MT2000 series remote I/O module

User 's Manual

Rev: F

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Safety requirements

Warning: Only connect voltage within the specified range. If the voltage exceeds the specified range, it may cause equipment damage and even affect personal safety. The voltage range that can be connected to each port is detailed in the product specification section.

Warning: Do not attempt to operate the device in any other way not mentioned in this document. Incorrect operation of equipment may pose a danger. When the equipment is damaged, the internal security protection mechanism will also be affected.

Warning: Do not attempt to replace device components or modify the device using other methods not mentioned in this document. Do not repair the product yourself when it malfunctions.

Warning: Do not use the equipment in environments where explosions may occur or in the presence of flammable smoke. If necessary for such environments, please place the device in a suitable enclosure.

Warning: During the operation of the warning device, all chassis covers and filling panels must be closed.

Warning: For equipment with exhaust vents, do not insert foreign objects into the vents or block the air flow through the vents.

Measurement category

Warning: This device can only be used in measurement category I (CAT I).
Do not use this device to connect signals or perform measurements in measurement categories II/III/IV.

Measurement category description

Measurement Category I (CAT I) refers to measurements taken on circuits that are not directly connected to the main power supply. For example, measuring circuits that are not derived from the main power source, especially circuits derived from protected (internal) main power sources. In the latter case, the instantaneous stress will change. Therefore, users should understand the instantaneous tolerance of the device.

Measurement Category II (CAT II) refers to measurements taken on circuits directly connected to low-voltage equipment. For example, measuring household appliances, portable tools, and similar devices.

Measurement Category III (CAT III) refers to measurements conducted in building equipment. For example, measurements are taken on distribution boards, circuit breakers, circuits (including cables, busbars, junction boxes, switches, sockets) in fixed equipment, as well as industrial equipment and certain other devices (such as fixed motors permanently connected to fixed installations).

Measurement category IV (CAT IV) refers to measurements taken at the source of low-voltage equipment. For example, measurements taken on electricity meters, primary over Current protection equipment, and pulse control units.

Environment

Temperature	
Operation	0℃~55℃
Storage	-40℃~85℃
Humidity	
Operation	5% RH~95% RH, non-condensing
Storage	5% RH~95% RH, non-condensing
Pollution level	2
Highest altitude	2000m

Pollution level description

Pollution level 1: No pollution, or only dry non-conductive pollution occurs. This pollution level has no impact. For example, a clean room or an air-conditioned office environment.

Pollution level 2: Generally only dry non-conductive pollution occurs. Sometimes temporary conduction may occur due to condensation. For example: general indoor environment.

Pollution level 3: Conductive pollution occurs, or dry non-conductive pollution becomes conductive due to condensation. For example, an outdoor environment with a canopy.

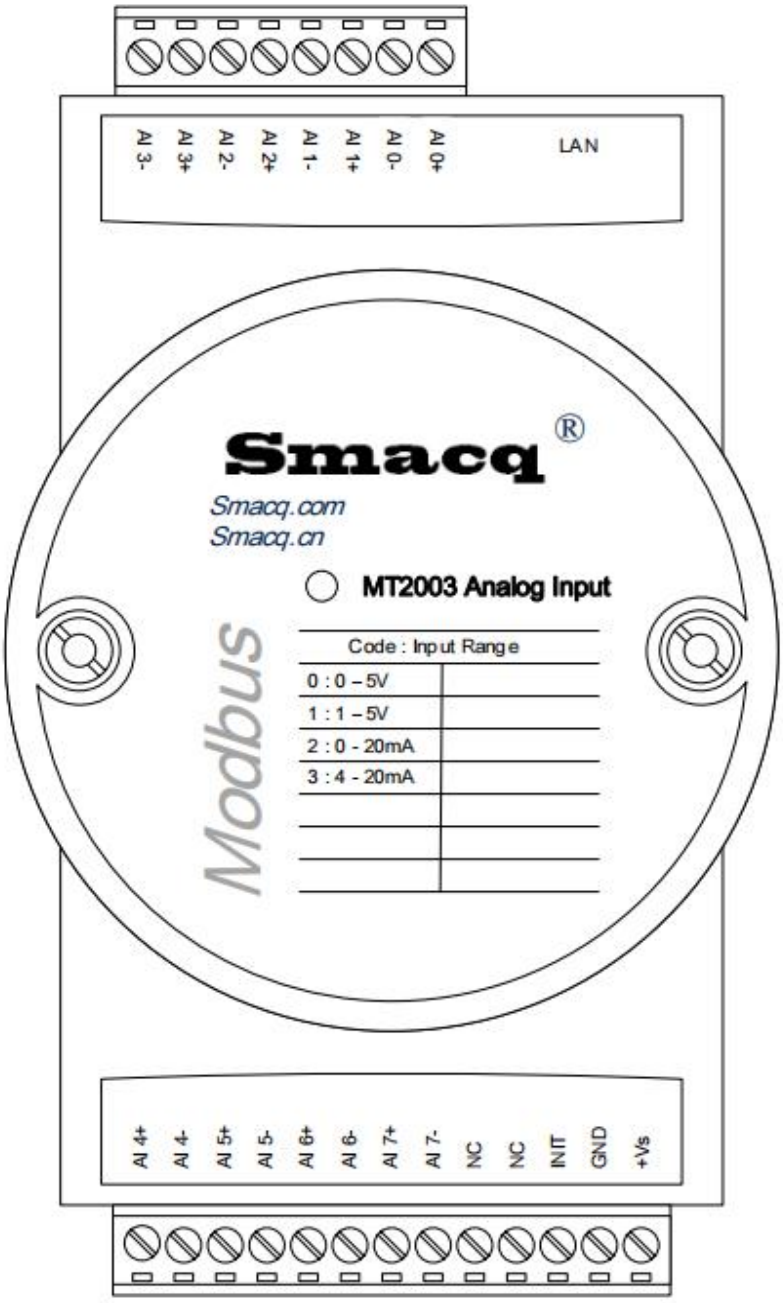
Pollution Level 4: Permanent conductive pollution caused by conductive dust, rainwater, or snow. For example: outdoor places.

Recycling precautions

Warning: Some substances contained in this product may be harmful to the environment or human health. To avoid releasing harmful substances into the environment or endangering human health, it is recommended to recycle this product using appropriate methods to ensure that most materials can be reused or recycled correctly. For information on handling or recycling, please contact local professional organizations.

1. Product Introduction

1.1. Overview



MT2003 Wiring Definition

Overview

The MT2000 series remote I/O module is a set of computer interface modules based on the Modbus TCP standard protocol. MT2000 is remotely controlled through the standard Modbus TCP protocol, with programmable analog input interfaces for multiple channels, and can be converted through programmable control.

Feature point

- 8-channel analog input
- MT2003, MT2013, 12 bit resolution (16 bit in high-resolution mode)
- Using standard Modbus TCP protocol
- Multi-range setting
- Built-in Watchdog Timer will automatically reset the module in case of system failure
- 9-24V power supply voltage range
- DIN-Rail Mounting and Piggyback Stack

Applications

- Remote data acquisition
- Process monitoring
- Industrial process control
- Energy management
- Monitor
- Safety system
- Laboratory automation
- Building automation
- Product testing

1.2. Product specifications

Common Specifications

Connection	
Interface	10/100M Ethernet Adaptive (RJ45)
Network Mode	TCP SERVER (Default), TCP CLIENT, UDP
Protocol	Modbus TCP
Watchdog Timer	1s
Power Supply	
Input Voltage	9-30 VDC
Electric Current	MT2003：60mA (Max) @ 24V MT2013：60mA (Max) @ 24V MT2093：60mA (Max) @ 24V

MT2003 Product Specification

Analog input	
Channels	8
Input Type	Voltage, Current (Switch through Jumper setting)
Resolution	12-bit 16-bit (High-resolution mode)
Voltage range	0-5V, 1-5V
Current range	0-20mA, 4-20mA (Default)
Integral time	20ms
Input coupling mode	DC
Voltage input impedance	10M Ω (Typical values)
Current input impedance	249Ω
Accuracy	Voltage range ± (% of reading + % of range) 0.05+0.1 Current range ± (% of reading + % of range) 0.1+0.2
Temperature coefficient	25ppm/℃
Isolation voltage	1500V

MT2013 Product Specification

Analog input	
Channels	8
Input Type	Voltage, Current (Switch through Jumper setting)
Resolution	12-bit 16-bit (High-resolution mode)
Voltage range	0-10V (Default), 2-10V
Current range	0-20mA, 4-20mA
Integral time	20ms
Input coupling mode	DC
Voltage input impedance	10M Ω (Typical values)
Current input impedance	249Ω
Accuracy	Voltage range ± (% of reading+% of range) 0.05+0.1 Current range ± (% of reading+% of range) 0.1+0.2
Temperature coefficient	25ppm/℃
Isolation voltage	1500V

MT2093 Product Specification

Analog input	
Channels	8
Input Type	Voltage, Current (Switch through Jumper setting)
Resolution	12-bit 16-bit (High-resolution mode)
Voltage range	0-5V, 1-5V
Current range	0-20mA, 4-20mA (Default)
Integral time	10ms, supports active data upload
Input coupling mode	DC
Voltage input impedance	10M Ω (Typical values)
Current input impedance	249Ω
Accuracy	Voltage range ± (% of reading+% of range) 0.05+0.1 Current range ± (% of reading+% of range) 0.1+0.2
Temperature coefficient	25ppm/℃
Isolation voltage	1500V

2. Product unpacking and packing list

2.1. Product unboxing

To prevent equipment damage from electrostatic discharge (ESD), please note the following:

- Please wear a grounded wristband or touch a grounded object first to ensure that the human body is grounded.
- Before removing the equipment from the packaging, please first place the anti-static packaging in contact with a grounded object.
- Do not touch the exposed pins of the connector.
- Please place the device inside an anti-static rod when not in use.

If the product is damaged after unpacking, please contact us promptly.

2.2. Packing list

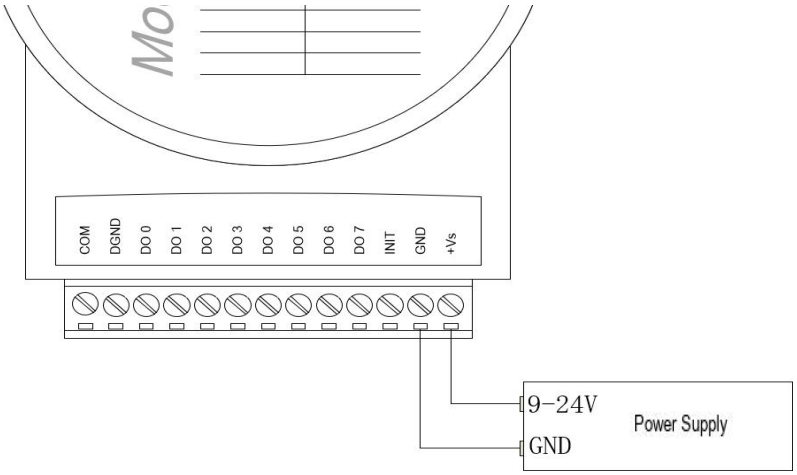
Name	Specification Description	Quantity
MT2000	MT2000 Remote I/O Module	1
Include Attachments		
Wiring terminals	13 Pin/Green/3.81	1
Wiring terminals	8 Pin/Green/3.81	1

3.Installation and simple testing

3.1. Hardware install

Before installation and debugging, the following equipment needs to be prepared:

- MT2000 Remote I/O Module
- A Windows series computer with Ethernet interface
- A DC Power Supply (9-24V)



Power Connection Diagram

3.2. Software installation

We provide an application for configuring, detecting, and easy-to-use MT2000 series remote I/O modules, which can only be installed on the Windows desktop operating system. Double click to run setup. exe for installation.

Software installation diagram

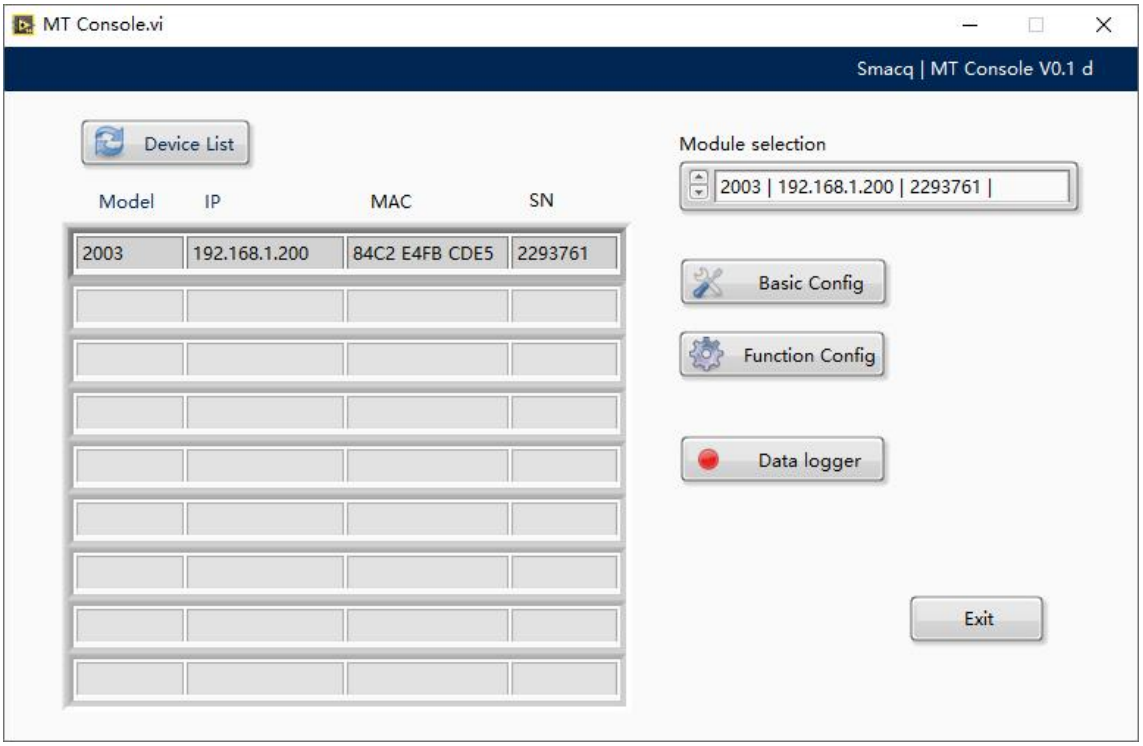
3.3. Simple testing

The MT2000 series remote I/O module is set to its initial value before leaving the factory, as shown in the table below. If the settings of the MT2000 series remote I/O module have been modified and the settings have been forgotten, a wire can be used to connect the Initiate and GND terminals, and then the power of the MT2000 can be turned on. The LED indicator of the MT2000 will flash three times at a frequency of 1Hz, and then disconnect the connection between the Initiate and GND. At this time, the MT2000 remote I/O module will be restored to its factory default values.

Table 1 Default Value List

Parameter	**Default value**
IP address	192.168.1.200
Gateway	192.168.1.1
Subnet mask	255.255.255.0
DHCP	CLOSE
Network mode	TCP SERVER
Local port	502
Random Local Port	CLOSE
Target IP	192.168.1.100
Target Port	1000

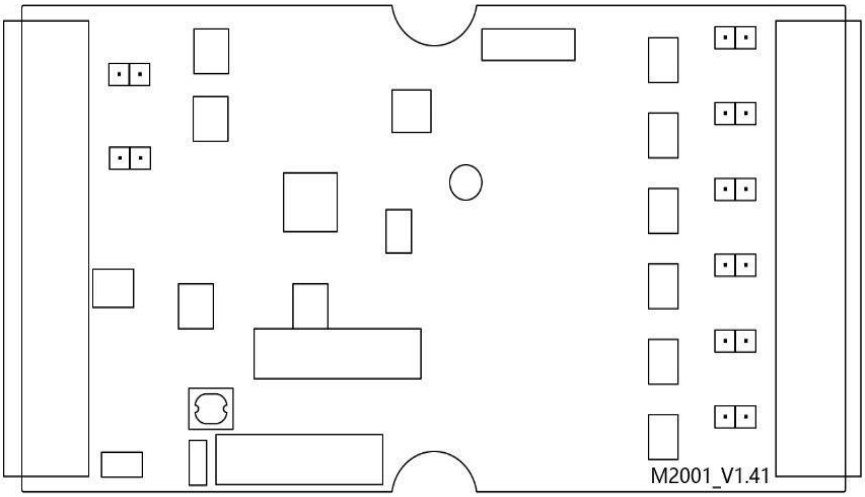
Run the MT Console configuration software.



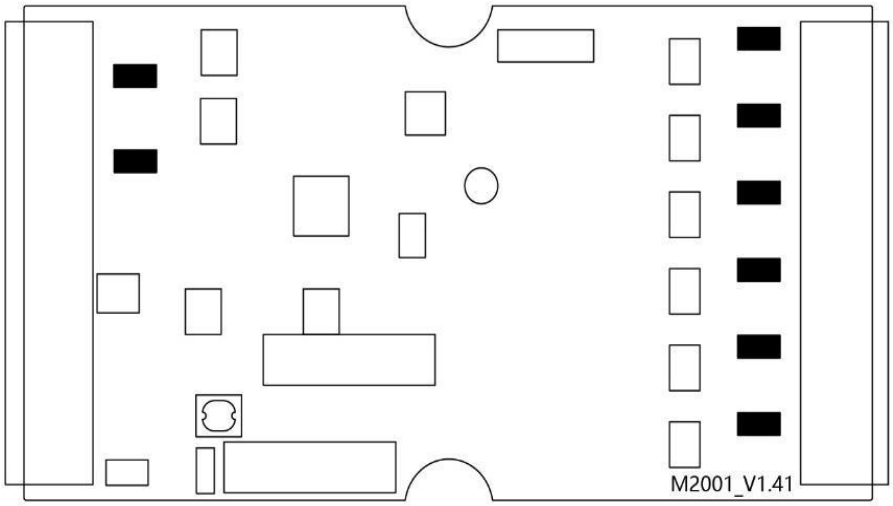
MT series DAQ setting software

4. Analog input

In the MT2000 series remote I/O module, the MT2000 is equipped with 8 voltage/Current switchable analog input channels. Inside MT2000, each channel has a Jumper bit to set the input type for that channel. When the Jumper is not connected, this channel is a voltage input channel; When the Jumper is connected, this channel is the Current input channel. A new MT2003 and MT2093 have a default range of 4-20mA, and jumpers are already connected internally. A new MT2013 has a default range of 0-10V and the Jumper is not connected.

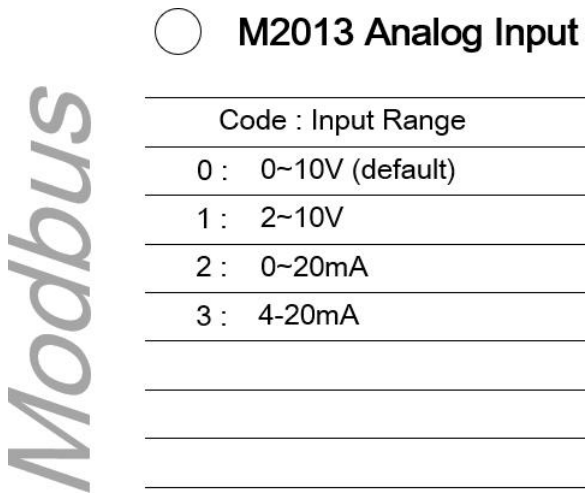


The picture shows that the Jumper cap is not connected.
At this time, it is voltage acquisition type



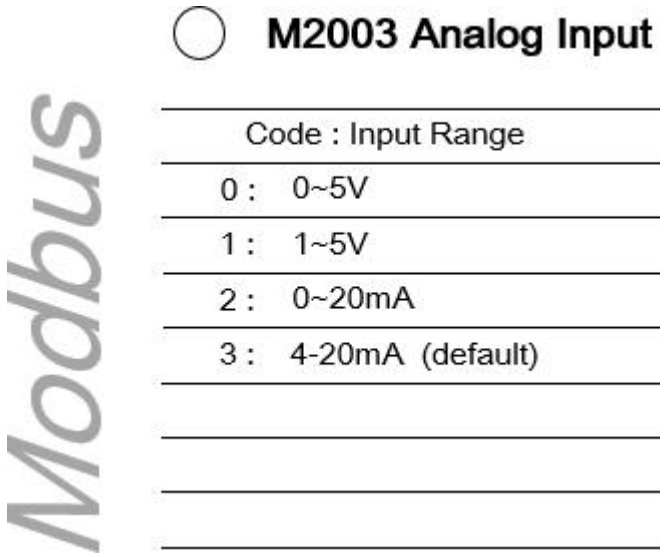
The picture shows that the Jumper cap is connected.
At this time, it is Current acquisition type

At the leave factory, these Jumper positions will be set according to the default input range. The default range is marked on the front panel of the module, as shown in the figure below. The default range is 0~10V, so there is no Jumper wire connected inside. If you need to measure a 20mA Current signal, you need to open the housing and plug in the Jumper cap on the corresponding channel.



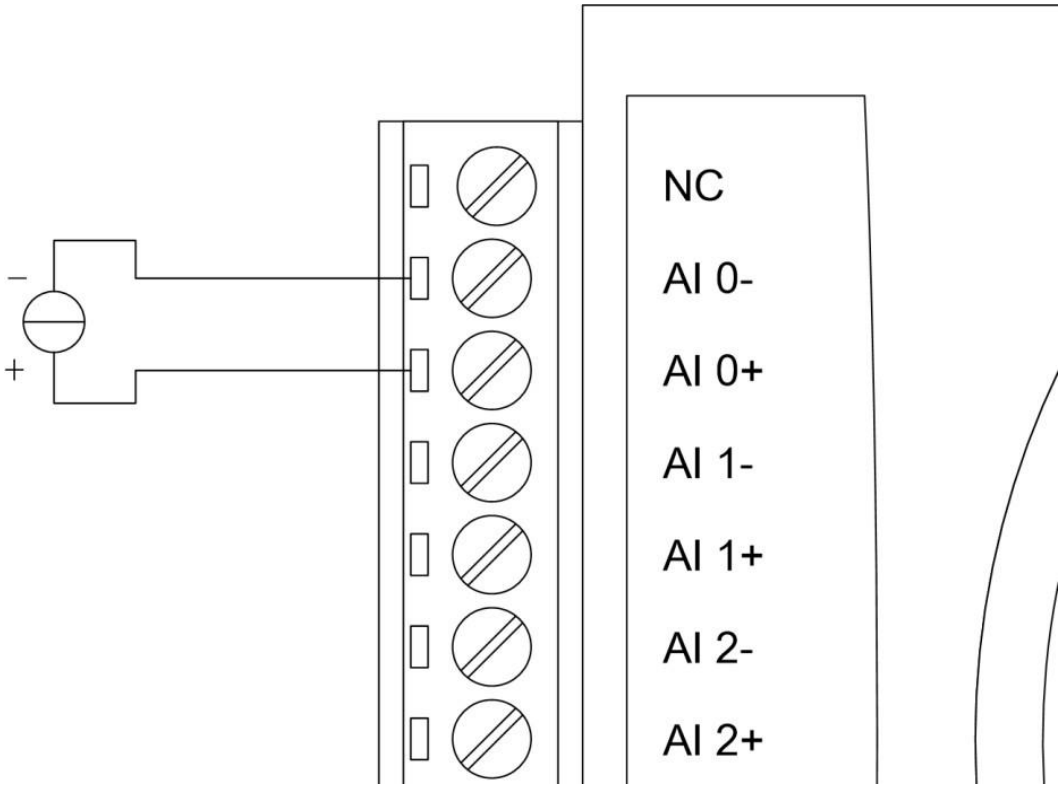
Default voltage range in the diagram

As shown in the figure below, the default range is 4~20mA, and a Jumper is already connected inside. If you need to measure a 5V voltage signal, you need to open the casing and remove the corresponding channel Jumper cap.

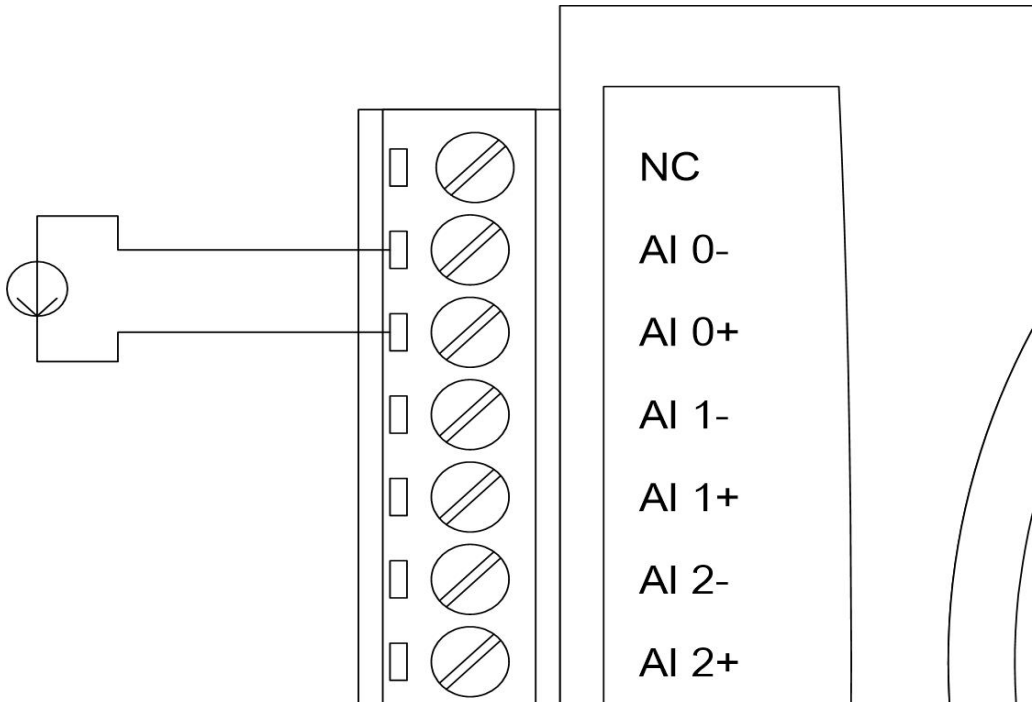


Default Current range in the diagram

In addition, after switching the jumper, we also need to set the corresponding channel range in the software and save the default settings. After completing these operations, you can connect the signals as shown in the following diagram.



Schematic diagram of voltage signal analog input connection



Schematic diagram of Current signal analog input connection

5. Programming instructions

The MT2000 series remote I/O module is a set of computer interface modules based on Modbus TCP, and its programming rules follow The relevant conventions of Modbus TCP protocol.

MODBUS TCP Command Message Description

For the convenience of users who are using the Modbus TCP protocol for the first time, several commonly used Modbus command messages are briefly illustrated here. If you are already familiar with the Modbus TCP protocol, you can directly view the following mapping table.

01 Function code

Used to read the status of the coil (DO)

To read the status of 8 coils starting from address 1 of a module, the host **sends** the following command:

Fixed message header*	Remaining bytes	Module address**	Function code	Coil address	Number of coils
0x 0000 0000 00	0x06	0x01	0x01	0x0000	0x0008

The module **returns** the following data:

Fixed message header*	Remaining bytes	Module address**	Function code	Coil address	Number of coils
0x 0000 0000 00	0x05	0x01	0x01	0x01	0x05

The state of each coil corresponds to one bit of data, and 8 coils correspond exactly to one byte of data. If 9-16 coils of data are read at a time, the byte count is 2, and so on. The binary representation of data 0x05 is 00000101, indicating that DO0 and DO2 states are 1, and the remaining DO states are 0.

02 Function code

Used to read discrete quantity (DI) states

To read the 8 discrete states of a module starting from address 10001, the host **sends** the following command:

Fixed message header*	Remaining bytes	Module address**	Function code	Coil address	Number of coils
0x 0000 0000 00	0x06	0x01	0x02	0x0000	0x0008

The module **returns** the following data:

Fixed message header*	Remaining bytes	Module address**	Function code	Coil address	Number of coils
0x 0000 0000 00	0x05	0x01	0x02	0x01	0x05

Each discrete state corresponds to one bit of data, and 8 coils correspond to exactly 1 byte of data. If 9-16 coils of data are read at a time, the number of bytes is 2, and so on. The binary representation of data 0x05 is 00000101, indicating that DI0 and DI2 are in the 1 state, and the remaining DO states are in the 0 state.

03 Function code

Used for reading and holding registers

To read the status of three registers starting from address 40201 in a module, the host **sends** the following command:

Fixed message header*	Remaining bytes	Module address**	Function code	Coil address	Number of coils
0x 0000 0000 00	0x06	0x01	0x03	0x00C8	0x0003

The module **returns** the following data:

Fixed message header*	Remaining bytes	Module address**	Function code	Coil address	Number of coils
0x 0000 0000 00	0x09	0x01	0x03	0x06	0x0001 0023 0005

0x0001 represents the data of register 40201, 0x0023 represents the data of register 40202, and 0x0005 represents the data of register 4020 For the specific meaning of the data, please refer to the Modbus mapping table.

04 Function code

Used for reading input registers

To read the status of the three registers starting from address 30101 in a module, the host **sends** the following command:

Fixed message header*	Remaining bytes	Module address**	Function code	Register address	No.of registers
0x 0000 0000 00	0x06	0x01	0x04	0x0064	0x0003

The module **returns** the following data:

Fixed message header*	Remaining bytes	Slave address**	Function code	Byte count	Data
0x 0000 0000 00	0x09	0x01	0x04	0x06	0x0001 0023 0005

0x0001 is the data of register 30101, 0x0023 is the data of register 30102, and 0x0005 is the data of register 30103 For the specific meaning of the data, please refer to the Modbus mapping table.

05 Function code

Used for writing a single coil (DO)

To control the coil status of address 1 in a module, the host **sends** the following command:

Fixed message header*	Remaining bytes	Module address**	Function code	Coil address	Coil status
0x0000 0000 00	0x06	0x01	0x05	0x0000	0xFF00 (set to 1) 0x0000 (set to 0)

The module **returns** the same data as the **sent** content.

06 Function code

Used for writing and holding registers

If it is necessary to write register data with address 40201 to a module, the host **sends** the following command:

Fixed message header*	Remaining bytes	Module address**	Function code	Register address	Data
0x0000 0000 00	0x06	0x01	0x06	0x00C8	0x001C

The module **returns** the same data as the sent content.

15 (0x0F) Function code

Used for writing multiple coils (DO)

To read the status of the 8 coils starting from address 1 of a module, the host **sends** the following command:

Fixed message header*	Remaining bytes	Module address* *	Function code	Coil address	Number of coils	Byte count	Data
0x0000 0000 00	0x06	0x01	0x0F	0x0000	0x0008	0x01	0x05

The module **returns** the following data:

Fixed message header*	Remaining bytes	Slave address**	Function code	Byte count	Data
0x0000 0000 00	0x05	0x01	0x0F	0x0000	0x0008

The state of each coil corresponds to one bit of data, and 8 coils correspond exactly to one byte of data. If data is written to 9-16 coils at a time, the byte count is 2, and so on. The binary representation of data 0x05 is 00000 101, indicating that DO0 and DO2 states are 1, and the remaining DO states are 0.

16 (0x10) Function code

Used to write multiple hold registers

If you need to read the data from two registers of a module starting from address 40201, the host **sends** the following command:

Fixed message header*	Remaining words Number of sections	Module address**	Function code	Register address	Register quantity	Byte count	Data
0x0000 0000 00	0x06	0x01	0x10	0x00C8	0x0002	0x04	0x0001 0023

The data of each register corresponds to 2 bytes of data, and the data of 2 registers is 4 bytes, and so on. 0x0001 is the data of register 40101, and 0x0023 is the data of register 40102.

The module **returns** the following data:

Fixed message header*	Remaining bytes	Slave address**	Function code	Register address	Number of registers
0x0000 0000 00	0x05	0x01	0x10	0x00C8	0x0002

*The header of Modbus TCP generally uses a fixed set of five 0X00 bytes, which can also represent specific meanings. You can refer to the Modbus TCP protocol manual by yourself, and detailed explanations will not be provided here.

**The MT2000 series remote I/O module has a fixed slave address of 0x01 and does not involve any other addresses, so the protocol will not be explained in detail.

MT2000 Series Remote I/O Module Universal Function Modbus Mapping Table

Address 4X	Function	Explain	Attribute	Command
40201	Model number		Read	0x03
40202-40203	Serial number		Read	0x03
40204	Version number		Read	0x03

MT2000 Series Remote I/O Module Modbus Mapping Table

Analog input register list

Address 3X	Channel	Function	Attribute	Command
30001	AI 0	Analog input register	Read	0x04
30002	AI 1	Analog input register	Read	0x04
30003	AI 2	Analog input register	Read	0x04
30004	AI 3	Analog input register	Read	0x04
30005	AI 4	Analog input register	Read	0x04
30006	AI 5	Analog input register	Read	0x04
30007	AI 6	Analog input register	Read	0x04
30008	AI 7	Analog input register	Read	0x04

Comparison Table of Analog Input Register Data and Voltage/Current Values for MT2003 and MT2093 High Resolution Mode (Factory Default)

Analog input range	Analog input register data values (Decimal)
0-5V	0-65535, 0 corresponds to 0V, 65535 corresponds to 5V
1-5V	0-65535, 0 corresponds to 1V, 65535 corresponds to 5V
0-20mA	0-65535, 0 corresponds to 0mA, 65535 corresponds to 20mA
4-20mA	0-65535, 0 corresponds to 4mA, 65535 corresponds to 20mA

Comparison Table of MT2013 High Resolution Mode (Factory Default) Analog Input Register Data and Voltage/Current Values

Analog input range	Analog input register data values (Decimal)
0-10V	0-65535, 0 corresponds to 0V, 65535 corresponds to 10V
2-10V	0-65535, 0 corresponds to 2V, 65535 corresponds to 10V
0-20mA	0-65535, 0 corresponds to 0mA, 65535 corresponds to 20mA
4-20mA	0-65535, 0 corresponds to 4mA, 65535 corresponds to 20mA

Comparison Table of MT2003 and MT2093 12 bit Analog Input Register Data and Voltage/Current Values

Analog input range	Analog input register data values (Decimal)
0-5V	0-4095, 0 corresponds to 0V, 4095 corresponds to 5V
1-5V	0-4095, 0 corresponds to 1V, 4095 corresponds to 5V
0-20mA	0-4095, 0 corresponds to 0mA, 4095 corresponds to 20mA
4-20mA	0-4095, 0 corresponds to 4mA, 4095 corresponds to 20mA

Comparison Table of MT2013 12 bit Analog Input Register Data and Voltage/Current Values

Analog input range	Analog input register data values (Decimal)
0-10V	0-4095, 0 corresponds to 0V, 4095 corresponds to 10V
2-10V	0-4095, 0 corresponds to 2V, 4095 corresponds to 10V
0-20mA	0-4095, 0 corresponds to 0mA, 4095 corresponds to 20mA
4-20mA	0-4095, 0 corresponds to 4mA, 4095 corresponds to 20mA

List of analog input range registers

Address 4X	Channel	Function	Attribute	Command
40101	AI 0	Range register	Write/Read	0x03,0x06,0x10
40102	AI 1	Range register	Write/Read	0x03,0x06,0x10
40103	AI 2	Range register	Write/Read	0x03,0x06,0x10
40104	AI 3	Range register	Write/Read	0x03,0x06,0x10
40105	AI 4	Range register	Write/Read	0x03,0x06,0x10
40106	AI 5	Range register	Write/Read	0x03,0x06,0x10
40107	AI 6	Range register	Write/Read	0x03,0x06,0x10
40108	AI 7	Range register	Write/Read	0x03,0x06,0x10

MT2003, MT2093 Analog Input Range Register Range and Set Value Comparison Table

Analog input range	Analog input range register setting value (Decimal)
0-5V	0
1-5V	1
0-20mA	2
4-20mA	3 (Default)

MT2013 Analog Input Range Register Range and Set Value Comparison Table

Analog input range	Analog input range register setting value (Decimal)
0-10V	0 (Default)
2-10V	1
0-20mA	2
4-20mA	3

List of analog input high-resolution mode registers

Address 4X	Channel	Function	Attribute	Command
40121	AI 0-7	1: Open 0: Close	Write/Read	0x03,0x06,0x10

MT2093 Active Upload Function Description
Active Upload Register

Address 4X	Channel	Function	Attribute	Command
40401	AI 0-7	Write data greater than or equal to 10 and start entering active upload mode; Write data less than 10 and stop uploading. Upload frequency based on written data, unit ms, minimum 10ms.	Write/Read	0x03,0x06,0x10

Proactively upload data format

Fixed message header*	Remaining bytes	Slave address**	Function code	Byte count	Data
0x 0000 0000 00	0x13	0x01	0x04	0x10	0x0001 0023 0005 4516 5A6C 0011 3FFF 0042

The first two bytes of the fixed message header indicate data sorting, starting from 0 and ending at 65535. Once the maximum value is exceeded, a loop will occur. Every two bytes in the data represent the data of a channel, where 0x0001 represents the data of AI0, 0x0023 represents the data of AI1, and so on.

6. After sales service and warranty

Smacq Technologies. Co., Ltd. promises that its products are under warranty. If the product malfunctions during normal use, we will provide free repair or replacement of parts for the user. For detailed warranty instructions, please refer to the warranty instructions inside the packaging box.

Except for the warranties mentioned in this manual and warranty instructions, our company does not provide any other express or implied warranties, including but not limited to any implied warranties regarding the merchant ability and fitness for a particular purpose of the product.

For more technical support and service details, or if you have any questions while using this product and this document, please feel free to contact us:

Phone: (86-10) 52482802
E-mail: service@smacq.com
Website: http://www.smacq.com
http://www.smacq.cn

7. Ordering information

Main Equipment

Model	Description
MT2003	12 bit, 8-channel analog input (Voltage_5V/Current_20mA)
MT2013	12 bit, 8-channel analog input (Voltage_10V/Current_20mA)
MT2093	12 bit, 8-channel analog input (Voltage_5V/Current_20mA) Supporting up to 10ms sampling Actively connected report

Standard Accessories

Model	Description
TB13-3.81	Bolt terminal connector, 13 positions, 3.81mm
SDIN	DIN-Rail mounting bracket

8. Document Revision History

Date	Edition	Remarks
2022.04.14	Rev: A	First release.
2022.07.25	Rev: B	Revise some errors.
2023.04.26	Rev: C	Add some content to MT2013.
2024.01.12	Rev: D	Add Jumper instructions.
2024.04.2	Rev: E	Add some content to MT2093.
2024.07.3	Rev: F	Modify some commands with incorrect instructions.