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RX Horizontal Multi-Function Distributed I/O

ETHERNET IP Agreement
Remote IO Module
Distributed IO module

CATALOGUE

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1.Preface

1.1 Usage of the document

This document describes product specifications, installation, operation, and configuration, as well as network protocols. This document is intended for use only by trained electrical automation engineers.

(1) Disclaimer

The author has made the necessary checks on the documentation, but with the development of the product upgrade, the documentation may contain technical parameters or editing errors, we reserve the right to make adjustments and changes without prior notice to the user.

(2) Trademarks

The Industrial Ethernet Protocol (Ethernet/IP) was developed by ODVA and supported by Rockwell Automation.

(3) Patent description

The designer of this product has applied for patent protection for the appearance and technical implementation of the product, and any attempt to copy, copy or reverse design may violate the law.

(4) Copyright

Do not copy, distribute, or use this document without the authorization of the author.

1.2 Security Matters

This product is a professional equipment used in industrial occasions, and only staff with electrical operation experience can use it. Please read this manual carefully before use and follow the instructions to avoid personal injury or product damage.

The product complies with the IP20 protection grade design and must be installed in a power distribution cabinet that is dustproof and moisture-proof.

1.3 Document History

Release	date	description
V1.00	2019.08.02	Release
V1.10	2019.12.06	Added Analog Description

1.4 Reference Files

《IEC11631-22007 Programmable controllers –Part 2:Equipment requirements and tests》;

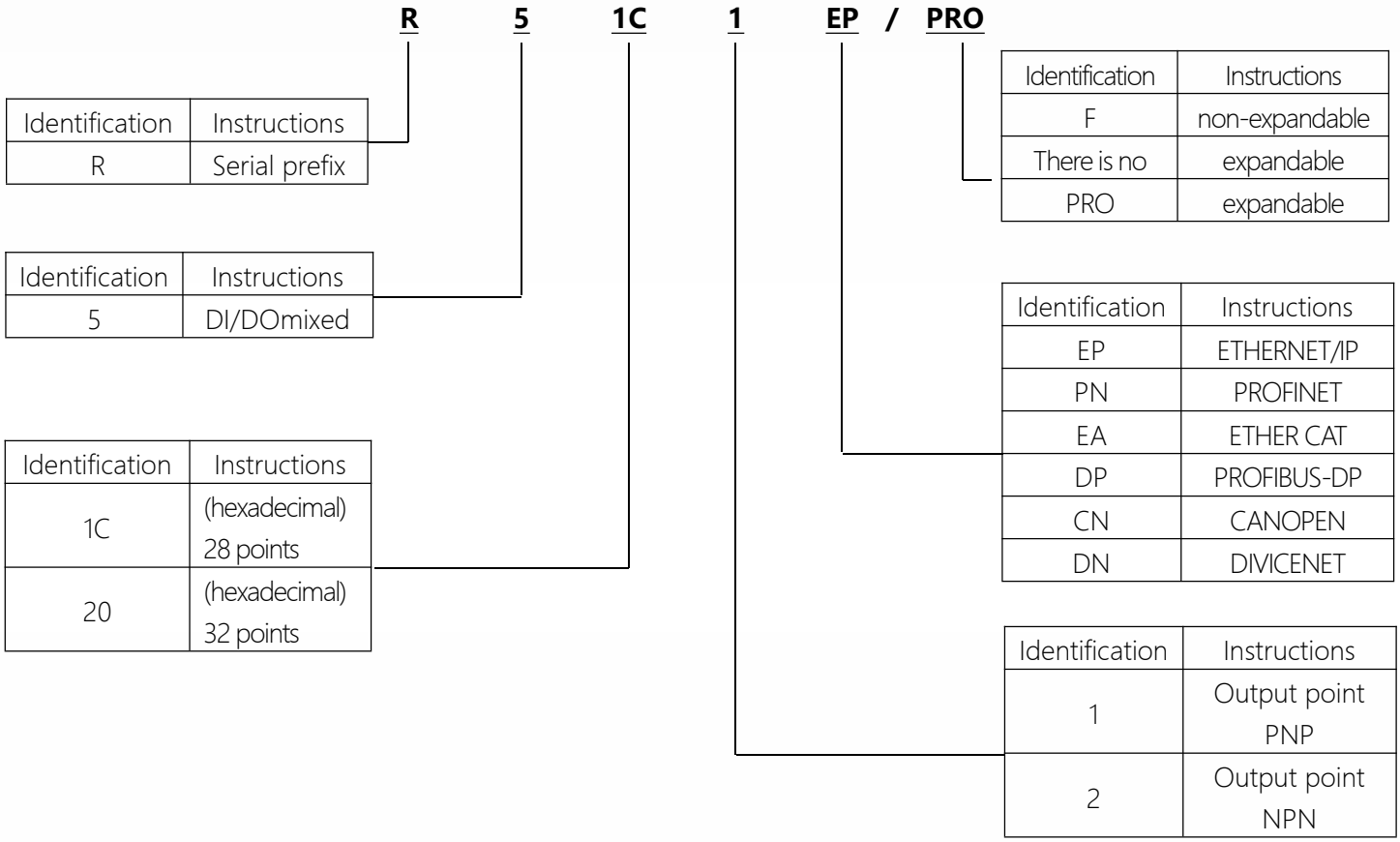
《IEC/TR 61158 Industrial Communication Network - Fieldbus Specification》;

《IEC61784-1 Industrial Communication Network - Industry regulations Part I Fieldbus Industry Regulations》;

2. Product overview

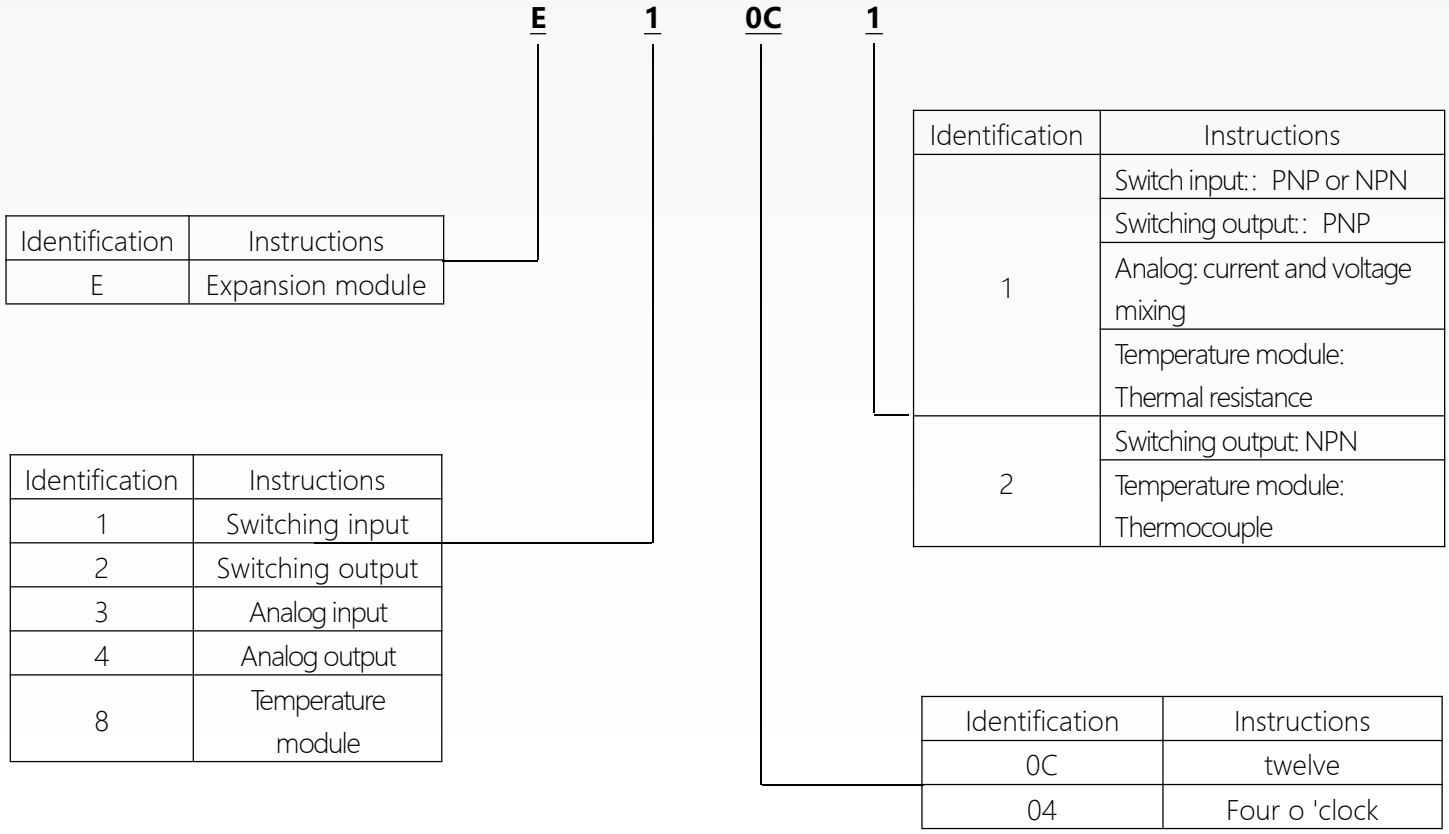
2.1 Model List

R51C1-The R51C1-EP series remote I/O products support the standard ETHERNET IP industrial ETHERNET communication protocol, and can directly provide high-performance input and output functions without the need for additional ETHERNET IP bus couplers through the integrated digital or analog I/O interface of the module body. The expandable version of the module can also increase the required IO points by selecting different expansion modules



Number	Model number	Make clear
1	R51C1-EP/F	16DI, 12DQ (PNP), fixed I/O points, ETHERNET IP remote I/O module
2	R51C1-EP/PRO	16DI, 12DQ (PNP), scalable, ETHERNET IPT remote I/O module
3	R51C2-EP/F	16DI, 12DQ (NPN), fixed I/O points, ETHERNET IP remote I/O module
4	R51C2-EP/PRO	16DI, 12DQ (NPN), fixed I/O points, ETHERNET IP remote I/O module

Table 1 ETHERNET IP remote I/O modules



Identification	Instructions
E	Expansion module

Identification	Instructions
1	Switching input
2	Switching output
3	Analog input
4	Analog output
8	Temperature module

Identification	Instructions
1	Switch input: : PNP or NPN
	Switching output: : PNP
	Analog: current and voltage mixing
	Temperature module: Thermal resistance
2	Switching output: NPN
	Temperature module: Thermocouple

Identification	Instructions
0C	twelve
04	Four o 'clock

Number	Model number	Make clear
1	E10C1	12DI, source/drain type, digital input expansion module
2	E20C1	12DQ (PNP), digital output expansion module
3	E20C2	12DQ (NPN), digital output expansion module
4	E3041	12BIT 4-channel analog input expansion module
4	E4041	12BIT 4-channel analog output expansion module
5	E8041	4-channel thermal resistance module
6	E8042	4-channel thermocouple module

Table 2 Expansion modules *

* Note: The extension module is common with other protocol bus IO modules, please refer to other corresponding product manuals for detailed instructions and usage.

2.2 R51C1-EP Specifications

This document only describes the product specifications of the R51C1-EP/F. For specifications of other models, please contact your supplier.

2.3 DI Specifications

Digital input (DI) specifications are shown in Table 3.

Number	Item	Make clear
1	Number of channels	16
2	Access type	2 bytes
3	Ton	Type. 18uS / Max. 35uS
4	Toff	Type. 135uS / Max. 250uS
5	Input type	Source type or drain type
6	Input connector	Pluggable connector
7	Rated input voltage	24 V DC (-15 %/+20 %), (IEC 61131-2, type 2)
8	"0" signal level	-3...+5 V (IEC 61131-2, type 2)
9	"1" signal level	15...30 V (IEC 61131-2, type 2)
10	Input current	Typ. 10mA/Ch (IEC 61131-2, type 2)
11	Electrical isolation	Input/Control area: 500V DC

Table 3 Digital input specifications

2.4 DQ Specifications

MOSFET Digital Output (DQ) specifications are shown in Table 4.

Number	Item	Make clear
1	Number of channels	12
2	Access type	2 bytes
3	Ton	Type. 12uS / Max. 25uS
4	Toff	Type.10mS/Max.20mS (no load)
5	Output type	Source type
6	Output connector	Pluggable connector source type
7	Load type	Pure resistance, sensibility, light bulb
8	Rated output voltage	24 V DC (-15 %/+20 %), (IEC 61131-2, type 2)
9	Maximum output current	Max. 0.5A /Ch, independent short-circuit protection for each channel
10	Rated total output current	6A
11	Power connector	2 sets of 2-PIN spring connectors

Table 4 MOSFET output specifications

2.5 ETHERNET IP communication specifications

Table 5 lists ETHERNET IP communication specifications.

Number	Item	Make clear
1	agreement	ETHERNET IP
2	Transmission rate	10/100 Mbaud, automatic identification of transmission speed
3	Bus interface	Industrial Ethernet with dual RJ45 switches, compliant with IEEE 802.xx standard, with auto-negotiation and auto-cross functions
5	Correspondence address	Unique MAC address in the world
6	Transmission cable	CAT5e Shielded cable
7	ETHERNET IP characteristics	Media Redundancy Protocol (MRP), shared devices, synchronous communication
8	Port protection	Transformer isolation, 1500V DC (IEC61000-4-2)

Table 5 ETHERNET IP communication specifications

2.5.1Expanding Interfaces

The R51C1-EP/F is a non-expandable module. The specifications of the expansion interface of the R51C1-EP/Pro module are shown as follows.

Number	Item	Make clear
1	Interface supply voltage	DC 5V
2	Maximum supply current	1.5A
3	Maximum number of expansion slots	7

Table 6 Extended specifications

2.5.2 Power Specifications

The module power supply is divided into three independent parts: control part, digital input, MOSFET digital output, and are isolated from each other. So you need to provide three separate power supplies to each part of the circuit or directly connect them in parallel.

①Control voltage using 24V DC (-15% /+ 20%), maximum 0.5A current consumption, with polarity reverse protection; Electrical isolation from the rest of the I/O section withstands 500V DC.

② The digital input voltage is 24V DC (-15% /+ 20%), and the maximum current consumption is 16*10mA; Electrical isolation from the rest of the I/O section withstands 500V DC.

③ The MOSFET digital output part uses 24V DC (-15% /+ 20%), the maximum 8*0.5A current consumption, with channel independent overcurrent protection; Electrical isolation from the rest of the I/O section withstands 500V DC.

3. Structure description

3.1 Shell

The module adopts Rx series remote I/O module standard shell design, the size is: 120.5 * 80 * 62 (W/H/D, mm), the lower guide rail clip is higher than the part of the size h=5.5mm, support IP20 protection level.

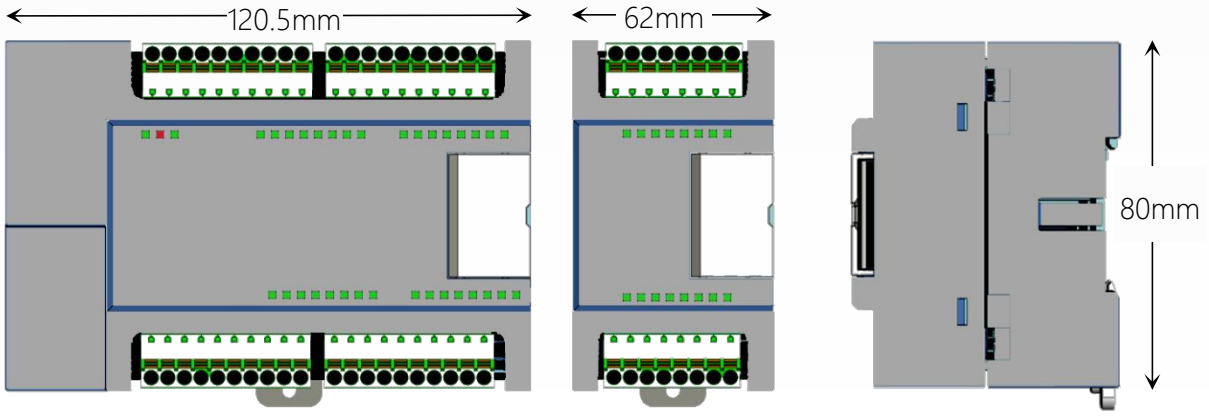


Figure 1 Module size diagram

3.2 Installation Mode

① The design of the module adopts natural convection heat dissipation. At least 25 mm space must be left above and below the device to facilitate normal heat dissipation. The distance between the front panel and the backplane should be at least 75 mm.

②The module can be easily mounted on a standard DIN rail or control cabinet backplane, the rail specification is: TS35/7.5, as shown in Figure 2.

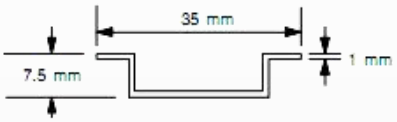
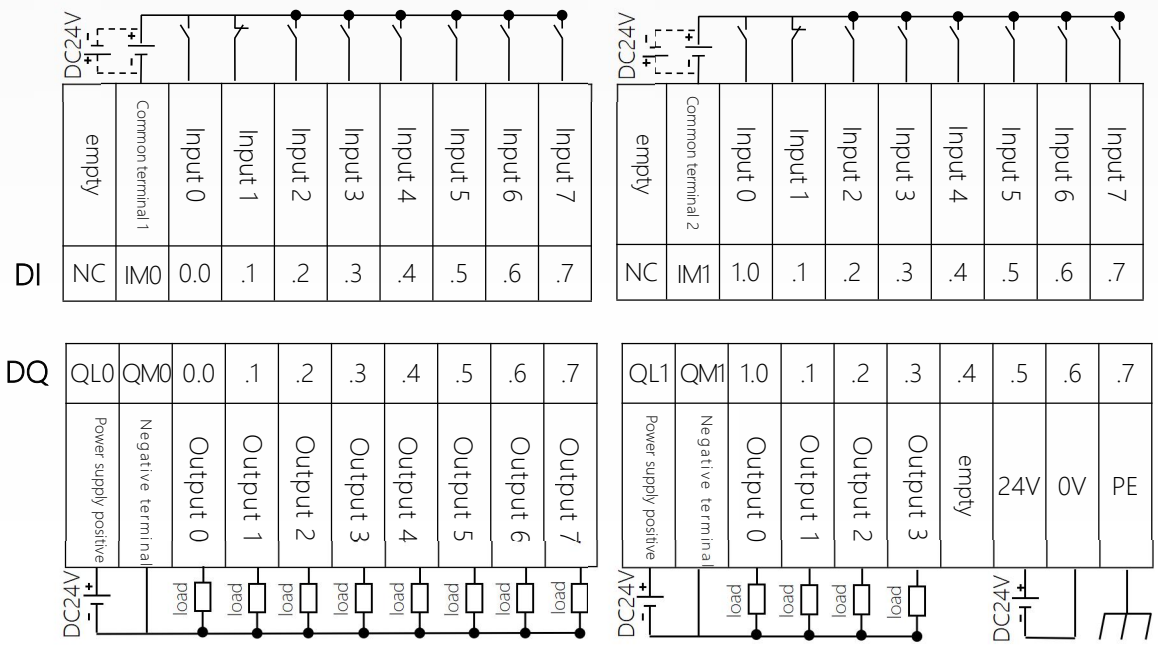


Figure 2 DIN rail

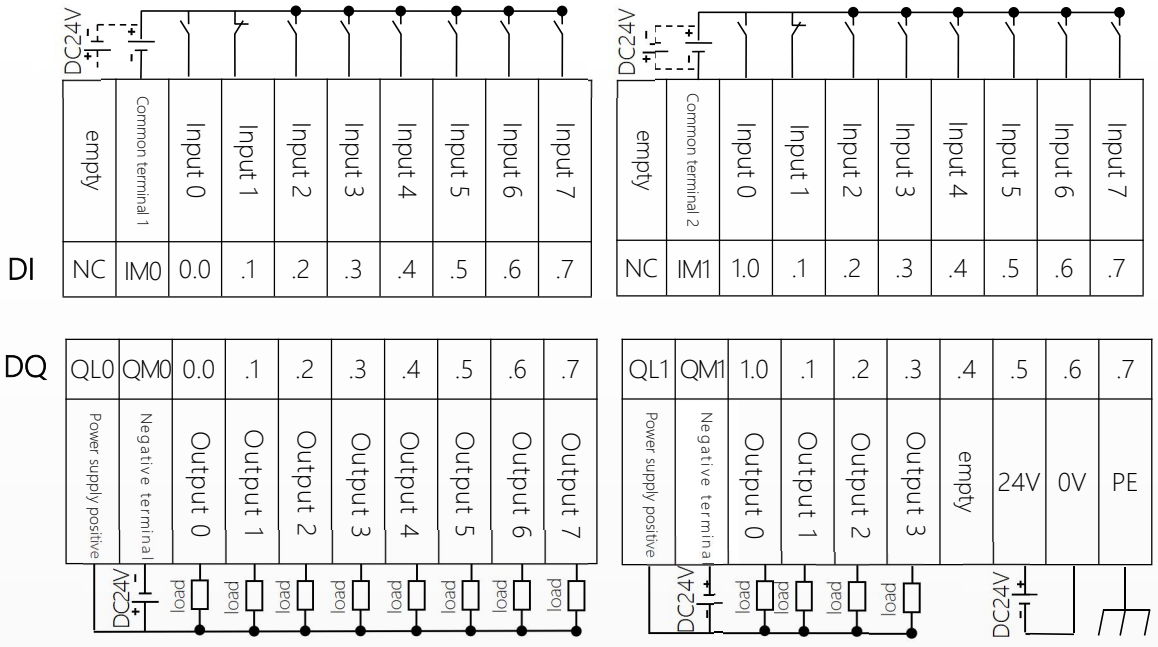
4.Hardware description

4.1 R51CX-EP Wiring Diagram

R51C1-EP/XX



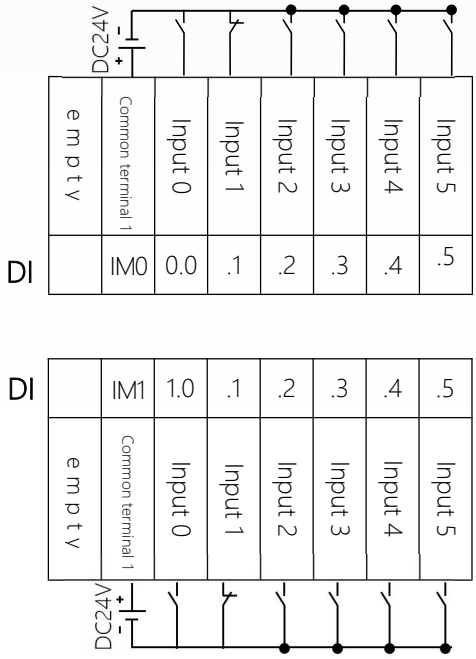
R51C2-EP/XX



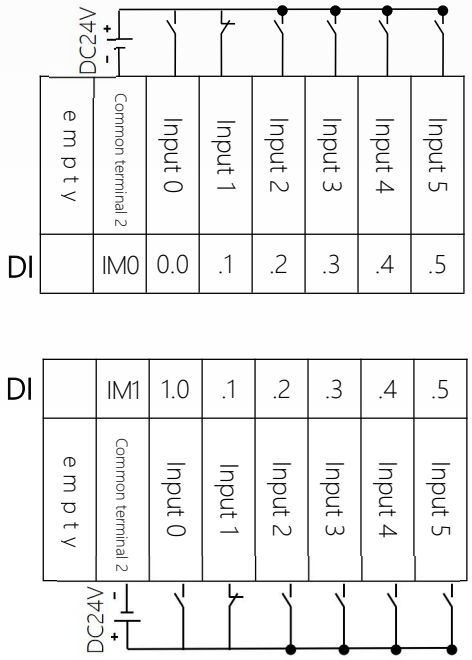
4.2 Expansion Module Wiring Diagram

E10C1
Digital quantity 12 points input module

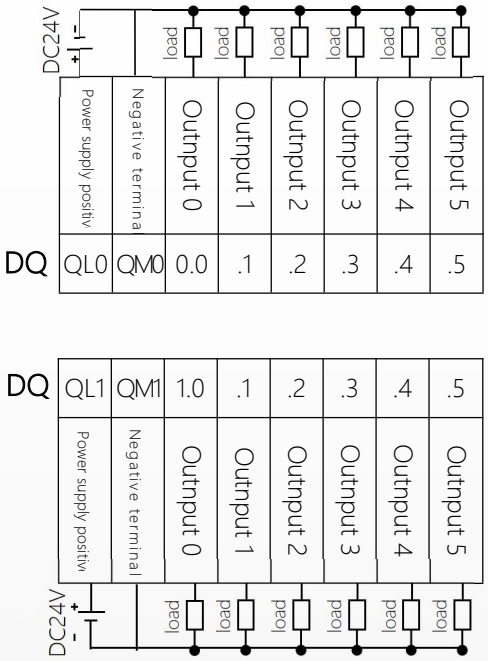
NPN connection



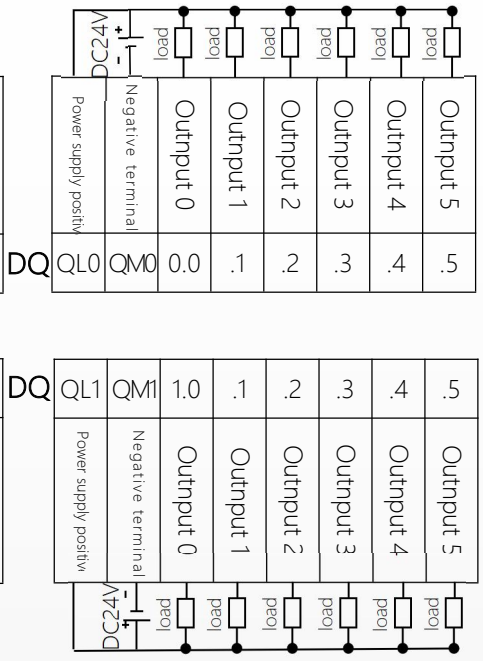
PNP connection



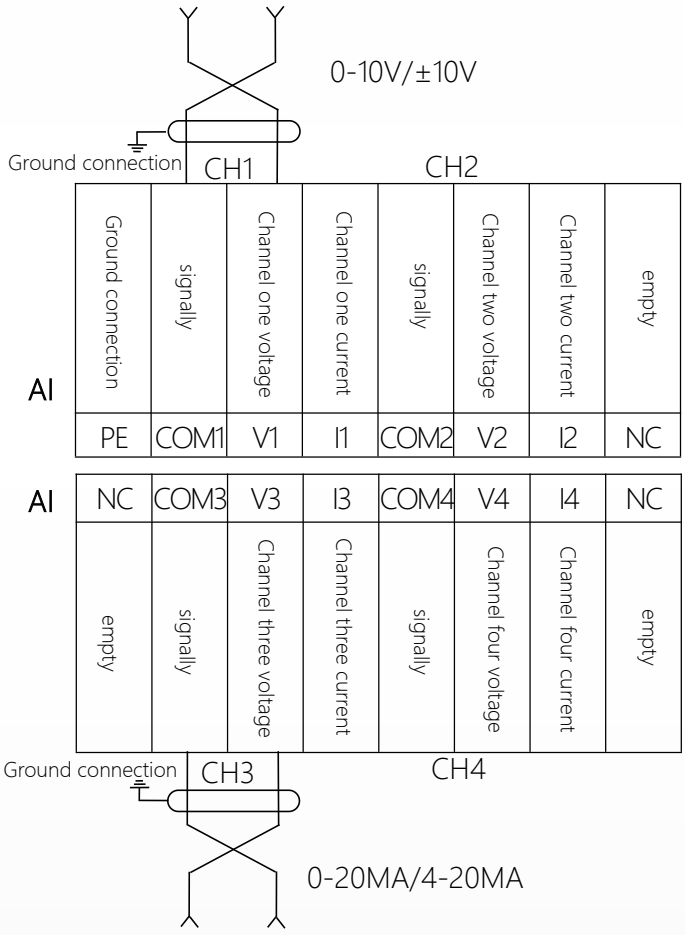
E20C1
Digital 12-point output module PNP type



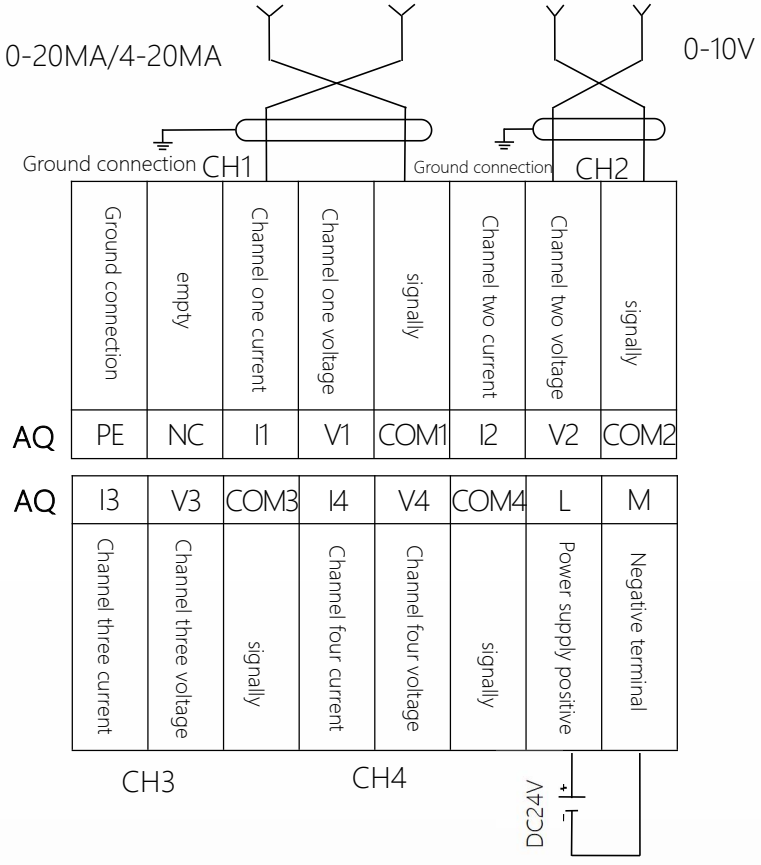
E20C2
Digital quantity 12 point output module NPN type



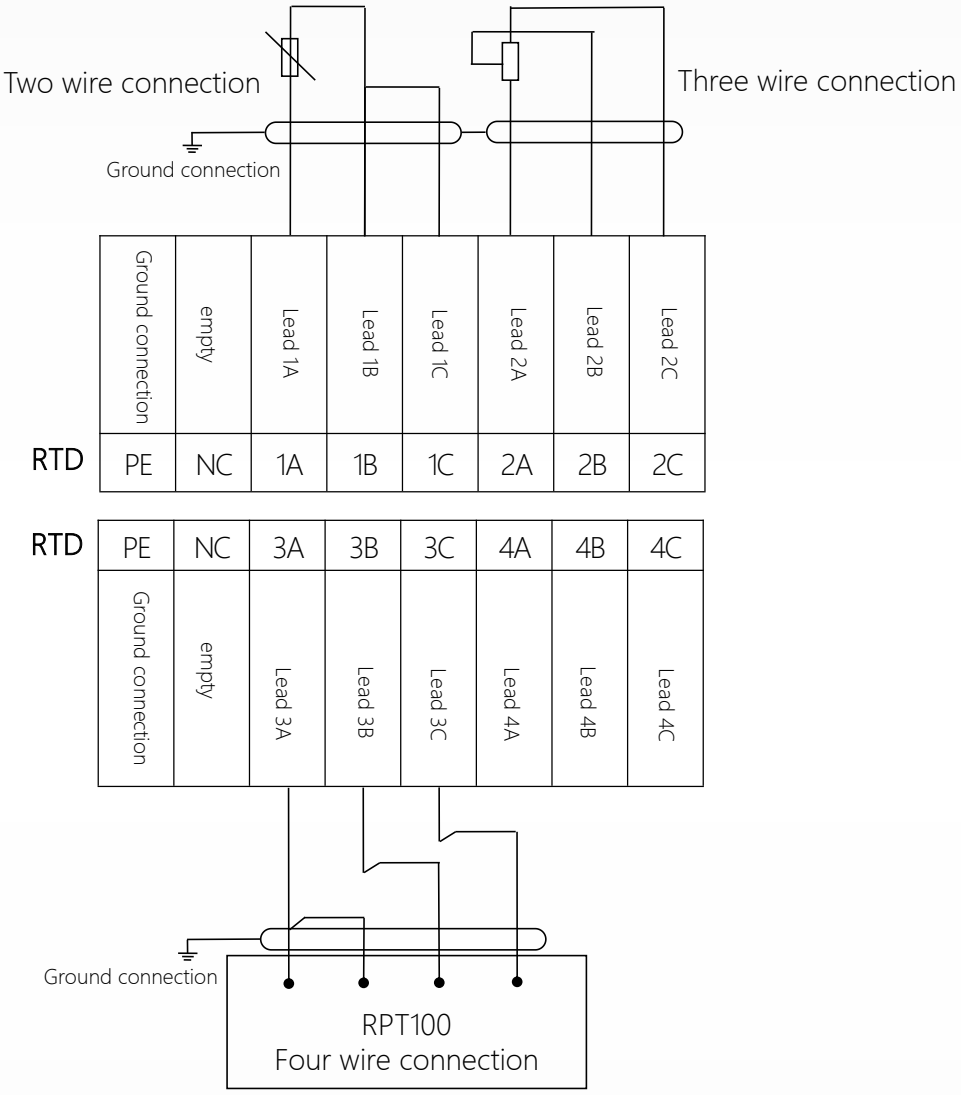
E3041
4 channel analog input module



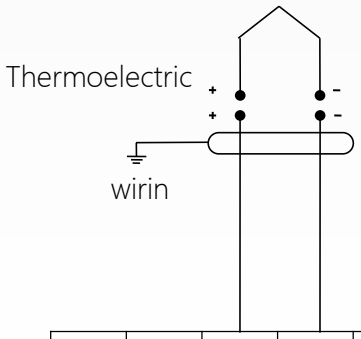
E4041
4 channel analog output module



E8041
4-channel thermal resistance module



E8042
4-channel thermocouple module



	Ground connection	empty	Lead 1A	Lead 1B	empty	Lead 2A	Lead 2B	empty
TC	PE	NC	1A	1B	NC	2A	2B	NC

TC	PE	NC	3A	3B	NC	4A	4B	NC
	Ground connection	empty	Lead 3A	Lead 3B	empty	Lead 4A	Lead 4B	empty

4.3 Communication Ports

The module uses a physical port for communication in a double RJ45 socket and provides the switch function.

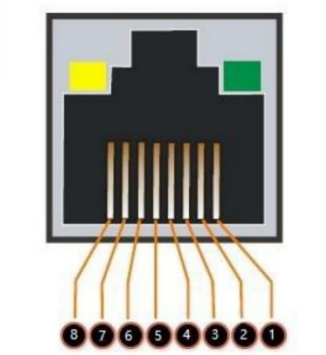


Table 7 ETHERNET IP communication interfaces

Lead	Signal	Description
1	TD+	Data sending end
2	TD-	Data sending negative end
3	RD+	Data receiving terminal
4	NC	Unused
5	NC	Unused
6	RX-	Data receiving negative end
7	NC	Unused
8	NC	Unused

4.4 LED Indicator

The LED indicator of the module is divided into three parts: system status indicator, I/O status indicator, RJ45 link indicator

4.4.1 System Status Description Table 5-1 describes the operating status of the system

PWR(green)	ERR(red)	RUN(green)	Instructions
○	○	○	Abnormal power supply
●	●	○	Communication interface fault
●	○	●	The module successfully entered the operate state and successfully established cyclic data interaction with the master station.

Table 8 System status indicators ● The green light is on. ● Indicates that the red light is on ○ Not bright

4.4.2 I/O Status Indicator

The green LED of the digital input/output port indicates the status of the corresponding channel. If the indicator is on, the logical status of the input/output port is 1. If the indicator is off, the logical status of the input/output port is 0.

4.4.3 RJ45 Indicators

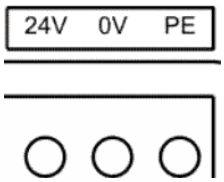
Under normal circumstances, the RJ45 port indicator should be green and blinking yellow, if not, it indicates that a fault has occurred. If the green is off, the RJ45 port is not connected to the Hub or switch. If the yellow indicator is off, the module may be faulty

Table 9: Table 9 RJ45 indicator description

LINK1/LINK2	ACT1/ACT2	Instructions
○	uncorrelated	The RJ45 port is not connected to a network cable or is not properly connected
●	uncorrelated	The RJ45 port correctly identifies the Ethernet network
uncorrelated	○	The RJ45 port has no data interaction
uncorrelated	●	The RJ45 port has data interaction

Table 9 Description of RJ45 indicators

4.5 Power Supply

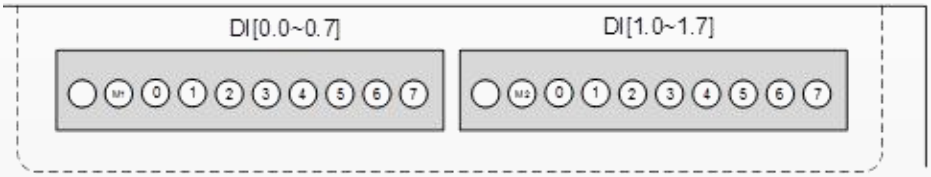


24V	24V, positive DC power supply
0V	0V, negative DC power supply
PE	Touch the ground

Table 10 Power terminal

4.6 Digital Input interface

The digital input interface is connected using two sets of 10P pluggable connectors. A total of 16 input signals are divided into DI-0 and DI-1 groups, as shown in the following figure.



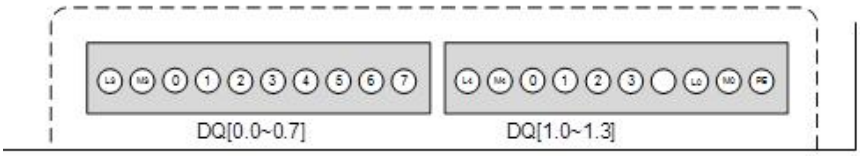
Digital Input-0		Digital Input-1	
O	empty	O	empty
IM1(*)	DI Public end 1	IM2(*)	DI Public end 2
0	DI-0.0	0	DI-1.0
1	DI-0.1	1	DI-1.1
2	DI-0.2	2	DI-1.2
3	DI-0.3	3	DI-1.3
4	DI-0.4	4	DI-1.4
5	DI-0.5	5	DI-1.5
6	DI-0.6	6	DI-1.6
7	DI-0.7	7	DI-1.7

Table 11 Digital input terminals

Note * : M1 and M2 are directly connected inside the module.

4.7 Digital Output Interface

The digital output interface is connected using two sets of 10P pluggable connectors, and the 12 output signals occupy the 16P part on the left side of the connector. Each digital output port is designed with an independent 0.5A overcurrent protection.



Digital Output -0		Digital Output -1	
L3(*)	DQ power supply positive electrode	L4(*)	DQ power supply positive electrode
IM3(*)	DQ power supply negative	IM4(*)	DQ power supply negative
0	DQ-0.0	0	DQ-0.0
1	DQ -0.1	1	DQ -0.1
2	DQ -0.2	2	DQ -0.2
3	DQ -0.3	3	DQ -0.3
4	DQ -0.4	O	empty
5	DQ -0.5	24V	Module power supply. For details, see section 0
6	DQ -0.6	0V	
7	DQ -0.7	PE	

Table 12 Digital output terminals

Note * : L3/M3 and L4/M4 are directly connected in parallel inside the module, and are insulated from the control circuit. External 24V DC power supply needs to be provided separately for the DQ circuit when used

5.ETHERNET/IP Protocol

5.1 What is ETHERNET IP?

Definition:

EtherNet/IP is the name of an Ethernet network that uses a common industrial protocol. The "IP" in EtherNet/IP means the industrial protocol, which can be regarded as the Ethernet/industrial protocol.

EtherNet/IP looks similar to another protocol name widely used for Ethernet (actually a pair of protocols).

TCP/IP is used to verify the transmission of information and specify a path for the information

TCP = Transmission Control Protocol

IP = Internetwork protocol

EtherNet/IP and TCP/IP are two completely different protocols, designed for completely different purposes. EtherNet/IP networks use both TCP and IP protocols in addition to the common industrial protocol CIP.

Although EtherNet/IP was originally developed by Rockwell Automation, it is an open network. Many companies, including competitors, sell EtherNet/IP compatible products. That's one of the reasons it's so attractive to our customers.

ODVA, the Association of Open Device Network Manufacturers, manages the development of open network technologies based on the Common Industrial Protocol (CIPTM) and assists manufacturers and consumers of CIP networks through tools, training, and sales activities.

5.2 Network Topology

The following diagram shows a typical network layout for ETHERNET IP IO. The inverter can be integrated into the system using ETHERNET IP to Modbus gateway.

Figure 4

Trunk/branch topology configuration diagram

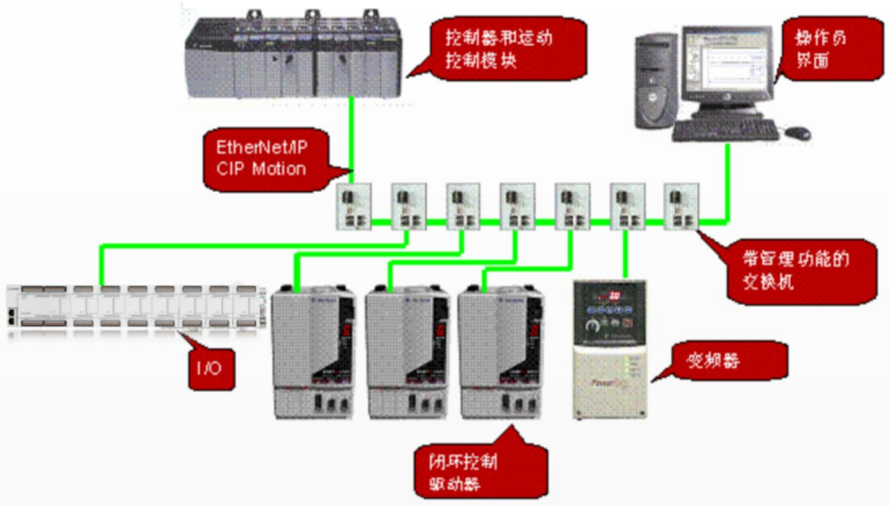


Figure 3: Network structure of ETHERNET IP

5.3 Module configuration and address assignment

5.3.1 R51C1-EP/F R51C1-EP/Pro Address Mapping

R51C1-EP/F R51C1-EP/Pro DI/DQ data is mapped to the memory space of the master station through the configuration file, as shown in the figure.

16 input digits mapped to 2-byte In addresses;

12 digital output is mapped to a 2-byte Out address;

5.3.2 IP Address of the expansion module

E10C1 input the In address mapped to 2 bytes for the 12 digits

E20C1 outputs 12 digits mapped to 2-byte Out addresses

The E3041 has four analog inputs, each using two bytes of space, mapped to an 8-byte In address in the controller

E4041 has 4 analog outputs, each using 2 bytes of space, mapped to an 8-byte Out address in the controller

5.4 Module Parameters

Each module has specific parameters, which need to be flexibly configured under the hardware configuration interface according to the field situation. And along with the hardware configuration downloaded to the controller. In the initial running state, the controller sends these data to the module. If the module in the actual configuration field is inconsistent with the hardware configuration in the program, and the transmitted parameters are inconsistent with the actual situation, the module parameter configuration is not successful, and the controller will report an error during operation. The following describes the configuration parameters of the module based on AB software.

5.4.1 Digital Input (DI) Our company independently configurs software Settings based on RxTool

As shown in 4, the numeric input contains two parameters.

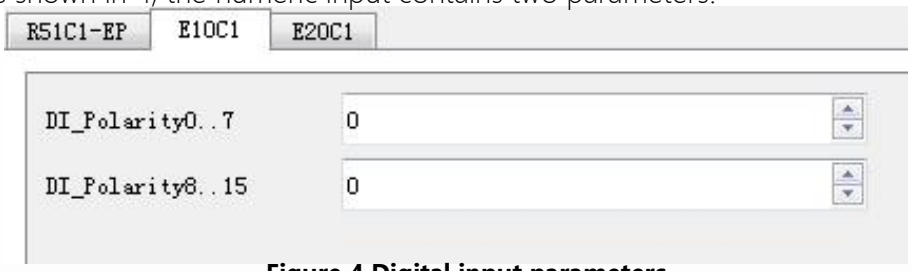


Figure 4 Digital input parameters

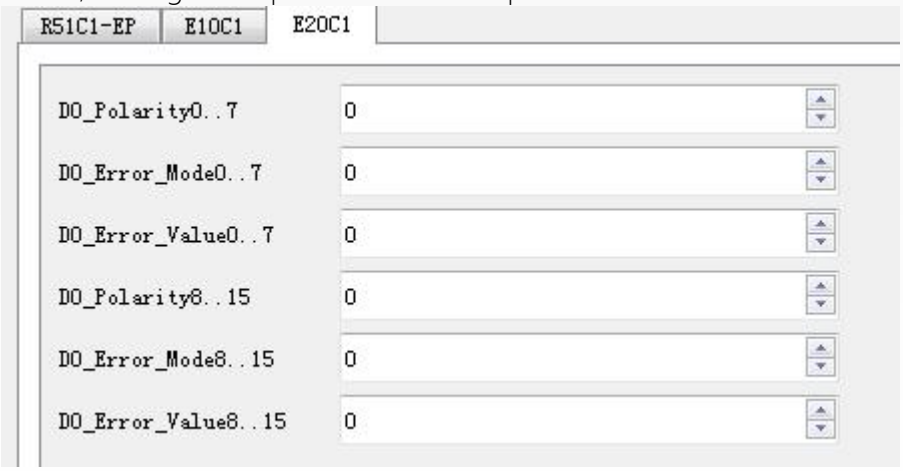
Parameter description

Parameter	name	format	Input range	Instructions
DI_Polarity0..7	DI[7..0] Polarity reversal	decimalism	0~255	The binary bits of this parameter correspond to the numeric input channel (Bit0 corresponds to DI-0.0, and so on). If the corresponding bit is set to 0, the port input value is not processed. If the value is set to 1, the port input value is selected. Example: Polarity[7..0] When set to "4" (0000 0100B in binary), the "DI-0.2" port input value read by the configuration will be the opposite value。
DI_Polarity8..15	DI[15..8] Polarity reversal	decimalism	0~255	

Table 13 Description of digital input parameters

5.4.2 Digital Output (DQ) Our company independently configurs software Settings based on RxTool

As shown in 5, the digital output contains three parameters.



As shown in 5, the digital output contains three parameters.

Parameter description

Parameter	name	format	Input range	Instructions
DO_Polarity0..7 DO_Polarity8..15	Polarity reversal	decimalism	0~255	The binary bits of this parameter correspond to the DQ0.x port (Bit0 corresponds to DQ-0.0, and so on). If the corresponding bit is set to 0, the port output value is not processed. If the value is set to 1, the port output value is taken. Example: Polarity[7..0] When the parameter is set to "4" (0000 0100B in binary), the output value of the "DQ-0.2" port will be the opposite of the actual configuration written value.
DO_Error_Mode0..7 DO_Error_Mode8..15	fail-safe Mode enable	decimalism	0~255	The fail-safe status value of the DQ0.x port is enabled. The binary bit of this parameter corresponds to the DQ0.x port (Bit0 corresponds to DQ-0.0, and so on). When the module enters the fail-safe state, if the bit of Error Mode is 1, the Value of the bit of Error Value[7..0] is output to the corresponding DQ0.x port.
DO_Error_Value0..7 DO_Error_Value8..15	fail-safe Status value	decimalism	0~255	If the binary bit corresponding to Error Mode[7..0] is set to Enable, the value of the parameter is output to the DQ port when the system enters the fail-safe state.

Table 14 Description of digital output parameters

5.4.3 Analog Input (AI) Our company independently configs software Settings based on RxTool

Parameter description

Parameter	name	format	Input range	Instructions
CHx_Measuring _Range	Measuring range	symbol	"Voltage+/-10V" "Voltage +/- 5V" "Voltage +/- 2.5V" "Voltage 0 to 10V" "Voltage 0 to 5V" "Current +/- 20mA" "Current 0 to 20mA" "Current 4 to 20mA" "Disable" (默认 Voltage+/-10V)	Select the corresponding analog dose input range Disable indicates that the sampling channel is disabled
CHx_Offset	Sampling deviation	decimalism	0-65536 (Default 0)	These two parameters are mainly used to calibrate the analog front end. Vi=Vr* Gain/1000+ Offset; (Vi reads the data actually entered by Vr)
CHx_Gain	Sampling gain	decimalism	0-65536 (Default 1000)	
CHx AverageNum	Sampling and averaging times	decimalism	0-255 (Default is 20 times)	The average value algorithm is used in the module, and adjusting this parameter can adjust the average value depth and improve the sampling accuracy, on the contrary, it will reduce the response time.

Table 15 Description of analog input parameters

5.4.5 Analog Output (AO) We independently configure software Settings based on RxTool

Parameter description

Parameter	name	format	Input range	Instructions
CHx_Output_Range	Output range	symbol	"Voltage+/-10V" "Voltage 0 to 10V" "Current 0 to 20mA" "Current 4 to 20mA" "Disable" (acquiesce Voltage+/-10V)	Select the corresponding analog input range. Disable indicates that the sampling channel is disabled
CHx_Offset	Output value offset	decimalism	0-65536 (acquiesce 0)	These two parameters are mainly used to calibrate the simulation back end. The purpose is to make the encoding depth can maximize the amplitude of the rated input signal without compressing, in order to reduce the signal loss caused by the error of the analog back end Vr=Vo* Gain/1000+ Offset; (Data written by Vo program Vr actual input data)
CHx_Gain	Output value gain	decimalism	0-65536 (acquiesce 1000)	
CHx_Error_Mode	The fault output mode was enabled	symbol	Hold Error Value	The value output by the module after a fault occurs in Hold mode remains the current value When a module fails in the Error Value mode, the median value of CH1_Error_Value is output by the module
CHx_Error_Value	Fault output mode value	decimalism	0-65536 (acquiesce 1000)	

Table 16 Description of analog output parameters

5.5 Simulated data representation

The simulated data are all represented by 16bit data and high position. If if 16 bits are not met the corresponding status data is invalid

For example, the low 4bit ADC data is saved as "0" unchanged. Select a polar analog during configuration. The high position of the data is the symbol bit in the following table:

	-/+10V	-/+5V	-/+2.5 V	0-10V	0-5V	-/+20 Ma	0-20Ma	4-20Ma
Full bias	32000	32000	32000	65520	65520	32000	65520	65520
0	0	0	0	0	0	0	0	0
Negative full bias	-32000	-32000	-32000	There is no	There is no	-32000	There is no	There is no

Table 17 describes the simulated data

Value calculation

Example: The E3041 12BIT analog input module is configured as follows:

CH1_Output_Range: Voltage+/-10V

CH1_Offset: 100 (DEC)

CH1_Gain: 2000 (DEC)

If the front end is simulated in channel 1. There is a -2.5V voltage input calculated as follows

-2.5V in data should be decimal data -8000 =(-32000/-10V)*-2.5:

Vi=Vr* Gain/1000+ Offset;

So the data we get from this program is

Decimal data: -16100 (DEC)

Hexadecimal data: C11C (H)

The E3041 12BIT analog input module is configured as follows:

CH2_Output_Range: "Current 4 to 20mA"

CH2_Offset: 100 (DEC)

CH2_Gain: 500 (DEC)

If the front end is simulated in channel 2. There is a 10mA electrical current input calculated as follows

10mA in data should be decimal data 32500= (65,000/20mA)*10mA:

Then calculate Ii=Ir* Gain/1000+ Offset according to the formula;

So the data we get from this program is

Decimal data: 16350 (DEC)

Hexadecimal data: 3FDE (H)

5.5.1Analog Output (A0)

Parameter description

Param_list	Output type
Param_Offset	Data value offset
Param_Gain	Data value gain amplification
Param_Error_Mode	Failure mode setting "0" is not maintained, and "1" outputs the set value
Param_ Error_Value	The output set value in case of failure

1. Output type range (default 0: Voltage+/-10V)

Parameter description

Parameter	name	format	Input range	Instructions
CHx_Measuring_ Range	Measuring range	symbol	0- "Voltage 0~10V" 1- "Current 0 to 20mA" 2- "Current 4 to 20mA" 255-"Disable" (default Voltage 0~10V)	Select the corresponding analog output range Disable indicates that the sampling channel is disabled

Table 18 Description of analog input parameters

2. Data value offset (default 0x0)

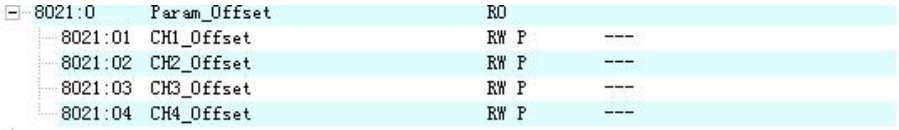


FIG. 6 Simulated magnitude deviation

3. Data gain amplification (1000 magnification is 1)

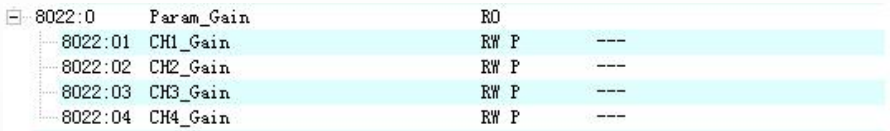


FIG. 7 Analog magnitude gain parameters

5.6 Simulated data representation

The simulated data are all represented by 16bit data and high position. If if 16 bits are not met the corresponding status data is invalid

For example, the low 4bit ADC data is saved as "0" unchanged. Select a polar analog during configuration. The high position of the data is the symbol bit in the following table:

	0~10V	0-20mA	4-20mA
Full bias	32500	32500	32500
0	0	0	0
Negative full bias	There is no	There is no	There is no

Table 19 describes simulated data

5.7 Device Database Files (EDS)

ETHERNET IP uses device database files (EDS) to describe the communication characteristics of a device.

5.7.1 File Name

R51C1_EP.eds Indicates the accompanying EDS file.

- "R51C1-EP" indicates the product number used. This version can be used on the R51C1-EP/F R51C1-EP/Pro remote I/O module.

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