ODOT-PNM02

Protocol Converter

User Manual

V1.5

2020.07.22

Modbus-RTU/ASCll to ProfiNet Converter

Odot Automation System Co., Ltd.

2018-03

Version Information

The document has the following modifications：

Date	Version Number	Modify content	Author
20180301	V1.0	release version	CCL
20180801	V1.1	update content	CCL
20190520	V1.2	Added related descriptions used in Step7	LJP
20190924	V1.3	Freeport mode added	CCL
20191118	V1.4	Added the application of Freeport mode in TIA/STEP7 V5.5/STEP 7-MicroWIN SMART	CCL
20200722	V1.5	Product hardware upgrading，hardware description update.	CCL

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Software download

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

Revision description：

1.GSD file 20190312 and above, in gateway slave mode: To avoid the problem of address overlap when customers use Area 0 and Area 4 to output data, use Area 1 and Area 3 for PN output data, and Area 0 and

Area 4 for input data.

2、GSD file 20190803 and above versions are applicable to ABB Profinet master station system.

3、Firmware V1.6 and above version add function: when the gateway works in transparent transmission mode，When the serial port selects the master-slave response mode, it also supports the active data reporting function.

catalog

1.product description

1.1 Product Features

ODOT-PNM02 gateway is a Modbus-RTU/ASCII to ProfiNet protocol converter. It can realize the conversion from Modbus-RTU/ASCII to ProfiNet protocol. Any device with RS485/RS232/RS422 interface supporting Modbus-RTU protocol can use this product to realize interconnection with industrial bus ProfiNet. Such as: PLC, DCS, distributed IO, frequency converter, motor start protection device, intelligent high and low voltage electrical appliances, electricity measuring device, intelligent field measuring equipment and instruments, etc.

1.2 The main technical parameters

◆ Installation method：35mm standard rail installation

◆ dimension：110*110*27.5mm

◆ Support standard ProfiNet I/O Device V2.3

◆ Profiet data area：The maximum input is 1440 bytes, and the maximum output is 1440 bytes.

◆ It supports RT (synchronization), IRT (isochronous synchronization), MRP (media redundancy protocol), and does not support MRPD (media path planning redundancy) functions, so IRT and MRP functions cannot be used at the same time.

◆ Maximum slots: 50

◆ Serial port isolation: optocoupler isolation, power isolation

◆ Number of serial ports: support dual serial port RS485/RS232 or single serial port RS422

◆ Serial port terminal resistance: an external 120Ω resistance is required.

◆ Serial protocol：Supports Modbus-RTU/ASCII Master、Modbus-RTU/ASCIIA Slave

◆ Serial port parameters：Support 1200-115200 baud rate, support none, odd, even parity

◆ Number of Modbus stations supported by serial port: 50 (limited by slot)

◆ Support Modbus function code：01/02/03/04/05/06/15/16

◆ Power supply: 9-36VDC input, nominal 24VDC

◆ Operating temperature：-40~85℃

◆ Storage temperature：-55~125℃

◆ environment humidity：5%-95%(No condensation)

◆ Protection level：IP20

## 2.Hardware description

2.1 Appearance

Power terminal

Profinet interface

Indicator light

Buckle

Serial port line

Modbus/Profinet Gateway
ODOT-PNM02

Power Supply: 9~36 VDC
Operating Temperature: -40~85°C
Humidity: 5~95%RH (non-condensing)

Symbol Description
PWR: Power Status
DF: Device Fault
SF: System Fault
BF: Bus Fault
CO1:   1#Serial Status
CO2:   2#Serial Status

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The upper panel has two ProfiNet interfaces and power connection terminals. PORT1 and PORT2, the two interfaces have the same function. These two interfaces have the switch function, that is, the host computer can access the equipment connected to PORT2 through the PORT1

interface, as shown in the figure below (the computer IP is 192.168.1.92, the computer is connected to the PORT2 port, Siemens S7 -1200 connects to PORT1), the upper computer software can search for devices in the same ProfiNet　Network.
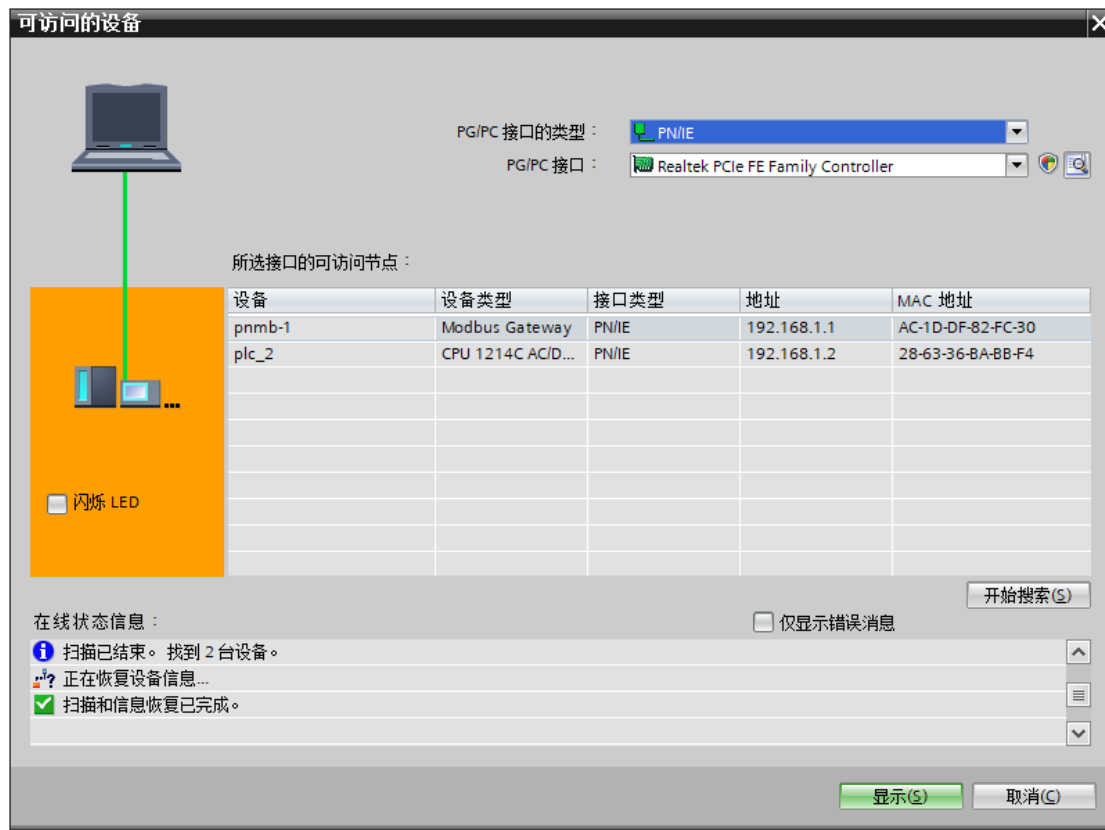
The front panel is a gateway serial port terminal. The serial port terminal is 2 serial ports when used for RS-232 communication or RS-485 communication, and 1 serial port when used for RS-422 communication. For specific definitions, see 2.3 Terminal Definitions.

2.2 Indicator light description

The equipment has six LED status indicators, the symbol definition

and status description are shown in the table below.

Symbol	Definition	Status	Description
PWR	Power indicator	Red light is always on	power supply on
		Red light off	Power is not turned on
DF	Equipment status indication	Red light is always on	Equipment failure
		Red light off	Equipment is normal
SF	System status indication	Red light is always on	system error
		Flashing red	Lighting test
		Red light off	System is normal
BF	Bus status indication	Red light is always on	The network cable is not connected
		Flashing red	The bus configuration is not configured
		Red light off	Bus is normal
CO1	Serial port 1 status indication	Flashing green	Serial 1 has data transmission and reception
		Green light off	Serial 1 no data

		transmission and reception
CO2	Serial port 2 status indication	Red light off	Serial 2 has data transmission and reception
		Green light off	Serial 2 no data transmission and reception

2.3 Terminal definition

The equipment wiring adopts 6Pin 3.81mm pitch plug-in terminal.

The terminal definition of RS485 interface is shown in the table below。

Serial number	Logo	Wiring definition		
		RS485	RS232	RS422
1	1TA+	Serial port1 (A+)		Serial port1 (TX+)
2	1TB-	Serial port1 (B-)		Serial port1 (TX-)
3	1R+			Serial port1 (RX+)
4	1R-			Serial port1 (RX-)

5	GND	Common ground (signal ground)		
6	1TX		Serial port1 1 (TX)	
7	1RX		Serial port1 1 (RX)	
8	PE	Shield ground		
9	2TA+	Serial port 2 (A+)		Serial port2 (TX+)
10	2TB-	Serial port 2 (B-)		Serial port2 (TX-)
11	2R+			Serial port2 (RX+)
12	2R-			Serial port2 (RX-)
13	GND	Common ground (signal ground)		
14	2TX		Serial port 2 (TX)	
15	2RX		Serial port 2 (RX)	
16	PE	Shield ground		

2.4 External terminal resistance

According to the actual situation on site, a 120Ω terminal resistor needs to be connected to the serial port of the gateway. The RS485 bus supports a maximum of 32 nodes without relays. The nodes are connected by a "daisy chain" connection. Terminal resistors are required at both ends of the communication cable, and the resistance is required to be approximately equal to the characteristics of the transmission cable. impedance. In short-distance transmission, termination resistors are not required, that is, termination resistors are generally not required below 300 meters. The terminating resistor is connected to the two ends of the transmission cable.When the gateway is applied in the field, if the field RS485 bus is far away and the field interference is large, it is necessary to add 120Ω terminal resistance at both ends of the RS485 bus to prevent the reflection of the serial signal.

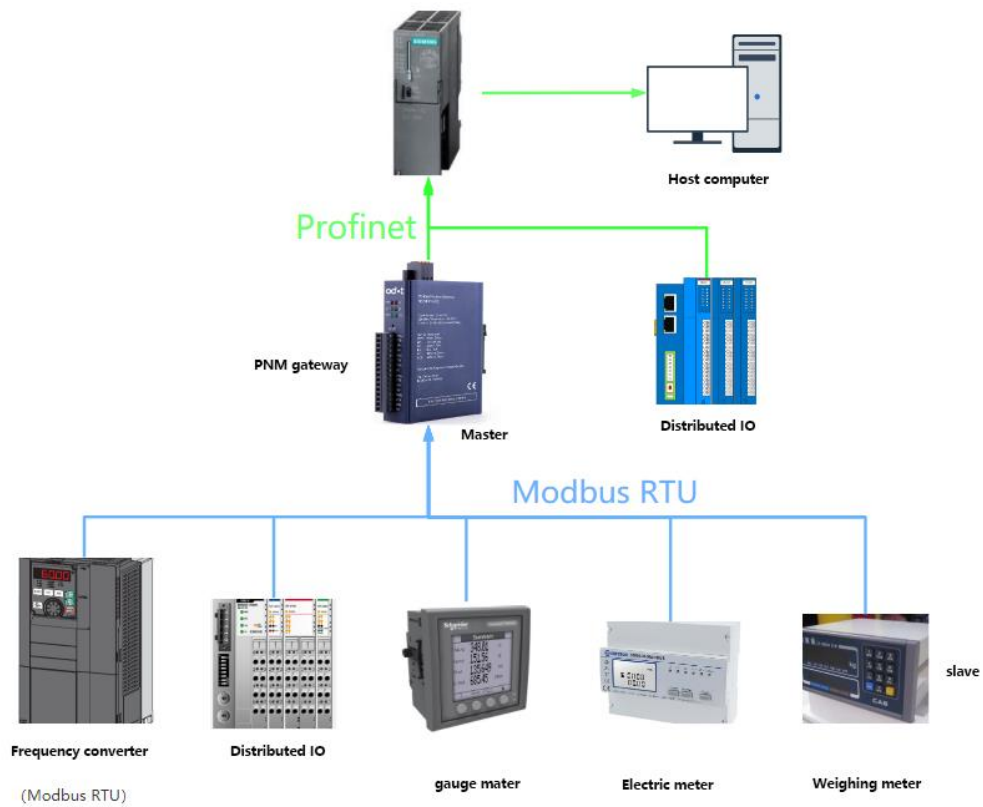Note: The 120Ω resistor is attached in the box, please check it.
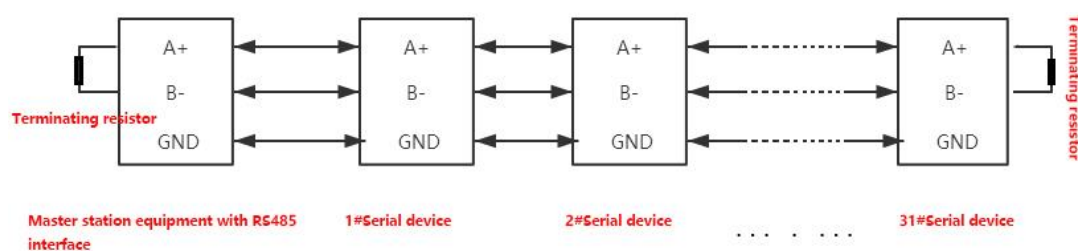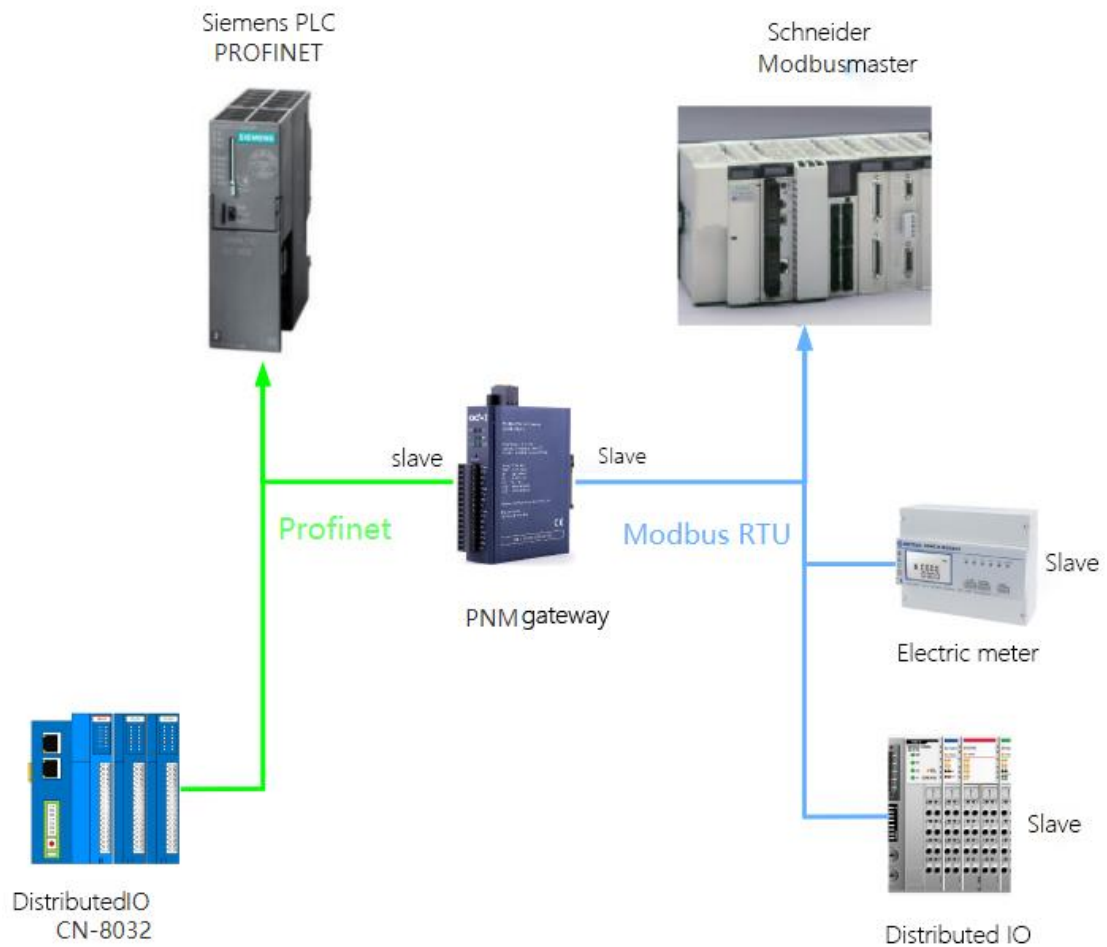
2.5 Installation size

3.Product application topology

Topology diagram of master Mode

Topology diagram of slave mode

4.Firmware upgrade

When the module firmware is updated, the module firmware needs to be upgraded. The upgrade needs to be performed in IAP mode.

After pressing the reset button, power on the module with 24Vdc. When the SF and BF indicator lights flash red, it means entering the IAP module. Connect the 485 ports A and B of the USB to 485 converter to the 1TA+ and 1TB- ports of the gateway serial port 1, and connect the USB interface of the converter to the USB interface of the computer

Install the upgrade software: Firmware Update Tool V1.0.0.8
After the installation is complete, open the upgrade software, select the serial port of the interface, and then check the serial port number on my computer-"Device Manager". The baud rate is set to 115200. Click to read device information, you can read the internal firmware information of the gateway.
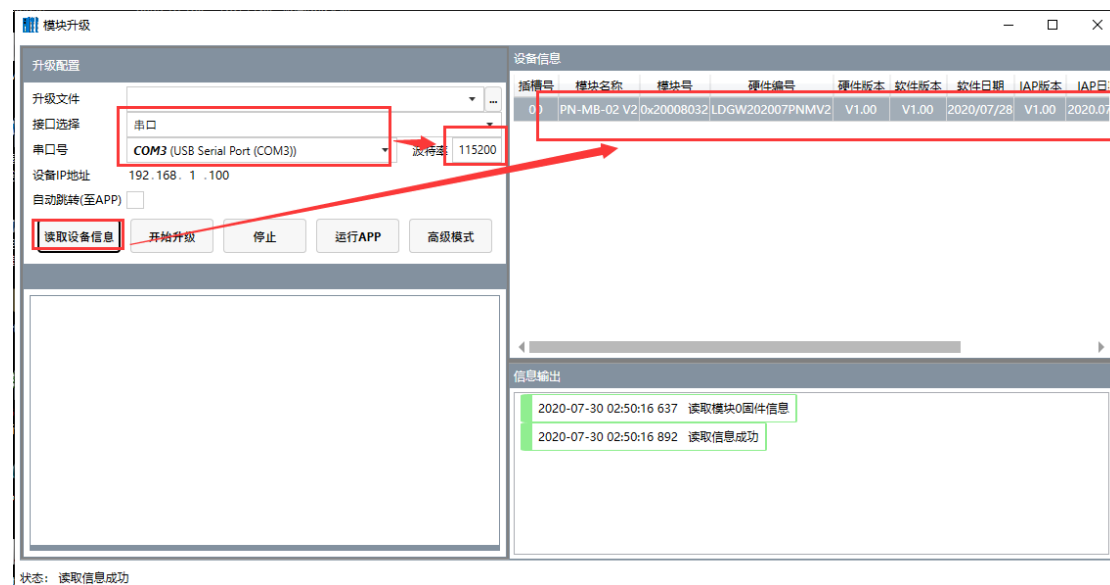
Click on ⬚，In the pop-up interface, select the new firmware file, click Open, and the new firmware information will be displayed in the lower left corner.
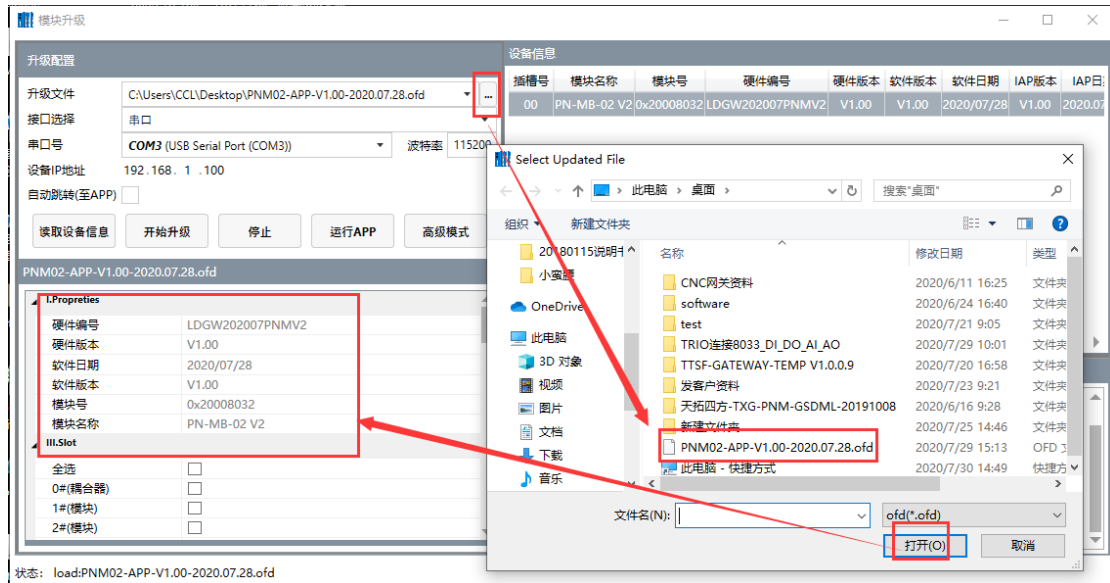
Select 0# coupler, tick "√", click to start upgrading, and click to run APP after completion. Or select automatic jump (to APP) and click to start the upgrade.
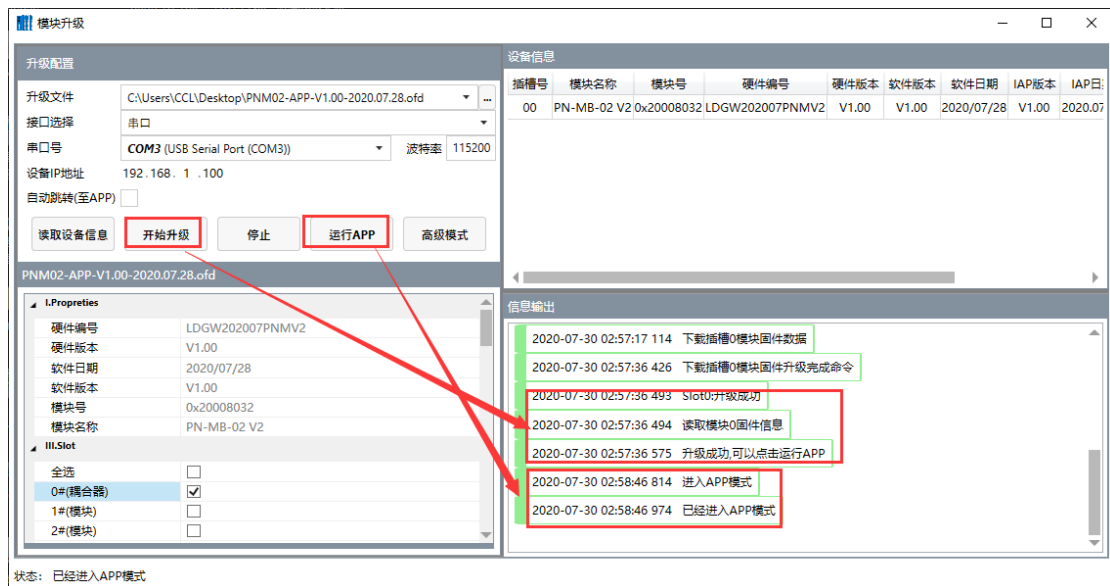
When entering APP mode, all indicators will flash once.

5.Appendix

6. Modbus-RTU Introduction to Agreement

For you, you only need to understand that Modbus has 8 important function codes corresponding to 4 areas: 4 for reading, 2 for writing a single bit or register, and 2 for writing multiple bits or multiple registers. (Address description uses PLC address)

6.1 Modbus Storage area

The storage area of the controller (or Modbus device) involved in Modbus is identified by 0XXXX, 1XXXX, 3XXXX, 4XXXX.

Store ID	Name	type of data	Read/ write	Storage unit address
0XXXX	Output coil	Bit	Read/ write	00001~0XXXX, XXXX：Related to equipment

1XXXX	Discrete input	Bit	Read only	10001~1XXXX, XXXX：Related to equipment
3XXXX	Input register	word	Read only	30001~3XXXX, XXXX：Related to equipment
4XXXX	Output/holding register	word	Read/write	40001~4XXXX, XXXX：Related to equipment

6.2 Modbus function code

The Modbus message is relatively fixed, so you only need to understand it a little bit. After reading a few messages, you will know its structure, and you can inquire about it when you need it.

（1）Read output coil status

（2）function code：01H

Master query message format：

address	function code	Start address high	Start address low	High number of coils	Low number of coils	CRC
0x11	0x01	0x00	0x13	0x00	0x25	xxxx

Function: Read the 0XXXX status of the slave output coil.

Note: The start address of the coil of some equipment is 00000, which corresponds to the address 00001 in the equipment, which is sequentially extended.

This example: read the output coil of slave station 0x11, the register start address is 0x13=19, the number of coils is 0x0025H=37; therefore, the function of this query message is: read 0x11(17) slave station output coil 00019—00055, A total of 37 coil states.

address	function code	Byte count	Coil state 19-26	Coil state 27-34	Coil state 35-42	Coil state 43-50	Coil state 51-55	CRC
0x11	0x01	0x05	0xCD	0x6B	0xB2	0x0E	0x1B	xxxx

Slave response format:

Function: Slave machine returns to output coil 0XXXX state

(2) Read discrete input state

(3) function code：02H

Master station inquiry message format：

address	function code	Start address high	Start address low	High number of coils	Low number of coils	CRC
0x11	0x02	0x00	0xC4	0x00	0x16	xxxx

Function: Read the status of the slave input coil 1XXXX.

Note: The start address of some equipment coils is 10000, which corresponds to the address 10001 in the equipment, which will be

extended sequentially.

This example: read the input coil of slave station 0x11, the starting address is 0x00C4=196, and the number of coils is 0x0016=22.

Therefore, the function of this inquiry message is: read 0x11 (17) slave station input coil 10196-10217, a total of 22 discrete input states.

Slave response format：

address	function code	Byte count	DI 10196-10203	DI 10204-10211	DI 10212-10217	CRC
0x11	0x02	0x03	0xAC	0xDB	0x35	xxxx

Function: Slave machine returns to input coil 1 XXXX state

(3) Read output/holding register

function code：03H

Master station inquiry message format:

address	function code	Register start address high	Register start address low	High register number	Low register number	CRC
0x11	0x03	0x00	0x6B	0x00	0x03	xxxx

Function: Read the value of the slave holding register 4XXXX.

Note: Some device registers start address 40000 corresponds to 40001 address in the device, and it is postponed sequentially.

This example: read the value of the holding register of the slave station 0x11, the starting address is 0x006BH=107, and the number of registers is 0x0003; therefore, the function of this query message is:

reading the 3 holding registers 40107-40109 of the slave station No. 0x11 (17H) value

address	function code	Byte count	Register 40107 high	Low bit of register 40107	Register 40108 high	Register 40108 low	Register 40109 high	Register 40109 low	CRC
0x11	0x03	0x06	0x02	0x2B	0x01	0x06	0x2A	0x64	xxxx

Function: The slave station returns the value of the holding register: (40107)=0x022B, (40108)=0x0106, (40109)=0x2A64

(4) Read the input register

(5) function code：04H

Master station inquiry message format:

address	function code	Register start address high	Register start address low	High register number	Low register number	CRC
0x11	0x04	0x00	0x08	0x00	0x01	xxxx

Function: Read the value of slave station input register 3XXXX.

Note: In some devices, the register start address 30000 corresponds to the address 30001 in the device, and it is extended sequentially.

This example: Reading the value of the input register of slave station 0x11, starting at 0x0008H Note: In some devices, the starting address of the register 30000 corresponds to the address 30001 in the device, and it is extended sequentially.

This example: read the input register value of slave station 0x11, the

starting place is 0x0008H, and the register number is 0x0001;

Therefore, the function of this query message: read the value of 1 input register 30008 of slave station 0x11 (17); the number of registers is 0x0001;

Therefore, the function of this query message: read the value of 1 input register 30008 of slave station 0x11 (17);

Slave response format：

address	function code	Byte count	Input register 30008 high	Input register 30008 low data	CRC
0x11	0x04	0x02	0x01	0x01	xxxx

Function: Slave station returns the value of input register 30008;

(30008)=0x0101

(6) Force a single coil

(7) Function code: 05H

(8) Master station inquiry message format:

address	function code	Coil address high	Coil address low	Disconnect mark	Disconnect mark	CRC
0x11	0x05	0x00	0xAC	0xFF	0x00	xxxx

Function: Forcibly set the value of 0x01(17) slave coil 0XXXX. In some devices, the coil start address 00000 corresponds to the address

00001 in the device, which is sequentially extended.

Disconnect mark=FF00，Set coil ON。

Disconnect mark=0000，Set coil OFF。

Example: The starting address is 0x00AC=172. Forcibly set the No. 17 slave coil 0172 to ON.

Response format: original text return

address	function code	Coil address high	Coil address low	Disconnect mark	Disconnect mark	CRC
0x11	0x05	0x00	0xAC	0xFF	0x00	xxxx

Function: Forcibly set the No. 17 slave coil 0172 ON to return the original text

（6）Preset single holding register

function code：06H

Master station inquiry message format:

address	function code	Coil address high	Register start address low	High register number	Low register number	CRC
0x11	0x06	0x00	0x87	0x03	0x9E	xxxx

Function: Preset order to hold the value of register 4XXXX. In some devices, the coil start address of 40000 corresponds to the address of 40001 in the device, which is sequentially extended.

Example: preset the single holding register 40135 of No. 17 slave to 0x039E;

Response format: original text return

address	function code	Coil address high	Register start address low	High register number	Low register number	CRC
0x11	0x06	0x00	0x87	0x03	0x9E	xxxx

Function: Preset No. 17 slave single holding register 40135 as

0x039E and return to the original text.

(7) Forced multiple coils

(8) function code：0FH

address	function code	High bit of coil start address	Low bit of coil start address	High number of coils	Low number of coils	Byte count	Coil state 20-27	Coil state 28-29	CRC

						0x02	0xCD	0x00	xxxx
0x11	0x0F	0x00	0x13	0x00	0x0A				

Master station inquiry message format:

Function: Force multiple continuous coils 0XXXX to ON/OFF state.

Note: In some devices, the coil start address 00000 corresponds to the address 00001 in the device, which is sequentially extended.

In this example: forcibly set multiple continuous coils from the slave station of No. 0x11, the start address of the coil is 0x0013=19, and the number of coils is 0x000A=10

Therefore, the function of this query message is: forcibly set the value of 0x11(17) slave station 10 coils 00019-00028;

CDH→00019-00026; 00H→00027-00028;

Slave response format:

address	function code	High bit of coil start address	Low bit of coil start address	High number of coils	Low number of coils	CRC
0x11	0x0F	0x00	0x13	0x00	0x0A	xxxx

(9) Preset multiple registers

(10) function code：10H

Master station inquiry message format:

address	function code	Start register address high	Start register address Low	High register number	Low register number	Byte count	Data high	Low-level data	Data high	Data low	CRC
0x11	0x10	0x00	0x87	0x00	0x02	0x04	0x 01	0x 05	0x 0A	0x 10	xx xx

Function: preset multiple holding register values 4XXXX of the slave.

Note: In some devices, the starting address of the holding register 40000 corresponds to the address 40001 in the device, which is extended in turn.

This example: preset multiple holding register values of slave station 0x11, the starting address of the register is 0x0087=135, and the number of coils is 0x0002=2.

Therefore, the function of this query message is: preset the values of 2 holding registers of the slave station of No. 0x11 (17); 0105H→40135; 0A10H→40136.

Response format:

address	function code	Start register address high	Start register address Low	High register number	Low register number	CRC
0x11	0x10	0x00	0x87	0x00	0x02	xxxx

7.Brief introduction of serial network topology

7.1 RS232

RS232 is one of the serial communication interfaces of industrial control, and it is widely used to connect computer serial interfaces and peripherals. RS232 uses a signal line and a signal return line to form a common ground transmission form. The three-wire connection method can realize full-duplex communication. The transmission signal is a single-ended signal. This common ground transmission is prone to common mode interference. Therefore, the anti-noise interference is weak and the transmission distance is limited. The RS232 interface standard stipulates that the maximum transmission distance standard value is 50 feet (approximately 15 meters) when the symbol distortion is less than 4%. (Long-distance communication above 15m needs to be adopted Modem), the maximum transmission distance is also related to the communication baud rate. In actual use, if the transmission distance is far,

please lower the baud rate. In order to reduce the external electromagnetic interference during signal transmission, please use shielded cables as communication cables.

The RS232 interface standard stipulates on TXD and RXD:

RS232 uses negative logic to transmit signals, and takes -(3~15)V signal as logic "1"; takes +(3~15)V signal as logic "0"; voltage between -3~+3V It is meaningless, and a voltage lower than -15V or higher than +15V is also meaningless.

RS232 interface classification:

DB9 male connector

The upper left corner is 1, the lower right corner is 9

9-pin RS232 serial port（DB9）		
PIN	Name	Effect
1	CD	Carrier detect
2	RXD	Receive data
3	TXD	Receive data
4	DTR	Data terminal is ready
5	GND	Signal ground

6	DSR	Data ready
7	RTS	Request to send
8	CTS	Clear to send
9	RI	Ring alert

Because the RS232 interface has the above-mentioned electrical characteristics, it can only realize point-to-point communication.

The RS232 communication wiring diagram is shown in the figure:

Communication equipment with RS232

Terminal equipment with RS232 interface
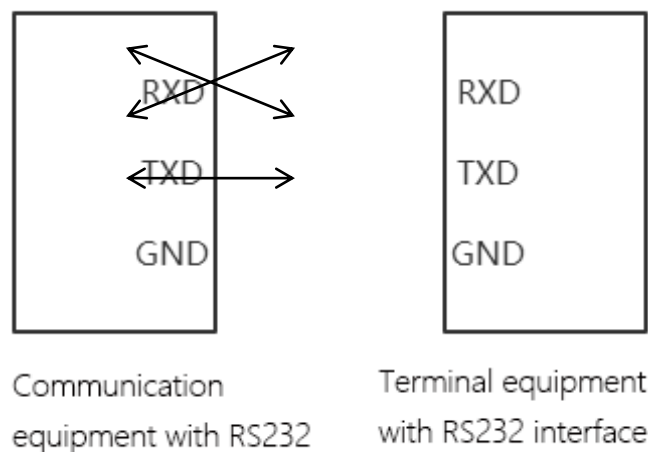
7.2 RS422

The full name of RS422 interface standard is "Electrical Characteristics of Balanced Voltage Digital Interface Circuit", which defines the characteristics of the interface circuit. RS422 adopts four-wire plus ground wire (T+, T-, R+, R-, GND), full-duplex, differential transmission, multi-point communication data transmission protocol. It adopts balanced transmission and adopts unidirectional/non-reversible

transmission line with or without enabling end. Because the receiver adopts high input impedance and the transmission driver has stronger driving ability than RS232, it is allowed to connect multiple receiving nodes on the same transmission line, up to 10 nodes can be connected. That is, a master device (Master), and the rest are slave devices (Salve). The slave devices cannot communicate, so RS-422 supports point-to-many two-way communication.

The maximum transmission distance of RS-422 is 4000 feet (about 1219 meters), and the maximum transmission rate is 10Mb/s. The length of the balanced twisted pair is inversely proportional to the transmission rate, and the maximum transmission distance is only possible when the rate is below 100kb/s. Only in a short distance can the highest transmission rate be obtained. Generally, the maximum transmission rate that can be obtained on a 100-meter-long twisted pair cable is only 1Mb/s.

RS-422 needs to be connected to a terminal resistor, and its resistance is required to be approximately equal to the characteristic impedance of the transmission cable. In short-distance transmission, no terminating resistor is needed, that is, no terminating resistor is generally required below 300 meters. The terminating resistor is connected to the far end of the transmission cable.

In the one-master-multi-slave network connection, the sending ends

of all slave stations are connected to the receiving end of the last

connected to the master station through a daisy chain; the receiving ends

of all slaves are connected to the last connected to the master station
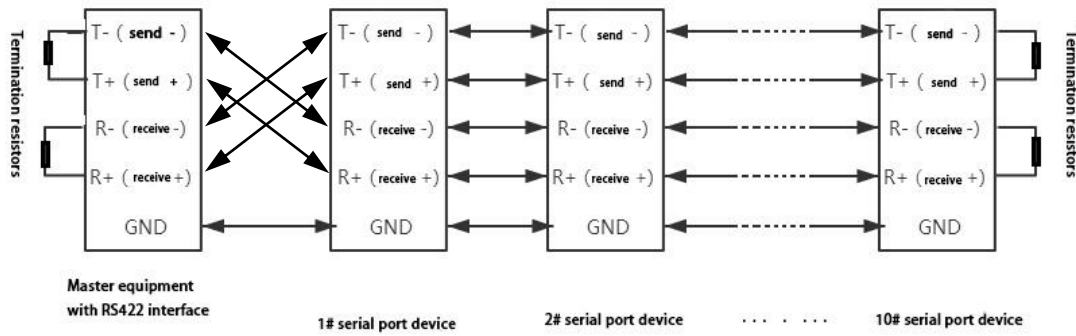
through a daisy chain. Sender.

RS422 pin definition:

RS422（9Pin）		effect	Remarks
3	R-	Receiving negative	Must connect
2	T-	Send negative	Must connect
7	R+	Receiving positive	Must connect
8	T+	Send positive	Must connect

The upper left corner is 1, the lower right corner is 9

The RS422 communication wiring diagram is shown in the figure:

7.3 RS485

Since RS-485 is developed on the basis of RS-422, many electrical regulations of RS-485 are similar to RS-422. For example, balanced transmission methods are adopted, and terminating resistors are required to be connected to the transmission line. RS-485 can adopt two-wire and four-wire methods, and the two-wire system can realize true multi-point two-way communication.

RS485 is a standard that defines the electrical characteristics of drivers and receivers in a balanced digital multipoint system. It uses a combination of balanced drivers and differential receivers to enhance the ability to resist common mode interference, that is, to resist noise interference. Since the half-duplex network composed of RS485 interface generally adopts two-wire connection mode, and uses differential signals to transmit data, the voltage difference between the two wires is -(2~6)V, which means logic "0", the voltage difference between the two wires +(2~6)V means logic "1".

The RS485 signal transmission distance is related to the

communication baud rate. The higher the baud rate, the shorter the transmission distance. When the baud rate is not higher than 100KbpS, the theoretical maximum communication distance is about 1200 meters. In actual use, due to Factors such as electromagnetic interference often fail to reach the maximum communication distance. If you are communicating over a longer distance, please lower the baud rate. To reduce the signal's electromagnetic interference during transmission, please use twisted-pair shielded cables as communication cables.

The RS485 bus supports a maximum of 32 nodes without relays. The nodes are connected by a "daisy chain" connection. Terminal resistors are required at both ends of the communication cable, and the resistance is required to be approximately equal to the characteristics of the transmission cable. impedance. In short-distance transmission, no terminating resistor is needed, that is, no terminating resistor is generally required below 300 meters. The terminating resistor is connected to the two ends of the transmission cable.
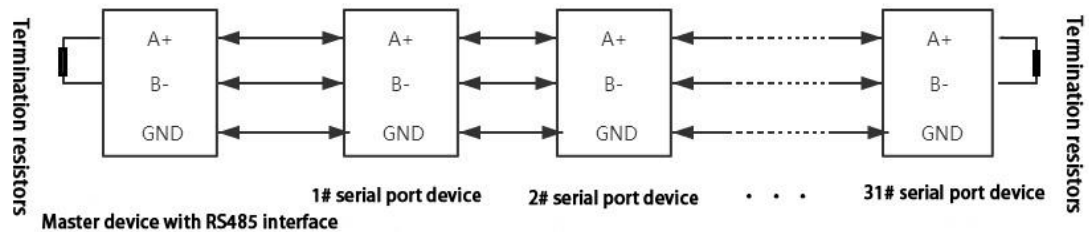
RS485 9-pin pin definition:

Pin	Name	Effect	Note
1	Data-/B-/485-	Send positive	Must connect
2	Data+/A+/485	Receivin	Must

	+	g positive	connect
5	GND	Ground wire	

The RS485 communication wiring diagram is shown in the

figure:

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