M3000 series remote I/O module

User 's Manual

Rev: B

Smacq

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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.

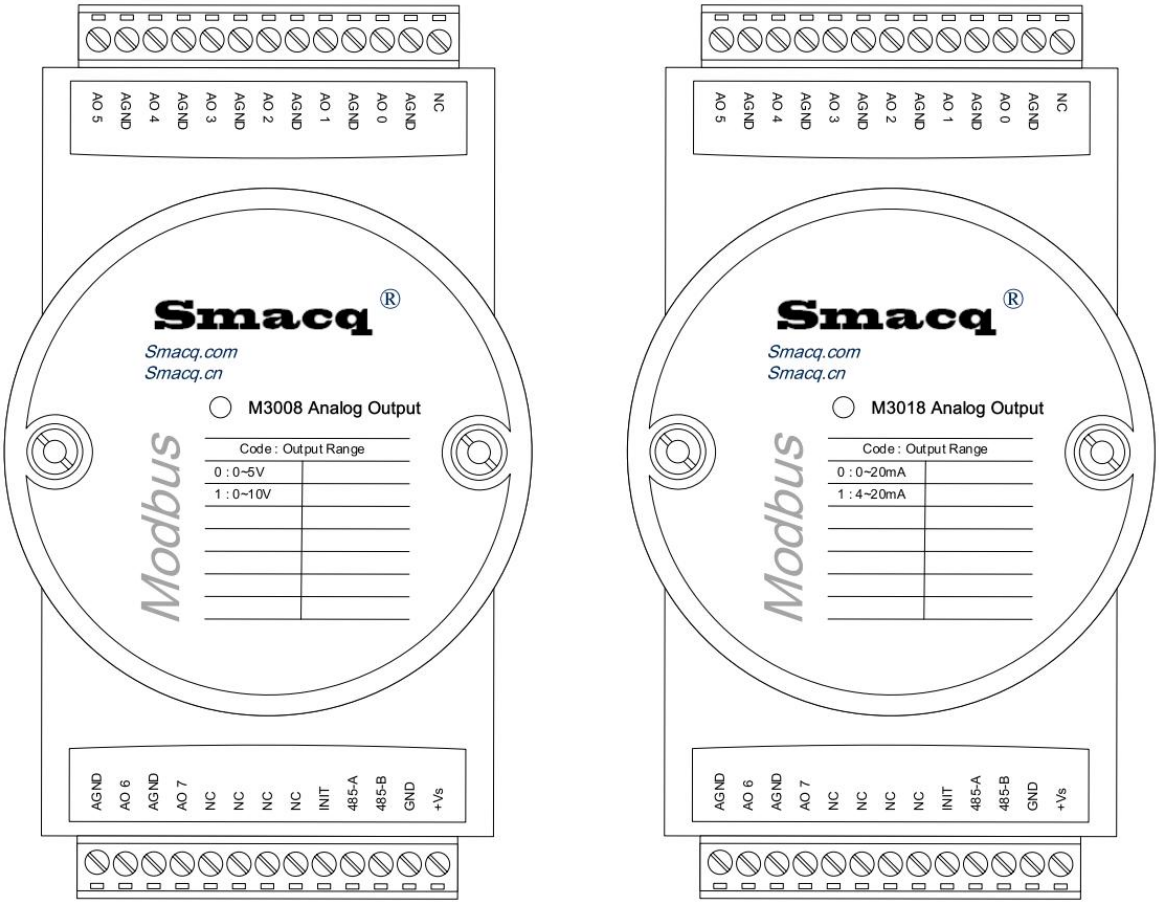
Pollution Level 4: Permanent conductive pollution caused by conductive dust, rainwater, or snow. For example: outdoor places.

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



M3000 Wiring Definition

Overview

The M3000 series remote I/O module is a set of computer interface modules based on the Modbus RTU standard protocol.The M3000 have RS485 interface, which is remotely controlled through the standard Modbus RTU protocol, with programmable analog output interfaces for multiple channels, and can be converted through programmable control.

Feature point

- 2/4/8-channel analog output
- Analog output resolution rate 12-bit
- Using standard Modbus RTU protocol
- Built-in Watchdog Timer will automatically reset the module in case of system failure
- 0-5V, 0-10V Voltage output
- 0-20mA, 4-20mA Current output
- 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

2. Product specifications

Common Specifications

Connection	
Interface	RS-485 (2-Wire)
Baud rate (bps)	1200,2400,4800,9600(Default),19200,38400,57600,115200
Checksum	NONE, ODD, EVEN(Default)
Stop bits	1(Default), 2
Protocol	Modbus RTU
Watchdog Timer	0.1seconds to 40 seconds
Power Supply	
Input Voltage	9-30 VDC
Electric Current	M3002：90mA (Max) @ 24V M3004：95mA (Max) @ 24V M3008：100mA (Max) @ 24V M3012：110mA (Max) @ 24V M3014：220mA (Max) @ 24V M3018：350mA (Max) @ 24V

M300x Product Specification

Analog output	
Channels	M3002：2 M3004：4 M3008：8
Output type	Voltage
Resolution	12-bit
Voltage range	0-5VDC, 0-10VDC
Accuracy	0-5V: 0.1%+10mV 0-10V: 0.1%+20mV
Output impedance	< 1 Ω
Temperature coefficient	25ppm/°C
Isolation voltage	1500V

M301x Product Specification

Analog output	
Channels	M3012：2 M3014：4 M3018：8
Output type	Current
Resolution	12-bit
Voltage range	0-20mA, 4-20mA
Accuracy	0.1%+ 40uA
Output impedance	< 25Ω
Temperature coefficient	25ppm/°C
Isolation voltage	1500V

3.Product unpacking and packing list

3.1. 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.

3.2. Packing list

Name	Specification Description	Quantity
M3000	M3000 Remote I/O Module	1
Include Attachments		
Wiring terminals	13 Pin/Green/3.81	2

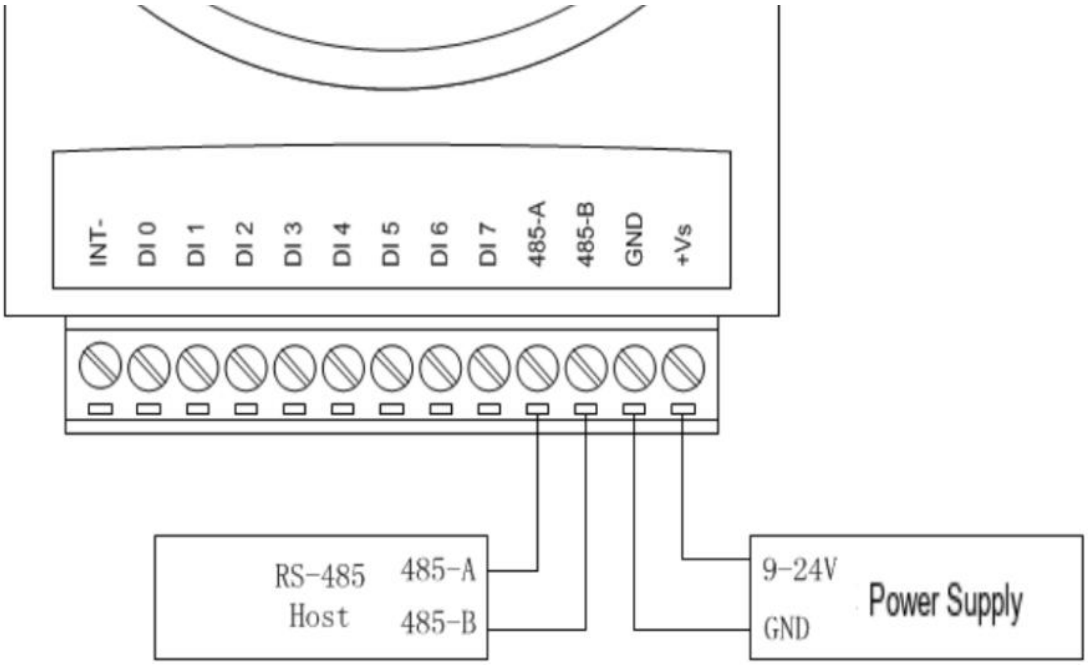
4. Installation and simple testing

4.1. Hardware install

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

- M3000 Remote I/O Module
- A Windows series computer with RS-485 interface
- A DC Power Supply (9-24V)
- A USB to RS-485 converter, such as SDS1001(if the computer does not have an RS-485 interface)

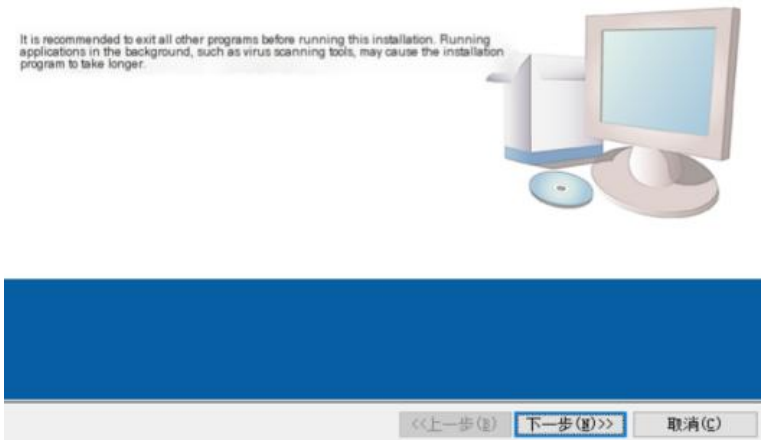
Connect the power supply and RS-485 cable according to the instruction in the following diagram. When selecting power cables, due to the limitation of DC voltage drop, using thicker wires would be more suitable. In addition, long wires can also cause interference to communication lines. It is best to use shielded twisted pair cables that comply with EIA RS-485 when selecting RS-485 cables to reduce interference.



Power Connection Diagram

4.2. Software installation

We provide an application for configuring, detecting, and easy-to-use M3000 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

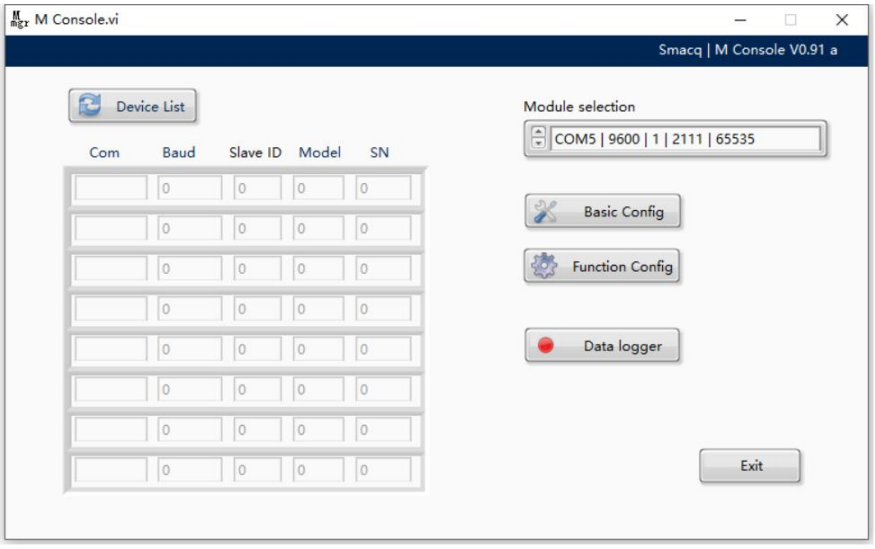
4.3. Simple testing

The M3000 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 M3000 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 M3000 can be turned on. The LED indicator of the M3000 will flash three times at a frequency of 1Hz, and then disconnect the connection between the Initiate and GND. At this time, the M3000 remote I/O module will be restored to its factory default values.

Table 1 Default Value List

Parameter	**Default value**
485 Address	0x01
Baud rate	9600
Checksum	EVEN
Stop bit	1

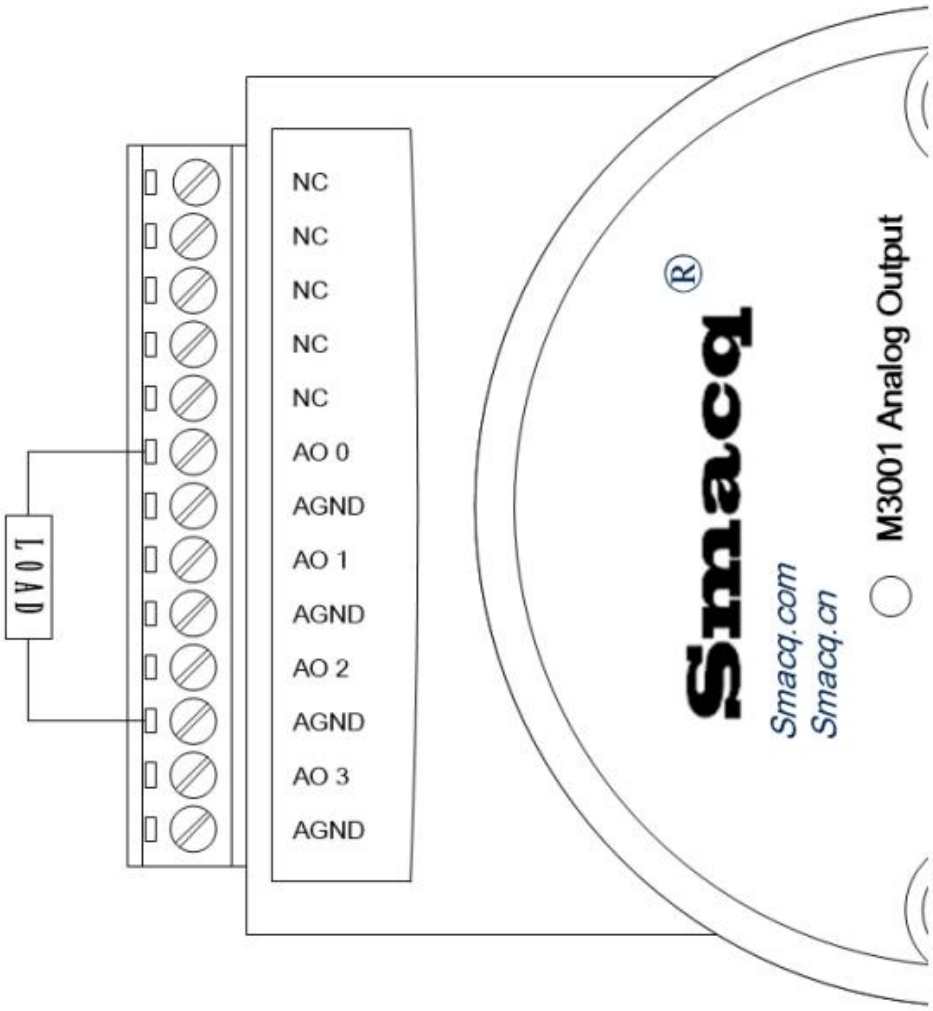
Run the M Console configuration software, in the figure below. Please refer to the "M Console Quick Use Guide" for software operations.



M series DAQ setting software

5. Analog output

In the M3000 series remote I/O module, the M3000 is equipped with multiple analog output channels.



Schematic diagram of signal analog output connection

6. Programming instructions

The M3000 series remote I/O module is a set of computer interface modules based on Modbus RTU, and its programming rules follow The relevant conventions of Modbus RTU protocol.

For the convenience of different application scenarios, the M3000 series remote IO module is equipped with two versions of MODBUS address schemes, namely V1.0 and V2.0. The V1.0 version is a non offset address scheme, while V2.0 is an offset address scheme. Since the release of this manual, V2.0 is the default setting. If necessary, the version can be switched through the M Console software.

Comparison table between coil/register address and Modbus message address.

Coil/Register Address	V1.0 Modbus Message Address	V2.0 Modbus Message Address
1~9999	1~9999，0x000~0x270F	0~9998，0x0000~0x270E
10001~19999	10001~19999，0x2711~0x4E1F	0~9998，0x0000~0x270E
30001~39999	30001~39999，0x7531~0x9C3F	0~9998，0x0000~0x270E
40001~49999	40001~49999，0x9C41~0xC34F	0~9998，0x0000~0x270E

MODBUS RTU Command Message Description

For the convenience of users who are using the Modbus RTU protocol for the first time, here are several commonly used Modbus command messages as examples. If you are already familiar with the Modbus RTU 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:

Module address	Function code	Coil address	Read the number of coils	CRC verification
0x01	0x01	0x0000	0x0008	2-byte CRC check

The module **returns** the following data:

Module address	Function code	Byte count	data	CRC verification
0x01	0x01	0x01	0x05	2-byte CRC check

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 0000 0101, 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:

Module address	Function code	Coil address	Read the quantity of discrete quantities	CRC verification
0x01	0x02	0x0000	0x0008	2-byte CRC check

The module **returns** the following data:

Module address	Function code	Byte count	data	CRC verification
0x01	0x02	0x01	0x05	2-byte CRC check

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 0000 0101, 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:

Module address	Function code	Register address	Read the number of registers	CRC verification
0x01	0x03	0x00C8	0x0003	2-byte CRC check

The module **returns** the following data:

Module address	Function code	Byte count	data	CRC verification
0x01	0x03	0x06	0x0001 0023 0005	2-byte CRC check

0x0001 represents the data of register 40201, 0x0023 represents the data of register 40202, and 0x0005 represents the data of register 40203 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:

Module address	Function code	Register address	Read the number of registers	CRC verification
0x01	0x04	0x0064	0x0003	2-byte CRC check

The module **returns** the following data:

Module address	Function code	Byte count	data	CRC verification
0x01	0x04	0x06	0x0001 0023 0005	2-byte CRC check

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:

Module address	Function code	Coil address	Coil status	CRC verification
0x01	0x05	0x0000	0xFF00 (set to 1) 0x0000 (set to 0)	2-byte CRC check

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:

Module address	Function code	Register address	data	CRC verification
0x01	0x06	0x00C8	0x001C	2-byte CRC check

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:

Module address	Function code	Coil address	Number of coils	Byte count	data	CRC verification
0x01	0x0F	0x0000	0x0008	0x01	0x05	2-byte CRC check

The state of each coil corresponds to one bit of data, and 8 coils correspond exactly to one byte of data. If 9-16 are written in a single time.The number of bytes for each coil's data is 2, and so on. The binary representation of data 0x05 is 0000 0101, which represents DO0 and DO2 has a state of 1, while the remaining DO states are 0.

The module **returns** the following data:

Module address	Function code	Coil address	Number of coils	CRC verification
0x01	0x0F	0x0000	0x0008	2-byte CRC check

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:

Module address	Function code	Register address	Number of registers	Byte count	data	CRC verification
0x01	0x10	0x00C8	0x0002	0x04	0x0001 0023	2-byte CRC check

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 4101, and 0x0023 is the data of register 4102.

The module **returns** the following data:

Module address	Function code	Register address	Number of registers	CRC verification
0x01	0x10	0x00C8	0x0002	2-byte CRC check

M3000 Series Remote I/O Module Universal Function Modbus Mapping Table

Address 4X	Function	Explain	Attribute	Command
40201	485 Address	1-255	Read/Write	0x03,0x06,0x10
40202	Serial port settings	0-3 bits: Baud rate [1] 4-5 bits: Checksum [2] 6-7 bits: Stop bit [3]	Read/Write	0x03,0x06,0x10
40203	Watchdog	0-255 0: Turn off the Watchdog 1-255: Set Watchdog Time (Units 100ms)	Read/Write	0x03,0x06,0x10
40204	Model		Read	0x03
40205	Version number		Read	0x03
40206	Serial number		Read	0x03

[1]Baud rate comparison table

Set value	Baud rate
0	1200
1	2400
2	4800
3 (Default)	9600
4	19200
5	38400
6	57600
7	115200

[2]Checksum type comparison table

Set value	Parity
0	NONE
1	ODD
2 (Default)	EVEN

[3]Stop bit comparison table

Set value	Stop bit
0 (Default)	1
1	2

Taking a baud rate of 9600, a stop bit of 2, and even parity as an example, the serial port setting value is 0x0063 (01100011).

M300x Series Remote I/O Module Modbus Mapping Table

Analog output registers list

Address 4X	Channel**	Function	Attribute	Command
40001	AO 0	Analog output register *	Write/Read	0x03,0x06,0x10
40002	AO 1	Voltage output	Write/Read	0x03,0x06,0x10
40003	AO 2	Range 0:0-4095 corresponds to 0-5V	Write/Read	0x03,0x06,0x10
40004	AO 3	Range 1:0-4095 corresponds to 0-10V	Write/Read	0x03,0x06,0x10
40005	AO 4	Current output	Write/Read	0x03,0x06,0x10
40006	AO 5	Range 0:0-4095 corresponds to 0-20mA	Write/Read	0x03,0x06,0x10
40007	AO 6	Range 1:0-4095 corresponds to 4-20mA	Write/Read	0x03,0x06,0x10
40008	AO 7		Write/Read	0x03,0x06,0x10
40101	AO 0	Analog output range selection register	Write/Read	0x03,0x06,0x10
40102	AO 1	Voltage output	Write/Read	0x03,0x06,0x10
40103	AO 2	0: 0-5V	Write/Read	0x03,0x06,0x10
40104	AO 3	1: 0-10V	Write/Read	0x03,0x06,0x10
40105	AO 4	Current output	Write/Read	0x03,0x06,0x10
40106	AO 5	0: 0-20mA	Write/Read	0x03,0x06,0x10
40107	AO 6	1: 4-20mA	Write/Read	0x03,0x06,0x10
40108	AO 7		Write/Read	0x03,0x06,0x10

*Taking the 0-10V range as an example, the value that should be set for outputting 2V is (2/10) * 4095=819

**Different models have different numbers of output channels

M30x2: AO 0 and AO 1 are valid, other channels are invalid;

M30x4: AO 0, AO 1, AO 2, AO 3 are valid, other channels are invalid;

M30x8: All channels are valid.

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
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7. Ordering information

Main Equipment

Model	Description
M3002	2-channel analog voltage output, 0-5V and 0-10V range
M3004	4-channel analog voltage output, 0-5V and 0-10V range
M3008	8-channel analog voltage output, 0-5V and 0-10V range
M3012	2-channel analog current output, 0-20mA and 4-20mA range
M3014	4-channel analog current output, 0-20mA and 4-20mA range
M3018	8-channel analog current output, 0-20mA and 4-20mA range

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
2018.08.22	Rev: A	First release.
2024.07.10	Rev: B	Add some models.