;

GN refers to the power supply ground; NC stands for spare terminal (the same below)

LED Indicator

The LED indicator (RDY and COM) shows the working and communication status when power-on. See Table 4 for details.

Table 4 LED Indicator Description

RDY	COM	Meaning
On	On	Normal;
Flash	Off	To be initialized, communication not established error;
Off	Off	Module power-off or damaged.

Terminal Definition

Base terminal connection is shown in Figure 2-12, and terminal definitions in Table 5.

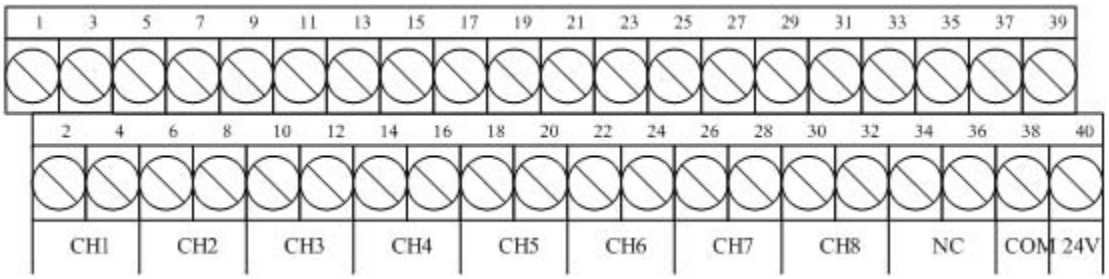


Figure 2-12 Base Terminals Connection

Table 5 Terminal Definitions

NO		Model
Channel No	**Terminal No**	**FM147A**
1	1	NC
	2	GN
	3	Vin 1+
	4	Vin 1-
… …	… …	… …
8	29	NC
	30	GN
	31	Vin 1+
	32	Vin 1-
NC	33~36	NC
COM	37	C+
	38	C-
24V	39	V+
	40	V-

Cold-end Temperature Compensation

Thermocouple cold-end compensation module FM192B-CC works with FM147A to measure cold-end

compensation temperature.

FM192B-CC converts cold-end temperature signal into corresponding voltage signal. FM147A receives the voltage signal through terminal base and reports to the controller. The controller calculates the environment temperature according to the voltage value and executes cold-end compensation accordingly.

See figure 2-13 for the diagram of FM192B-CC.

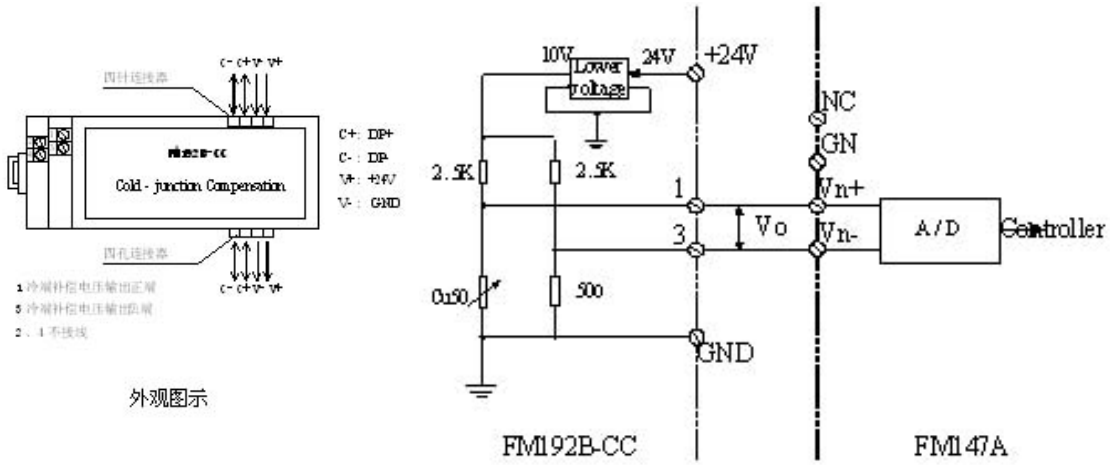


Figure 2-13 FM192B-CC Diagram

FM192B-CC output voltage $Vo=10(\frac{RT}{RT+2500}-0.0196)$（Unit：V）

RT refers to the resistance value of Cu50.

Instruction：

It is recommended that the configuration ad position of FM192B-CC modules should be as follows:

1. Physical positions of FM192B-CC and compensated FM147A should be as close as possible;
2. In case that multiple FM147A share one FM192B-CC, FM147A and FM192B-CC should be placed in the same line, and FM192B-CC should be placed among the multiple FM147A modules;
3. Distant FM147A are distant (different lines of the same cabinet, or in different cabinets) should be compensated by multiple FM192B-CC modules.

Specifications

Model	FM147A	FM192B-CC	
Input feature			
Channel number	8	DCV output	0~49mV
Signal type	Thermocouple (J, K, T, N, E, R, S and B) or millivoltage signal		
Range	-5～+75mV；-5～+35mV; 0～+78.125mV；0～+39.0625mV		
Conversion accuracy	0.2%F.S. (J，K，T，N，E) 0.3%F.S. (R，S，B，T)	Scope	0~50℃
CMMRR	Better than 90dB		

NMMRR	Better than 60dB	Deviation	±1℃
Input impedance	More than 1MΩ		
Sampling rate	1 time/s		
Channel endurance	30V@ continuous; 50VP-P@1mS peak		
Communication			
Protocol	ProfiBus-DP protocol	—	
Baud rate	500Kbps/93.75Kbps/45.45Kbps/31.25Kbps/19.2Kbps/9.6Kbps		
Communication and system isolated	500Vrms		
Power supply			
Power voltage	24VDC±5%		
Power consumption （Max）	5W@24VDC	＜0.5W	
Working environment			
Working temperature	0℃~45℃		
Working humidity	5~90% relative humidity, non-condensing		
Storage temperature	-15℃~85℃		
Storage humidity	5~95% relative humidity, non-condensing		
Physical feature			
Dimension	114mm×63mm×101mm (W×H×D)	95mm×40mm×46mm	
Installation	Mounted on DIN35 rail on terminal base	DIN35 rail	
Anti-confusion key	3	—	
Protection degree	IP40		

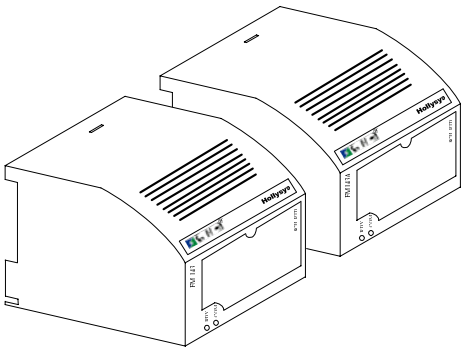
Appendix：Thermocouple temperature measure scope

Scale	Standard No.	Temperature range (°C)	Voltage range (mV)
B	ITS-90[1]	40~1820	0~13.820
	GB/T 2902-1998[2] II	600~1700	1.792~12.433
R	ITS-90	-50~1768	-0.226~21.101
	GB/T 1598-1998 I	0~1600	0.000~18.849
S	ITS-90	-50~1768	-0.236~18.693
	GB/T 3772-1998 I	0~1600	0.000~16.777
K	ITS-90	-270~1372	-6.458~54.886
	GB/T 2614-1998 I	-40~1100	-1.527~45.119
	GB/T 2614-1998 II	-40~1300	-1.527~52.410
	GB/T 2614-1998 III	-200~40	-5.891~1.612
N	ITS-90	-270~1300	-4.345~47.513

[1] 1990 International Temperature Standard
[2] 1998 National Standard of P.R.C.

	GB/T 2614-1998 I	-40~1100	-1.023~40.087
	GB/T 2614-1998 II	-40~1300	-1.023~47.513
	GB/T 2614-1998 III	-200~40	-3.990~1.065
E	ITS-90	-270~1000	-9.835~76.373
	GB/T 4993-1998 I	-40~800	-2.255~61.017
	GB/T 4993-1998 II	-40~900	-2.255~68.787
	GB/T 4993-1998 III	-200~40	-8.825~2.420
J	ITS-90	-210~1200	-8.095~69.553
	GB/T 4994-1998 I	-40~750	-1.961~42.281
T	ITS-90	-270~400	-6.258~20.872
	GB/T 2903-1998 I	-40~350	-1.475~17.819
	GB/T 2903-1998 III	-200~40	-5.603~1.612

8-Channel RTD Analog Input Module FM143/FM143A



Features

- **8-channel RTD input**
- **Software filtration**
- **Built-in Profibus-DP slave interface**
- **Signal channel over-voltage proof**
- **24VDC reverse proof**
- **Hardware watchdog**
- **Hot swap**
- **Real-time status display**

Model	Input channel	Signal range
FM143	8	50~383.02 ohm
FM143A		0~147.15 ohm

Overview

RTD module works with resistance temperature measuring components such as Cu50, Cu100, Pt10 and Pt100, to process the RTD signal from the field.

See figure 2-14 for diagram of RTD module.

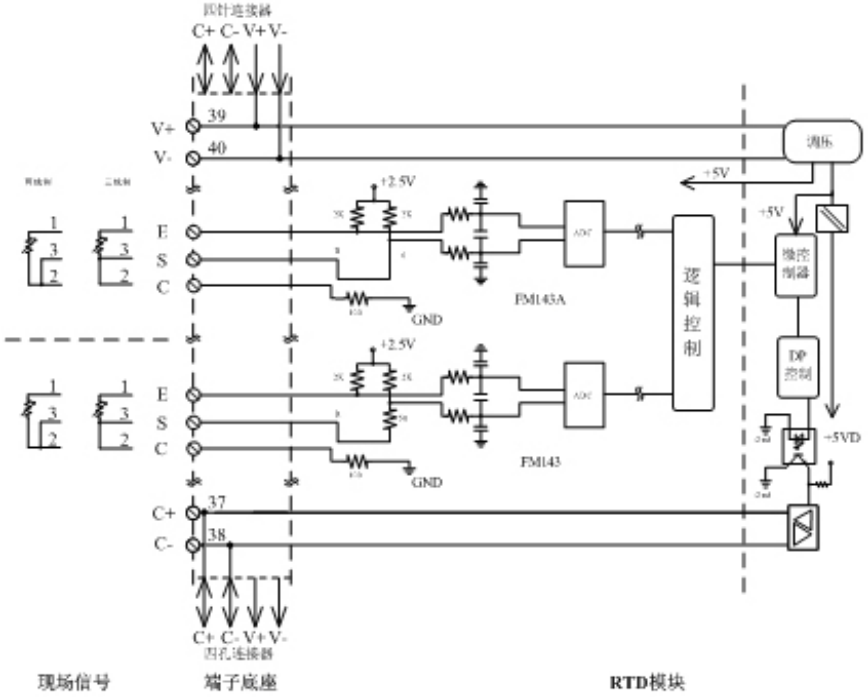


Figure 2-14 RTD Diagram

Instruction:

V+ and V - stand for the positive and negative ends of 24VDC power supply;

C+ and C- stand for the positive and negative signals of communication;

En and Sn stand for both input terminals of resistance temperature sensors;

Cn stands for one input terminal of resistance temperature sensor（common line）;

NC stands for spare terminal (the same below)

LED Indicator

The LED indicator (RDY and COM) show the working and communication status when power-on.

Table 6 LED Indicator Descriptions

RDY	COM	Meaning
On	On	Normal
Flash	Off	To be initialized, communication not established or error
Off	Off	Module power-off or damaged

Terminal Definition

Base terminal connection is shown in Figure 2-15. See Table 7 for terminal definition.

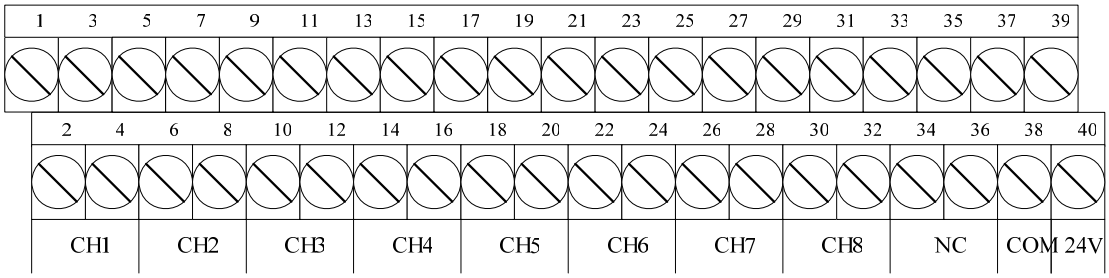


Figure 2-15 Base Terminals

Table 7 Terminal Definitions

No.		Model	
Channel No.	**Terminal No.**	**FM143**	**FM143A**
1	1	E1	
	2	C1	
	3	S1	
	4	NC	
……	……	……	
8	29	E8	
	30	C8	
	31	S8	
	32	NC	
NC	33~36	NC	
COM	37	C+	
	38	C-	
24V	39	V+	
	40	V-	

Specifications

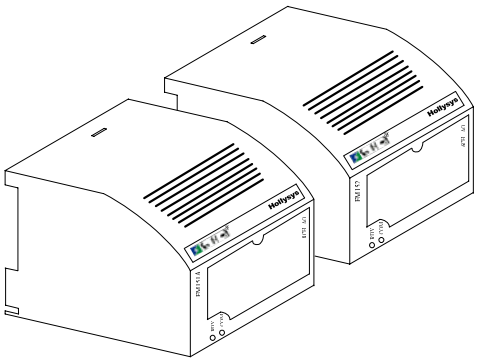
Model	FM143	FM43A
Input features		
Channel number	8	
Signal type	RTD	
Range	50~383.02Ω; 50~204.5Ω; 50~86.65Ω	0~147.15Ω; 0~71.08Ω
Conversion accuracy	0.2%@25℃; F.S.	
CMMRR	Better than 90dB	
NMMRR	Better than 40dB	
Sampling rate	2 times/s@Max	
Channel endurance	±40VDC	
Communication		
Protocol	ProfiBus-DP protocol	
Baud rate	500Kbps/93.75Kbps/45.45Kbps/31.25Kbps/19.2Kbps/9.6Kbps	
Communication and system isolated	500Vrms	
Power supply		
Power voltage	24VDC±5%	
Power consumption	4.8W@24VDC	

（Max）	
Working environment	
Working temperature	0℃~45℃
Working humidity	5~90% relative humidity, non condensing
Storage temperature	-15℃~65℃
Storage humidity	5~95% relative humidity, non condensing
Physical features	
Dimension	114mm×63mm×101mm (W×H×D)
Installation	At DIN35
Anti-confusion key	5
Protection degree	IP40

6/8-Channel Analog Output Module FM151A/FM152

Features

- **6/8-channel 4~20mA current output**
- **Redundant current output（FM152）**
- **Built-in Profibus-DP slave interface**
- **Current overload proof**
- **24VDC reverse proof**
- **Hardware watchdog**
- **Hot swap**
- **Real-time status display**



Model	Output channel	Signal scope
FM151A	8	4~20mA
FM152 (Channel redundancy)	6	

Overview

FM151A is non-redundant AO module. FM152 works with terminal base FM132 to compose redundant output mode. In case of ProfiBus-DP master signal, if the module is active, the corresponding channel opens and current signal outputs to the field; if the module is standby, the corresponding channel breaks off.

Note：for FM151A, if field load resistance ≥250Ω, 8-channel output; if field load ＜250Ω, 6-channel output due to heating limit.

The power supply is 24VDC and the diagram is shown in Figure 2-16.

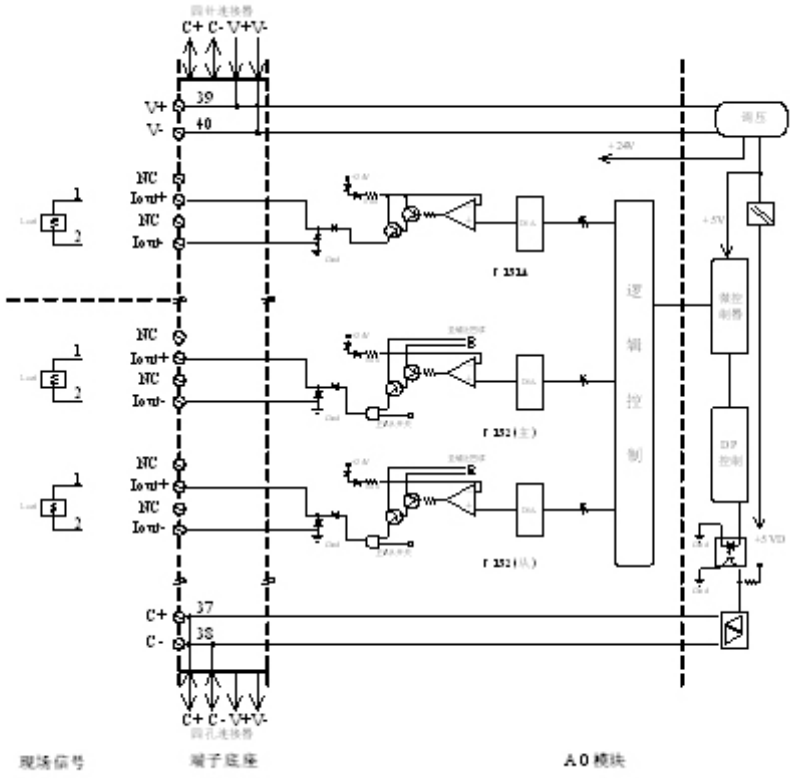


Figure 2-16 AO Diagram

Instruction:

V+ and V- stand for the positive and negative ends of 24VDC power supply;

C+ and C- stand for the positive and negative signals of communication;

Iout+ and Iout- stand for the positive and negative ends of current signal output;

NC stands for spare terminals (the same below).

LED Indicator

The LED indicators (RDY and COM) show the working and communication status.

Table 8 LED Indicator Descriptions

RDY	COM	Descriptions
On	On	Normal
Flash	Off	To be initiated, communication not established or error
Off	Off	Module power-off or damaged

For redundant FM152, LED indicators（RDY and COM）on the panel show the working and communication status. See Table 9 and 10 for details.

Table 9 Active Module LED Indicator Descriptions

RDY	COM	Active/Standby Status	Descriptions
On	On	Active	Normal
Interval flash[3]	On	Active	Communication normal, channel output error or output channel damaged

Flash [1]	Off	—	To be initiated, communication not established or error
Off	Off	—	Module power-off or damaged

Table 10 Standby Module LED Indicator Descriptions

RDY	COM	Active/Standby Status	Descriptions
Flash [2]	Off	Standby	Communication established in normal running
Flash [1]	On	—	To be initiated, communication not established or error
Off	Off	—	Module power-off or damaged

Note 1：Flash evenly at a rate of 4-5 times/s;

2：Flash evenly at a rate of 1-2 times/s;

3：Flash unevenly, first flash three times（interval 0.5 second）then off for 2 seconds, and so on.

Terminal Definition

Base terminal connection is shown in Figure 2-11 and see Table 11 for terminal definition.

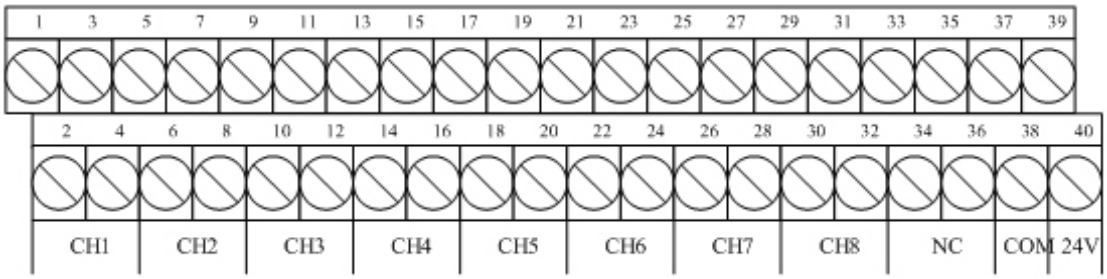


Figure 2-17 Base Terminals

Table 11 Terminal Definition

No.		Model	
Channel No.	**Terminal No.**	**FM151A**	**FM152**
1	1	Iout1+	
	2	Iout1-	
	3	NC	
	4	NC	
… …	… …	… …	
6	21	Iout1+	
	22	Iout1-	
	23	NC	
	24	NC	
7	25	Iout7+	NC
	26	Iout7-	NC
	27	NC	NC
	28	NC	NC

8	29	Iout8+	NC
	30	Iout8-	NC
	31	NC	NC
	32	NC	NC
NC	33~36	NC	
COM	37	C+	
	38	C-	
24V	39	V+	
	40	V-	

Specifications

Model	FM151A	FM152
Output features		
Channel number	8	6
Signal scope	4～20mA	
Output accuracy	0.2%@25℃，F.S.	
Active/standby shift time	—	≤5ms
Temperature drift	Max.±100ppm/℃	
Load capacity（Max）	Max.750Ω@24VDC	
Communication		
Protocol	ProfiBus-DP	
Baud rate	500Kbps/93.75Kbps/45.45Kbps/31.25Kbps/19.2Kbps/9.6Kbps	
Communication and system isolated	500Vrms	1000Vrms
Power supply		
Power voltage	24VDC±5%	
Power consumption（Max）	6W@24VDC (8-channel output 20mA simultaneously)	5W@24VDC (6-channel output 20mA simultaneously)
Working environment		
Working temperature	0℃~45℃	
Working humidity	5~90% relative humidity, non-condensing	
Storage temperature	-15℃~65℃	
Storage humidity	5~95% relative humidity, non-condensing	
Physical feature		
Dimension	114mm×63mm×101mm (W×H×D)	
Installation	Mounted on terminal base on DIN35 rail	Mounted on FM132 on DIN35 rail
Key position	4	5
Protection degree	IP40	

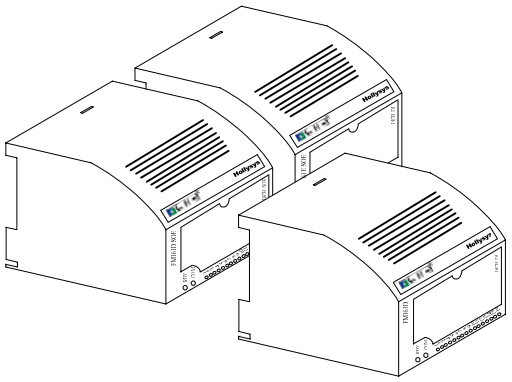
16-Channel Digital Input Module

FM161D/FM161D-48/FM161D-SOE/FM161D-48-SOE

FM161E-SOE/FM161E-48-SOE

Features

- **16-channel contact digital /SOE[3]signal input**
- **De-bouncing**
- **Support common ground dry contact signal input**
- **Built-in Profibus-DP slave interface**
- **Channel over-voltage proof**
- **24VDC reverse proof**
- **Hardware watchdog**
- **Hot swap**
- **Real-time status display**



Model	Input channel	Signal type	Query power
FM161D	16	Dry contact signal	24VDC
FM161D-48			48VDC
FM161D-SOE	16		24VDC
FM161D-48-SOE			48VDC
FM161E-SOE	15+1		24VDC
FM161E-48-SOE			48VDC

Overview

DI module provides 24VDC and 48VDC query power, which is provided by independent power supply. The working power is 24VDC. See Figure 2-18 for its diagram.

[3] SOE, or Sequence Of Event, is digital input signal with time mark.

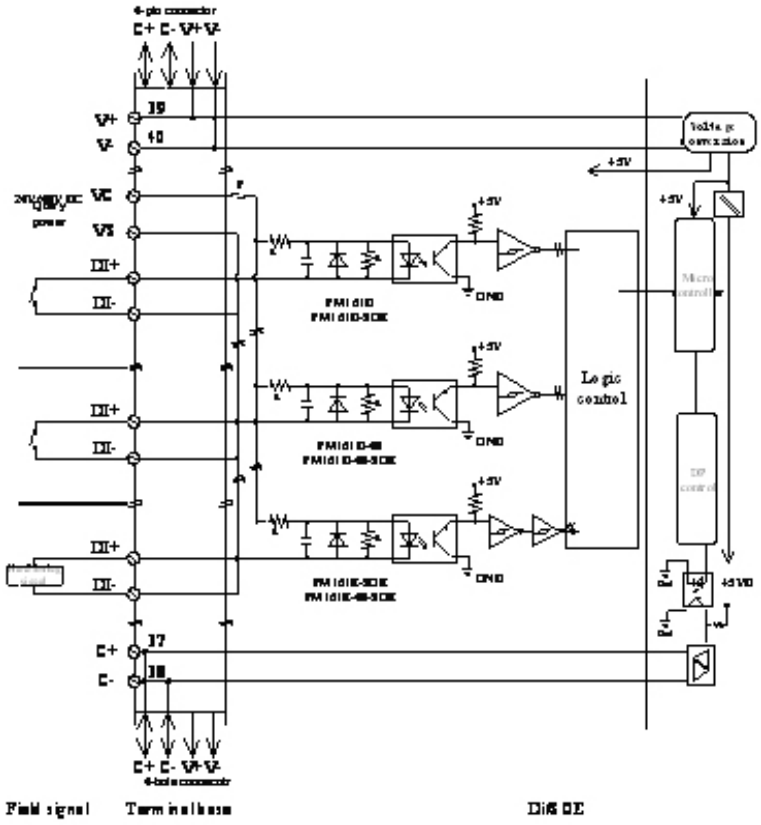


Figure 2-18 Diagram

Instructions：

V+ and V- stand for the positive and negative ends of 24VDC power supply;

C+ and C- stand for the positive and negative signal of communication;

DI+ and DI- stand for the positive and negative ends of digital /SOE signal input;

VC and VS stand for the positive and negative ends of 24V/48V DC query power. (the same below)

LED Indicator

The state indicating lights (RDY and COM) show the working and communication state when the module is power on. Table 12 below shows the state and the meaning of the lights.

Table 12 LED Indicators

RDY	COM	Definitions
On	On	Normal
Flash	Off	To be initialized, communication not established or error
Off	Off	Module power-off or damaged

Note：16 channel LED indicators show the status of Channel 1～16: “On” shows channel closes and “Off” shows channel breaks off.

Terminal Definition

Terminal connection is shown in Figure 2-19 and see Table 13 for terminal definition.

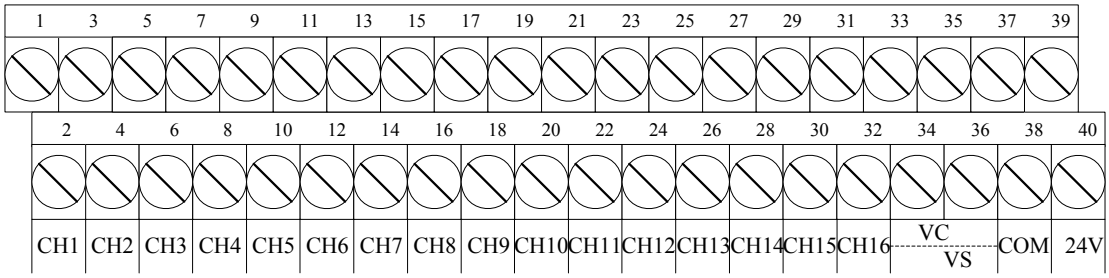


Figure 2-19 Base Terminals

Table 13 Terminal Definitions

No.		Model			
Channel No.	**Terminal No.**	**FM161D FM161D-SOE**	**FM161D-48 FM161D-48-SOE**	**FM161E-SOE**	**FM161E-48-SOE**
1	1	DI1+		DI1+	
	2	DI1-		DI1-	
… …	… …	… …		… …	
16	31	DI16+		Hard timing signal input +	
	32	DI16-		Hard timing signal input -	
VC/VS	33	VC1		VC1	
	34	VS1		VS1	
VC/VS	35	VC2		VC2	
	36	VS2		VS2	
COM	37	C+		C+	
	38	C-		C-	
24V	39	V+		V+	
	40	V-		V-	

Note：VC1 and VS1 stand for the positive and negative ends of 24/48VDC query power required by digital input channel 1~8;

VC2 and VS2 tand for the positive and negative ends of 24/48VDC query power required by digital input channel 9~16.

Specifications

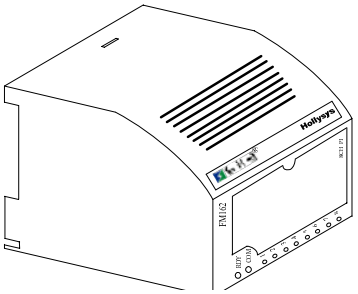
Model	**FM161D FM161D-SOE**	**FM161D-48 FM161D-48-SOE**	**FM161E-SOE**	**FM161E-48-SOE**
Input features				
Channel number	16		15	
Hard time-setting signal input	—		1	
Signal type	Dry contract			
Logic “0”	0～12VDC	0～24VDC	0～12VDC	0～24VDC
Logic “1”	18～32VDC	36～65VDC	18～32VDC	36～65VDC
Full channel scan	<1ms			

time				
Resolution	1ms		1ms@ innerstation, 2ms@ interstation	
De-bounding	10ms			
Query power	24VDC±20% 5mA	48VDC±20% 5mA	24VDC± 20% 5mA	48VDC±20% 5mA
Field and system isolated	1000Vrms			
Communication				
Protocol	ProfiBus-DP salve			
Baud rate	500Kbps/93.75Kbps/45.45Kbps/31.25Kbps/19.2Kbps/9.6Kbps			
Communication and system isolated	500Vrms			
Power supply				
Power voltage	24VDC±5%			
Power consumption （Max）	3.6W@24VDC			
Working environment				
Working temperature	0℃~45℃			
Working humidity	5~90% relative humidity, non-condensing			
Storage temperature	-15℃~65℃			
Storage humidity	5~95% relative humidity, non-condensing			
Physical features				
Dimension	114mm×63mm×101mm (W×H×D)			
Installation	Mounted on terminal base on DIN35 rail			
Anti-confusion key	1			
Protection degree	IP40			

8-Channel Pulse Input Module FM162

Features

- **8-channel pulse signal input**
- **Support counting and frequency measuring**
- **Built-in Profibus-DP slave interface**
- **24VDC reverse proof, channel voltage overload proof**



- **Hardware watchdog**
- **Support hot swap**
- **Real-time status display**

Model	Signal channel	Frequecy measure scope	Counting scope
FM162	8	0~10K Hz	0~65565

Overview

PI module processes pulse input signals from the control field. The frequency measuring and counting can be configured according to users' requirements. Each channel can be set as either frequency measuring or counting. Both frequency measuring channel and counting channel are allowed in the same module. The working power is 24VDC. PI module diagram is shown in Figure 2-20.

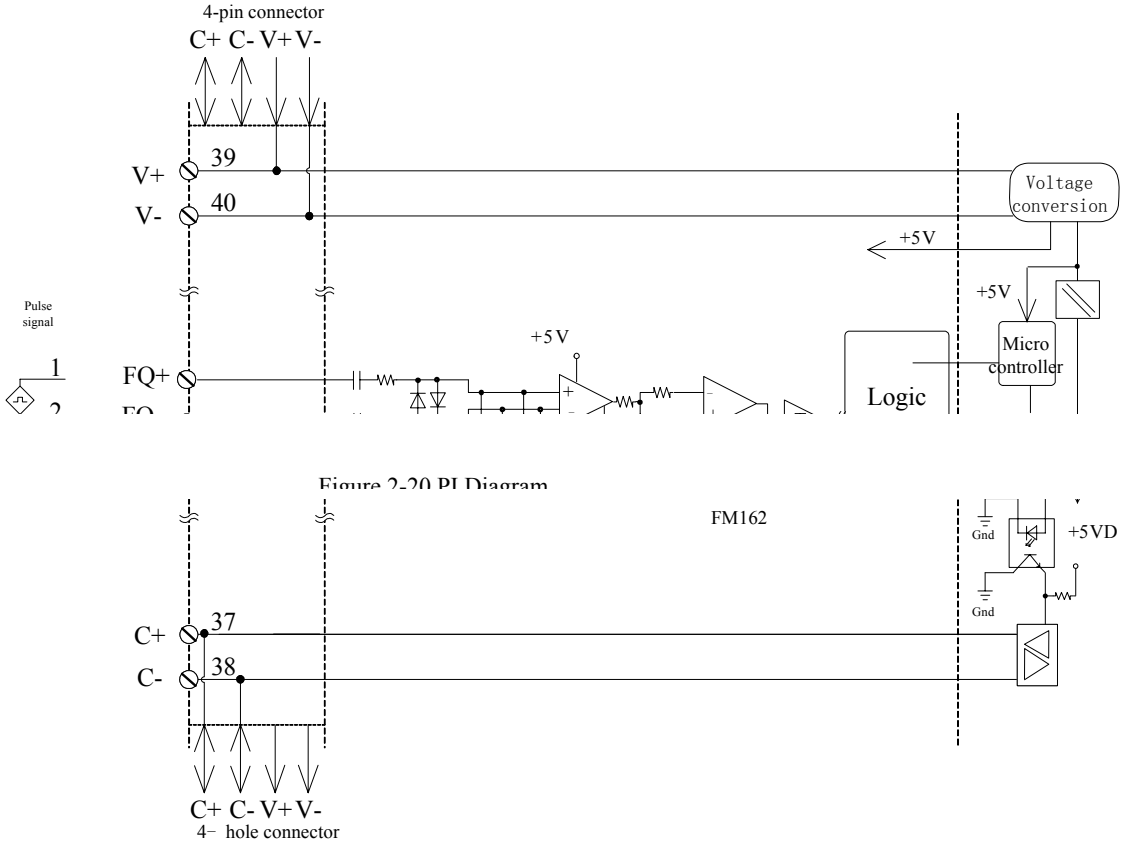


Figure 2-20 PI Diagram

Instruction:

V+ and V- stand for the positive and negative ends of 24VDC power supply;

C+ and C- stand for the positive and negative signal of communication;

FQ+ and FQ- stand for the positive and negative ends of pulse input signals;

NC stands for spare terminals. (the same below)

LED Indicator

The LED indicators (RDY and COM) show the working and communication status when power on.

Table 14 LED Indicators

RDY	COM	Meaning
On	On	Normal
Flash	Off	To be initialized, communication not established or communication line error;
Off	Off	Module power-off or damaged

Note：8 channel LED indicators show the status of Channel 1～8: Flashing frequencies correspond to the pulse frequencies of 8 input channels.

Terminal Definition

Base terminal is shown in Figure 2-21. See table 15 for terminal definition.

Figure 2-21 Base Terminals

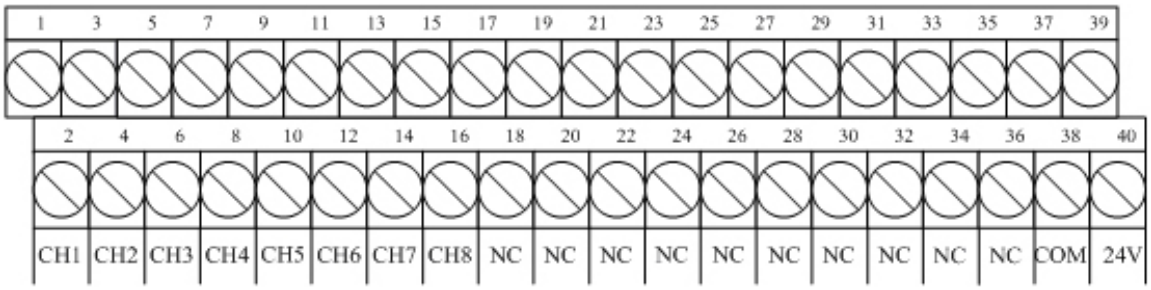


Table 15 Terminal Definitions

No.		Model
Channel No.	**Terminal No.**	**FM162**
1	1	FQ1+
	2	FQ1-
… …	… …	… …
8	15	FQ8+
	16	FQ8-
NC	17~36	NC
COM	37	C+
	38	C-
24V	39	V+
	40	V-

Specifications

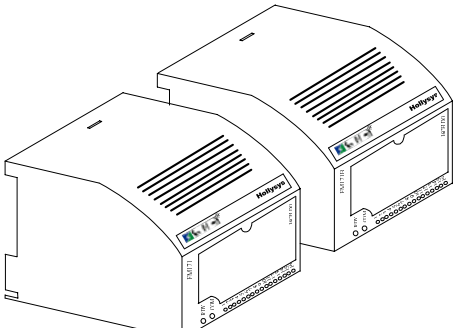
Model	FM162
Input features	
Channel number	8

Input impedance	10KΩ
Voltage	0.5~24V
Channel endurance	±40V
Frequency measure	
Frequency measure scope	0~10K Hz
Frequency measure accuracy	±1Hz
Counting	
Counting scope	0~65565
Counting accuracy	±5
Communication	
Protocol	ProfiBus-DP
Baud rate	500Kbps/93.75Kbps/45.45Kbps/31.25Kbps/19.2Kbps/9.6Kbps
Communication and system isolated	500Vrms
Power supply	
Power voltage	24VDC±5%
Power consumption （Max）	2.5W@24VDC
Working environment	
Working temperature	0℃~45℃
Working humidity	5~90% relative humidity, non-condensing
Storage temperature	-15℃~65℃
Storage humidity	5~95% relative humidity, non-condensing
Physical features	
Dimension	114mm×63mm×101mm (W×H×D)
Installation	Mounted on terminal base on DIN35 rail
Anti-confusion key	1
Protection degree	IP40

16-Channel Digital Output Module FM171/FM171B

Features

- **16-channel digital output**
- **Relay output（FM171）**
- **Transistor output（FM171B）**
- **Built-in Profibus-DP slave interface**



- **24VDC reverse proof**
- **Hardware watchdog**
- **Support hot swap**
- **Real-time status display**

Model	Output channel	Signal type
FM171	16	Relay
FM171B		Transistor

Overview

DO modules work with special terminal bases and external terminal templates. The working power of DO module is 24VDC and the diagram is shown in Figure 2-22.

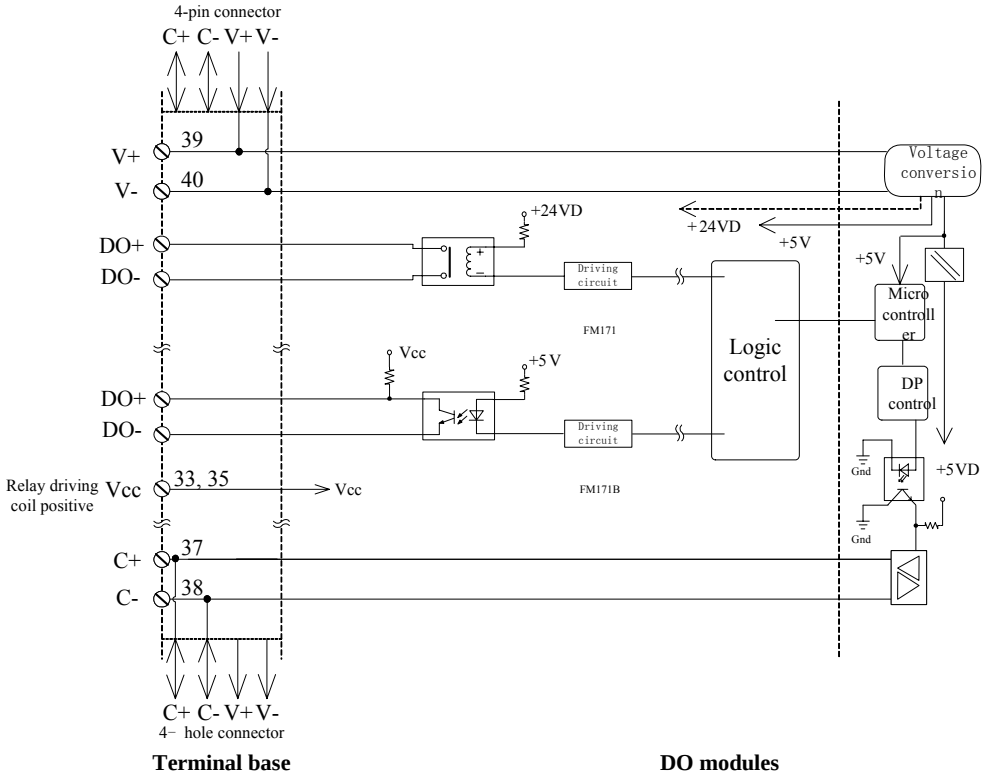


Figure 2-22 DO Diagram

Instruction:

V+ and V- stand for the positive and negative ends of 24VDC power supply;

C+ and C- stand for the positive and negative signals of communication;

DO+ and DO- stand for the positive and negative ends of digital output constant contacts;

Vcc refers to the positive end of middle relay 24VDC power supply connected to FM171B; (DO+ is short connected with Vcc inside the module) (the same below)

LED Indicator

The LED indicators (RDY and COM) show the working and communication status.

Table 16 LED Indicators

RDY	COM	Descriptions
On	On	Normal
Flash	Off	To be initialized, communication not established or communication line error
Off	Off	Module power-off or damaged

Note：16 channel LED indicators show the status of Channel 1～16: "On" indicates channel closes and "Off" indicates channel breaks off.

Terminal Definition

The terminal connection is shown in Figure 2-23. See Table 17 for terminal definition.

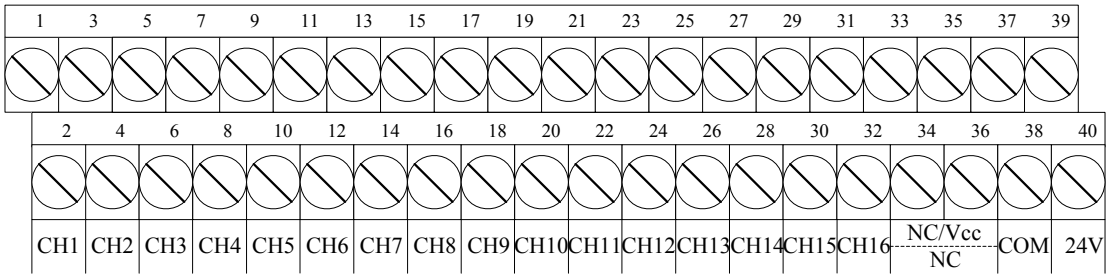


Figure 2-23 Base Terminal Connection

Table 17 Terminal Definitions

No.		Model	
Channel No.	Terminal No.	FM171	FM171B
1	1	DO1+	
	2	DO1-	
… …	… …	… …	
16	31	DO16+	
	32	DO16-	
External relay drives positive end of coil power supply (FM171B)	33	NC	Vcc
	34	NC	
	35	NC	Vcc
	36	NC	
COM	37	C+	
	38	C-	
24V	39	V+	
	40	V-	

Note：Vcc refers to the positive end of middle relay 24VDC power supply connected to FM171B; (DO+ and Vcc are short connected inside the module)

Specifications

Model	FM171	FM171B
Output features		

Channel number	16	
Signal type	Passive normal open contact	Transistor
Switch rate	20 times/m	—
Switch capacity	500mA@24V DC	50mA@24V DC
Switch lifespan	2×10^5	—
Response/conduction time	6ms	60us
Release/blocking time	3ms	53us
Field and system isolated	—	1500VAC
Communication		
Protocol	ProfiBus-DP	
Baud rate	500Kbps/93.75Kbps/45.45Kbps/31.25Kbps/19.2Kbps/9.6Kbps	
Communication and system isolated	500Vrms	
Power supply		
Power voltage	24VDC±5%	
Power consumption （Max）	5.4W@24VDC	3.5W@24VDC
Working environment		
Working temperature	0℃~45℃	
Working humidity	5~90% relative humidity, non-condensing	
Storage temperature	-15℃~65℃	
Storage humidity	5~95% relative humidity, non-condensing	
Physical feature		
Dimension	114mm×63mm×101mm (W×H×D)	
Installation	Mounted on terminal base on DIN35 rail	
Terminal base	FM131A；FM131-C-A；FM131-E-A	
Terminal template	FM138DCC；FM138DCD；FM138ACC；FM138ACD	FM138DCC；FM138DCD；FM138ACC；FM138ACD；FM138SSRC；FM138SSRD
Anti-confusion key	6	
Protection degree	IP40	

FM131A Standard Terminal Module

Features

- **Easy mounting on 35mm rail or plane mounting**
- **Accommodate all MACS I/O modules**
- **Easy address-setting**

- **Anti-confusion key**
- **Support cascade connection**

Connecting Field Equipment

Step 1: Define the relation between field signals and base terminal signals according to the requirements of I/O module.

Step 2: Define the route and length of the signal according to signal types and position of I/O modules and field equipment.

Step 3: Process two ends of the signal into easy connection shape as shown in figure 2-24.

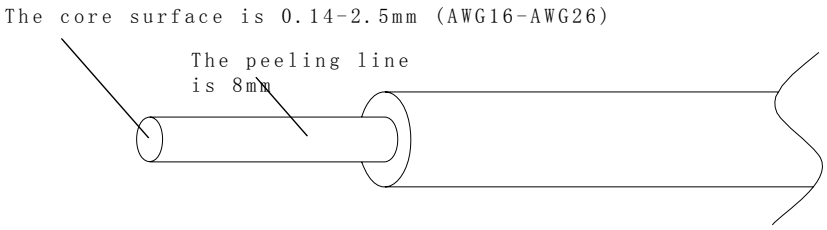


Figure 2-24 Requirement for Signal Line

Step 4: Serial number is put up to the signal cable end close to the base (Figure 2-25). Select plastic thimble according to the size and color of the signal cable, and set the plastic thimble at the signal cable (The serial number means "The signal connects with terminal 10 of FM141 module).

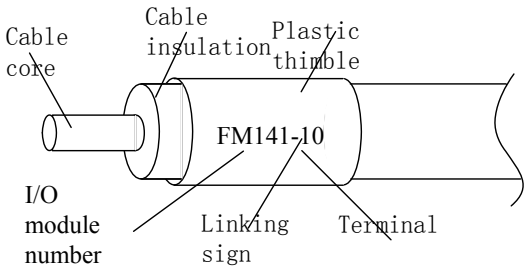


Figure 2-25 Serial Number of Signal Cable to Base Terminal

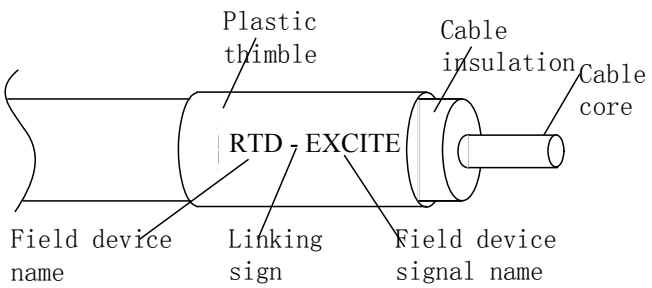


Figure 2-26 Serial Number of Signal Cable to Field Device

Step 5: Serial number is put up to the signal cable end close to equipment (Fig 2-26). Select plastic thimble according to the size and color of the signal cable, and set the plastic thimble at the signal cable (The serial number of figure means " The signal connects with EXCITE terminal of RTD).

Step 6: As shown in Fig 2-27, connect the signal cables to terminals of base and field equipment.

For easy operation, first connect the field signal cable to the even terminal and odd terminal next.

Step 7: Do examination after connecting a module with all field signal cables.

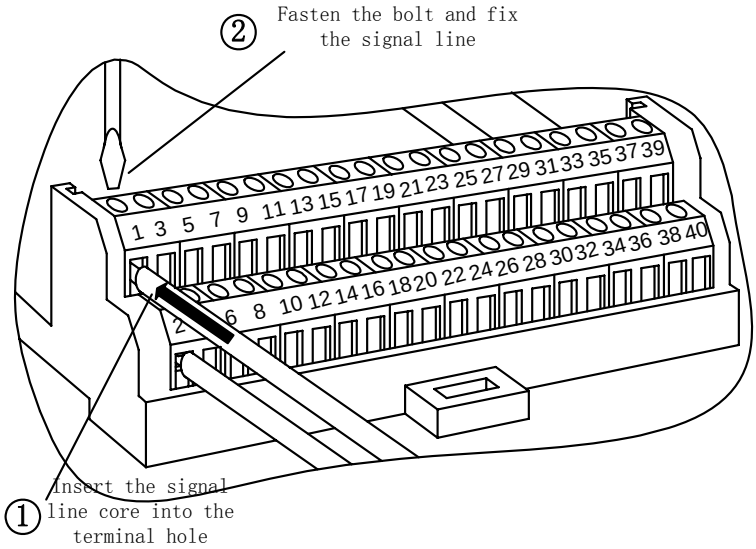


Fig 2-27 Connect the Signal Cable to Terminals

Flat Cable Connection Terminal Module FM131-C

Overview

FM131-C uses flat cables to connect modules and field signals, supports cascade modules connection and connection with DP terminal adaptor.

Configuration

FM131-C consists of EURO-connector, dial switch, horn socket and connection terminals as shown in Figure 2-28.

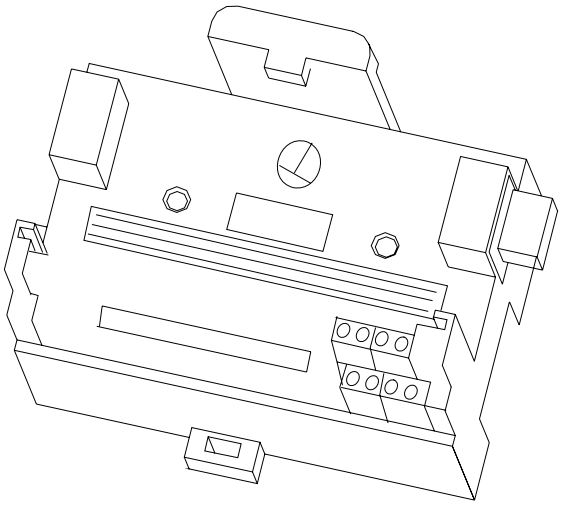


Figure 2-28 FM131-C

Instruction

Station Address Setup

Communication address is set according to 8-bit dial switch. Address No 1~126 can be set. "ON" corresponds to value "0" and "OFF" to value "1". DIP switch low bit corresponds to binary low bit.

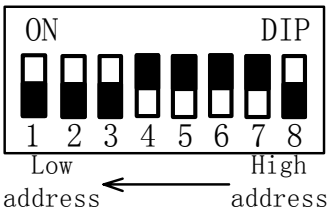


Figure 2-29 Dial Switch

Anti-confusion Key

Anti-confusion key can be dialed to 8 different positions.

Signal Connection

Horn Socket

Channel signals are introduced by horn connector. The socket pin Nos are shown in Figure 2-30:

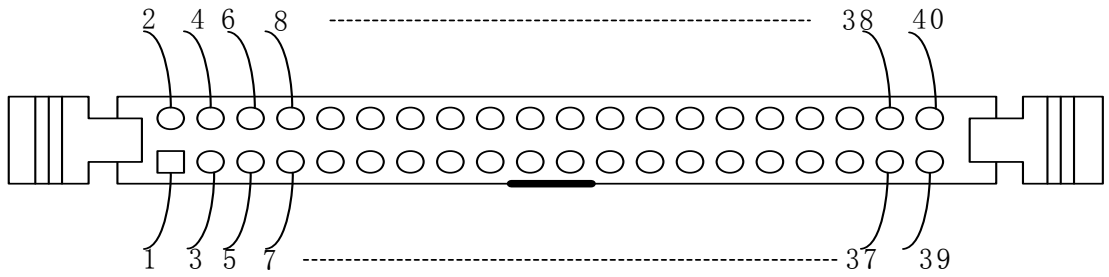


Figure 2-30 Horn Socket

Connection Terminals

Query power is introduced by connection terminals as shown in Figure 2-31:

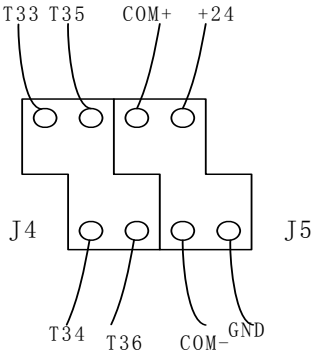


Figure 2-31 Connection Terminals

Note：T33 and T34 are external query power connection terminals of the first 8-channel, T33 connects to V+ and T34 to V-. T35 and T36 are external query power connection terminals of the second 8-channel; T35 connects to V+ and T36 to V-

Technical Specification

Model	FM131-C
Mounting	Mounted on 35 mmDIN or hang
Working temperature	0℃~45℃
Working humidity	5~95% relative humidity, non-condensing
Storage temperature	-15℃~65℃
Storage humidity	5~95% relative humidity, non-condensing
Protection degree	IP40

16-Channel Digital Output Terminal Plate

FM138-ACC/FM138-ACD/FM138-DCC/FM138-DCD/FM138-SSRC/FM138-SSRD

Overview

Digital output terminal plate works with FM171/FM171B DO modules and FM131-C-A/FM131-E-A, connects DO signals to digital output terminal plate, drives the relay, and controls field AC/DC load.

AC relay output terminal plate FM138-ACC/D, DC relay output terminal plate FM138-DCC/D or standard FM138-SSRC/D are optional depending on field demand.

LED Indicator

When the digital output terminal plate is power on, 16 LED indicators（D1～D16）display signal conduction of 16 channels. LED On indicates channel conduction and LED Off indicates channel block.

Terminal Definition

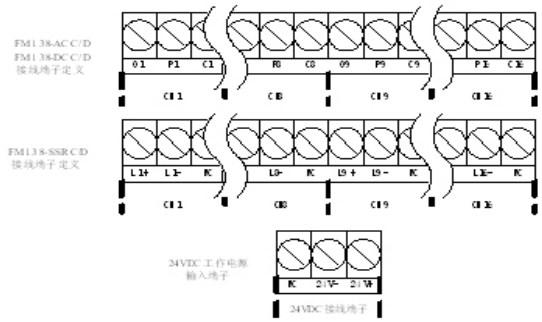


Figure 2-32 Base Connection Terminals

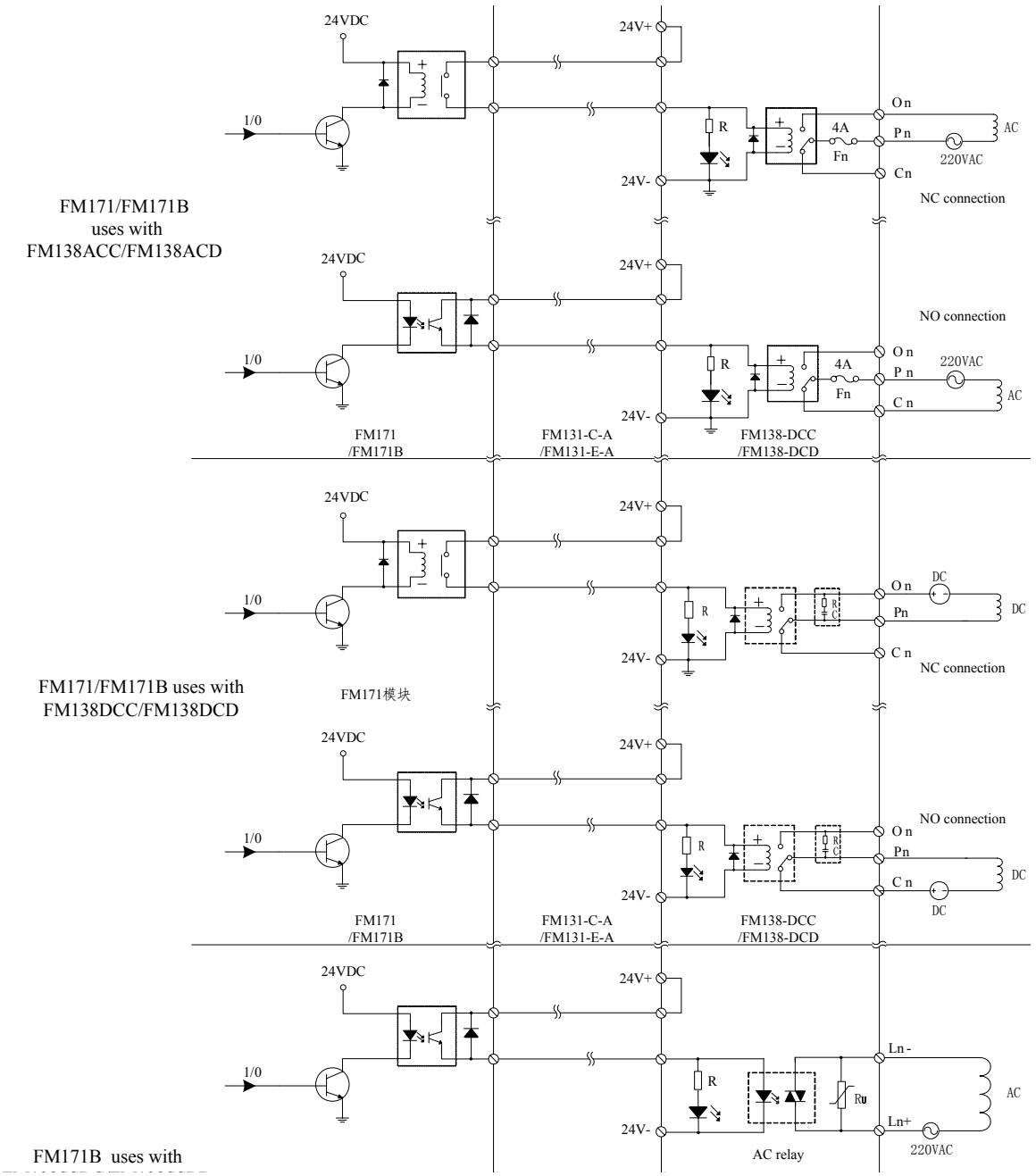


Figure 2-33 FM138 circuit diagram

Figure 2-33 Circuit Diagram

Table 18 Terminal Definition

No.	Model					
Channel No.	**FM138 -ACC**	**FM138 -ACD**	**FM138 -DCC**	**FM138 -DCD**	**FM138 -SSRC**	**FM138 -SSRD**
CH1	O.1				L1+	
	COM.1				L1-	
	C.1				NC	
……	……				……	
CH16	O.16				L16+	
	COM.16				L16-	
	C.16				NC	
Terminal plate 24VDC working power input connection terminal						
24VDC Working power	NC					
	24V-					
	24V+					

Note：for FM138-SSRC/D, when using AC solid relay, there is no positive or negative difference for Ln+ and Ln- (n=1~16); when using DC solid relay, Ln+ connects with positive end and Ln- with negative end (n=1~16).

Specifications

Model	FM138 -ACC	FM138 -ACD	FM138 -DCC	FM138 -DCD	FM138 -SSRC	FM138 -SSRD
Output features						
Channel number	16(NO/NC contact)				16(NO contact)	
Relay switch capacity	4A@220VAC		8A@30VDC		AC 0~60V, 0~5A	
					DC 48~220V, 0.06~5A	
Relay input output endurance	5000Vrms，10mA @1min		4000Vrms， 10mA @1min			
Max switch speed	20/m (rating load)				—	
Relay conduction time	15 ms		8 ms		AC 10ms, DC 1ms	
Relay block time	5 ms		2 ms		AC 10ms, DC 300μs	
Output channel protection	Glass tube safety, 4A		Spark receiver XE1201, 0.1μ/AC250V		—	
Relay model	JW1FSN-DC24V		RP710024		AC solid state CMX60D5 DC solid state CX480D5	
Power supply						
Power voltage	24VDC±10%（externally-powered）					
Power consumption （Max）	10W@24VDC 16-channel relay conduction				8W@24VDC 16-channel relay conduction	
Working environment						
Working	0℃~45℃					

temperature						
Working humidity	5~90% relative humidity, non-condensing					
Storage temperature	-15℃~65℃					
Storage humidity	5~95% relative humidity, non-condensing					
Physical features						
Complement modules	FM171/FM171B				FM171B	
Complement bases	FM131-C-A	FM131-E-A	FM131-C-A	FM131-E-A	FM131-C-A	FM131-E-A
Complement cables	40Pin, flat	37Pin, round	40Pin, flat	37Pin, round	40Pin, flat	37Pin, round
Interface type	C	D	C	D	C	D
Dimension	120mm × 303mm × 55mm (W×H×D)					
Mounting	Mount on DIN35, connect with FM131-C/E-A base prefabricated cables, use with FM171/171B					

Note：There is no AC/DC solid relay in standard FM138-SSRC/D configuration

FM192-TR Active Terminal Adapter

Overview

FM192-TR DP FieldBus terminal adapter is designed for MACS^{TM} system, power supply 24VDC, connected with ProfiBus-DP and I/O modules of MACS^{TM} system.

Terminal Definition

4-pin connected is defined as in Table 19:

No.	Definition
1	+24V
2	GND
3	DP COM+
4	DP COM-

Chapter 3 Profibus-DP and Devices

Profibus-DP Introduction

Overview

Fieldbus realizes bidirectional serial multi-contact digital communication between field and intelligent measuring control devices. Profibus follows International Standard IEC61158 (European standard: EN50170/National standard: JB/T10308.3-2001).

ProfiBus is classified into three protocols: ProfiBus-DP, ProfiBus-FMS, and ProfiBus-PA. ProfiBus-DP is optimized high-speed communication connection, specially designed for the communication between automatic control system and distributed I/O.

Features

The system includes master station and slave station. The master station determines data communication. And when the master station has bus control, it can send information even without external requests. The slave station does not have bus control. It can only confirm received information or send information when requested.

ProfiBus adopts RS485 transmission technology, shielded pair-twisted cable as transmission medium, transmission rate 9.6Kps~12Mbps. Once in operation, all devices at each chain should have the same baud rate.

Profibus Parameters

Transmission technology

RS-485 pair-twisted cable or optical cable

Baud rate 9.6Kbps~12Mbps

Bus access

- Password transmission among master stations, data transmission between master station and slave station
- Support single-host and multi-host system
- Master-slave device, max 126 points in the bus

Communication

Point-to-point (users data transmission) or broadcast (control command)

Cycle master-slave user data transmission and non-cycle master-master data transmission

ProfiBus-DP Application in FM Hardware System

In FM hardware system, controller is ProfiBus-DP master station; I/O modules are ProfiBus slave stations. Master/slave stations and their connectors constitute the complete ProfiBus-DP network. The optimization of network configuration (including master/slave station numbers, transmission rate and distance) improves system stability.

Number of Stations

The maximum configuration recommended for each control station in FM hardware system:

Section 1 (terminal adapter + 2 master stations + 22 slave stations + repeaters)+ section 2 (23 slave stations + repeaters) + section 3 (23 salve stations + repeaters) + section 4 (23 slave stations + terminal adapters)

Baud Rate

Profibus-DP supports the following baud rates: (Unit: Kbps)

9.6, 19.2, 31.25, 45.45, 93.75, 500

Transmission Medium

RS485 pair-twisted cable or optical fiber.

The transmission medium of Profibus-DP pair-twisted line can be either type A or type B. A is shielded pair-twisted line and B is general pair-twisted line.

Table 20 Line A and B Description

Parameter	Line A	Line B
Feature impedance（Ω）	135~165	100~130
Unit length capacity（PF/m）	<30	<60
Loop resistance (Ω/km)（Ω/km）	110	——
Line core diameter（mm）	0.64	>0.53
Line core section area（mm^2）	>0.34	>0.22

Signal transmission distance varies with different medium and baud rates as shown in Table 21.

Table 21 Transmission Rate and Distance

Baud rate (Kbps)	9.6	19.2	93.75	187.5	500	1500	12000
Transmission Distance (Line A)	1200	1200	1200	1200	400	200	100
Transmission Distance (Line B)	1200	1200	1200	600	200	Not recommended	Not recommended

Note：This transmission distance excludes the repeater distance.

FM Hardware System Station Number Calculation

First check the max baud rate in Table 21 according to the communication distance, then the maximum station number according to Table 22 and the following formula.

FM Moduels Data Bits

FM I/O modules data bits are shown in Table 22:

Table 22 FM I/O Module Communication Data Bits (Each Control Cycle)

FM Module	Data bits	FM Module	Data bits
FM143	341bit	FM152	462bit

FM143A	341bit	FM161D	187bit
FM146A	528bit	FM161D-SOE	231bit
FM147A	341bit	FM162	341bit
FM148A	341bit	FM163A	330bit
FM148E	341bit	FM171	242bit
FM148R	341bit	FM171B	242bit
FM151A	550bit	—	—

Data Exchange Cycle

Two cycles for data exchange in FM hardware system:

One is CPU and DP main card data exchange cycle, or **I/O Cycle**;

The other is DP main card and I/O modules data exchange cycle, or **DP Cycle**.

To realize synchronization of two cycles, **DP Cycle should not exceed 2/3 of I/O Cycle.**

In FM hardware system, I/O Cycle is fixed. If slave station has SOE, I/O cycle is 30ms, or otherwise, 50ms. DP Cycle varies with module number and varieties.

In FM hardware system, follow the following formula for DP Cycle calculation:

DP Cycle (s)= ΣI/O total data (bit)/transmission rate (bit/s)

Profibus-DP Devices

Model	Base	Communication function
FM1200	FM1302	DP redundant controller
FM1201*	FM1303	DP repeater
FM1202	—	DP photoelectric transceiver
FM192A-TR	—	Active terminal adaptor

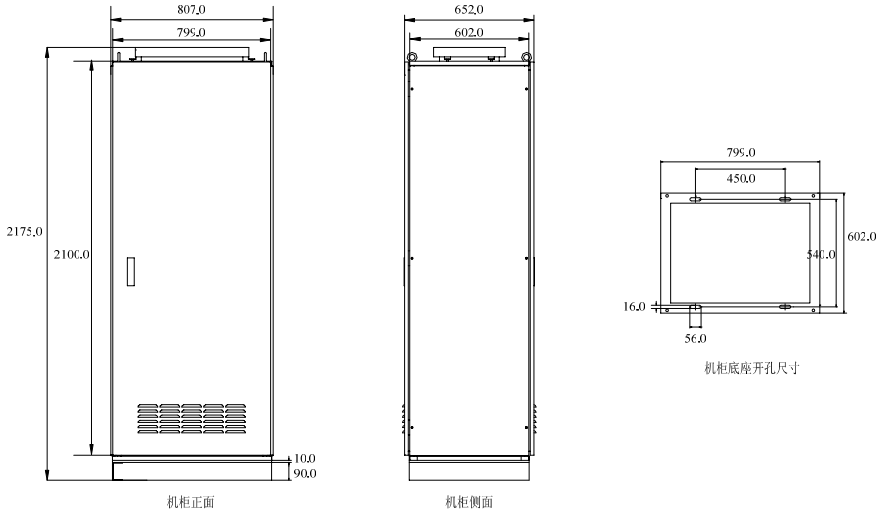
*** SIEMENS *6ES7-972-0AA01-0XA0* can be another option for DP repeater**

Chapter 4 FM Hardware Mounting

Control Cabinet

Dimensions

Field control cabinet has frame structure, with both front door and rear door, side blocks can be disassembled. Ventilation holes and dustproof cover on the bottom of both doors, exhaust unit on top of cabinet, file shelf inside the front door, and 4 flying rings on top of cabinet. Rubber insulation between cabinet base and body, 4 M12 foot screw holes on cabinet base.



Distribution

Independent mounting or integrated mounting (retain only the side blocks of the cabinets on both ends, connect the adjacent cabinet racks with side block screws M8); The front and the back of cabinet can be mounted 3 rails for 11 modules each; 66 I/O modules in one cabinet (2 for terminal adapter, 1 for DP repeater, 1 for thermocouple compensation module if any).

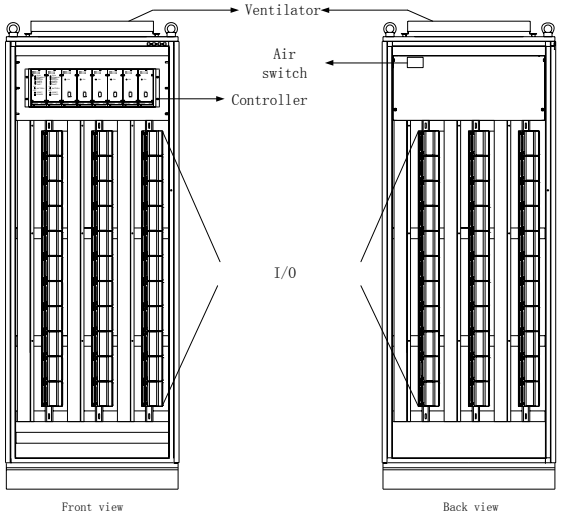


Figure 2-35 FM Hardware Mounting

Controller & Power Supply Mounting

Controller Rack Structure

Controller is mounted on the top of cabinet, including 1 pair redundant controller modules, 2-6 system power supply modules, and 1 controller cabinet rack.

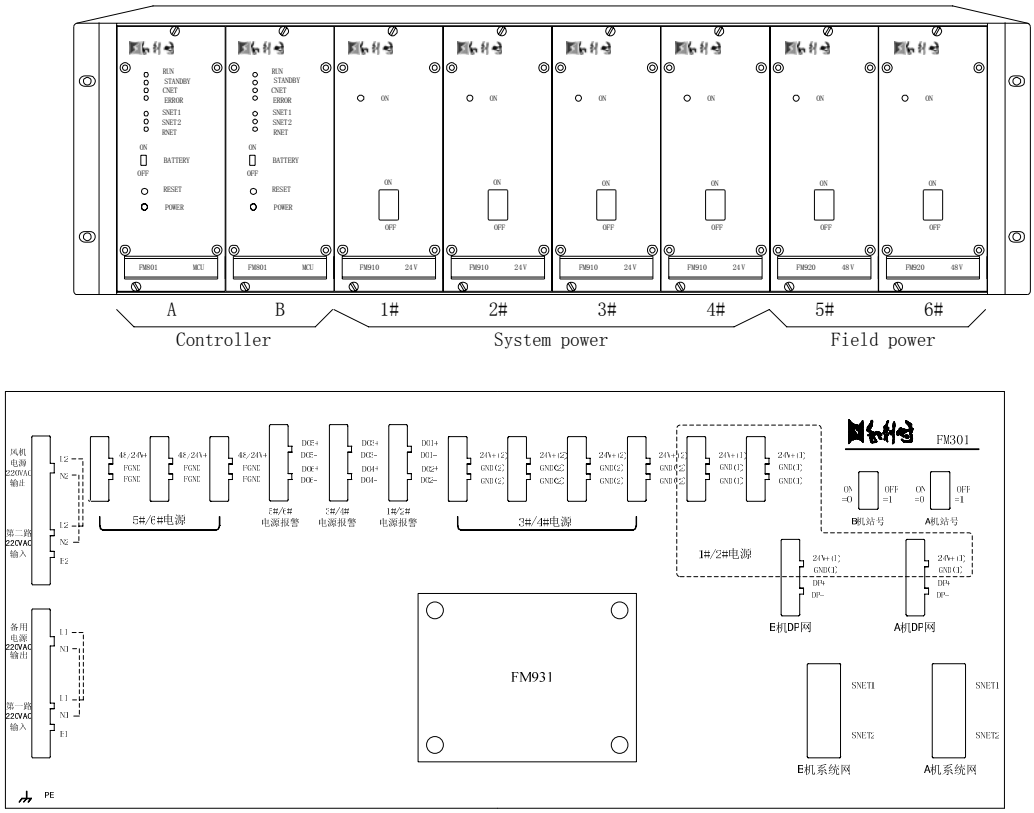


Figure 2-36 Controller Rack

Power Supply Configuration

AC Power Input

Channel 1 and channel 2 220VAC input socket connect field 220V AC power supply; L1 & L2 as live wire input end, N1 & N2 as null wire input end, E1 & E2 as AC grounding protection end.

Ventilator power output and backup power output are both 220VAC power output ends and can supply power for other field equipments.

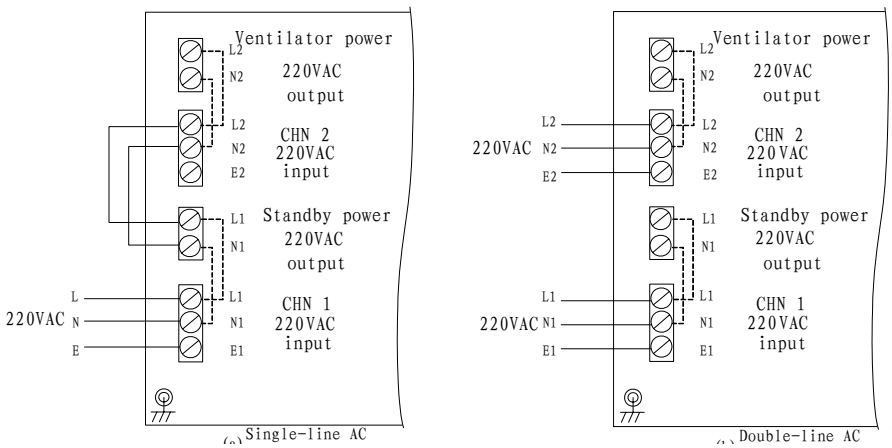


Figure 2-37 AC Power Supply Input Wiring

DC Power Output

See figure 2-37 for power supply reference number.

- 2 3-pin system power sockets connect 1#2# power supply modules for channel 1 power output;
- 4 3-pin power sockets connect 3#4# power supply modules for channel 2 power output;
- 3 3-pin field power supply sockets connect 5#6# power supply modules for 24VDC/48VDC query power output.
- 1#2# power alarm output corresponding to 1#2# power supply modules;
- 3#4# power alarm output corresponding to 3#4# power supply modules;
- 5#6# power alarm output corresponding to 5#6# power supply modules.

"DOn+" and "DOn-" (n=1~6) refer to the positive and negative ends of the alarm output of No. "n" power supply module. In normal power working conditions, "DOn+" and "DOn-" ends connect; when power error occurs, "DOn+" and "DOn-" ends break off.

In case query power should be multi-channel, query power distribution modules can be mounted on the backboard of controller rack. The power input of query power distribution module FM931 is supplied by field power socket on the backboard of controller rack.

Controller Setup

The right side of controller rack is connected with controller, 2 6-bit dial switch for setting controller station address; 2 4-pin socket as controller system power supply (1# 2# system power supply) and DP communication output interface; 4 RJ45 sockets as controller SNET output interface. See figure 2-38.

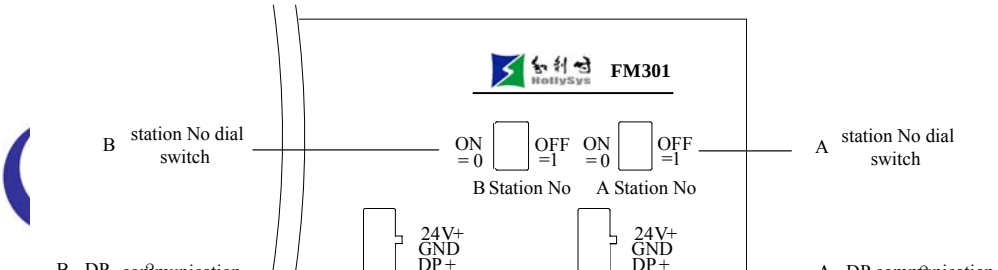
Control Station No. Setup

Dial switch from No. 1-6, ON as "0", OFF as "1", see the following formula:

$$\textbf{Station No.}=2^0\times K1+2^1\times K2+2^2\times K3+2^3\times K4+2^4\times K5+2^5\times K6$$

Ki=0 means switch "i" is switched to ON, Ki=1 means switch "i" is switched to OFF (I=1-6). **To ensure redundant configuration, master and slave station No. must be consistent with the actual station No. The control station setup should be done when power is off.**

See Figure 2-41 for the dial switch setup for station No.10:



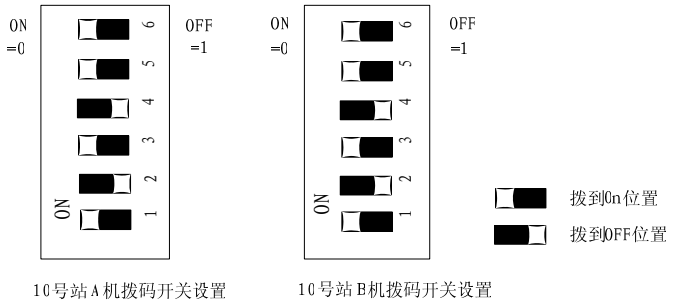


Figure 2-38 Controller Setup

Network Connection

SNET connection

In FM hardware system, redundant system network includes section 1 and section 2. To ensure maximum reliability, they should be connected to different exchangers. Figure 2-42 shows the connection of field control stations #10#11 with 10M Ethernet by 5-type twisted-pair cable.

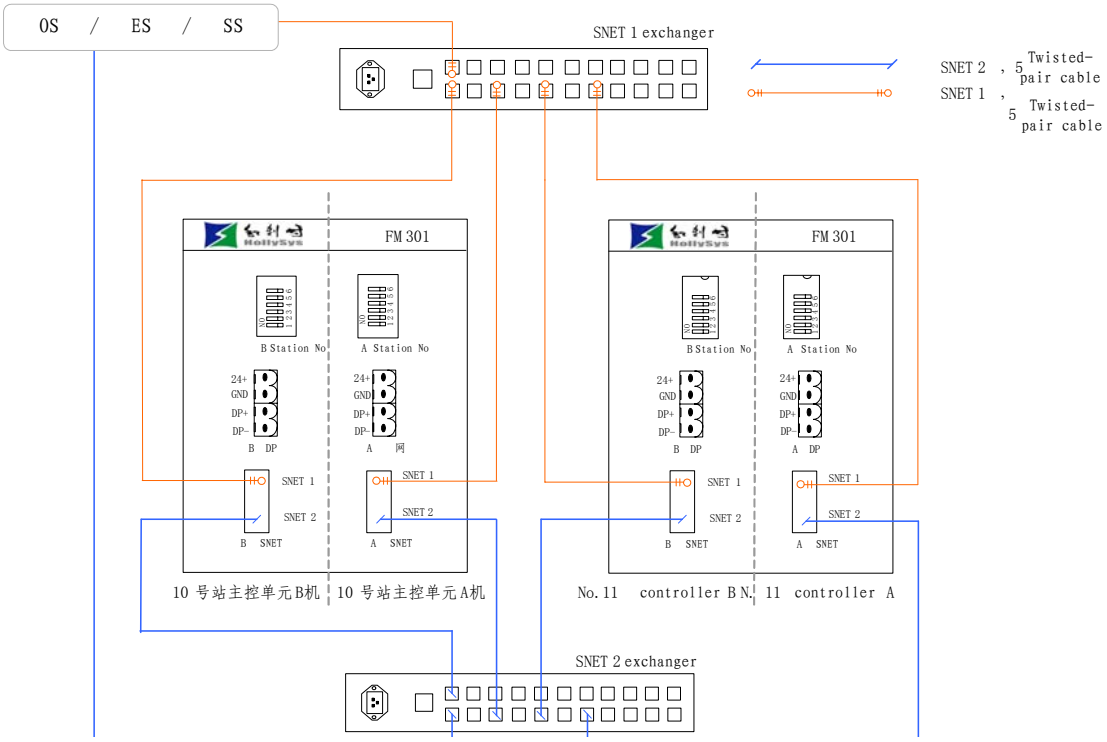


Figure 2-39 SNET Connection Examples

CNET connection

Through the communication/power interface on the backboard of controller rack, controller module CNET can be connected to DP bus by shielded twisted-pair cable. See figure 2-40.

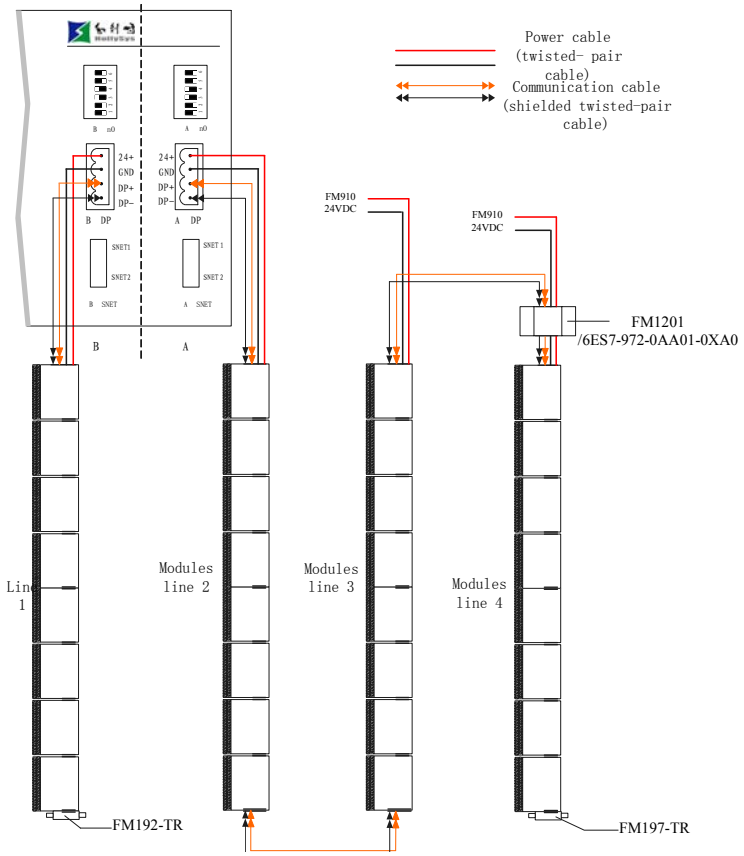


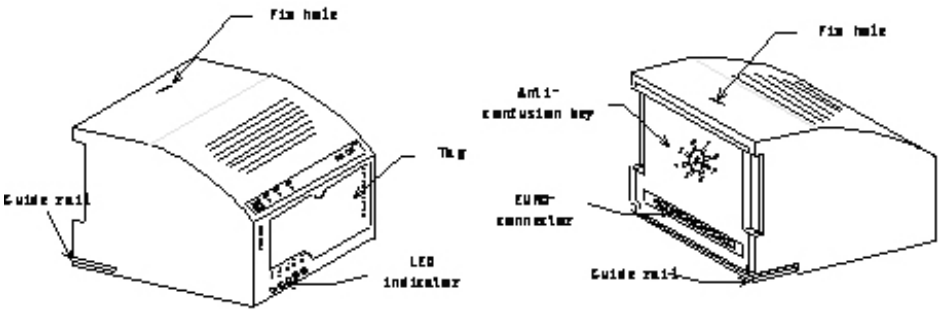
Figure 2-40 CNET Connection

As shown in Figure 2-43, the working power and DP communication of I/O modules are provided by the communication/power interface on controller rack backboard.

I/O Equipment Mounting

I/O Modules

FM I/O modules and terminal bases are shown in Figure 2-41.



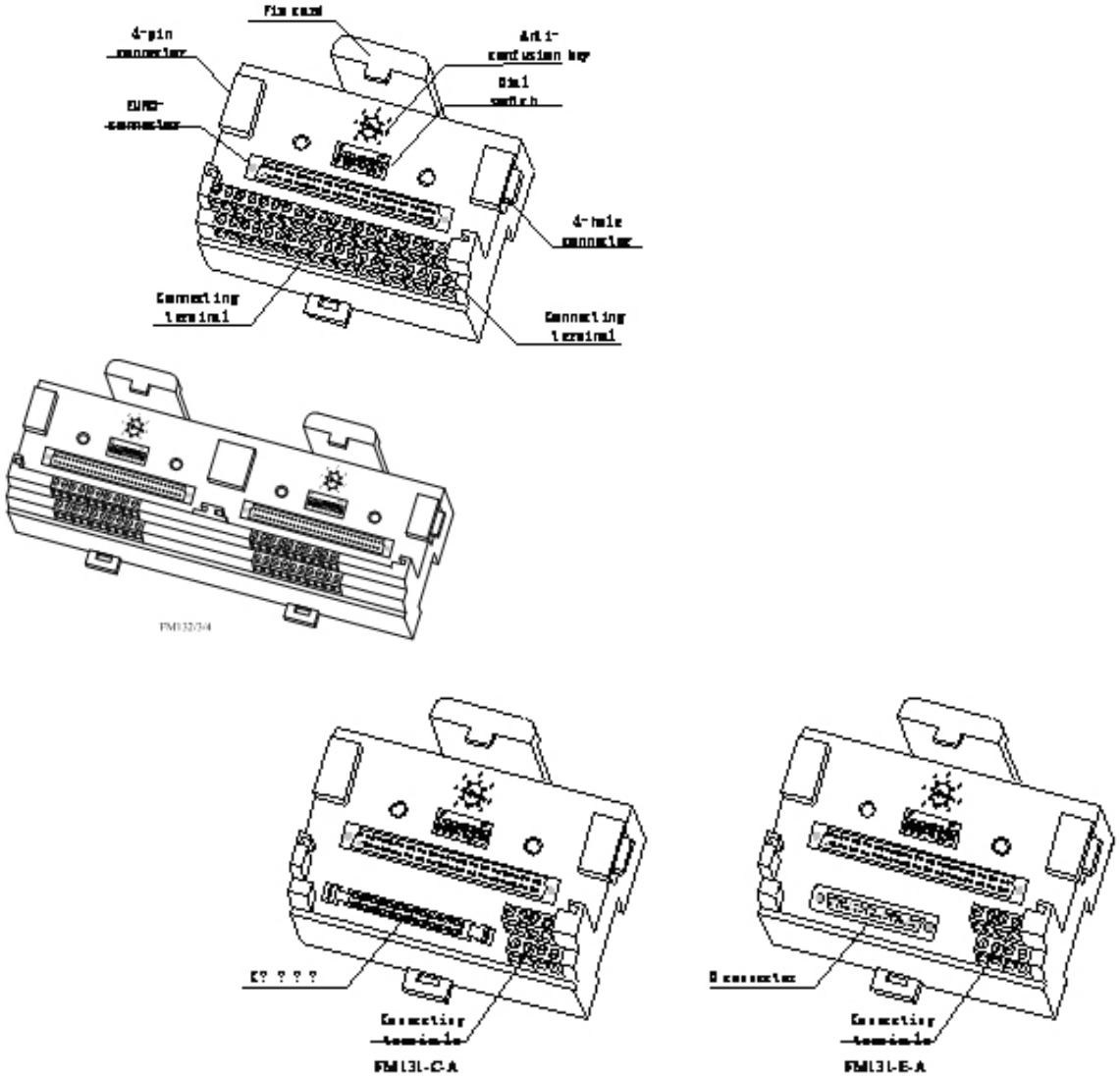


Figure 2-41 I/O Modules and Terminal Bases

Terminal Base Setup

Anti-confusion key setup

Move the anti-confusion key on the base clockwise until it fits the anti-confusion keyhole on the I/O module, as shown in Figure 2-42.

Figure 2-42 Anti-Confusion Key Setup

I/O address setup

8-bit dial switch is used to set address No.1~255. The low bit of dial switch corresponds to the low bit of communication station address binary value.

The dial switch is 1~8 from left to right, ON as "0" and OFF as "1", formula as follows:

Station No.

$$=2^0\times K1+2^1\times K2+2^2\times K3+2^3\times K4+2^4\times K5+2^5\times K6+2^6\times K7+2^7\times K8$$

Ki=0 means switch No. "i" is "ON". Ki=1 means switch No. "i" is "OFF". (i=1~6).

In figure 2-43, the corresponding module communication address is decimal 120 or hex 0x78**.**

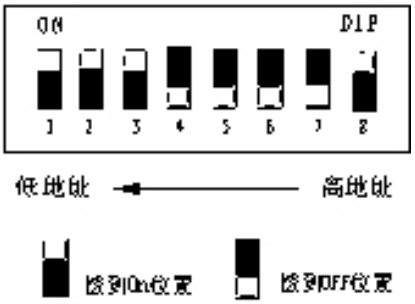


Figure 2-43 I/O Address Setup

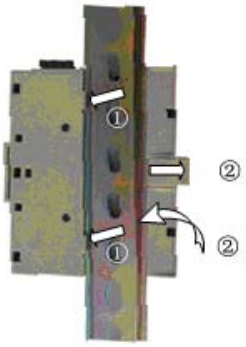


Figure 2-44 Terminal base installation

Terminal base installation and disassembly

Installation

1. Lock one side of DIN35 rail;
2. Remove the rail key and push in the module to lock the other side of DIN35 rail.

See figure 2-44.

Disassembly

1. Move aside the rail key;
2. Remove the base from DIN35;

See figure 2-45.

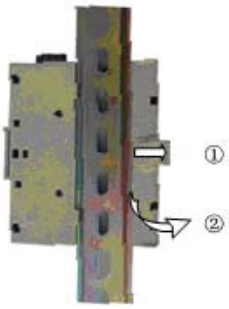
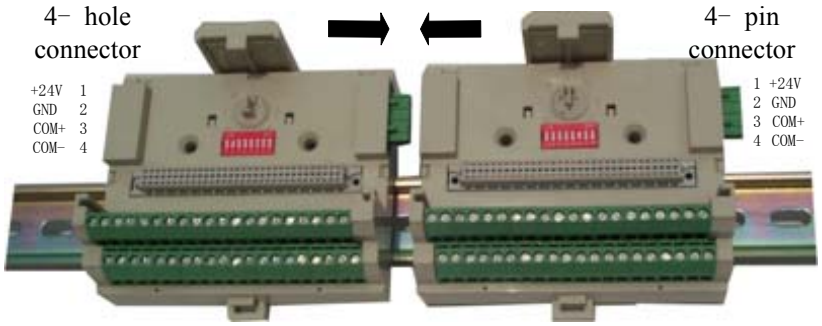


Figure 2-45 Terminal Base Disassembly

Terminal Base Connection

FM I/O modules are mounted on rails inside the cabinet. Terminal bases can be connected by 4-pin connector as shown in Figure 2-46.

Perfect connection



No	4- hole connector	4- pin connector
1	+24VDC	+24VDC
2	GND	GND
3	DP+	DP+

Figure 2-46

Model	Hardware Configuration	Special Modules	Port Ttype
FM131A	Standard	—	40-bit double-line connection terminal
FM131-C-A	External terminal module	—	40Pin C connector
FM131-E-A	External terminal module	—	37 Pin D connector
FM132	Redundant AO	FM152	40-bit double-line connection terminal
FM133	Redundant current AI	FM148R	40-bit double-line connection terminal
FM134	Redundant voltage AI	FM148R	40-bit double-line connection terminal

I/O Module Installation and Disassembly

Installation

1. Position the anti-confusion key according to the anti-confusion slots;
2. Set the I/O slave station communication address by dial switches;
3. Push the module into the base as in Figure 2-47.

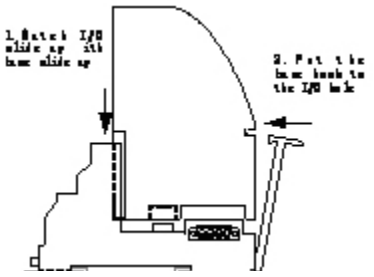


Figure 2-47 I/O Installation

Disassembly

1. Loosen the base hook;
2. Pull the module from the base as in Figure 2-48.

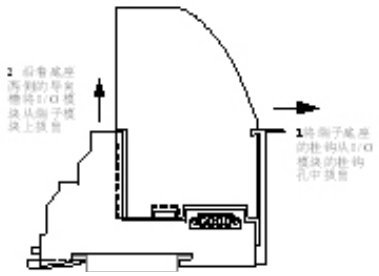


Figure 2-48 I/O Disassembly

Terminal Template Installation and Disassembly

Installation

1. Lock the key on the connection terminal side of the module to one side of the 35mmDIN rail.
2. Push the module in and lock the key on the rail.
3. Connect field wires and cables to terminal template as shown in Figure 2-49.

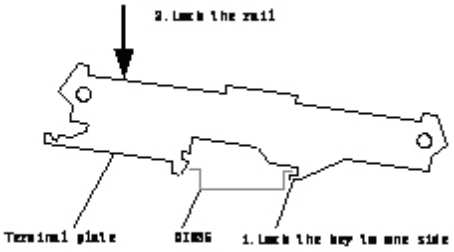


Figure 2-49 Installation

Disassembly

1. Disconnect field wires and flat cables;
2. Remove the key on one side of the module from 35mmDIN rail;

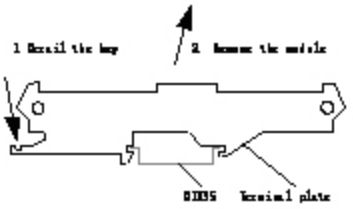


Figure 2-50 Disassembly

3. Pull the module out of 35mmDIN rail as shown in
4. Figure 2-50.

Signal Cable Connection

1. Define the corresponding relations between field device signal and base terminal signal.
2. Define the diameter and length of signal cable according to signal types and field device position.
3. Insert the signal cable into the terminal channel as shown in Figure 2-51.

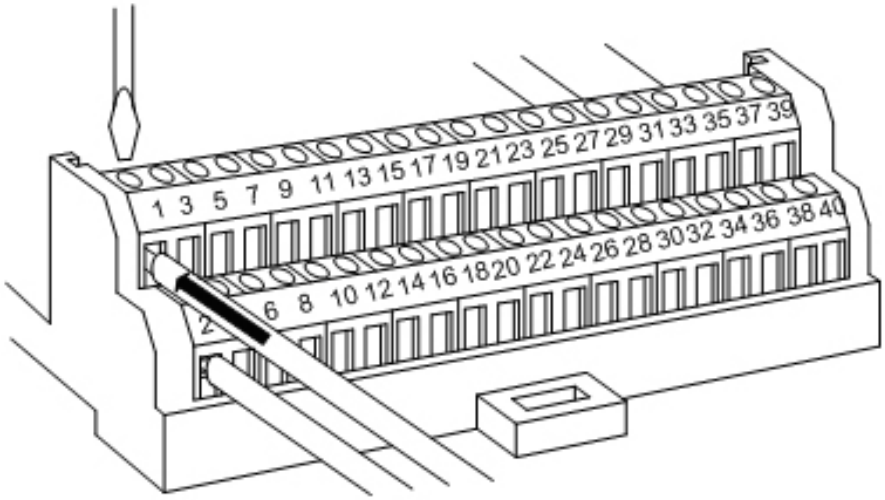


Figure 2-51 Signal Cable Connection

Power Supply and Grounding Requirements

Power Supply

The power supply system of field control station must guarantee continuous power supply.

Voltage：Single-phase 220VAC±15%

Frequency：50Hz ± 1Hz

Distortion rate：Less than 3%

Power supply lines into the field control cabinet only connect with live lines (L) and null lines (N). **Attention: The grounding of input AC power supply must be short connected with the protection grounding of control cabinet.** The output terminals of air switch connect to double-line 220VAC terminals of controller rack.

Field control station has double power supply, controller power input terminal wiring shown in figure 2-52, L as live wire, N as null wire, E as protection earth line of control cabinet.

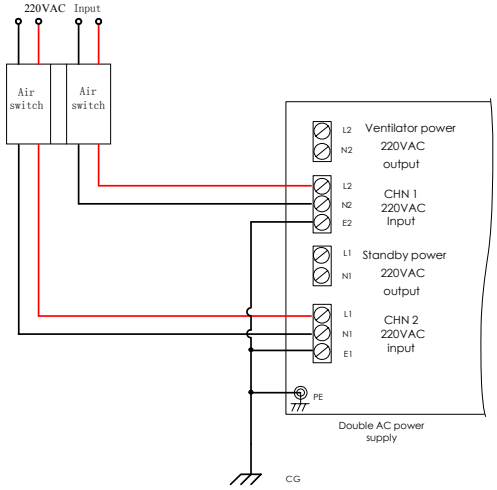


Figure 2-52 Double-line Power Supply Terminal Connection

Grounding Requirements

Field control station grounding system includes Cabinet Grounding (CG), Analog Grounding (AG) and Logic Grounding.

Cabinet Grounding: prevent equipment electrification or static electricity accumulation, avoid personal injury.

Analog Grounding: screen disturbance during signal transmission to improve signal quality. The shield layer of the light current signal cable into the field control station should have analog grounding.

Logic Grounding: or system power supply grounding providing references for the reliability and accuracy of DCS electronic system.

Intrinsically safe grounding and anti-thunder grounding are required in special conditions.

See Figure 2-53 for field control cabinet CG and AG.

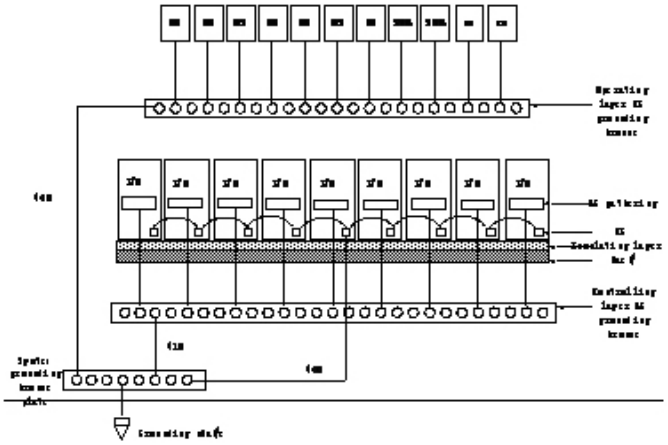


Figure 2-53 Field Control Cabinet Grounding