MG-CANEX Protocol Converter

User Manual

V1.2

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CANopen to Modbus TCP protocol converter

ODOT Automation System Co., Ltd.

2015-5

Version information

The following changes have been made to the document:

Date	Version number	Revise content	Author
2015-5-26	V1.0	Release version	GJ
2020-03-26	V1.1	Shell upgrading	CCL
2020-07-20	V1.2	Improve hardware and functions	CCL

Ownership rights information

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Software download

Please log on the official website: www.odotautomation.com and click on the corresponding product page to download.

Catalogue

1. Product Overview

1.1 Product Functions

MG-CANEX is a protocol converter from CANopen to Modbus TCP. The device plays as the master in the CANopen network and it could be connected to the standard CANopen slave devices. The data transmission

supports PDO, SDO, and error control supports Heartbeat. It Supports synchronous and asynchronous message sending.

As a TCP server in Modbus TCP network, the device could be accessed by 5 TCP clients at the same time, and it could be connected to PLC controller and various kinds of configuration software. It could also connect optical transceiver and to realize long-distance data transmission.

1.2 Functional characteristics

◆ The gateway comes with its own configuration software, and the parameter configuration information is downloaded to the gateway through the network port. The gateway automatically saves the latest configuration information. There is no need to load configuration after the gateway is powered off and on.

◆ Gateway is the master of CANopen on CANopen network, and can connect to the equipment of CANopen slave .

◆ The gateway is Modbus Server on Modbus TCP network and supports up to 5 TCP clients access. Double Ethernet port, with switch function, support cascade.

◆ 2KV network port isolation protection, 10M/100Mbps rate adaptive, automatic MDI/MDIX reversal.

◆ It supports address mapping mode, and realize the rapid response to TCP client request.

◆ Modbus TCP supports function code: 0 x01, 0 x02, 0 x03, 0 x04, 0

x05, 0 x06, 0 x0F, 0 x10.

- 6KB large data buffer, more data transfer volume.
- CAN interface supports CANopen working mode.
- CAN interface Baud rate: 10K~1Mbps.
- CANopen protocol conforms to DS301 V4.02 and supports NMT master, PDO, SDO and Heartbeat.
- It supports one-key reset function to restore factory Settings.
- 35mm DIN-rail installation.
- EMC meets EN 55022:2010 & EN55024:2010 international standards.

1.3 Technical parameters

The technical parameters of this product are shown in Table 1. Please use this product within the parameters of this product to obtain better performance.

Table1. Technical parameters

Environmental parameters	
Working temperature	-40~85℃/-20~70℃ optional
Storage temperature	-45~125℃
Working humidity	5%~95% （ No condensation ）
The power supply parameters	
Number of power ports	1way
Input voltage range	9~36VDC，3KV isolation voltage
Power consumption	Max.110mA@24V
Ethernet parameters	
Modbus TCP Function code	0x01，0x02，0x03，0x04，0x05，0x06，0x0F，0x10
Number of Ethernet ports	2 PCs of RJ45，10M，100M adaptive rate with switch function
Network protocol	ETHERNET，ARP，IP，TCP，ICMP
Number of TCP connections	The five largest
Modbus data store	0xxxx area（ coil ）：8192 Bit 1xxxx area（ Discrete input ）：8192 Bit 3xxxx area（ Input register ）：2048 Word 4xxxx area（ Hold register ）：2048 Word
CANopen parameters	
CAN baud rate	10K~1Mbps
CAN protocol	CANopen
Number of slave supported	16 stations
PDO functions	Support TPDO, RPDO data transmission
SDO functions	Fast SDO transfers of up to 4 bytes are supported
Error control	Support the Heartbeat

2. Hardware description

2.1 Product appearance

2.2 Indicator light description

The equipment has 6 LED status indicator lights, whose symbol definition and status description are shown in "Table 2".

Table 2. Indicator light instructions

Symbol	Definition	State	Instructions
PWR	Power Light on/off	Normally on	Power on
		Put out	The power is not switched on.
STA	System fault	Normally	TCP gateway

	indication	on	communication error
		Put out	TCP gateway communication is normal
RUN	Ethernet operating status	Flashing	Modbus-TCP data transceiver
	CAN operation status indication	Flashing (2Hz)	Pre-operating state
		A single flash	Stop state
		Normally on	Operating state
ERR	Ethernet error status	Flashing (2Hz)	The network port connection is abnormal.
	CAN error status indication	A single flash	CAN error frame reached alert value
		Double flash	Error control event
		Normally on	Bus-off
		Put out	The bus is normal.
CTX	CAN send instructions	Flashing	CAN is sending data.
		Put out	CAN did not send data.
CRX	CAN receive instructions	Flashing	CAN is receiving data.
		Put out	CAN did not receive data.

2.3 Terminal definition

The gateway wiring adopts 10Pin 3.81mm distance unplug wiring terminals. The definitions of CAN interface and power terminals are shown in Table 3.

Number	Terminal	Definition
1	NC	Empty
2	NC	Empty
3	NC	Empty
4	NC	Empty
5	NC	Empty
6	NC	Empty

7	NC	Empty
8	NC	Empty
9	CAN_L	CAN_L Signal lines
10	CAN_H	CAN_H Signal lines
11	SGND	CAN signal ground
12	PE	Ground terminal
13	NC	Empty
14	NC	Empty
15	NC	Empty
16	NC	Empty

Table 3. terminal definition

2.4 System reset

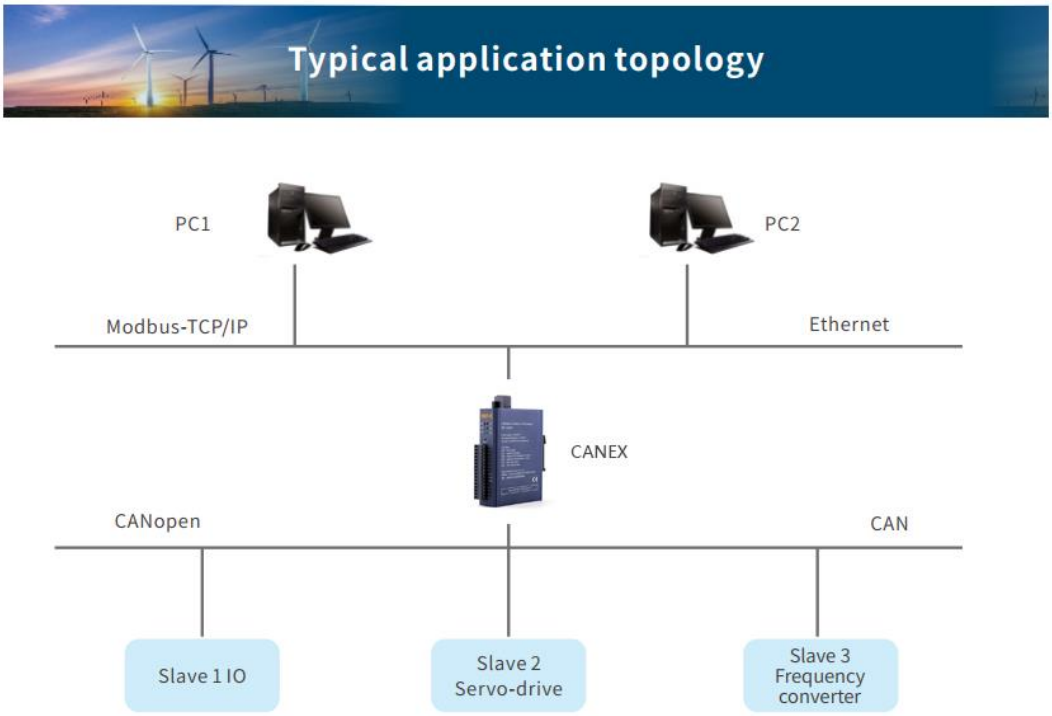
The device has a system RESET button, which can be triggered when the user forgets the IP address and configured port No. of the device and could not connect to the gateway. System parameters will be restored to factory Settings, and configuration parameters can be downloaded again after reset. When the reset button is triggered, all LED lights will be on, and after the device reset is completed, the lights will be off (except PWR).

2.5 Installation dimension

3. Product application topology

A typical network topology of the product is shown in Figure 1.

Figure 1. A typical network topology



4. Product usage

4.1 Operating principle of gateway

Gateway protocol transformation belongs to address mapping mode, and the data of all devices in CANopen network are mapped to Modbus TCP data store.

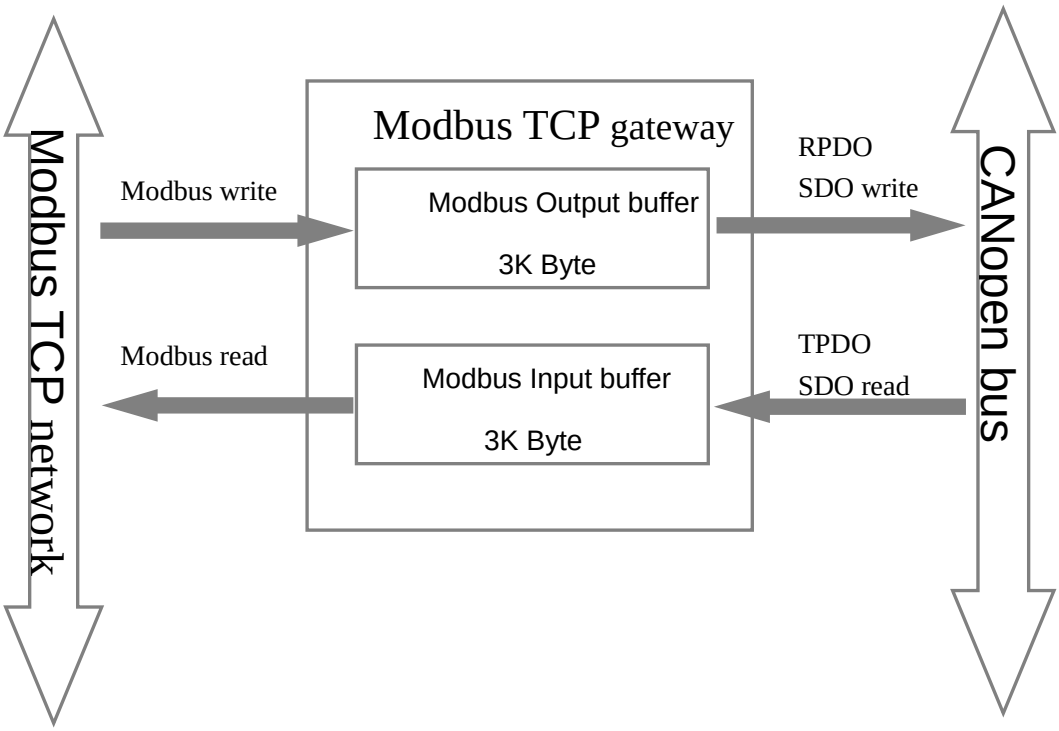
The TPDO of the CANopen slave equipment is mapped to the Modbus discrete quantity input and input register areas, and the RPDO is mapped to the Modbus coil and hold register areas.

The SDO read command of the CANopen station device is mapped to the Modbus input register area (3XXXX), and the SDO write command is

mapped to the Modbus hold register area (4XXXX).

When the gateway receives the data from the slave, the data is stored in the Modbus buffer. When the data in the Modbus buffer changes, the gateway will send the data from the slave RPDO/SDO write commands to the CANopen network.

The gateway data exchange principle is shown in the following figure.



PDO adopts the producer/consumer mode to transmit data, with no response except request, and fast response, which is suitable for situations with high requirements on response speed. SDO adopts the client/server mode for data transmission, with both requests and replies. The response speed is slow, but the reliability is high. So data with high reliability requirements can be configured with SDO commands to transfer data, or

PDO can be configured to transfer data.

4.2 Data objects are mapped in the Modbus cache

Data objects	Map to the Modbus register area	Modbus TCP Function code
TPDO（bit）	1xxxx	02
TPDO（word）	3xxxx	04
RPDO（bit）	0xxxx	5/15
RPDO（word）	4xxxx	6/16
SDO Write cycle	4xxxx	6/16
SDO Read cycle	3xxxx	04

4.3 Network function

4.3.1 Network scanning

The largest number of 127 nodes on the CANopen network, the gateway itself occupies one node address. The basic condition of the slave equipment on the CANopen network can be preliminarily scanned through the network scanning function.

Network scan function is realized by adding network scan module. The corresponding relation of the data address of the network scanning module is as follows:

数据方向	字偏移	描述	高字节								低字节								
		位	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0	数据说明
输入	0	扫描状态字	扫描到的网络节点数量								/						扫描中	0->1触发位	蓝色数据位为输出反馈值。
	1	模块信息	节点ID								节点状态机								
	2	模块信息	节点ID								节点状态机								
	.	.	.								.								
	.	.	.								.								
	126	模块信息	节点ID								节点状态机								
输出	0	扫描控制字	/								/							0->1触发位	扫描启动触发位。

Note: Green: read only;

Blue: Feedback

Control process:

1. Output trigger bit 0->1 rising edge, start the scan.

2. The scanning state is set to 1, and the number of nodes and module information are all reset.

3. Wait for the scan to complete, and the status bit in the scan is cleared to zero.

4. The number of nodes stores all nodes scanned by the current network, and the node ID and node state machine information are stored in the module information.

4.3.2 Emergency object

An emergency message is triggered by a fatal error that occurs within

the device and is sent to other devices with the highest priority by the relevant application device. Suitable for interrupt type error warning signals.

An emergency message consists of 8 bytes in the following format:

sender →receiver(s)

COB-ID	Byte0-1	Byte2	Byte3-7
0x080+Node_ID	error code	Error register (object 0x1001)	Manufacturer specific error area

The hexadecimal emergency error code is shown in Table 3-5 below. The 'XX' section of the emergency error code is defined by the corresponding device subprotocol.

Table 3-5 Emergency error codes (hexadecimal)

Emergency error code	Code function description
00xx	Error Reset or No Error
10xx	Generic Error
20xx	Current
21xx	Current，device input side
22xx	Current，inside the device
23xx	Current，device output side
30xx	Voltage
31xx	Mains voltage
32xx	Voltage inside the device

33xx	Output voltage
40xx	Temperature
41xx	Ambient temperature
42xx	Device temperature
50xx	Device hardware
60xx	Device software
61xx	Internal software
62xx	User software
63xx	Data set
70xx	Additional modules
80xx	Monitoring
81xx	communication
8110	CAN overrun
8120	Error Passive
8130	Life Guard Error or Heartbeat Error Or Heartbeat Error
8140	Recovered from Bus-Off
82xx	Protocol Error
8210	PDO no processed, Due to length error Due to length error
8220	Length exceed
90xx	External error

F0xx	Additional functions
FFxx	Device specific

In the device's object dictionary (index 0x1001), Table 3-6 describes the bit definition of the Error Register. The device could map internal errors to this status byte and could quickly view the current error.

Table 3-6:8-bit error register bit definition

Bit	Error type
0	Generic
1	Current
2	Voltage
3	Temperature
4	Communication
5	Device profile specific
6	Reserved (=0)
7	Manufacturer specific

Manufacturer specific error areas may contain additional error information related to the device. An emergency message is triggered by a fatal error that occurs within the device and is sent to other devices with the highest priority by the relevant application device. Suitable for interrupt type error warning signals.

The EMCY control module is added to realize the emergency alarm function. The corresponding relation of EMCY control module's data address is as follows:

字偏移	描述	高字节								低字节								
	位	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0	数据说明
0	状态字	EMCYDATA_Reset	Counter_Reset	Overflow_Reset	NonEmpty_Reset	/		Overflow	NonEmpty	/	NodeID							
1	溢出计数	Overflow_Couter																
2	EMCY数据1	Error_Code																
3	EMCY数据2	Manufacture_Data_0								Error_Register								
4	EMCY数据3	Manufacture_Data_2								Manufacture_Data_1								
5	EMCY数据4	Manufacture_Data_4								Manufacture_Data_3								
0	扫描控制字	EMCYDATA_Reset	Counter_Reset	Overflow_Reset	NonEmpty_Reset	/				/ NodeID								

Note: Blue: feedback; Green: Clearable

Control process:

1. Wait for input bit NonEmpty to set 1, indicating that an emergency message has been received.

2. Read emergency message NodeID, Error_Code, Error_Register, Manufacture_Data, and process alarm information.

3. Control the output bit NonEmpty_Reset rising edge to clear the input NonEmpty flag.

4. If the input bit Overflow is set to 1, it indicates that an emergency message is being discarded. Overflow_Couter indicates the number of emergency messages being discarded.

5. Control the output bit Overflow_Reset, Counter_Reset rising edge to clear the input Overflow, Overflow_Couter.

6. The rise edge of output bit EMCYDATA_Reset can be controlled to clear emergency message NodeID, Error_Code, Error_Register, Manufacture_Data.

4.3.3 NMT network management

The network management function of CANopen NMT can be

realized by reading and writing to the NMT control domain in the "System Control area". The NMT control register address range is 0x8000~0x8040.The Modbus TCP client can access this register group through 0x03, 0x06, and 0x0F function codes,

NMT command word is the network management control command, and the value of effective command word is as follows:

0x01: Start the remote node.

0x02: Stop the remote node.

0x80: Enter the pre-operation state.

0x81: Reset the node.

0x82: Reset communication.

Writing other NMT command values will be ignored. When the trigger bit changes from 0 to 1, the sending of an NMT command will be started. The NMT slave address is the remote node address, with the value of 1-127, 0 represents the broadcast address.

NMT state contains the current state of all satellite stations in the network (to acquire effective satellite state, it is necessary to start up the satellite's error control functions for Node or Heartbeat), and with read-only status contents, any values to be written to will be ignored, as shown in Table 7.Initialization state means that the master station receives the boot-up Boot message of the slave station; when the master station queries the slave state timeout or receives the slave heartbeat packet

timeout, it means that the slave is offline; when the slave state information is received, it is in three states: stop, operation and pre-operation; when no slave state information is received, it is unknown state.

Table 7. Slave status list

The status value	Node status
0x00	Initialization state
0x01	Offline
0x04	Stop state
0x05	Operating state
0x7F	Pre-operating state
0x0F	An unknown state

By adding NMT network management module submodule to control the slave state function. The corresponding relation of data address of NMT network management module is as follows:

数据方向	字偏移	描述	高字节								低字节							
		位	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
输入	0	NMT控制字	NMT命令字								0->1触发位	NodeID，0代表广播地址							输出的NMT控制字反馈
输出	0	NMT控制字	NMT命令字								0->1触发位	NodeID，0代表广播地址							NMT控制字

Note: Blue: data feedback

Control process:

1.NodeID node address assignment, which represents the NodeID to be operated, 0 represents the broadcast address.

2.NMT command word assignment.

3. Trigger bit 0-& GT;1 The rising edge triggers the NMT command send.

4.3.4 SDO Service Data Objects

The online read and write function of SDO can be realized through the read and write operation of SDO control field in "System control area", the SDO control register address range is 0x8046~0x806B.The Modbus TCP client can access the register group through the functional codes 0x03, 0x06, and 0x0F, and the specific encoding format of the data is shown in "Table 9".

Table 9.SDO control register encoding format

描述	高字节								低字节							
位	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0	数据说明
索引	Index																
节点ID/子索引	/	NodeID							SubIndex								
控制字	Abort_Code_Reset	Done_Reset	Error_Reset	/		SDO_Done	SDO_Error	SDO_Busy	/	Trigger	RW_Type	Byte_Len					
中止代码	Abort_Code_3								Abort_Code_2								
	Abort_Code_1								Abort_Code_0								
SDO数据1	SDO_Data_1																
.	.																
.	.																
SDO数据16	SDO_Data_16																
索引	Index																
节点ID/子索引	/	NodeID							SubIndex								
控制字	Abort_Code_Reset	Done_Reset	Error_Reset	/					/	Trigger	RW_Type	Byte_Len					
SDO数据1	SDO_Data_1																
.	.																
.	.																
SDO数据16	SDO_Data_16																

Note: Red: read only;

Blue: Feedback;

Orange: Conditional feedback;

Green: Reset.

Object Index, Sub-Index is the object parameter to be accessed. The SDO server has a valid address range of 1-127 from the slave number.

The Data Type definition for the object dictionary is shown in Table 10.

Table 10. Object dictionary data types

Number	Data type
0x01	BOOLEAN
0x02	INTEGER8
0x03	INTEGER16
0x04	INTEGER32
0x05	UNSIGNED8
0x06	UNSIGNED16
0x07	UNSIGNED32
0x08	REAL32
0x09	VISIBLE_STRING
0x0A	OCTET_STRING
0x0B	UNICODE_STRING
0x0C	TIME_OF_DAY
0x0D	TIM_DIFFERENCE

Control process:

A: reading process

1. Set the object Index/ sub-index/node address information Index/SubIndex/NodeID.

2. Set RW_Type to 0 to indicate SDO upload.

3. Set the bit Trigger rising edge, SDO transmission begins, and SDO_Busy bit is set to 1.

4. The user waits for SDO_Done to complete location 1.

5. If SDO_Error and Abort_Code are 0 in normal SDO transmission, the byte length of the object data read is stored in Byte_Len, and the value of the object is stored in SDO_Data, and the effective byte length is Byte_Len.

6. Abort code is stored in Abort_Code if SDO_Error bit is set to 1 for SDO transmission failure, indicating the cause of failure. Byte_Len and SDO_Data are emptied.

7. Control the rising edge of the Done_Reset/Error_Reset bit to clear the SDO_Done/SDO_Error flag bit, so as to start the next transmission.

8. Abort_Code_Reset bit can be controlled to remove error code Abort_Code.

B: the writing process

1. Set the object Index/ sub-index/node address information Index/SubIndex/NodeID.

2. Set RW_Type as 1 to represent SDO download, set the length of output data and output data value Byte_Len/SDO_Data, and the output value will be fed back to the corresponding input value.

3. Set the bit Trigger rising edge, SDO transmission begins, and SDO_Busy bit is set to 1.

4. The user waits for SDO_Done to complete location 1.

5. SDO_Error and Abort_Code are 0 if SDO transmission is normal.

6. Abort code is stored in Abort_Code if SDO_Error bit is set to 1 for SDO transmission failure, indicating the cause of failure.

7. Control the rising edge of the Done_Reset/Error_Reset bit to clear the SDO_Done/SDO_Error flag bit, so as to start the next transmission.

8. Abort_Code_Reset bit can be controlled to remove error code

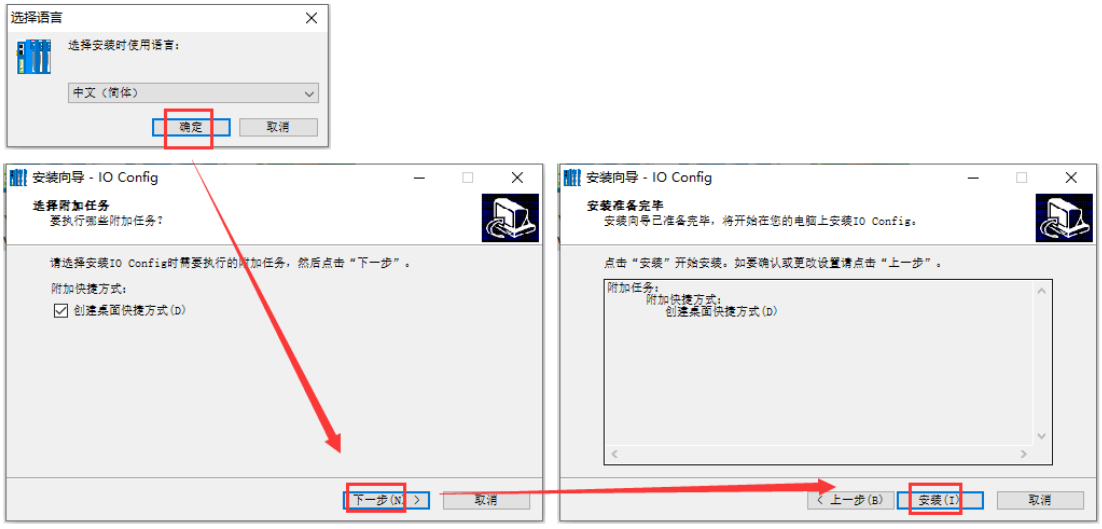
Abort_Code.

5. IOConfig configuration software

5.1 Software installation

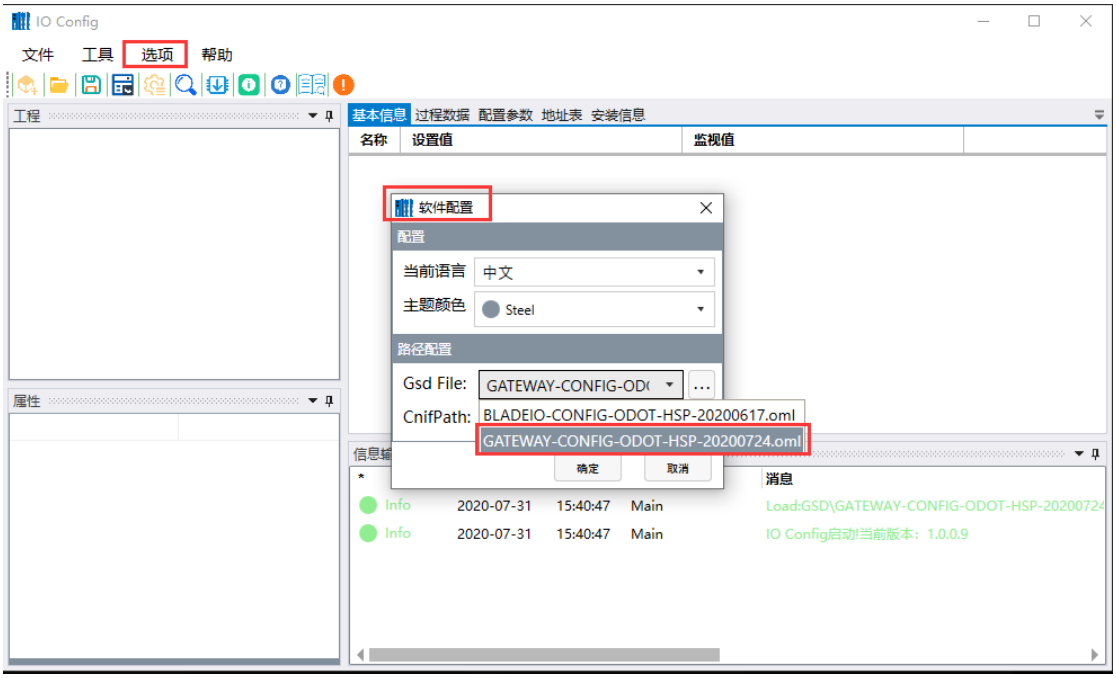
The company provides customers with IO Config V X.X.X.X (Fully with. Net 4.0) (the full version of the installation file with. Net 4.0 environment) and IO Config V X.X.X (Simplify) (the simplified version does not include. Net 4.0 environment) configuration software.

After the client receives the configuration software, double-click the icon and click install. Then click "OK" - "Next" - "Install" in the popup window. Check to create desktop Shortcut. After installation, an IOConfig shortcut icon will be generated on the desktop.

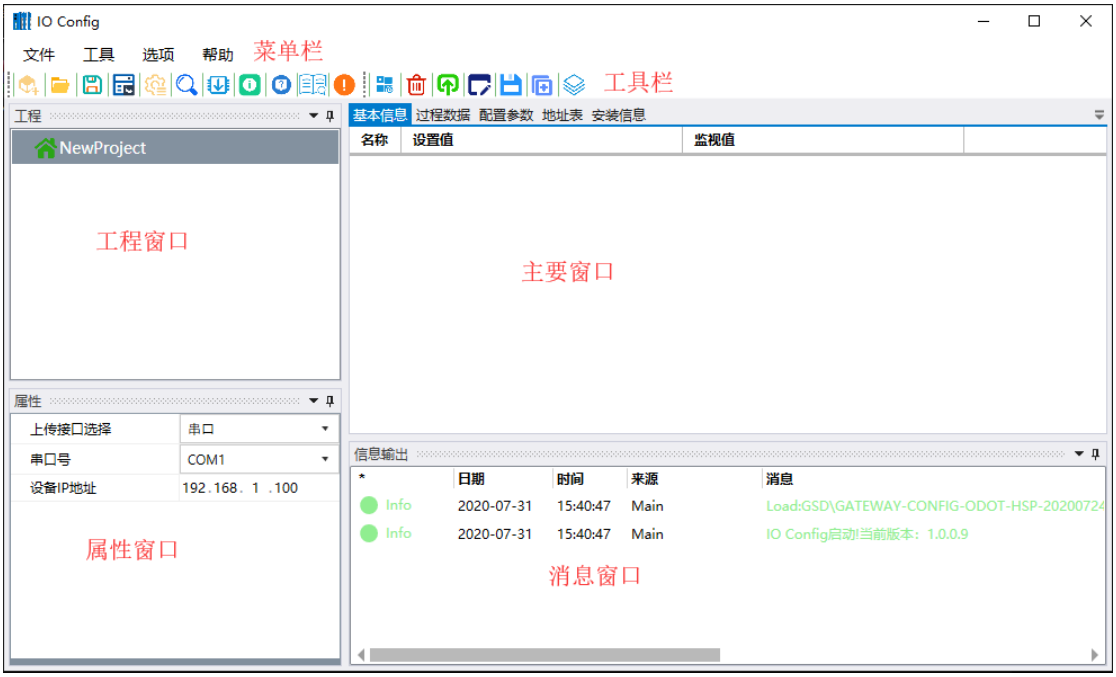


5.2 Load the hardware support package

After the installation is complete, you need to load the hardware support package for the gateway MG-CANEX. Open the software, click "Options" - "Configure", Gsd File path configuration File. Oml select "GATEWAY-CONFIG- odot-hSP-20200724.omL". Click OK.



5.3 Software interface



Menu bar: Menu of IOConfig software

Toolbar: A commonly user menu.

Project window: Tree displays currently active projects.

Properties window: Displays the specific parameters of the current item. Gateway (module name, module number, module description, device version, number of modules, interface selection, device IP address, serial port number, online refresh cycle), slave device (module name, module number, module description, number of submodules).

The main window

Basic information: you can view the gateway module name, module number, hardware version, software version, module description, current consumption.

Process data: Can be used to monitor channel data online.

Configuration parameters: Module parameters that can be modified by the module.

Address table: Modbus mapped address table.

Installation information: module description, current consumption, module size, residual current, and product picture can be viewed.

Message window: output the real-time information of the current operation, display the operation log of new project, upload, download, configuration parameter modification and so on

5.3.1 Main menu

◇File

Menu	Sub menu	Description
Engineer	New construction	Create new projects
	Open the project	Open the saved project
	Save	Save current project
	Save as	Save the current project as a new project
Exit		Close the project

Tool

Menu	Description
Search equipment	A new window pops up for MODBUS communication search device
Online upgrade	A new window pops up for the gateway firmware update

Options

Menu	Description
Configuration	Modify the software display language, software interface display color, hardware support package file path

Help

Menu	Description
About	View the configuration software version number
Abnormal help	New window pops up, abnormal exit reminder, Windows 7 SP1 /XP system the following version please install Microsoft patch.

5.3.2 Toolbar

Menu general shortcut icon

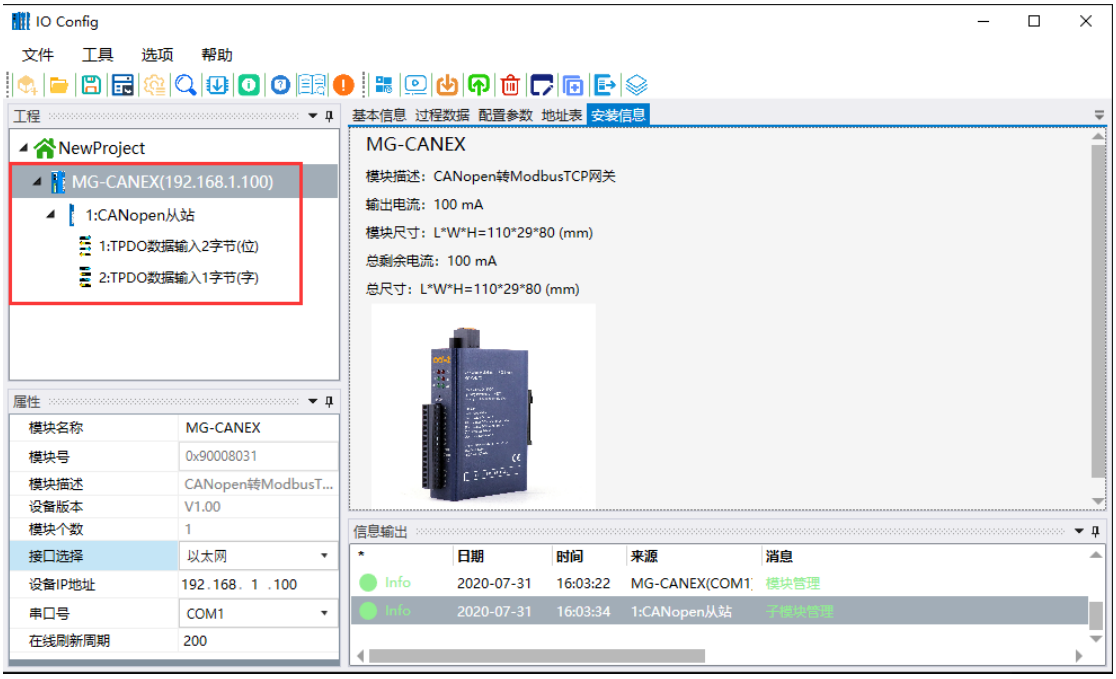
Icon	Name	Menu	Description
	New construction	Document - Project - New project	Create new projects
	Open the project	File - Project - Open project	Open the saved project
	All save	File - Project - Save all	Save current project
	Save as	File - Project - save as	Save the current project as a new project
	configuration	Options-Configuration	Software display language can be modified, software interface display color, device library description file path
	Search equipment	Tools - Search for devices	A new window pops up for MODBUS communication search device
	Online upgrade	Tools - Online upgrade	A new window pops up for the gateway firmware update
	About	Help - About	View the configuration software version number
	Help document	Help - Help documentation	Popup a new window, the IOConfig software manual
	Hardware manual	Help - Hardware manual	A new window pops up for all IO modules in the hardware manual
	Abnormal help	Help - Abnormal help	New window pops up, abnormal exit reminder, Windows 7 SP1 /XP system the following version please install Microsoft patch.

Adapter general shortcut icon

Icon	Name	Menu	Description
	Module management	Gateway - Module management	Add CANopen slave station
	Online	Gateway - Online	Gateway online monitoring.
	Download IO parameters	Gateway - Download the IO parameters	Download all gateway parameters
	Upload IO parameters	Gateway - Upload IO parameters	Upload all parameters of the gateway
	Delete	Gateway - Delete	Delete current gateway
	Rename	Gateway - Rename	Gateway renaming
	Copy	Gateway - Replication	Copy the gateway
	Export address list	Gateway - Export address table	Export gateway address correspondence
	Export document	Gateway - Export documents	Export all gateway and slave configuration information, including address table, slave configuration parameters, size diagram.

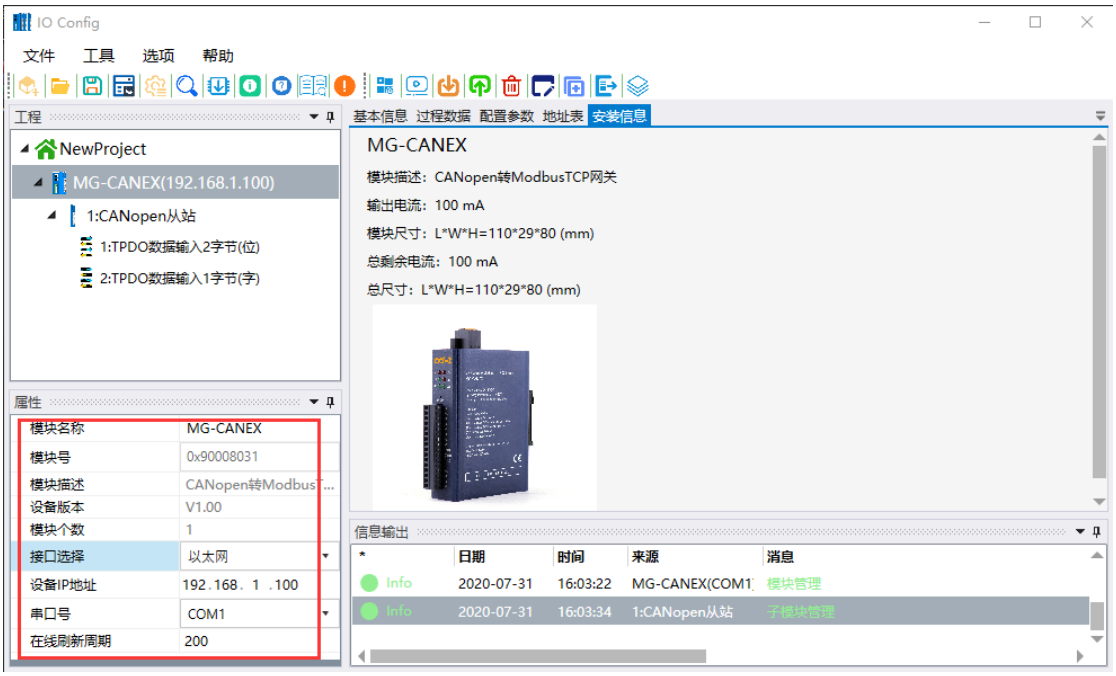
5.3.3 Project window

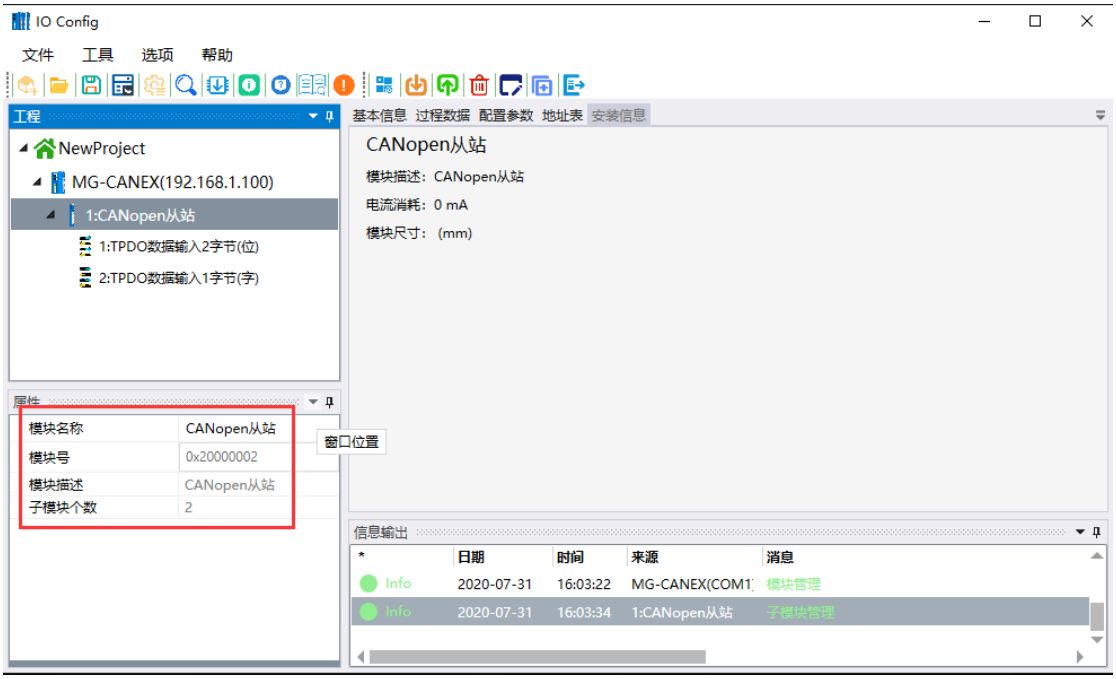
Displays the currently active project in a tree form



5.3.4 Properties window

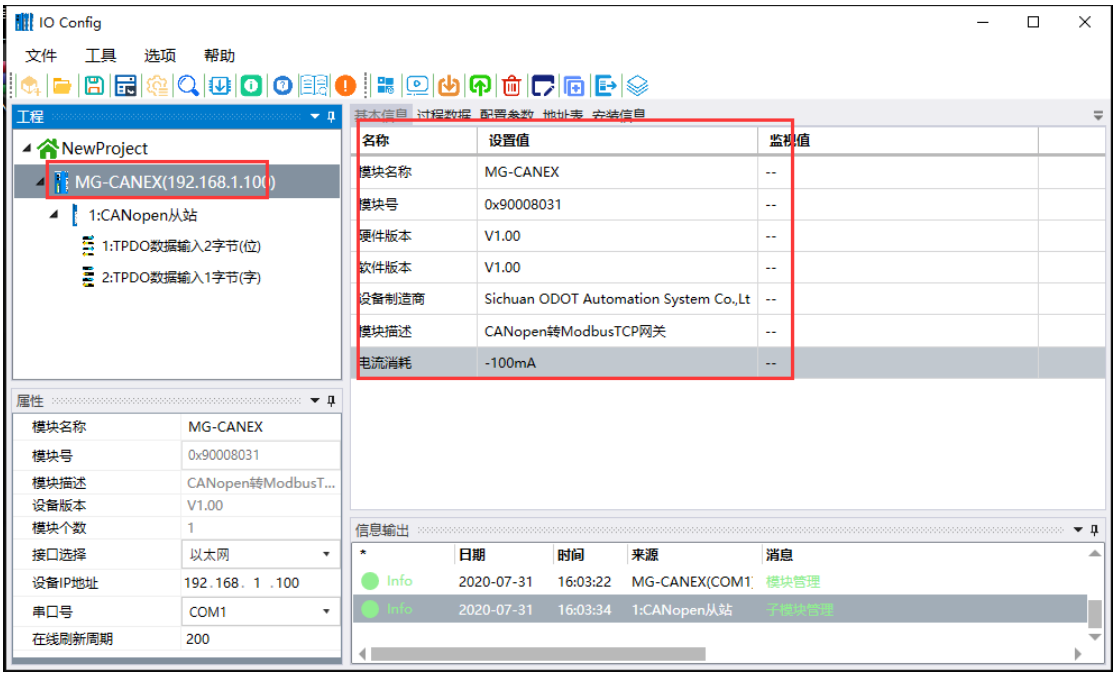
The properties window displays the specific parameters of the current item. Adapter module (module name, module number, module description, device version, number of modules, interface selection, device IP address, serial number, online refresh cycle), IO module (module name, module number, module description, number of sub-modules)


IO Config
文件 工具 选项 帮助
工程
NewProject
MG-CANEX(192.168.1.100)
1:CANopen从站
1:TPDO数据输入2字节(位)
2:TPDO数据输入1字节(字)
基本信息 过程数据 配置参数 地址表 安装信息
MG-CANEX
模块描述：CANopen转ModbusTCP网关
输出电流：100 mA
模块尺寸：L*W*H=110*29*80 (mm)
总剩余电流：100 mA
总尺寸：L*W*H=110*29*80 (mm)
属性
模块名称 MG-CANEX
模块号 0x90008031
模块描述 CANopen转Modbus...
设备版本 V1.00
模块个数 1
接口选择 以太网
设备IP地址 192.168.1.100
串口号 COM1
在线刷新周期 200
信息输出
* 日期 时间 来源 消息
Info 2020-07-31 16:03:22 MG-CANEX(COM1 模块管理
Info 2020-07-31 16:03:34 1:CANopen从站 子模块管理

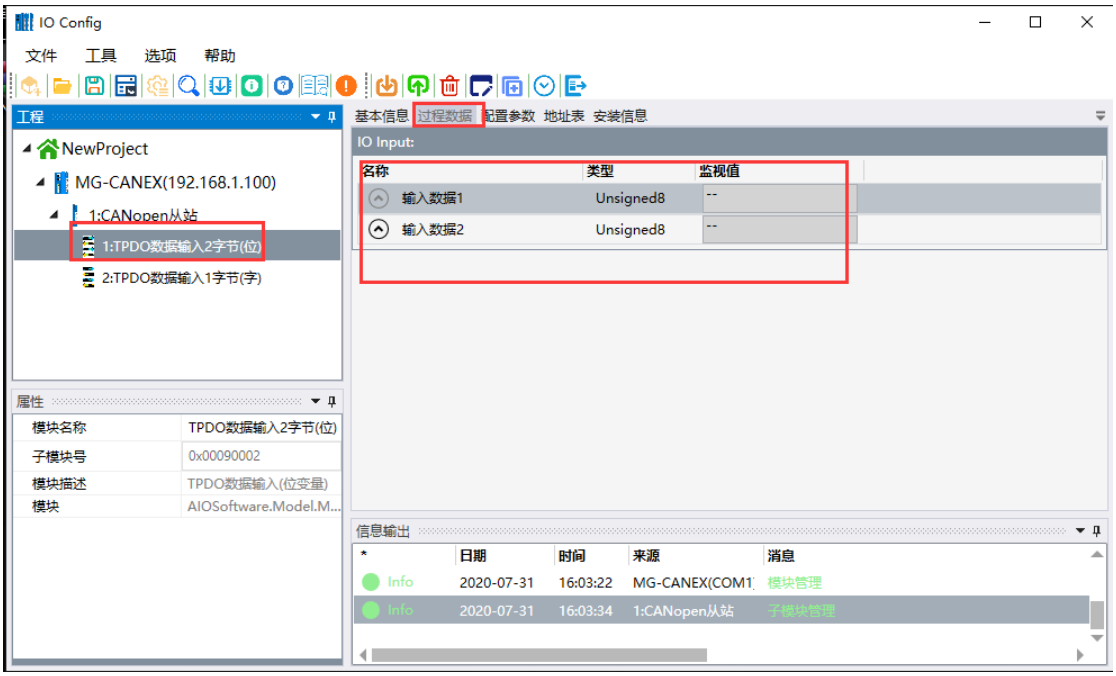

IO Config
文件 工具 选项 帮助
工程
NewProject
MG-CANEX(192.168.1.100)
1:CANopen从站
1:TPDO数据输入2字节(位)
2:TPDO数据输入1字节(字)
基本信息 过程数据 配置参数 地址表 安装信息
CANopen从站
模块描述：CANopen从站
电流消耗：0 mA
模块尺寸：(mm)
属性
模块名称 CANopen从站
模块号 0x20000002
模块描述 CANopen从站
子模块个数 2
窗口位置
信息输出
* 日期 时间 来源 消息
Info 2020-07-31 16:03:22 MG-CANEX(COM1 模块管理
Info 2020-07-31 16:03:34 1:CANopen从站 子模块管理

5.3.5 Main window

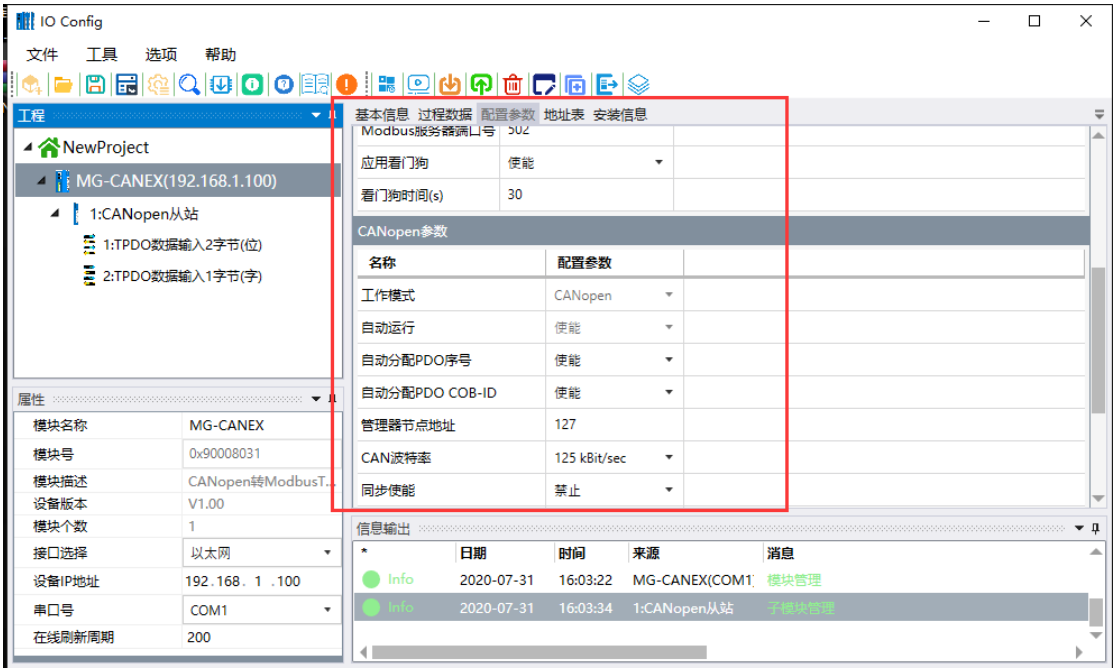
Basic information: Gateway and CANopen slave station device name, module number, hardware version, software version, module description, current consumption, device manufacturer can be displayed.



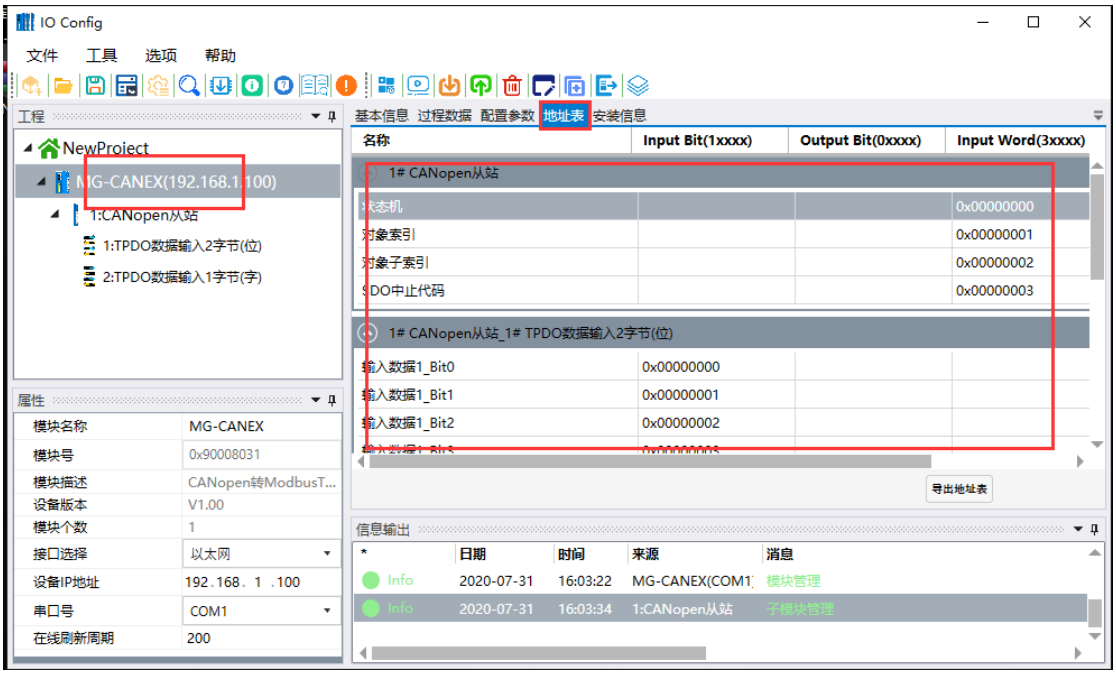
Process data: Displays read and write data from the CANopen slave station for online monitoring of channel data



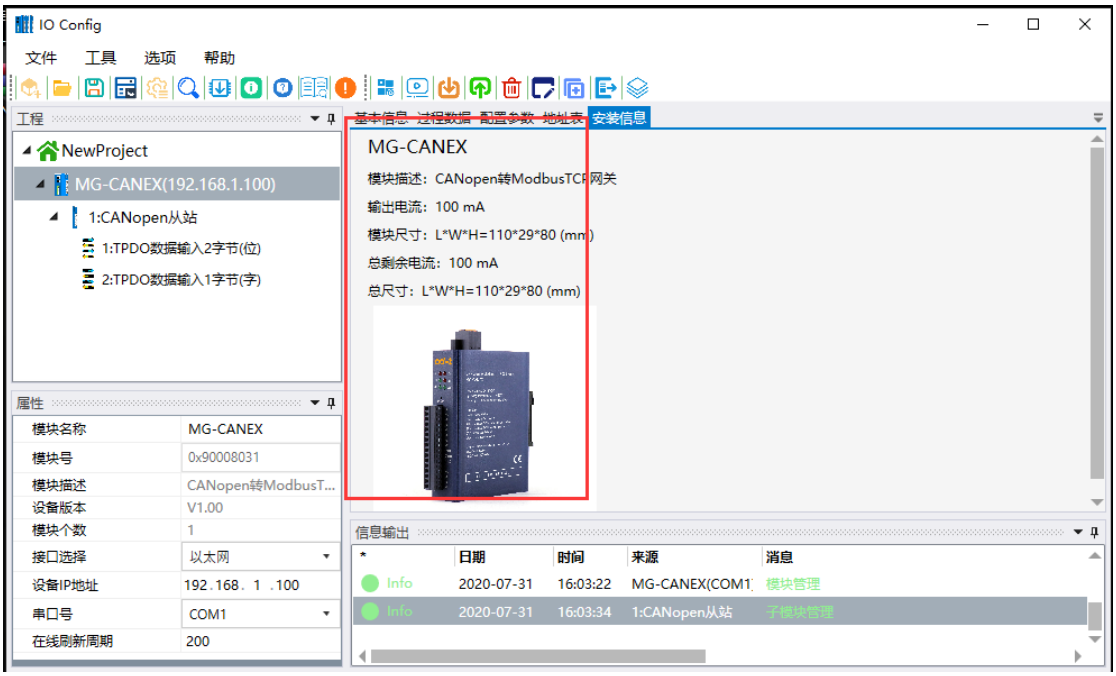
Configuration parameters: Display the gateway and CANopen setup parameters, which can be modified.



Address table: Displays the address map table for the gateway.

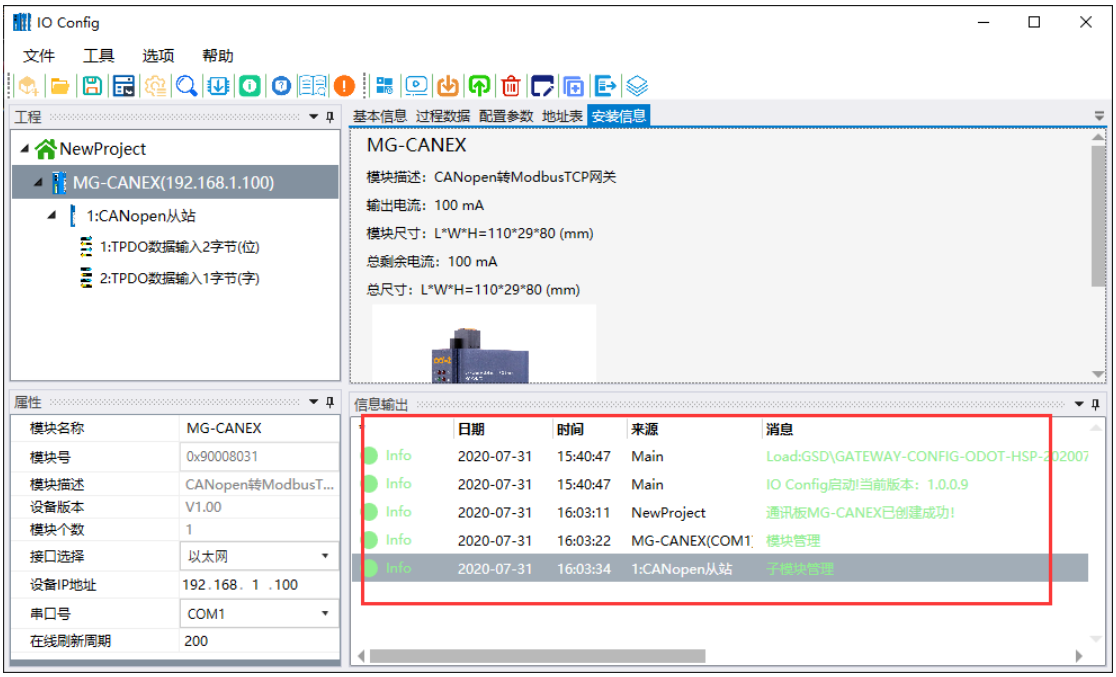


Installation information: gateway module description, current consumption, module size, residual current, and product picture can be displayed.



5.3.6 Message window

Displays real-time information about the current operation and all operation log records such as new project, upload, download, configuration parameter modification, copy and paste output.



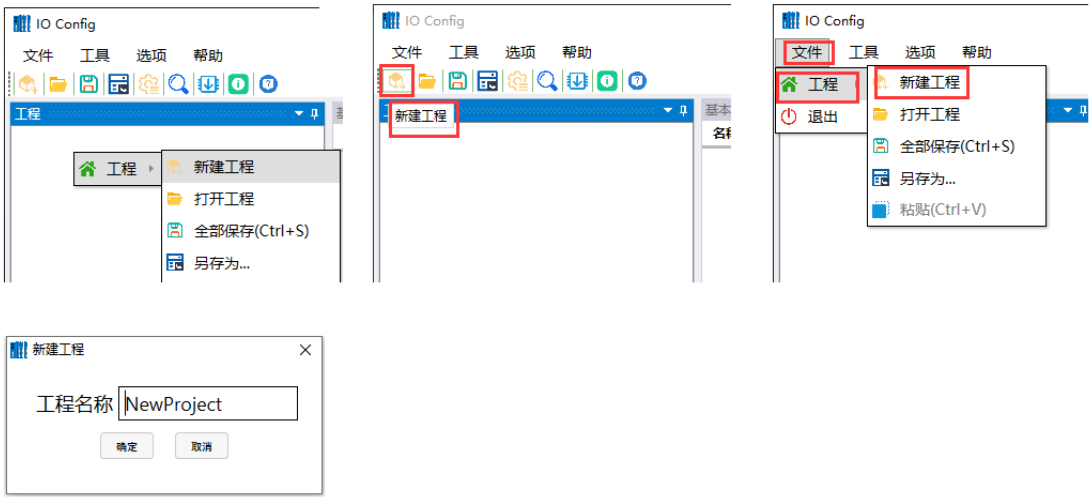
5.3.7 Shortcuts

Shortcuts	Menu	Description
F1		Go to the help documentation to see the remote IO hardware manual
Ctrl+C	Project/adapter - copy	Copy engineering, CN&CT module
Ctrl+V	Project/adapter - Paste	Paste engineering, CN&CT module
Delete	Project/adapter - Remove	Delete engineering, CN&CT modules
Ctrl+S	File - Project – Save all	Save configuration project
Ctrl+M	Adapter - Export address table	Export CN&CT address table

5.4 Gateway parameter configuration

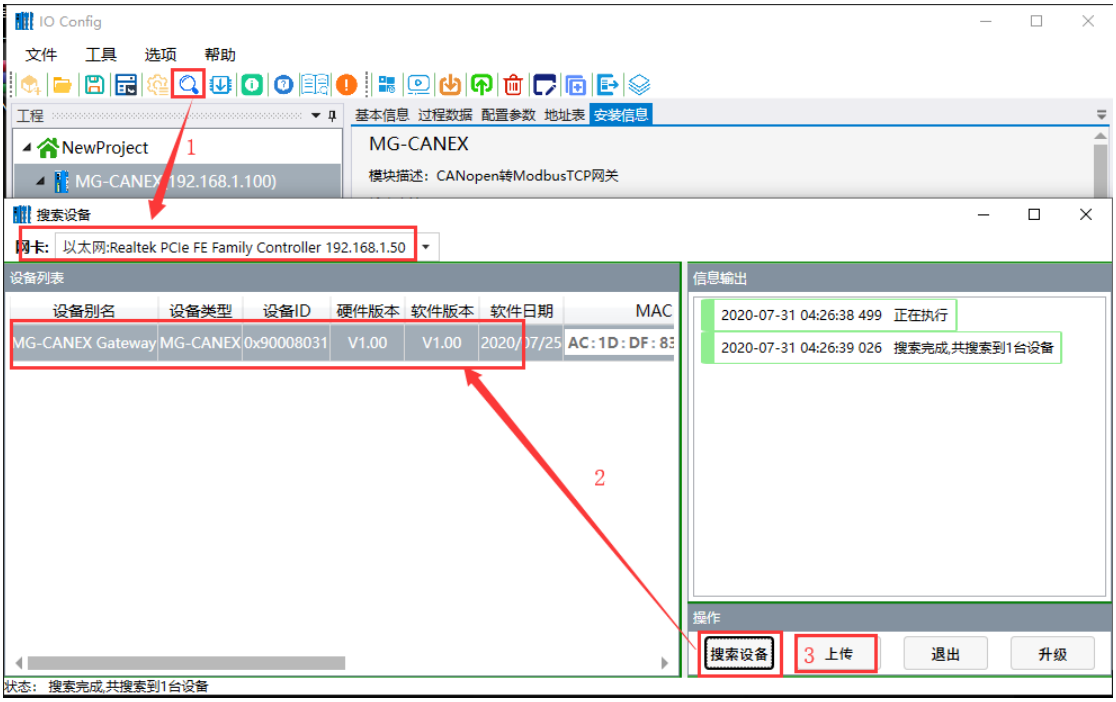
5.4.1. New project

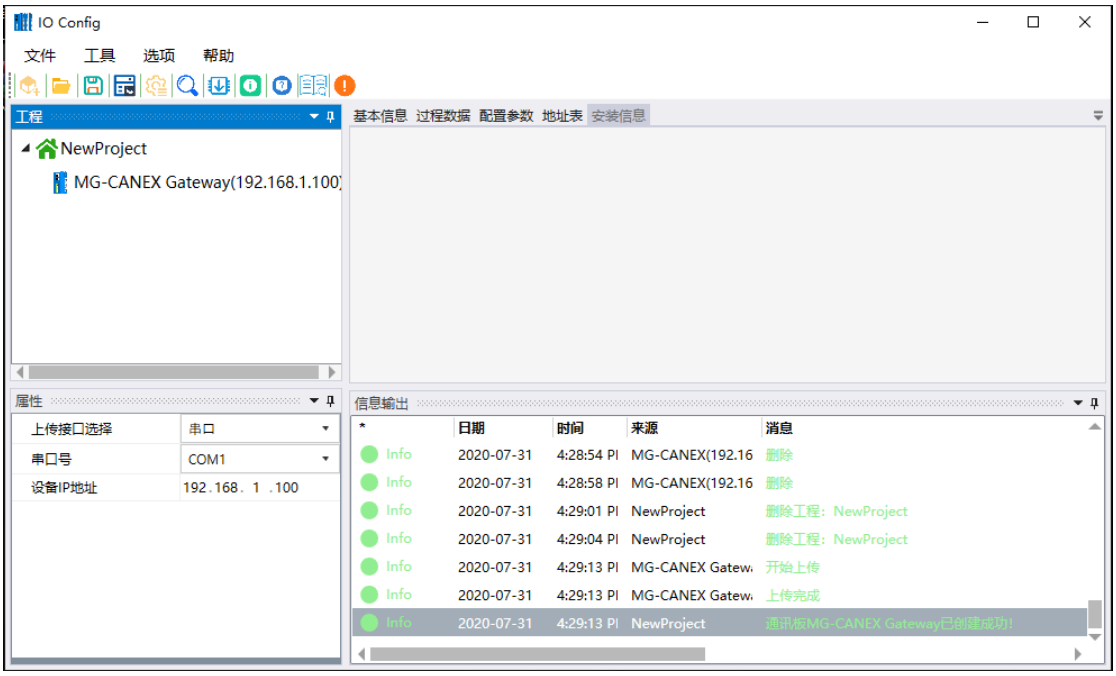
Double-click the IOConfig shortcut icon to create a new project. Right-click project - New Project in the project directory bar, or click shortcut key or menu bar file - Project - New Project to enter the project name manually.



5.4.2. Search the gateway

Set the local network card to 192.168.1. Click the shortcut key and select the local network card in the popup interface. Click "Search for Devices" in the lower right corner, and the gateway on the network will be scanned in the device list. Click Upload to create a gateway project.





5.4.3. Gateway parameter

Select the gateway and click to view the basic information, process data, configuration parameters and address table parameters of the gateway.

[Basic information]: Select the gateway or slave to view the module name, hardware version, software version and other relevant information.

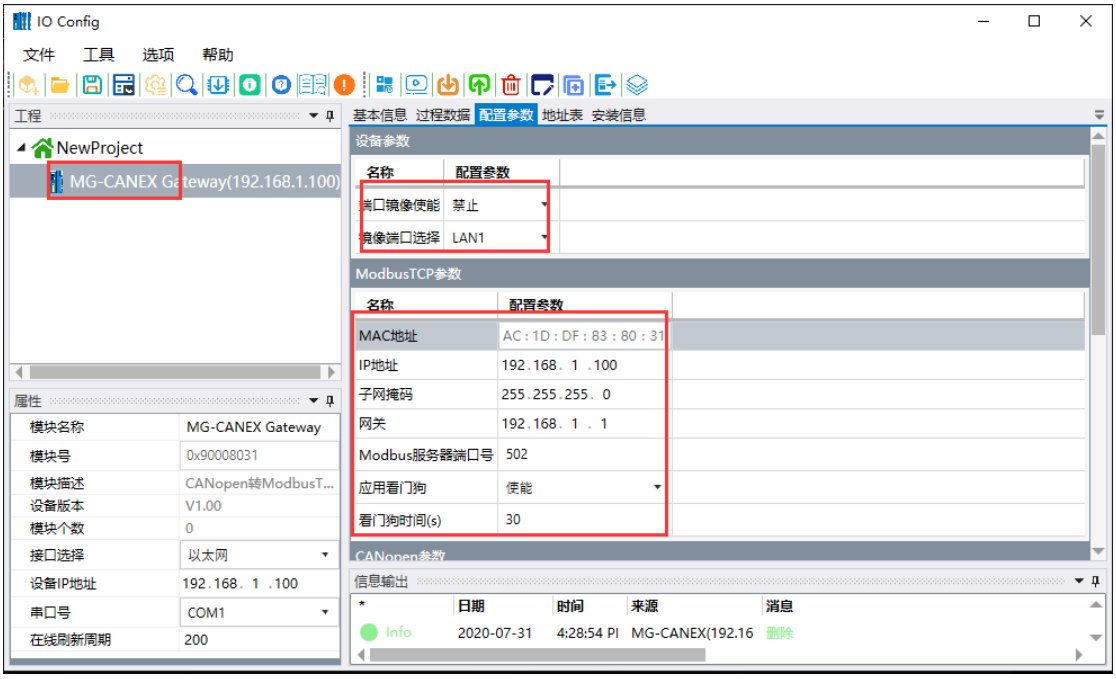
[Process Data]: Right click on the selected gateway and select "Online" to monitor the slave module online and check the online monitoring value.

[Configuration Parameters]: Select the corresponding module and the communication parameters of the module can be set.

[Address table]: You can view the sub-module of slave configuration and the corresponding address in Modbus TCP network.

Click configuration Parameters to view the device parameters,

MODBUS TCP parameters and CANopen parameters of the gateway.



Equipment parameters:

Port mirroring enabled: disabled, enabled optional, disabled by default.

Mirror port selection: LAN1, LAN2 optional, default LAN1. When port mirroring is enabled, this port is used to monitor adapter network packet data by default

Modbus TCP parameters:

MAC address: Read-only property.

IP address: The IP address of the gateway.

Subnet mask:

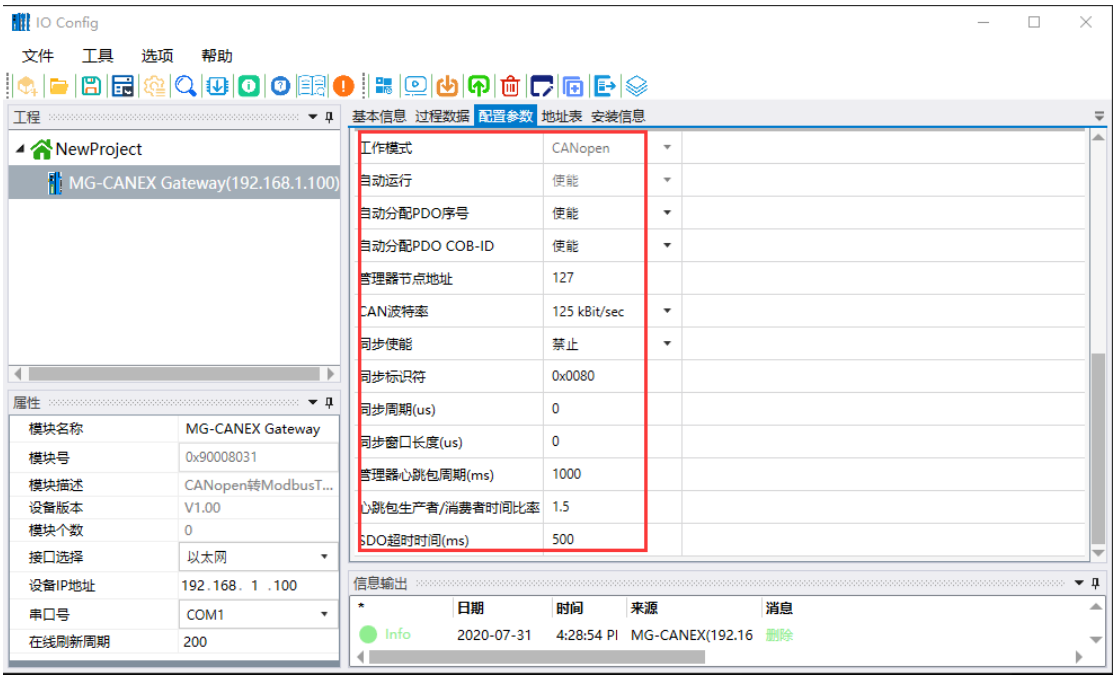
Gateway: Gateway address

Modbus server port number: 502

Application Watchdog: disabled, enabled optional, enabled by

default

Watchdog time: when watchdog enabled, if Modbus data exchange does not occur on the TCP connection during this time period, the TCP connection will be disconnected (other TCP connections with data exchange remain normal).(Default: 30)



CANopen parameters

Working mode: CANopen

Auto run: enable

Automatically assign PDO serial number: enable, disable optional, default: enable.

Automatically assigns PDOCOB-ID: enabled, disable optional, default: enabled.

Management node address: Set the node number of the gateway as the master in the CANopen network, default: 127.

CAN Baud rate: Sets the Baud rate of CANopen network communication.10K, 20K, 50K, 100K, 125K, 250K, 500K, 800K, 1MBit/ SEC optional, default 125kBit/ SEC.

Synchronization enable: disabled, enabled optional, default: disabled.

Synchronization identifier: Default 128.

Synchronization cycle (US) : Custom

Synchronization window length (US) : Custom

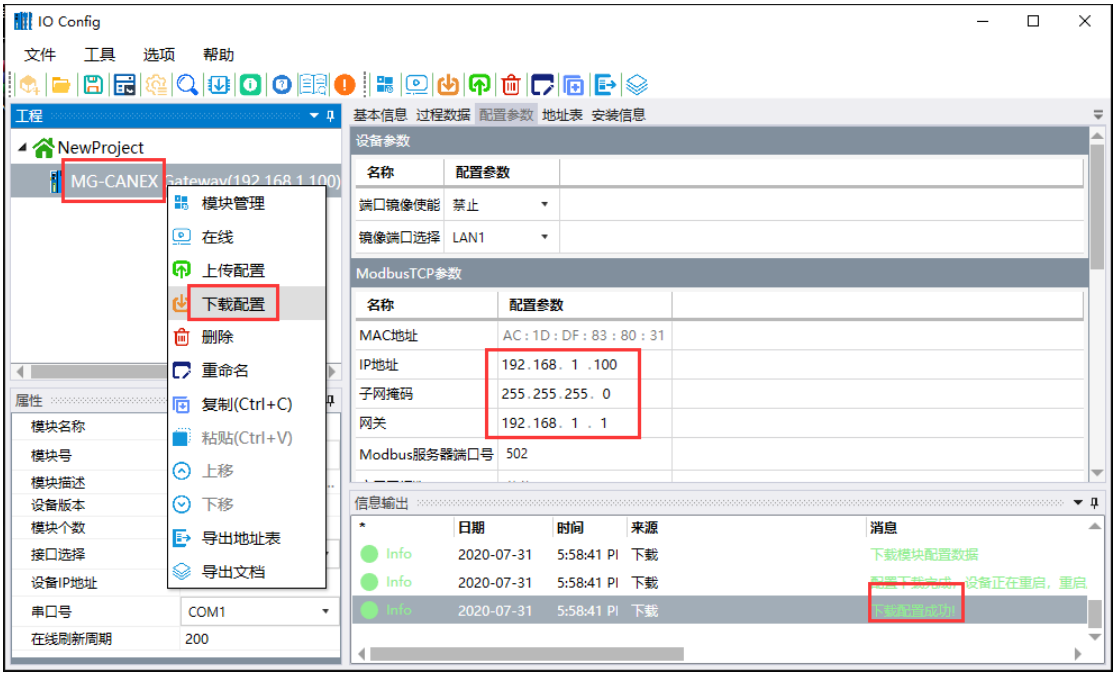
Manager heartbeat cycle (MS) : default 1000

Heartbeat package producer/consumer time ratio: more than 1.5

SDO timeout time (MS): default 500

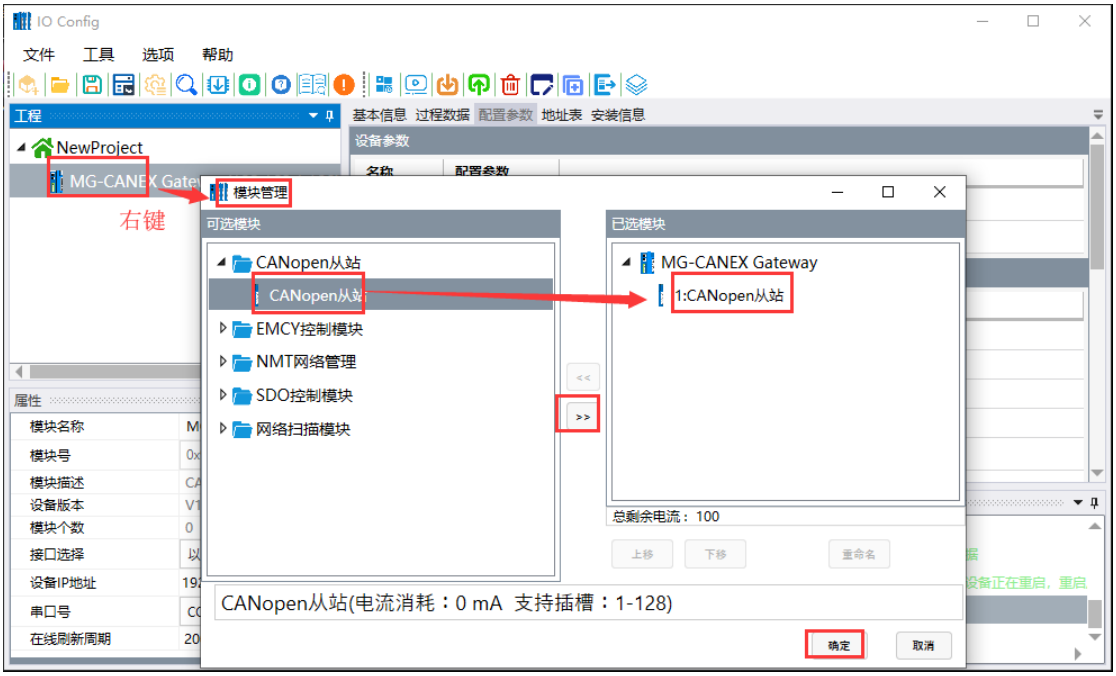
5.4.4. Modify the gateway IP address

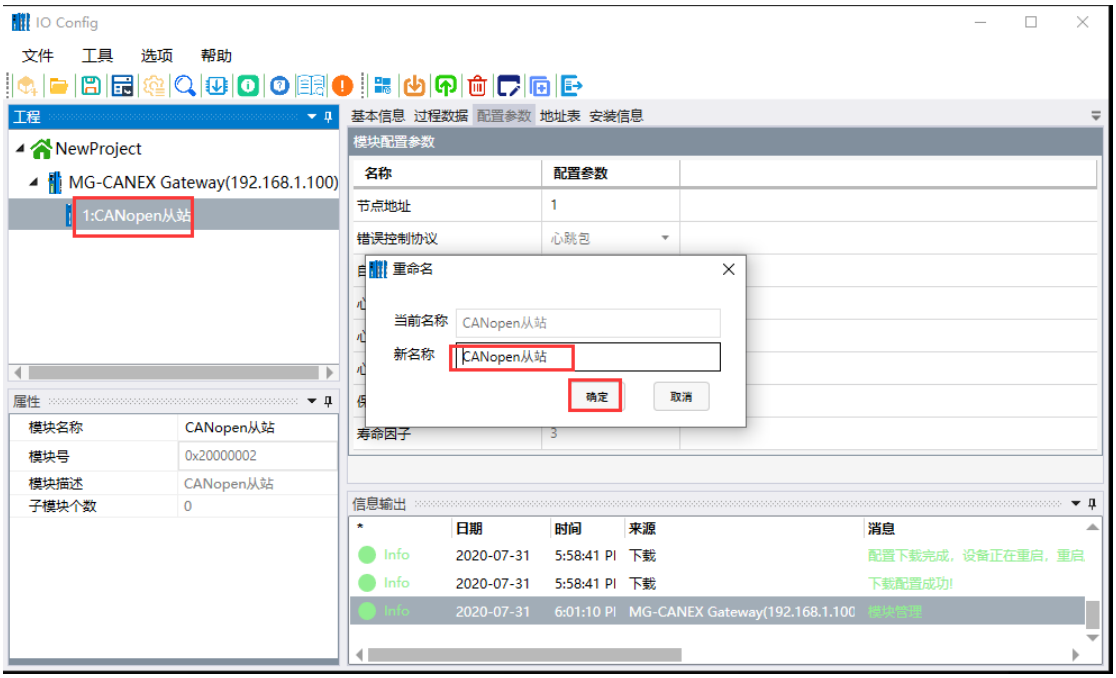
Modify the IP address and gateway parameter in Modbus TCP parameter in the gateway configuration parameter to the IP address required by the client. Right-click the gateway and click Download configuration to modify the IP address of the gateway.



5.4.5. CANopen slave parameters

Right-click the MG-Canex Gateway - "Module Management", select CANopen Slave station in the pop-up interface, and click OK. Add right-click the Mg-CANEX Gateway - "Module Management", select CANopen Slave Station in the Popup Interface, and click OK. After Adding a Slave Station, add a Slave Station as a Slave. Right-click the slave station and click rename to change the slave station name. After the slave station, right-click the slave station and click rename to modify the slave station name.





Select the CANopen slave device and click the amount configuration parameters in the main window to view the configuration parameters of the modified device.

Node address: is the number of the CANopen slave.

Error control protocol: Heartbeat packets

Auto run: enable

Heartbeat packet producer cycle (MS) : CANopen sends heartbeat packets from the station at the interval, default 1000.

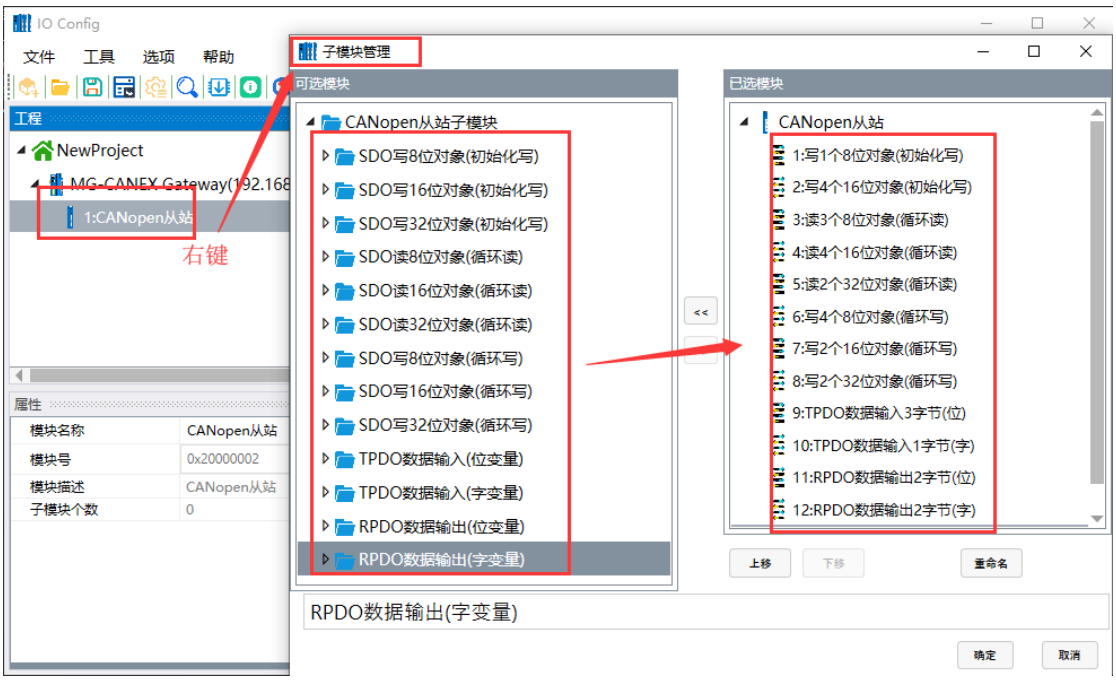
Heartbeat packet consumer (node ID) : Sets the heartbeat packet detected by the site of this slave, generally sets the node number of the primary station.

Heartbeat package producer/consumer time ratio: more than 1.5

Protection time (MS) :1000

Life factor: 3

Right click CANopen slave and click submodule management to add SDO read command, SDO write command, TPDO, RPDO. Click OK when finished.



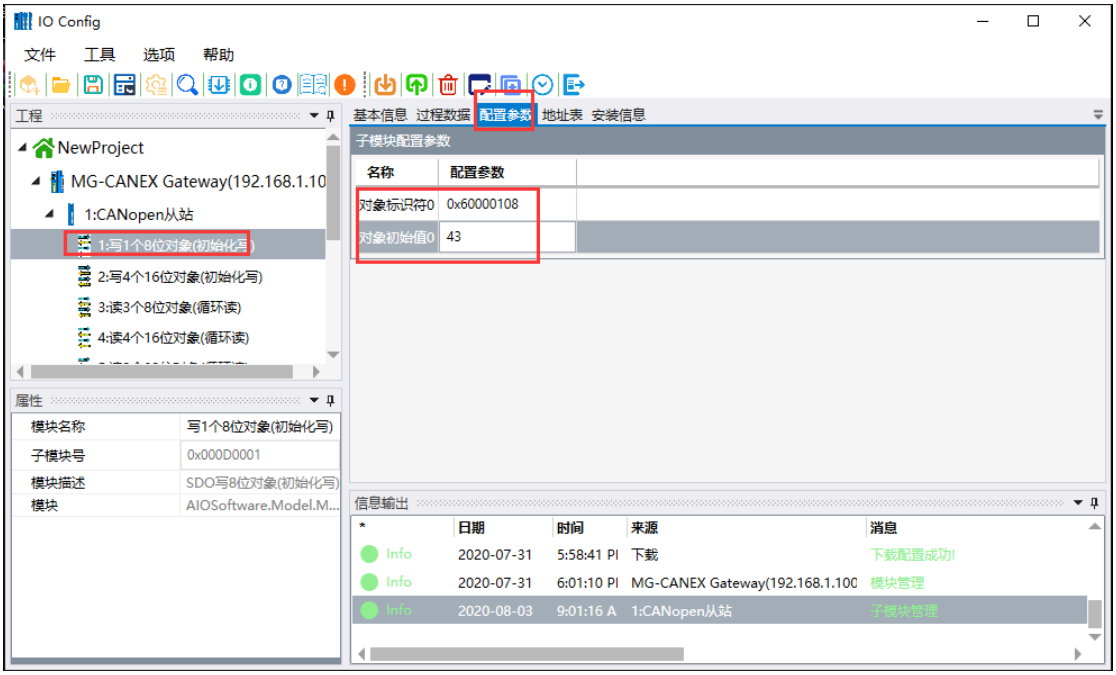
All selections support a maximum of 8, that is, 8 8-bit objects, 8

16-bit objects, 8 32-bit objects, 8 bytes (bits), 8 bytes (words).The call instruction is repeated after more than 8.

Service Data Object SDO

SDO writes 1 8-bit object (initialize write)

SDO initializers write without a corresponding mapping address and procedure data.



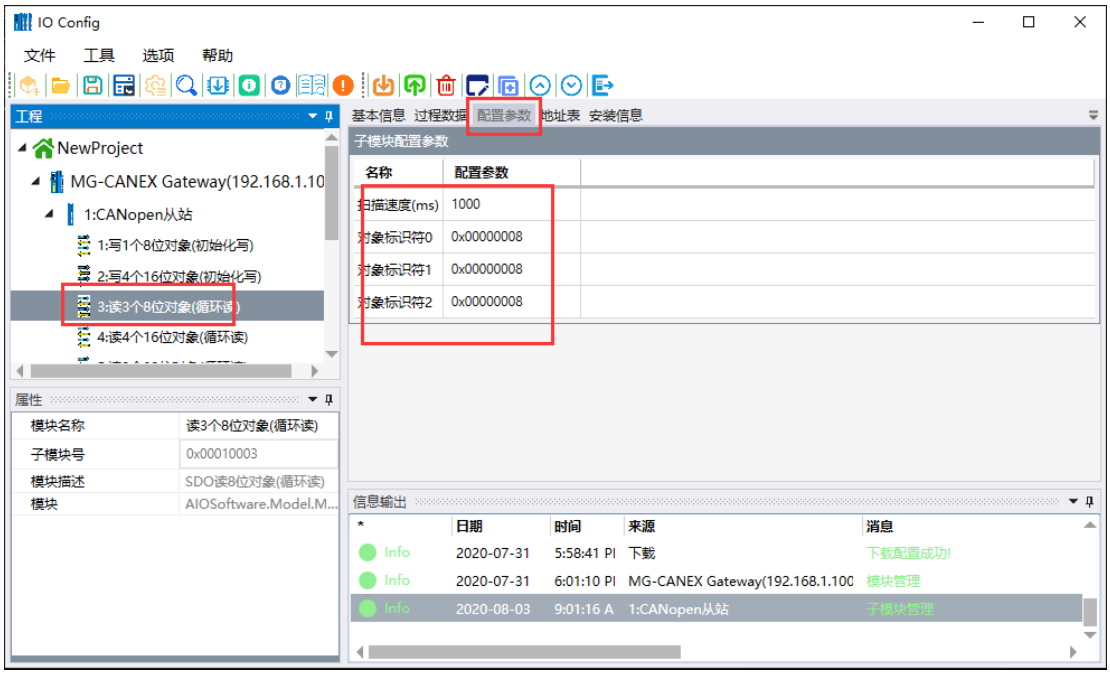
Configuration parameters:

Object identifier: Object index + object sub-index + bit length

Object initial value: non-zero value.

SDO reads 3 8-bit objects (circular reads)

SDO read instructions map to Modbus's register 3 address and procedure data.



Configuration parameters:

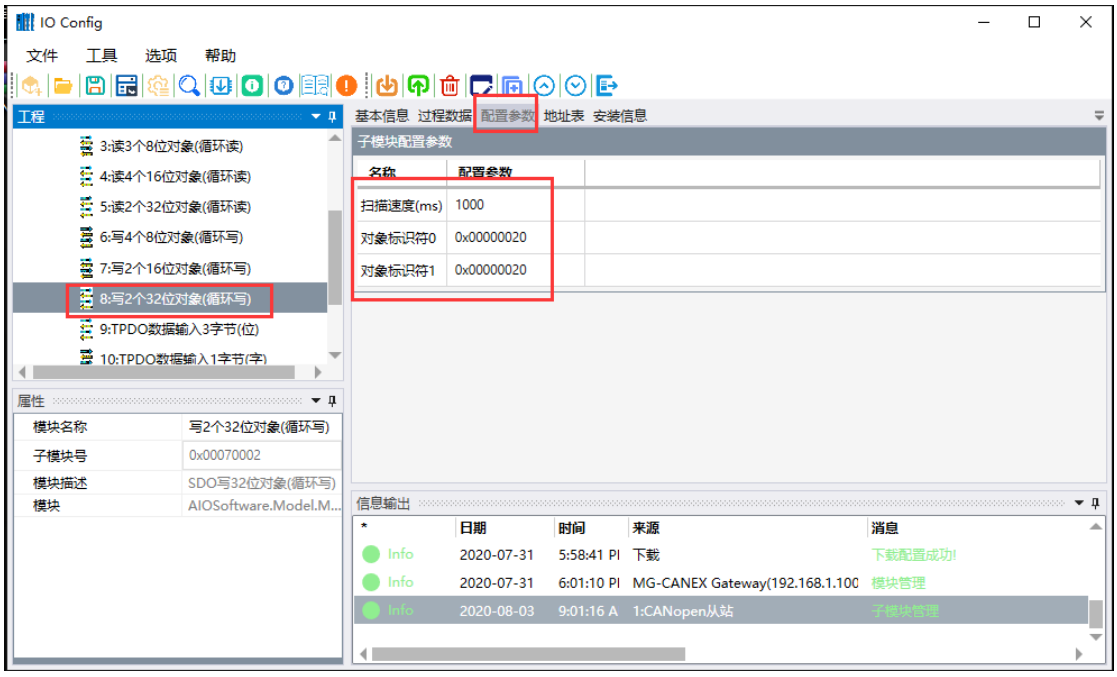
Scan speed (MS): SDO read data scan cycle, default 1000

Object identifier 0: Object 0 index + object 0 sub-index + bit length

Object identifier 1: Object 1 index + object 1 sub-index + bit length

Object identifier 2: Object 2 index + object 2 sub-index + bit length

SDO writes 2 32-bit objects (loop writes)



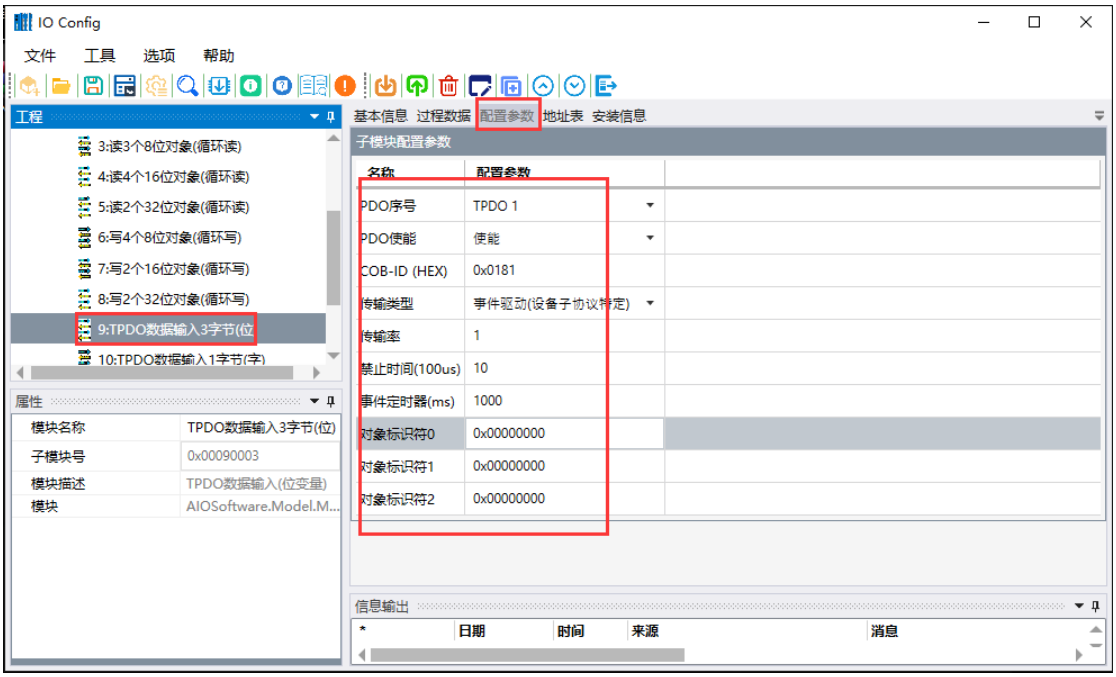
Configuration parameters:

Scan speed (MS): SDO read data scan cycle, default 1000

Object identifier 0: Object 0 index + object 0 sub-index + bit length

Object identifier 1: Object 1 index + object 1 sub-index + bit length

TPDO data input 3 bytes (bits)



Configuration parameters:

PDO serial number: TPDO1-TPDO64, custom, can not be called repeatedly.

PDO enable: enable, disable optional, default: enable.

Cob-id (HEX) : 0X180h+$NODEID, 0X280h+$NODEID, 0X380h+$NODEID, 0X480h+$NODEID, 0X580h+$NODEID....It cannot be called repeatedly and is used in conjunction with the PDO serial number

Transport types: synchronous (acyclic), synchronous (cyclic),

event-driven (manufacturer-specific), event-driven (device-protocol specific) optional, default event-driven (device-protocol specific)

Transfer rate: Custom

Disable time (100US) : Custom

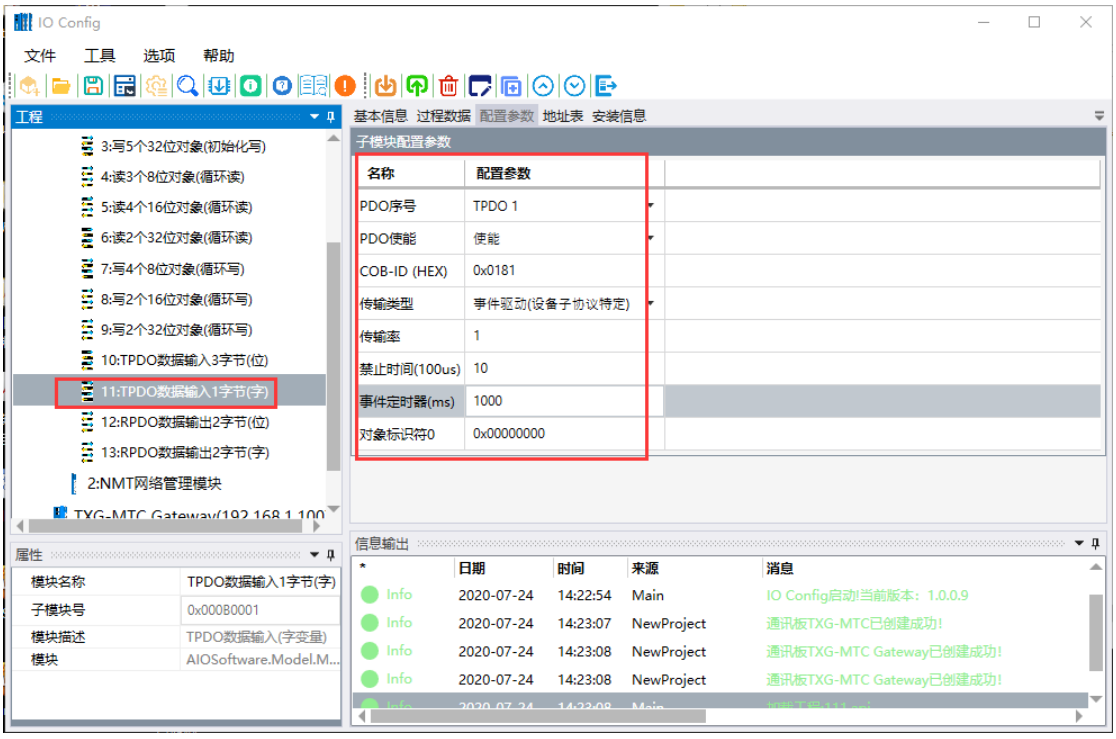
Event Timer (MS) : Custom

Object identifier 0: Object 0 index + object 0 sub-index + bit length

Object identifier 1: Object 1 index + object 1 sub-index + bit length

Object identifier 2: Object 2 index + object 2 sub-index + bit length

TPDO data input 1 byte (word)



Configuration parameters:

PDO serial number: TPDO1-TPDO64, custom, cannot be called repeatedly.

PDO enable: enable, disable optional, default: enable.

Cob-id (HEX): 0X180h+$NODEID, 0X280h+$NODEID, 0X380h+$NODEID, 0X480h+$NODEID, 0X580h+$NODEID....It cannot be called repeatedly and is used in conjunction with the PDO serial number

Transport types: synchronous (acyclic), synchronous (cyclic), event-driven (manufacturer-specific), event-driven (device-protocol specific) optional, default event-driven (device-protocol specific)

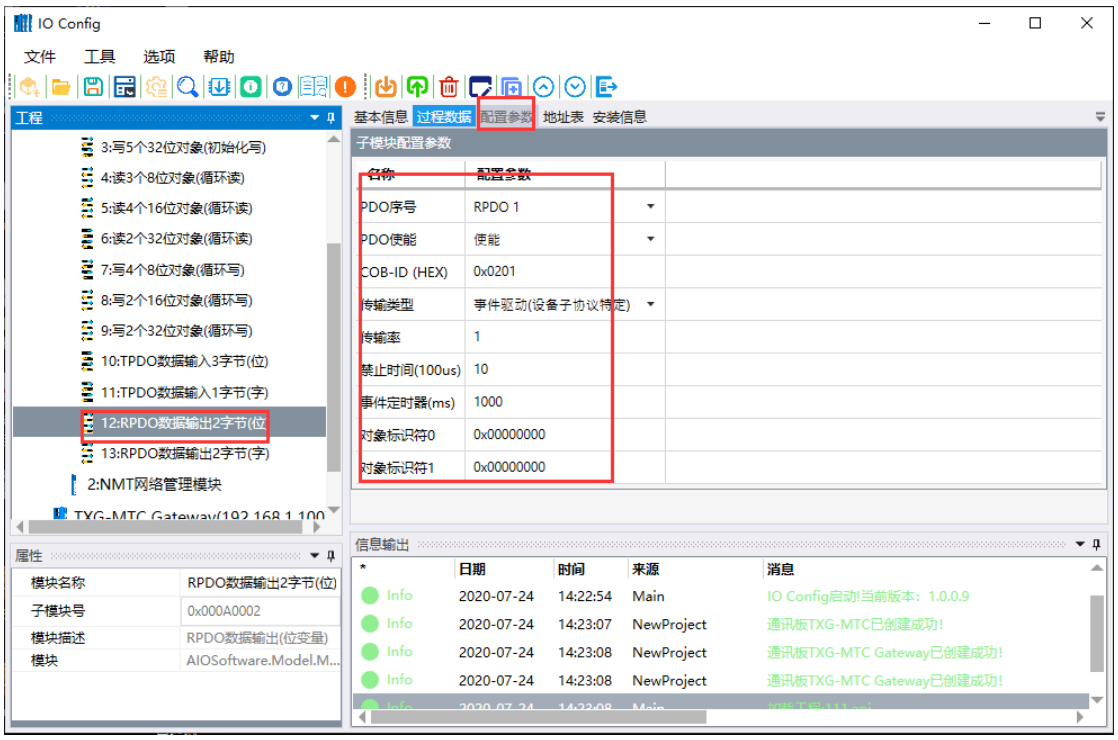
Transfer rate: Custom

Disable time (100US) : Custom

Event Timer (MS) : Custom

Object identifier 0: Object 0 index + object 0 sub-index + bit length

RPDO data output 2 bytes (bits)



Configuration parameters:

PDO serial number: RPDO1-RPDO64, custom, cannot be called repeatedly.

PDO enable: enable, disable optional, default: enable.

Cob-id (HEX) : 0X200h+$NODEID, 0X300h+$NODEID, 0X400h+$NODEID, 0X500h+$NODEID, 0X600h+$NODEID....It cannot be called repeatedly and is used in conjunction with the PDO serial number

Transport types: synchronous (acyclic), synchronous (cyclic), event-driven (manufacturer-specific), event-driven (device-protocol specific) optional, default event-driven (device-protocol specific)

Transfer rate: Custom

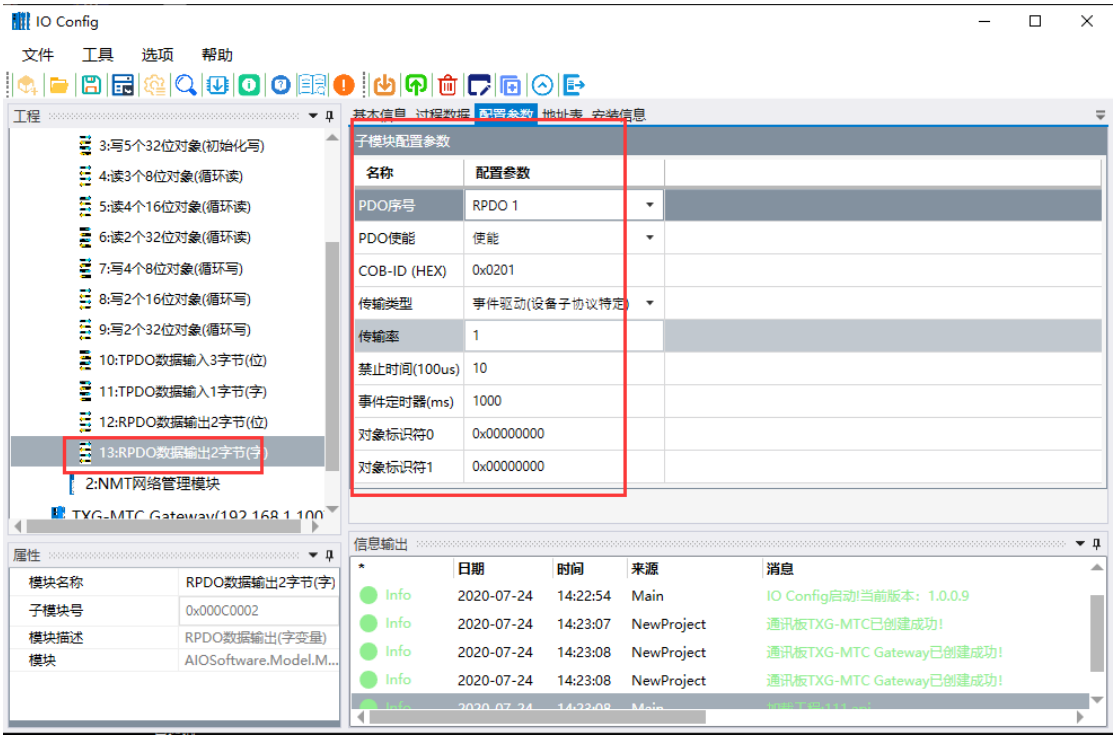
Disable time (100US) : Custom

Event Timer (MS) : Custom

Object identifier 0: Object 0 index + object 0 sub-index + bit length

Object identifier 1: Object 1 index + object 1 sub-index + bit length

RPDO data output 2 bytes (word)



Configuration parameters:

PDO serial number: RPDO1-RPDO64, custom, cannot be called repeatedly.

PDO enable: enable, disable optional, default: enable.

Cob-id (HEX) : 0X200h+$NODEID, 0X300h+$NODEID, 0X400h+$NODEID, 0X500h+$NODEID, 0X600h+$NODEID....It cannot be called repeatedly and is used in conjunction with the PDO serial number

Transport types: synchronous (acyclic), synchronous (cyclic), event-driven (manufacturer-specific), event-driven (device-protocol specific) optional, default event-driven (device-protocol specific)

Transfer rate: Custom

Disable time (100US) : Custom

Event Timer (MS) : Custom

Object identifier 0: Object 0 index + object 0 sub-index + bit length

Object identifier 1: Object 1 index + object 1 sub-index + bit length

5.4.6. Configure download and upload

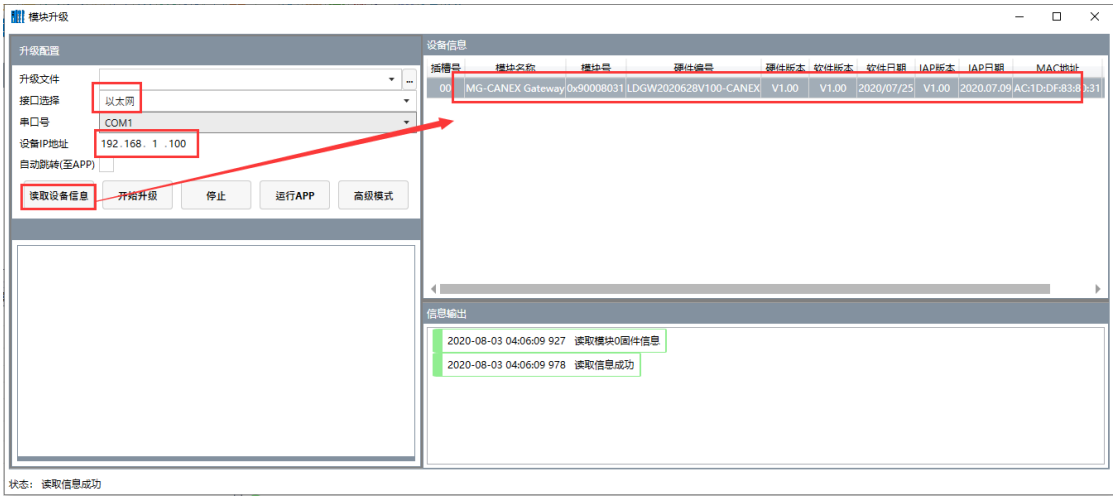
When the configuration parameters have been modified, right click on the gateway and click "Download Configuration" to download all the configuration to the gateway. After successful download, right-click the gateway and click "Upload Configuration" to assign PDO number and COB-ID number, or upload the mapping configuration that comes with the slave device of CANOPEN.

Data acquisition control can directly control CANopen slave station equipment by accessing Modbus address.

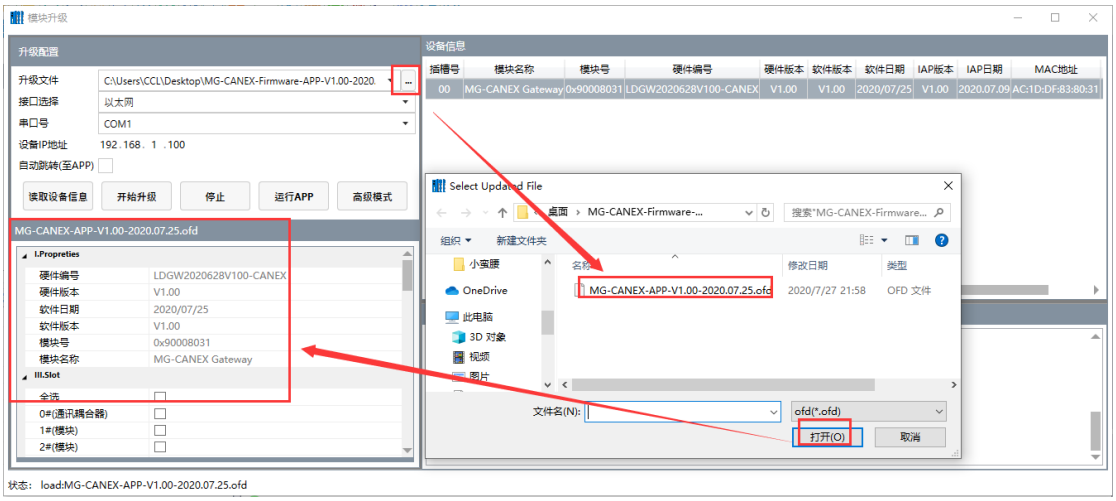
6. Firmware update

When the module firmware is updated, you need to upgrade the module firmware.

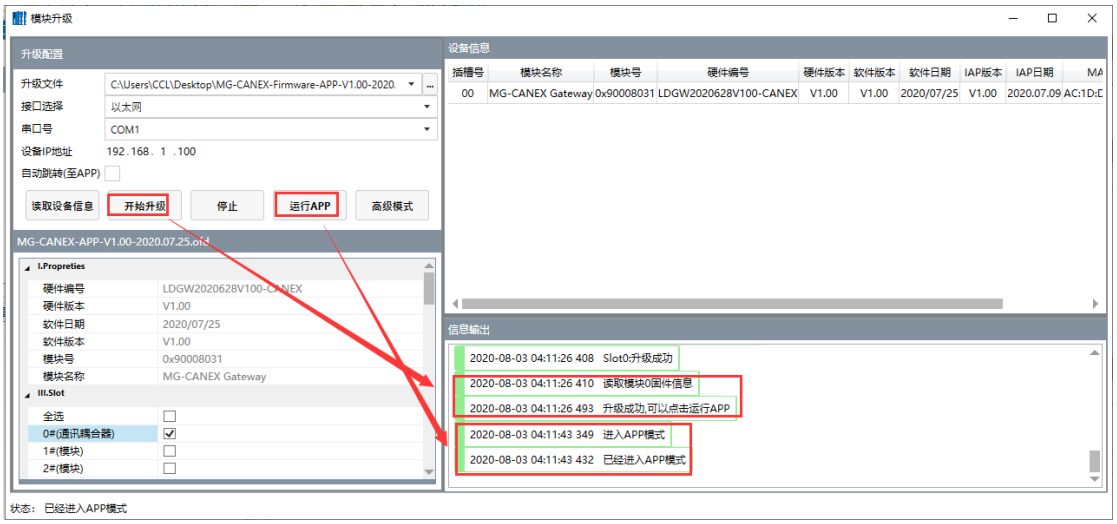
Open the IO Config software, click the tool online upgrade or click the shortcut key, select the interface Ethernet and device IP address, click read device information, and the internal firmware information of the gateway can be read.



Click ..., in the popup interface, select the new firmware file, click open, the new firmware information will be displayed in the lower left corner.



Select the 0# coupler, tick "√", click start upgrade, and click Run APP after completion. Or select automatic jump (to APP) and click to start the upgrade.



When entering APP mode, all the lights will flash on once.

7. Product application examples

7.1 Example of gateway communication with distributed IO

This example introduces our protocol converter to communicate between the remote IO with CANopen protocol and the upper computer with Modbus TCP protocol.

Hardware required for this example:

CANopen to Modbus TCP converter, remote IO with CANopen protocol, 24V switching power supply, a laptop

Software required for this example:

Upper computer software Modbus poll, protocol converter debugging software IO Config, EDS file reading software: Edseditor20DE, EDS file for remote IO.

7.1.1 Hardware wiring

Connect the gateway network port to the computer network port, and

ensure that the computer is in the 192.168.1 network segment. Gateway is connected with 24V power supply, remote IO is connected with power supply, CAN_L of gateway is connected with CAN_L of remote IO, CAN_H is connected with CAN_H, GND is connected with CAN_GND. Power on after confirmation.

7.1.2 Remote IO address query

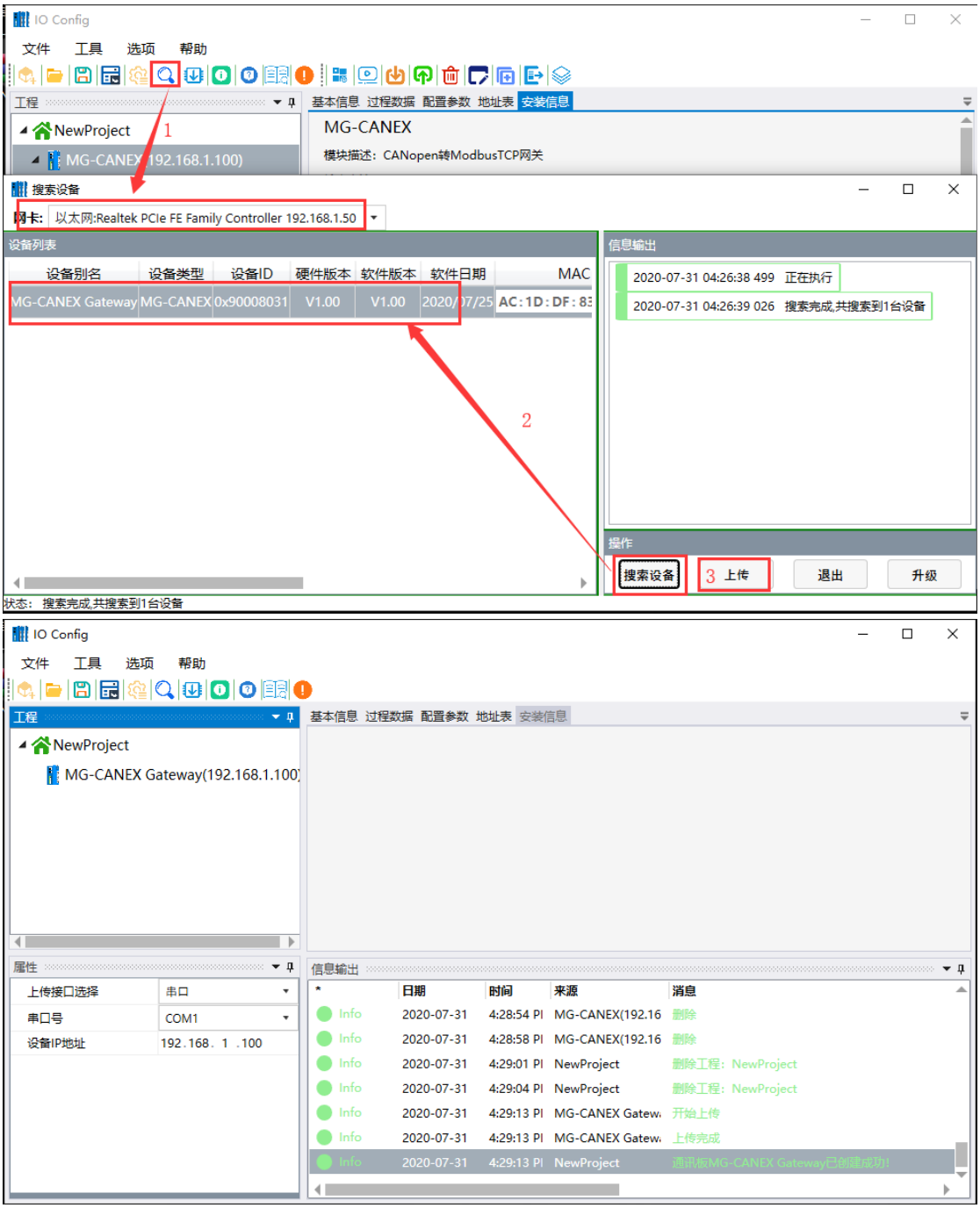
The hardware configuration of this remote IO example is as follows: a remote IO adapter, an 8DI digital input, an 8DO digital output, a 4AI analog input, and a 4AO analog output

Install and open software: Edseditor20de, open EDS file of remote IO with software, query "Object dictionary" to get the relevant address as follows: (Object identifier)

Object indexes	Object sub-indexes	Bit length	Attribute	Name	Data type
0x6000	0x01	0x08	RO	8DI digital input	Unsigned8
0x6401	0x01	0x10	RO	Analog input 1	integer16
0x6401	0x02	0x10	RO	Analog input 2	integer16
0x6401	0x03	0x10	RO	Analog input 3	integer16
0x6401	0x04	0x10	RO	Analog input 4	integer16
0x6200	0x01	0x08	RW	8DO digital output	Unsigned8
0x6411	0x01	0x10	RW	Analog output 1	integer16
0x6411	0x02	0x10	RW	Analog output 2	integer16
0x6411	0x03	0x10	RW	Analog output 3	integer16
0x6411	0x04	0x10	RW	Analog output 4	integer16

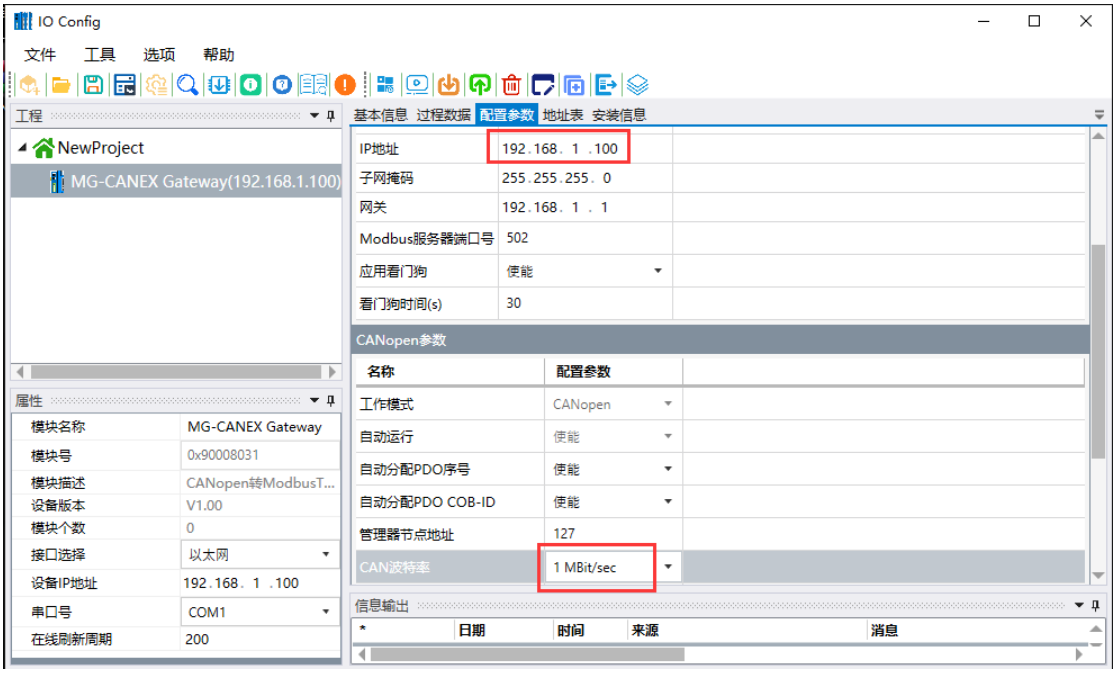
7.1.3 Gateway configuration

Open the configuration software "IO Config". Click Search, select the native network card in the popup interface, click Search device, the gateway device will be scanned in the device list, and click upload.

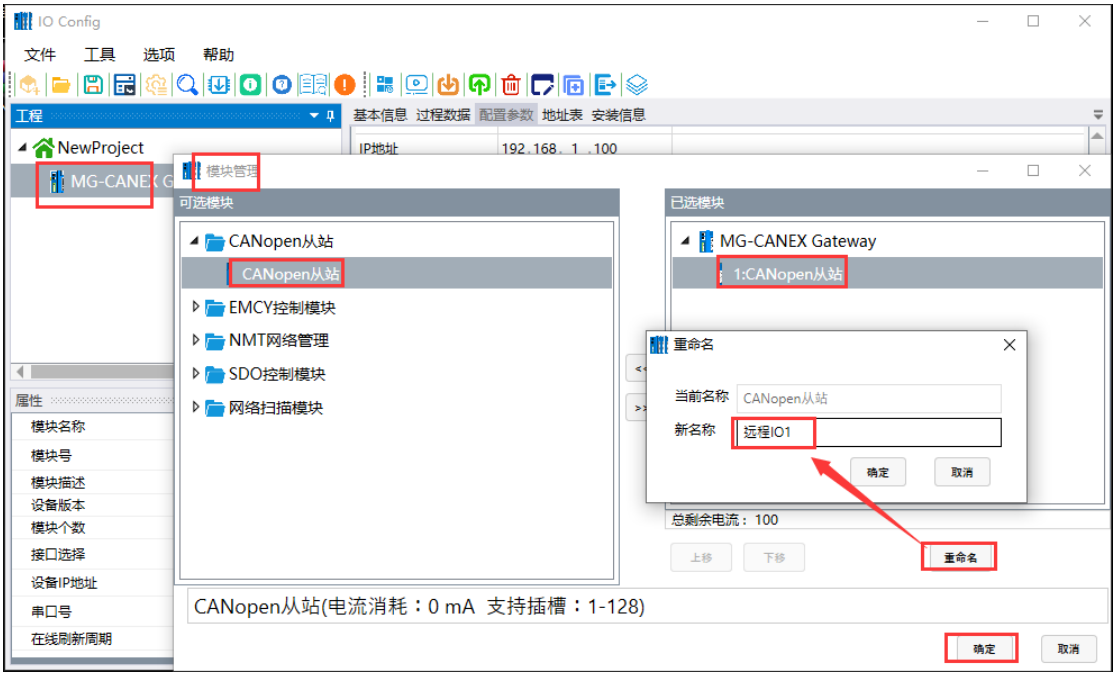


(3) Select the added gateway in the toolbar of the right window and select

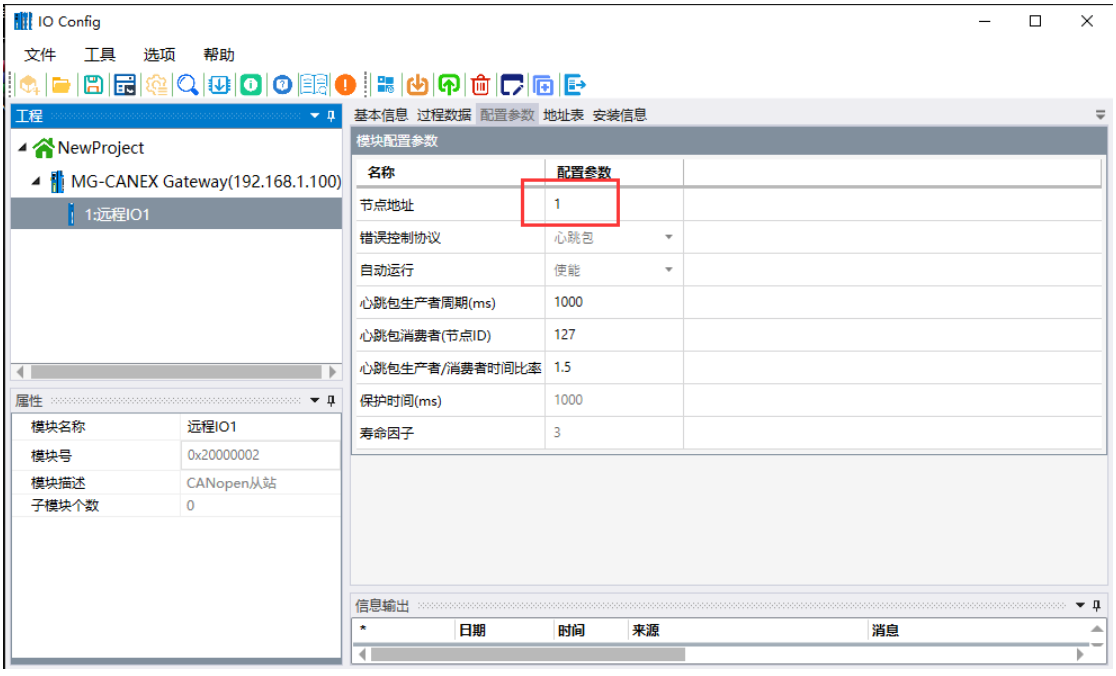
"Configuration Parameters" to set the gateway parameters. IP address: 192.168.1.100, CANopen Baud rate: 1M bit/ SEC.



(4) Select the added gateway, right click [Module Management] and double-click or click add CANopen slave station. And modify the slave station name called: remote IO1.



(5) Select the added slave station "remote IO1", and click [Configuration Parameters] in the right window to set the slave station node address to 1, while the rest defaults.



(6) Select the added slave, right click [Sub-module management], double-click or click add CANopen slave read instruction: Click OK after

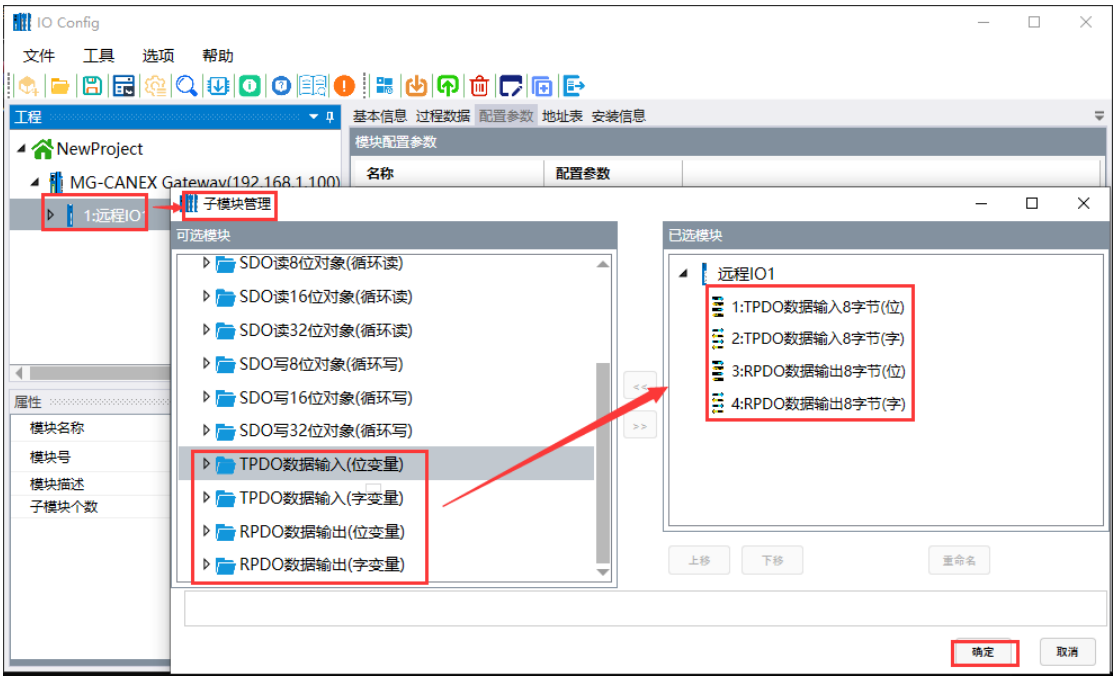
the selected module is selected.

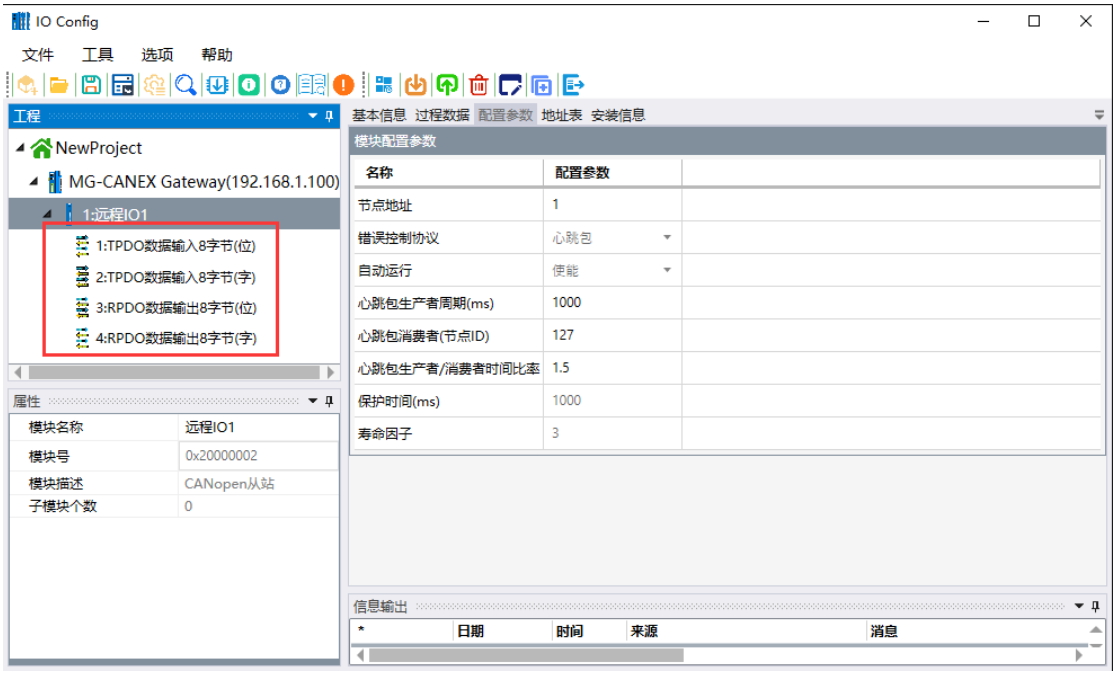
TPDO data input 8 bytes (bits)

TPDO data input 8 bytes (word)

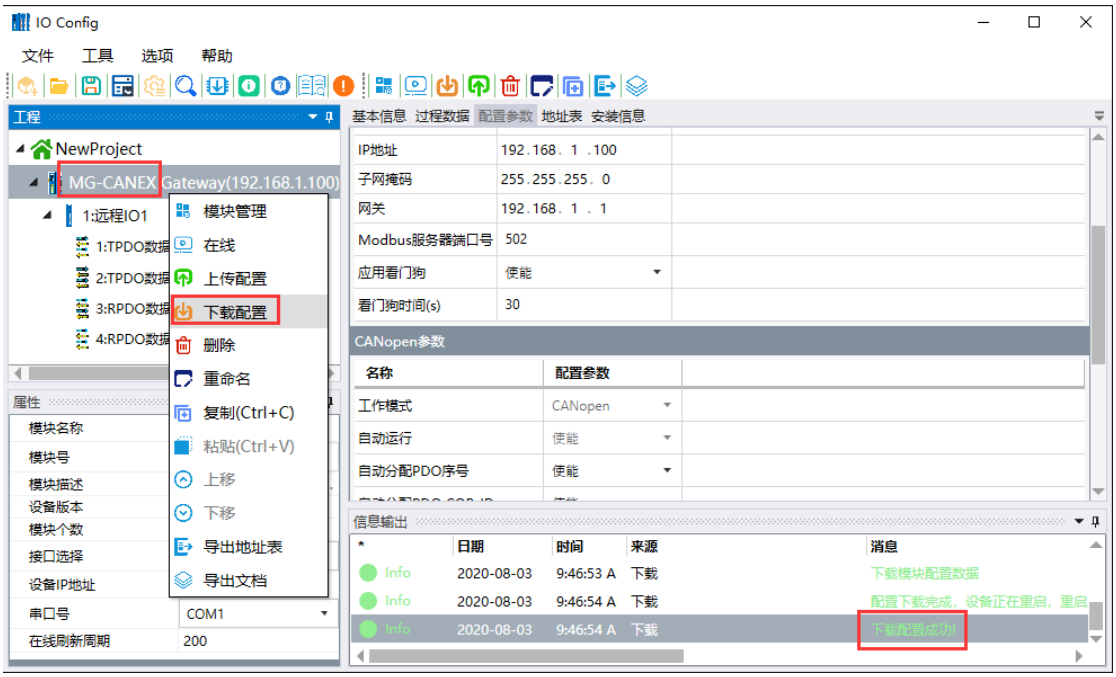
RPDO data input 8 bytes (bits)

RPDO data input 8 bytes (word)

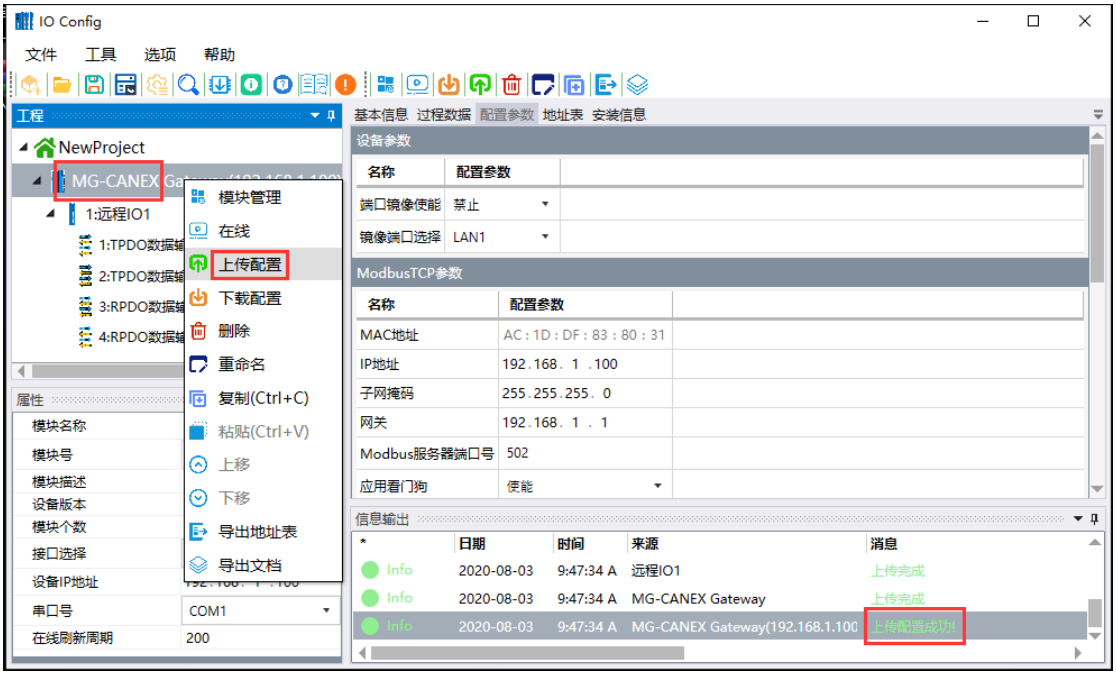


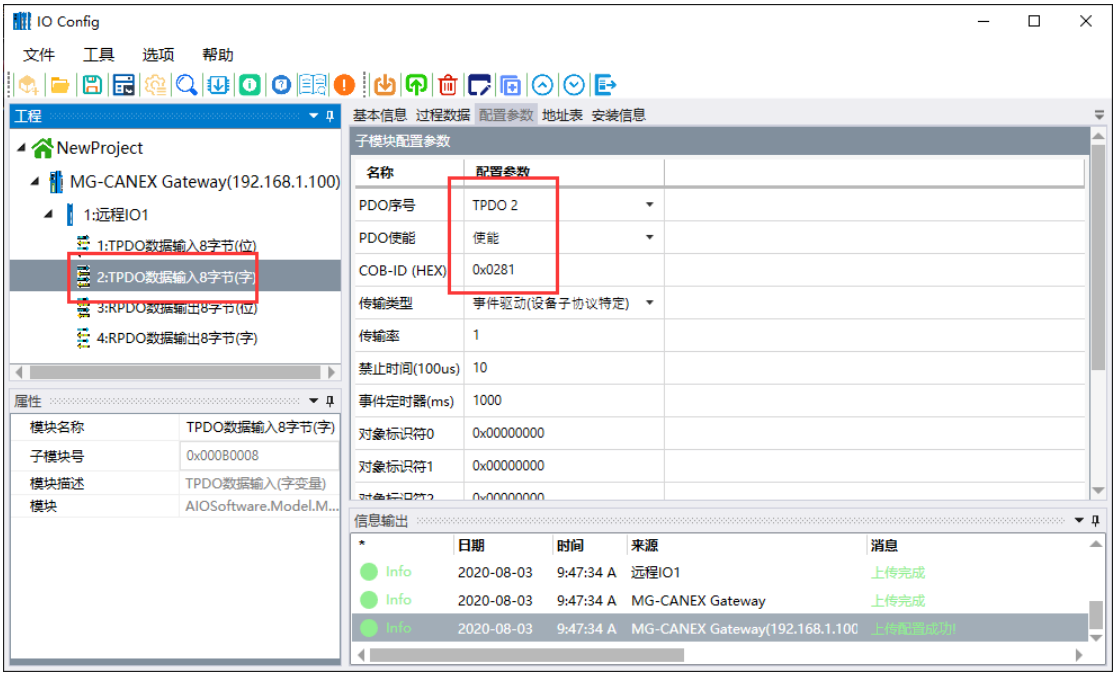


When all configurations are complete, right-click MG-CANEX and click Download configuration.

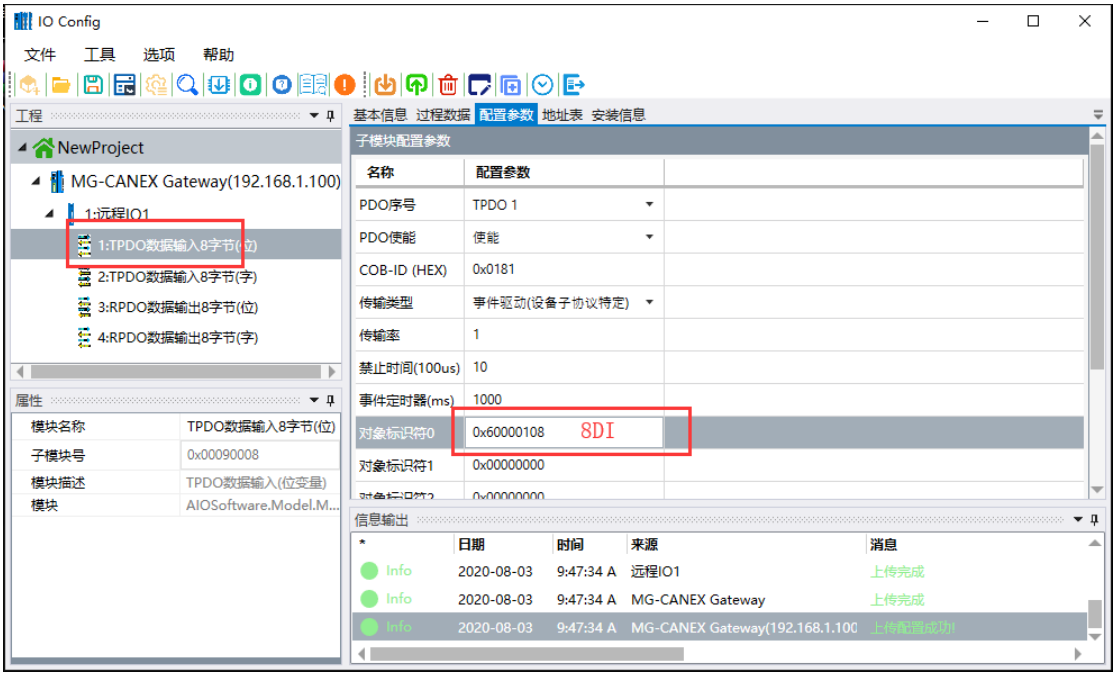


After downloading, right-click MG-CANEX and click Upload Configuration to automatically assign the PDO serial number and COB-ID number.

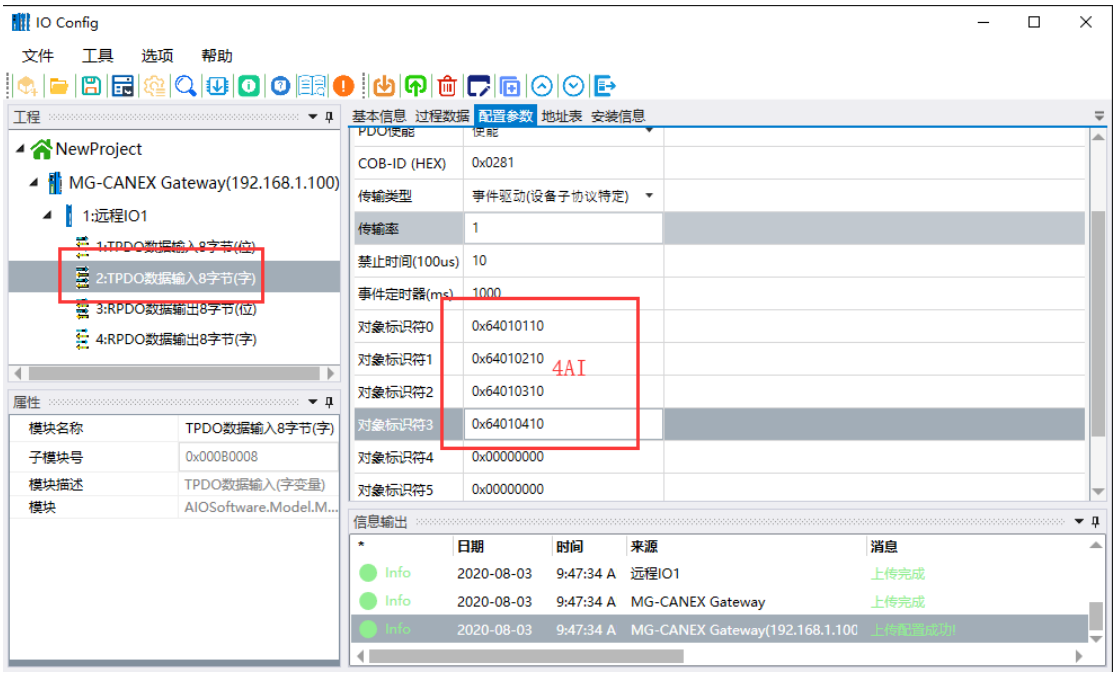




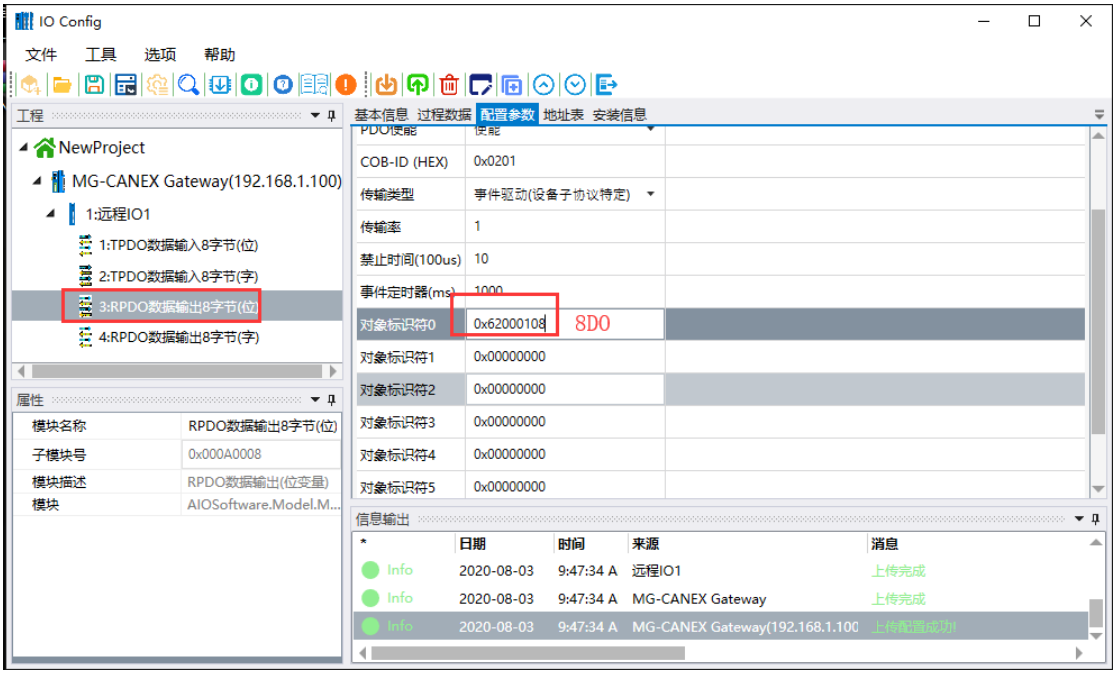
(7) Select the added PDO instruction and click [Configuration Parameters] to configure the object identifier parameters of each instruction.



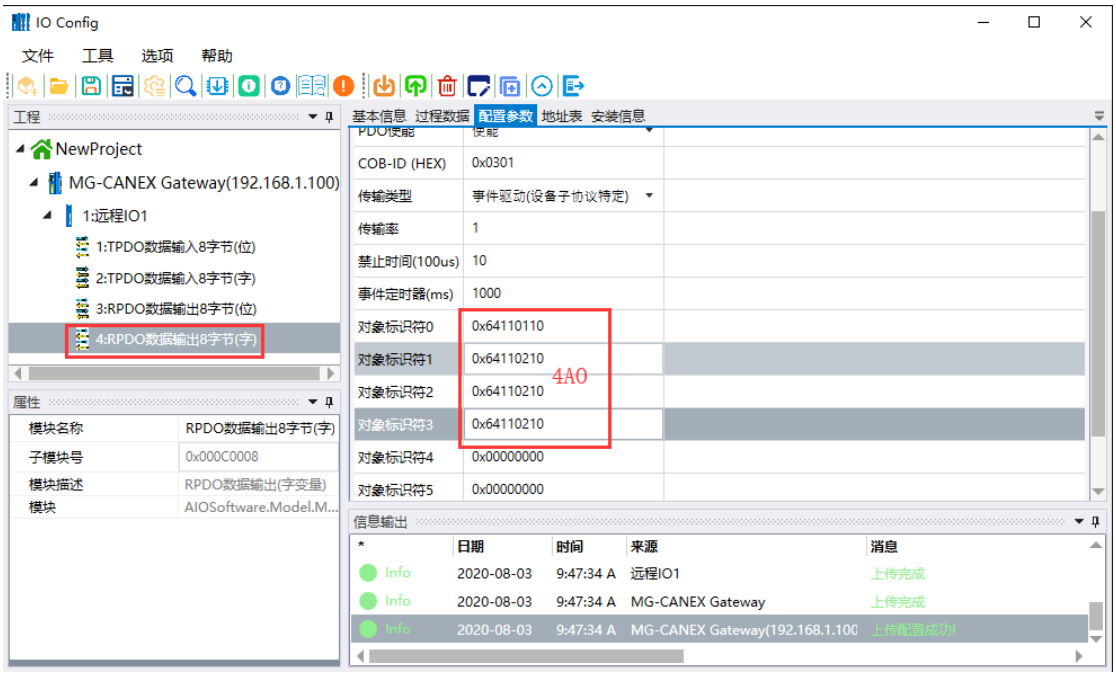
Configure the TPDO data entry 8-byte (word) instruction



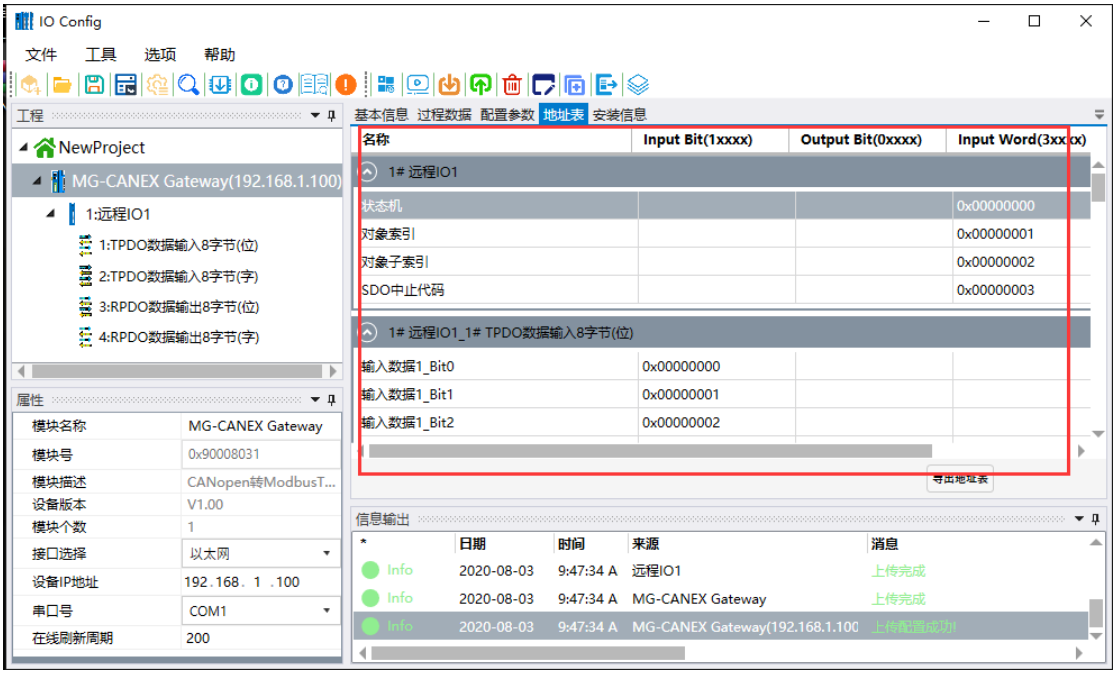
Enter 8-byte (bit) instruction configuration for RPDO data

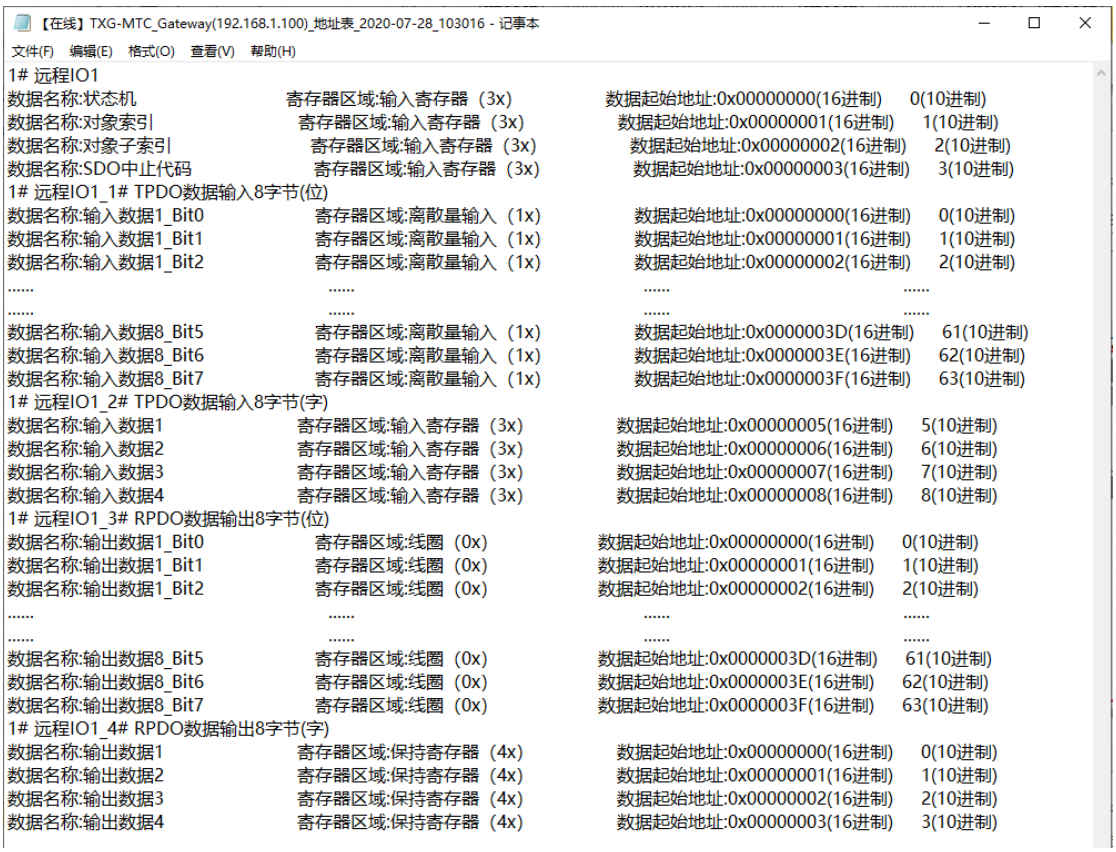


Enter 8-byte (word) instruction configuration for RPDO data

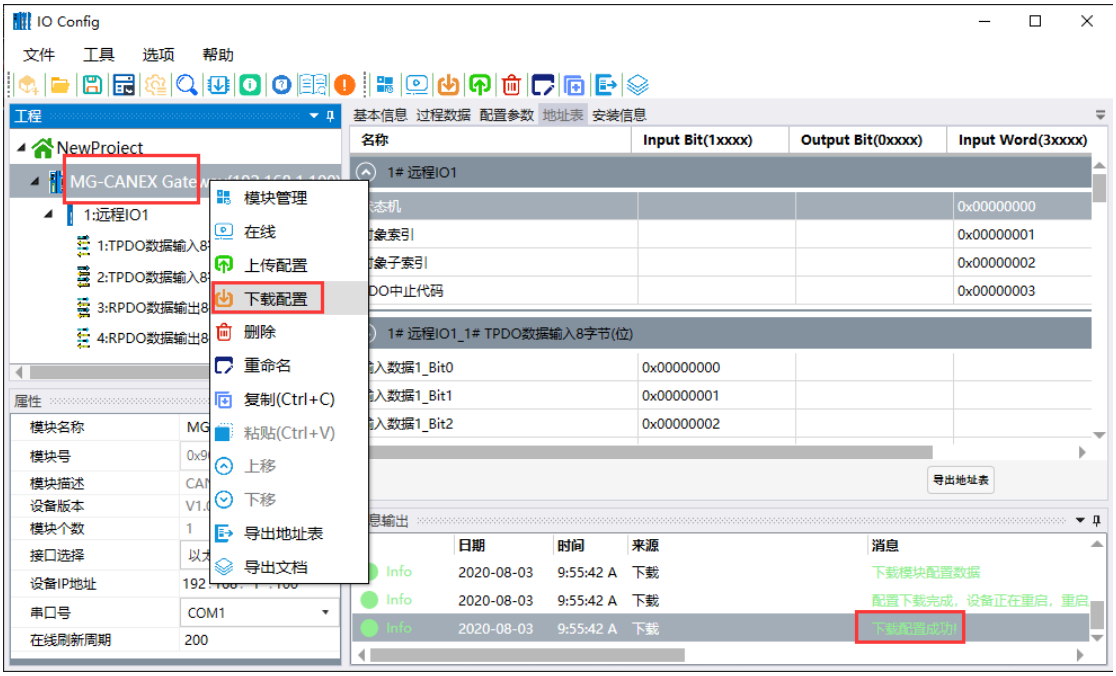


(8) Select the added instruction and select [address table] to see the Modbus address corresponding to the parameters read.



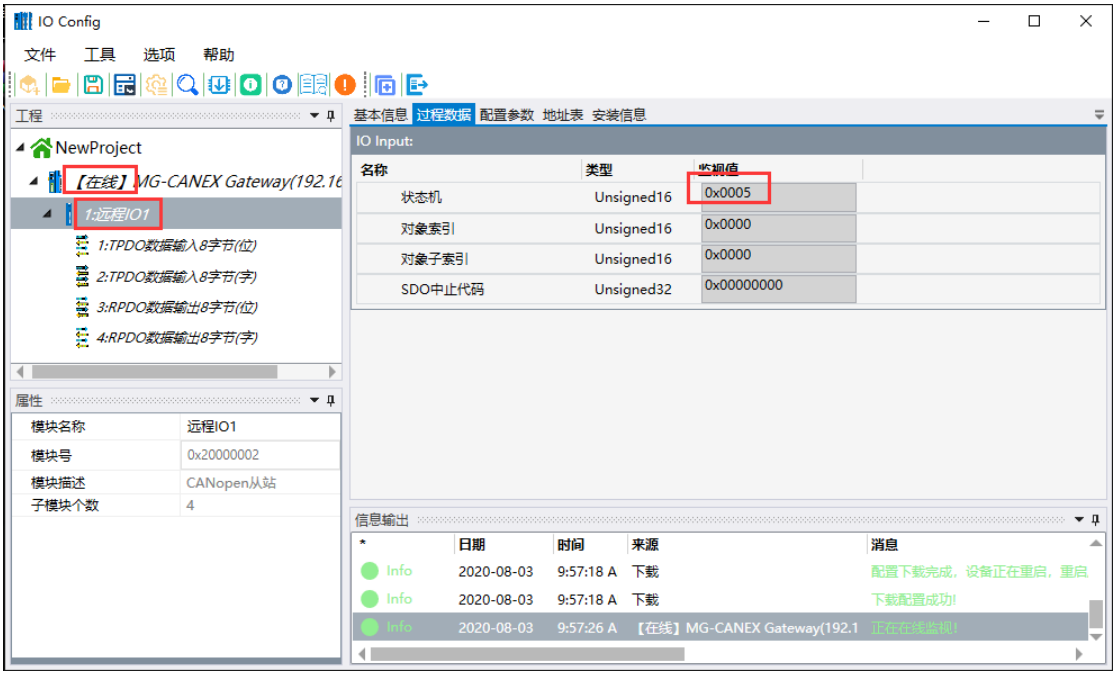


(8) After the object identifier modification is completed, right-click MG-CANEX and click download configuration.

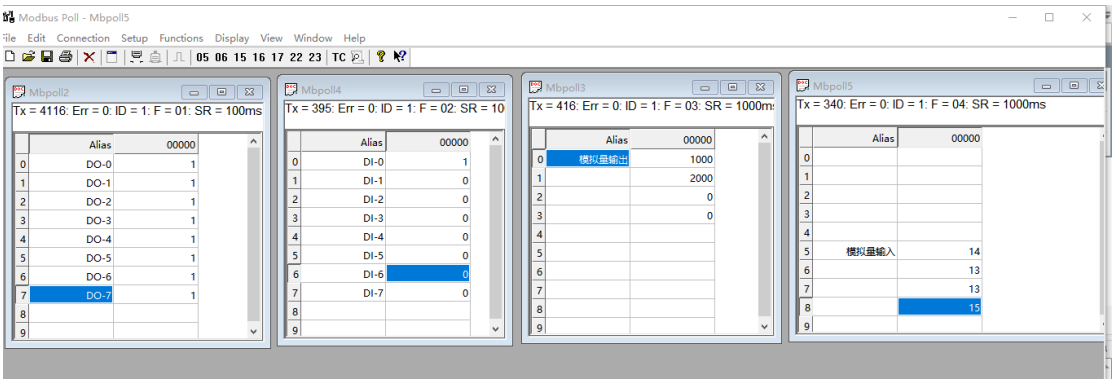


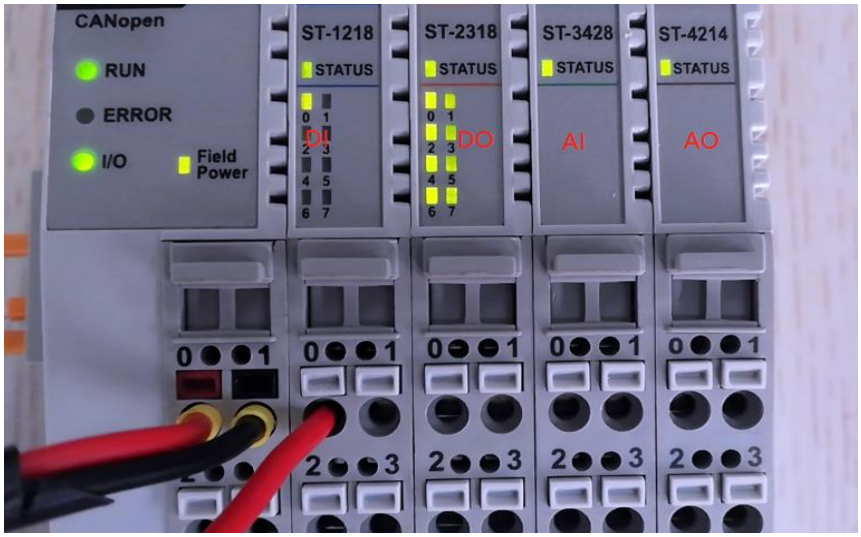
After successful download, select MG-CANEX Gateway, right click and

select "Online" to monitor the working status of the gateway online. The monitoring value of "state machine" is: 0x0005, indicating normal communication.



(9) Modbus poll software is used to simulate the upper computer, and the corresponding Modbus address is obtained.





8. Appendix: CANopen Protocol Introduction

1. CANopen Overview

CANopen is a high-level communication protocol built on the control Area Network (CAN). The CANopen protocol suite includes communication sub-protocols and device sub-protocols. It is a field bus commonly used in industrial control. CANopen's high real-time It is widely used in servo systems.

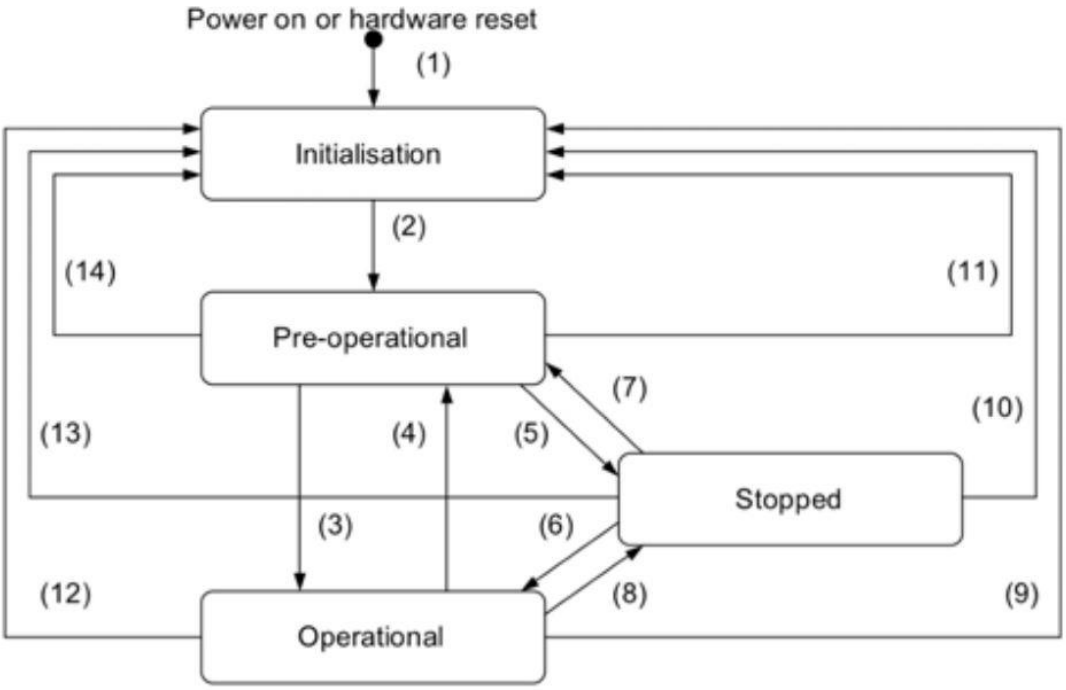
CANopen Data packets in the CANopen network are distinguished by identifiers. The range of COB-ID identifiers corresponding to the master-slave connection set predefined by CANopen is as follows:

Pre-defined master/slave connection set

Communication object	COB-ID range	Corresponding object dictionary
Network management	000h	
Synchronization message	080h	1005h，1006h，1007h，1008h
Timestamp message	100h	1012h，1013h
Emergency	081h~0FFh	1014h，1015h
Default SSDO（tx)	581h~5FFh	1200h
Default SSDO（rx)	601h~67Fh	1200h
Network management error control	701h~77Fh	1016h,1017h

2. NMT Network management

CANopen Data in the network adopts multiple transmission modes. NMT network management adopts the master-slave mode. In a CANopen network, there is one NMT master and multiple NMT slaves. The NMT master can control the start and stop status of the slave device through NMT commands. The NMT state diagram is as follows:



NMT Machine

Changes in NMT status

State change path	State change condition
1	Automatically initialize the device after power on
2	Automatically change after initialization
3，6	NMT Host's start remote node command
4，7	NMT Host enters pre-operational state command
5，8	NMT The host enters the stop state command
9，10，11	NMT Host reset remote node command
12，13，14	NMT Host reset remote node communication parameter command

NMT The message format is as follows：

COB-ID	Byte0	Byte1
0x000	CS （ Command word ）	Node-ID

The COB-ID of the NMT command is fixed at 0x000, and the Node-ID is the address of the node to be controlled. 0 is the broadcast address.

CS Command word description：

01h=start_remote_node　　81h=reset_node

02h=stop_remote_node　　82h=reset_communication

80h=enter_pre-operational

3. Service data object SDO

SDO communication adopts the client-server mode, and SDO is used to access the object dictionary of a device. The visitor is called a

client, and the CANopen device that the object dictionary is accessed and provides the requested service is called a server. The client's CAN message and the server's response CAN message always contain 8 bytes of data (although not all data bytes are necessarily meaningful). A client's request must have a response from the server.

SDO has 2 transmission mechanisms：

Expedited transfer: Up to 4 bytes of data can be transferred

Segmented transfer: The length of the transmitted data is greater than 4 bytes

4. SDO Transfer Protocol

Five request/response protocols are implemented in SDO: start domain download, domain segment download, start domain upload, domain segment upload, and domain transfer abort.

The syntax and details of the SDO command word (the first byte of the SDO CAN message) of these protocols are described in the following section: ('-' means irrelevant, should be 0)

（1）Start the domain download protocol

Start domain download								
Bit	7	6	5	4	3	2	1	0
Client→	0	0	1	-	n		e	s
←Server	0	0	1	-	-	-	-	-

Note：

◆ n ： If e=1 and s=1, it is valid, otherwise it is 0; it means the number of bytes of meaningless data in the data part (bytes 8-n to 7 are meaningless).

◆ e: 0 = normal transmission, 1 = accelerated transmission.

◆ s :Whether to specify the data length, 0 = data length is not specified, 1 = data length is specified.

◆ e = 0， s =0： Reserved by CiA.

◆ e =0， s = 1 ： The data byte is a byte counter, byte 4 is the low part of the data (LSB), and byte 7 is the high part of the data (MSB).

◆ e = 1 ： The data byte is the data to be downloaded (download).

（2）Start the domain upload protocol

Start domain upload								
Bit	7	6	5	4	3	2	1	0
Client→	0	1	0	-	-	-	-	-
←Server	0	1	0	-	n		e	s

Description：n，e，s：Same as starting domain download.

（3）Domain segment download protocol

Domain segment download								
Bit	7	6	5	4	3	2	1	0
Client→	0	0	0	t	n			c
←Server	0	0	1	t	-	-	-	-

Description：

◆ n ： The number of meaningless data bytes. If the segment length is not specified, it is 0.

◆ c ： : 0 = there are subsequent segments that need to be downloaded, 1 = the last segment.

◆ t ： Trigger bits, reseting and setting alternately for each subsequent segment (the first transmission is 0, equivalent to request/ Response).

（4）Domain segmentation upload protocol

Upload domain Segment								
Bit	7	6	5	4	3	2	1	0
Client→	0	1	1	t	-	-	-	-
←Server	0	0	0	t	n			c

Instruction：n，c，t ： Same as domain segmentation downloads.

（5）SDO clients or servers abort SDO transmissions by sending messages in the following format:

Upload domain Segment								
Bit	7	6	5	4	3	2	1	0
C→/←S	1	0	0	-	-	-	-	-

In the field transmission abort message, bytes 1 and 2 represent the object index, and bytes 3 represent the sub-index. Bytes 4 to 7 contain 32-bit abort codes to describe the cause of abort message transmission, as shown in Table 3-4.

Table 3- 4:16 Base Abort Code Table (bytes 4 through 7)

Suspend the code	Code function description
0503 0000	The triggering bits have not changed alternately.
0504 0000	SDO protocol timeout
0504 0001	Illegal or unknown Client/Server command word
0504 0002	Invalid Block size (Block Transfer mode only)

0504 0003	Invalid serial number (Block Transfer mode only)
0503 0004	CRC error (Block Transfer mode only)
0503 0005	Out of memory
0601 0000	Object does not support access
0601 0001	Attempting to read write-only objects
0601 0002	Attempting to write read-only objects
0602 0000	Objects do not exist in the object dictionary
0604 0041	The object cannot be mapped to PDO
0604 0042	The number and length of the mapped objects exceed the PDO length
0604 0043	General parameters are not compatible
0604 0047	General equipment internal incompatibility
0606 0000	A hardware error caused the object access to fail
0606 0010	Data type mismatch, service parameter length mismatch
0606 0012	Data type mismatch, service parameter length is too large
0606 0013	Data type mismatch, service parameter length is too short
0609 0011	The sub-index does not exist
0609 0030	Beyond the value range of the parameter (when writing access)

0609 0031	Write parameter value too large
0609 0032	Write parameter value too small
0609 0036	The maximum is less than the minimum
0800 0000	General error
0800 0020	Data cannot be transferred or saved to the application
0800 0021	Data cannot be transferred or saved to the application due to local control
0800 0022	Data cannot be transferred or saved to the application due to the current device state
0800 0023	Object dictionaries generate errors dynamically or object dictionaries do not exist (for example, object dictionaries are generated from files, but errors are generated due to file corruption)

5. Emergency Object

An emergency message is triggered by a fatal error that occurs within the device and is sent to other devices with the highest priority by the relevant application device. It is suitable for interrupt type error warning signals.

An emergency message consists of 8 bytes in the following format:

sender →receiver（s)

COB-ID	Byte0-1	Byte2	Byte3-7
0x080+Node_ID	Error code	Error register Object (0 x1001)	Manufacturer specific error area

The hexadecimal emergency error code is shown in Table 3-5 below. The 'XX' section of the emergency error code is defined by the corresponding device subprotocol.

Table 3-5 Emergency error codes (hexadecimal)

Emergency error code	Code function description
00xx	Error Reset or No Error
10xx	Generic Error
20xx	Current
21xx	Current，device input side
22xx	Current，inside the device
23xx	Current，device output side
30xx	Voltage
31xx	Mains voltage
32xx	Voltage inside the device
33xx	Output voltage
40xx	Temperature
41xx	Ambient temperature
42xx	Device temperature
50xx	Device hardware
60xx	Device software

61xx	Internal software
62xx	User software
63xx	Data set
70xx	Additional modules
80xx	Monitoring
81xx	communication
8110	CAN overrun
8120	Error Passive
8130	Life Guard Error or Heartbeat Error Or Heartbeat Error
8140	Recovered from Bus-Off
82xx	Protocol Error
8210	PDO no processed Due to length error Due to length error
8220	Length exceed
90xx	External error
F0xx	Additional functions
FFxx	Device specific

In the device's object dictionary (index 0x1001), Table 3-6 describes the bit definition of the Error Register. The device can map internal errors to this status byte and can quickly view the current error.

Table 3-6:8-bit error register bit definition

Bit	Error type
0	Generic
1	Current
2	Voltage
3	Temperature
4	Communication
5	Device profile specific
6	Reserved（=0)
7	Manufacturer specific

Manufacturer specific error areas may contain additional error information related to the device.

6. Process data object PDO

PDO objects are used to transmit real-time data. PDO objects adopt the producer-consumer pattern. Data is passed from one producer to multiple consumers. Data transfer is limited to 1-8 bytes (for example: a PDO can transfer up to 64 digital I/O values, or four 16-bit AD values).There are no additional protocol requirements for PDO communications. There are two types of PDO usage: data sending and data receiving. They are distinguished by TPDO and RPDO;

RPDO communication parameter index =1400h+RPDO number -1

TPDO communication parameter index =1800h+TPDO number -1

RPDO mapping parameter index =1600h+RPDO number -1

TPDO mapping parameter index =1A00+TPDO number -1

PDO transmission mode:

Synchronous transmission: Synchronous transmission (by receiving synchronous objects to achieve synchronization), synchronous transmission can be divided into non-periodic and periodic transmission. Aperiodic transports are pre-triggered by remote frames or by object-specific events specified in the device subprotocol. The cycle transmission is realized by receiving synchronization object (SYNC), which can be triggered by 1~240 synchronization objects.

Asynchronous transmission: Asynchronous transmission (triggered by a specific event) can be triggered in two ways: the first is by sending a remote frame with the same COB-ID as PDO to trigger the sending of PDO, and the second is triggered by an object specific event specified in the device subprotocol (for example, timing transmission, data change transmission, etc.).

The PDO communication parameter sub-02H is the transport type of PDO, which defines the method to trigger the TPDO transport or process the received RPDO index, as shown in the table:

Type	Synchronous		Asynchronous	Only RTR
	Cycle	Acyclic		
0		X		
1~240	X			
241~251	Save			
252	X			X
253			X	X
254，255			X	

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