

RS485/PROFIBUS-DP Adapter PM-125

User Manual



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SiboTech Automation Co., Ltd

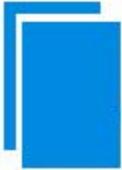
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1 About This Manual

1.1 General

This manual describes every parameter of the gateway PM-125 and provides using methods and some announcements that help users use the gateway. Please read this manual carefully before using the gateway.

1.2 Important user information

The data and examples in this manual can not be copied without authorization. Sibotech maybe upgrades the product without notifying users.

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The product has many applications. The users must make sure that all operations and results are in accordance with the safety of relevant field, and the safety includes laws, rules, codes and standards.

1.3 Terms

Profibus-DP: Profibus-DP protocol

RS485: Hardware specifications of serial interface

PM-125: RS485/Profibus-DP gateway

RS-25: Convert RS485/RS232 to RS232/RS485



2 About the Gateway

2.1 Product Function

The adapter PM-125 establishes communication between serial network and Profibus-DP network, and can connect a device with Modbus /RS485 interface with Profibus-DP network. Modbus/RS485 network device can be converted to Profibus-DP network device.

2.2 Feature

- **Widely used:** Most devices with RS485 interface can be connected to Profibus-DP network through PM-125. Such as converters with Modbus protocol or nonstandard protocol interface, motor startup protection devices, intelligent high and low voltage electrical equipments, power measuring devices, transmitters, intelligent field measuring equipments and instruments and so on.
- **Easy implementation:** Users needn't know the technical details of Profibus and serial, but refer to this manual and the application examples provided, complete configuration according to the requirements without complex programming, establish communication in a short time.
- **Minimum Configuration:** Support finishing mapping relationship between Modbus and Profibus-DP or configuring serial parameters and downloading to the adapter as factory settings. Need not be informed the end user about any serial technical details. Once completed, can need not change the configuration later.

2.3 Technical Specification

[1] Act as a Profibus-DP Slave at the side of Profibus-DP, serial port support Modbus Master/ Universal mode. The adapter establishes transparent communication between Profibus-DP and Modbus through the mapping relationship between Profibus-DP data communication area and Modbus data communication area.

[2] As a Modbus Master, PM-125 supports 01H, 02H, 03H, 04H, 05H, 06H, 0FH and 10H function codes. It can be configured up to 48 Modbus commands. 03H and 04H function codes support " Bytes mapping ", and be



convenient for the user to solve two network data between the big Endian and small Endian.

[3] Support the control mode of character timeout, character number and delimiter in universal mode, and have the function of sending automatically..

[4] Complete Profibus-DP V0 slave functionality according to EN50170 (IEC61158)

[5] As a Profibus-DP Slave, baud rate is self-adaptive and up to 12Mbps.

[6] Profibus input/output bytes number can be set through Step7 freely, the maximum number:

①Max Input Bytes ≤ 168 Bytes

②Max Output Bytes ≤ 168 Bytes

③Max Data Bytes ≤ 336 Bytes

[7]Max Module: 50

Modules: Status/Control (Optional)-Occupy one input-byte and one output-byte.

Bit 0 of input-byte: Serial device fault indication, 0 indicates that there is no fault in Modbus Slave, 1 indicates that there is something wrong with Modbus Slave, the other 7 bits reserved.

Bit 0 of output-byte: Set 1 to hold the fault status of device, Set 0 to refresh the status of Slave all the time, the other 7 bits reserved.

Note: The “Status/Control” module can only be valid in “Modbus master” mode.

4 Words Input, 4 Words Output

8 Words Input, 8 Words Output

16 Words Input, 16 Words Output

32 Words Input, 32 Words Output

64 Words Input, 64 Words Output

1 Byte Input

1 Word Input

8 Words Input

1 Byte Output

1 Word Output

8 Words Output

2 Words Input Consistent



4 Words Input Consistent

2 Words Output Consistent

4 Words Output Consistent

If use “Status /Control (Optional)” Module when configuration in STEP7, putting it at the bottom of all data modules is a better choice.

The Module will occupy one input byte and one output byte of PM-125 memory mapping, if you put it at the top of the memory or in the middle of the memory, you should reserve one input and output byte when you configure Modbus parameters in PMA-123.

[8] Modbus interface is RS485, half-duplex. Baud rate: 300, 600, 1200, 2400, 9600, 19200, 38400, 57600, 115200bps, and 8-bit data bit. Parity check mode: None, Odd Even, Mark and space can be selected.

[9] Power: 24VDC (11V~30V), 80mA (24VDC);

[10] Working temperature: -20°C~60°C, Humidity: 5%~95%;

[11] External dimensions: (Width) 70mm* (Height) 100mm* (Depth) 25mm;

[12] Installation: 35mm DIN RAIL;

[13] Protection Level: IP20;

2.4 Attention

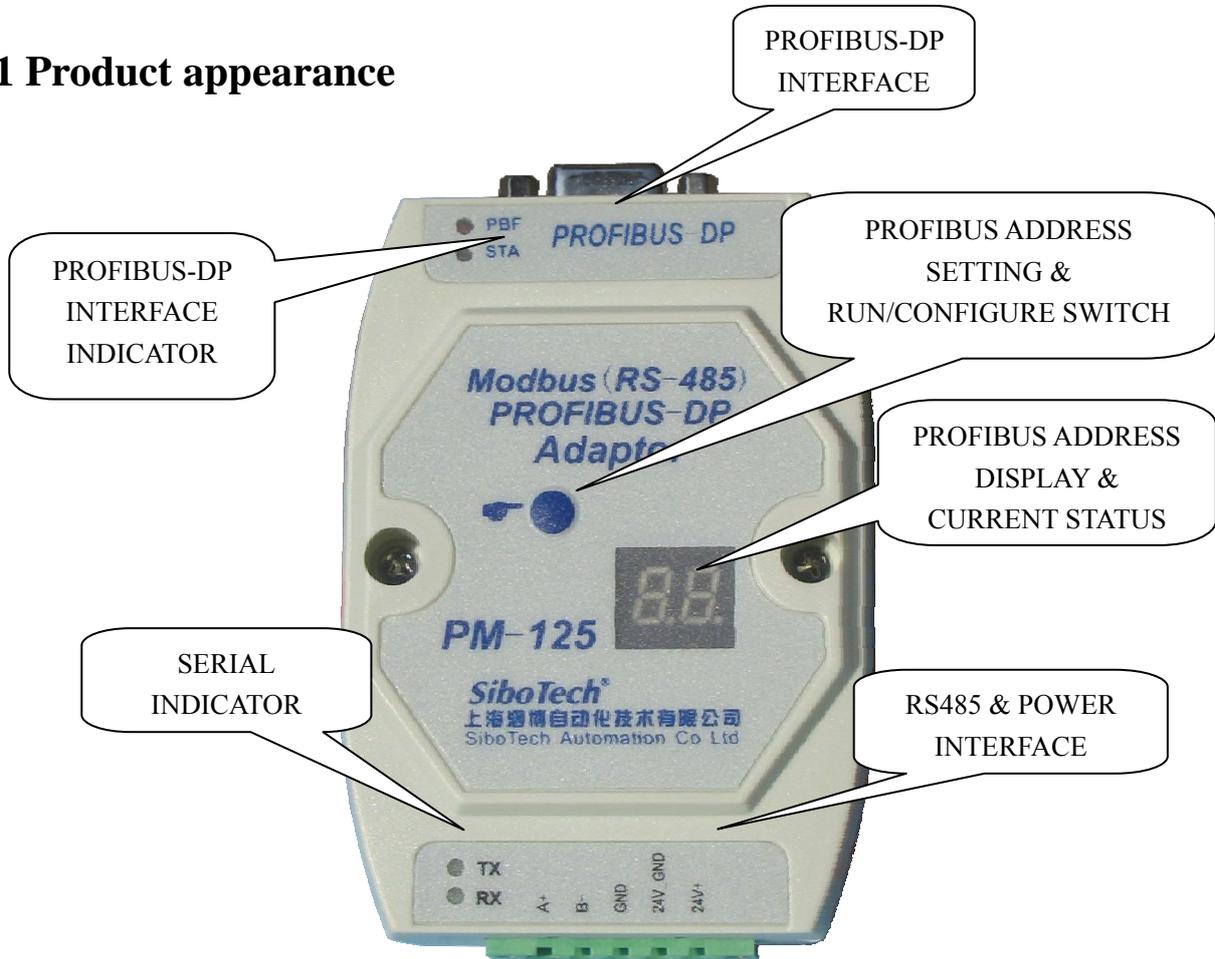
- ◆ To prevent stress, prevent module panel damage;
- ◆ To prevent bump, module may damage internal components;
- ◆ Power supply voltage control in the prospectus, within the scope of the requirements to burn module;
- ◆ To prevent water, water module will affect the normal work;
- ◆ Please check the wiring, before any wrong or short circuit.

2.5 Related Products

Other related products in Sibotech: PM-160, PM-127 and so on. If you want to get more information about these products, please visit Sibotech website: <http://www.sibotech.net/en> , or call the technical support hotline: +86-21-5102 8348.

3 Hardware Descriptions

3.1 Product appearance



3.2 Indicators

Indicator	Status	Description
STA	Green Blinking	Profibus-DP is communicating.
	Green Off	Be not communicating.
PBF	Always Red	Profibus-DP communication fails.
	Red Off	Communication is ok.
RX	Green Blinking	Serial port is receiving data.
	Green Off	Serial has no data received.



TX	Green Blinking	Serial port is sending data
	Green Off	Serial has no data sent.

3.3 Button and LED

- Configuration Button has two functions: Enter the mode of configuring parameters; Modify Profibus-DP address of the module.
- LED: Display the current Profibus-DP address and the status of running or configuration.

The default mode of PM-125 after powering on is normal communication mode, LED displays Profibus address, and always bright.

Double click on the button and enter the menu: (After double-clicking on the button, enter the configuration menu first)

Menu: Configuration menu, Set Profibus address menu

Configuration menu: CF, blinking;

Set Profibus menu: Ad, blinking.

Click on the button and turn to another menu at the status of displaying menu, long press the button more than 2.5s and turn to the status that menu shows.

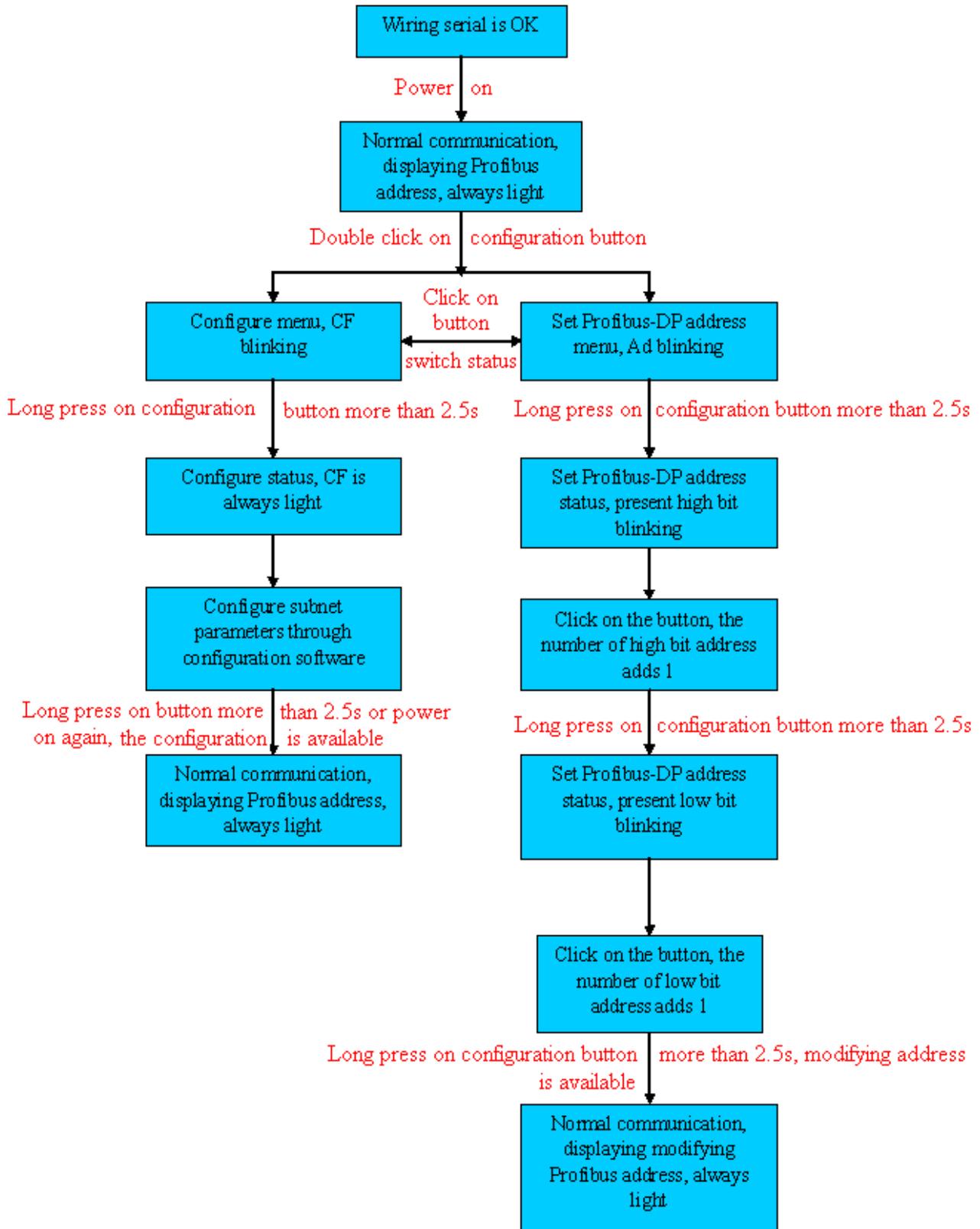
Configuration Status: CF always bright.

Set Profibus address Status: The high or low bit of present Profibus address blinking.

Configure Modbus parameters: configure relevant parameters through configuration software at the status of configuration, and download to PM-125, long press on the button more than 2.5s or power on PM-125 again, the configuration will be available and enter into normal communication status.

Set Profibus address: At the status of modifying Profibus address (High bit of current Profibus address is blinking, low bit is always bright), click on the button and the number adds 1 by itself, press the button more than 2.5s to enter into the mode of modifying low bit address(High bit is always bright, low bit is blinking), click on the button and the number adds 1 by itself, press the button more than 2.5s to save the new address and make it available, enter the status of normal communication. If there is no pressing button more than 10s, LED get back to display Profibus address, and the modifying address is null before. No overtime exiting function at

configuration status. Configuration button function is shown as follow:



Note: Except normal status and configuration status (LED always displays “CF”), if there is no pressing on button more than 10s, the LED returns back to the status of displaying Profibus address (normal mode), and the previous modifying is null.

3.4 Communication Port

3.4.1 RS485

The RS485 interface of PM-125 is standard, and we will describe RS485’s features of the product:

◆ The basic characteristics of RS-485 transmission technology

① Network topology: Linear bus, there are active bus termination resistors at both sides.

② Baud rate: 1200 bps~115.2Kbps.

③ Media: Shielded twisted-pair cable and also can cancel the shielding, depending on environmental conditions (EMC).

④ Site number: 32 stations per subsection (without repeater), and can up to 127 stations (with RS485 repeater).

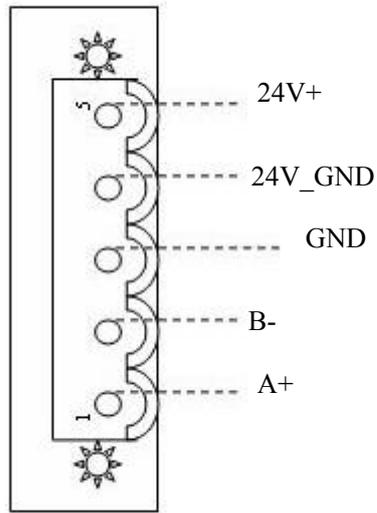
⑤ Plug connection: 5-pin pluggable terminal.

◆ The main points on RS-485 transmission equipments installation

① All the equipments are connected with RS-485 bus;

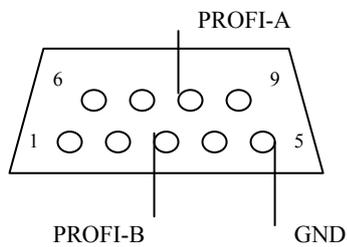
② The farthest end of each bus has a termination resistor—120Ω 1/2W to ensure reliable operation of the network..

Serial interface uses 5-pin pluggable terminal and users can wire it according to the wiring instructions on the panel.



Pin	Function
1	A+, RS485 Data Positive
2	B-, RS485 Data Negative
3	GND
4	24V_GND
5	24V+

3.4.2 Profibus-DP port



DB9 Pin	Function
3	PROFI_B, Data positive
5	GND (optional connection)



8	PROFI_A, Data negative
---	------------------------

4 Quick Start Guide

The follow steps will tell you how to configure PM-125 in short time:

1. Connect PM-125 Modbus/RS485 interface to PC COM, because the PC COM is RS232 interface, RS232/485 converter (such as RS-25) should be used here.
2. Power on PM-125, double-click on the configuration button and enter into menu mode (“CF” blinking), long press on the button more than 2.5s into configuration mode (CF is always bright), users can configure Modbus scanning commands through gateway configuration software PMA-123, the details can refer to “5 Instructions of software configuration”. After completing configuration, long press on the button more that 2.5s or power on PM-125 again to make sure that the configuration is available and enter normal communication mode.
3. Double-click on the button and enter into menu mode, and then click on the button, “Ad” blinking, long press on the button more than 2.5s into the mode of modifying Profibus-DP address (LED high bit blinking, and low bit always bright), click on the button and the number adds 1 by itself, long press on the button more than 2.5s and turn to the mode of modifying low bit address, click on the button and the number adds 1 by itself, long press on the button more than 2.5s to save new address and make sure that the address is available.
4. Register GSD file to Profibus-DP master configuration software.
5. In Profibus master configuration software, map the input/output of PM-125 to the memory of PLC or other master devices according to your requirements.
6. According to the instructions of RS485 interface in chapter 3, close the power and wire every pin of 5-pin terminal correctly.
7. According to the instructions of Profibus-DP interface in chapter 3, connect 3 pin and 8 pin correctly at least.
8. Connect Modbus devices with Profibus-DP master device, power on PM-125 and enter the normal mode of communication.



5 Instructions of configuration software

5.1 Notes before configuring

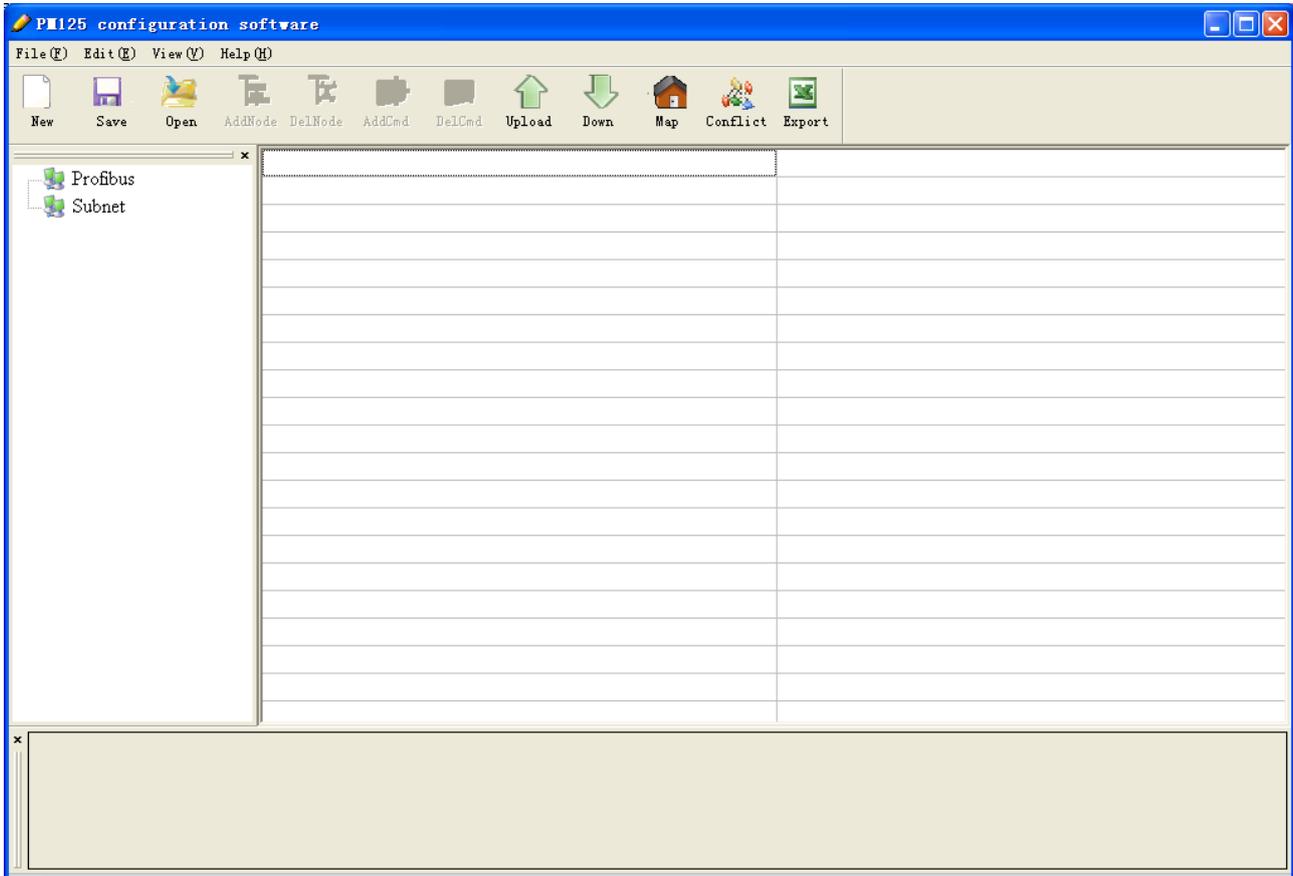
PMA-123 is a product based on Windows platform, and used to configure a variety of fieldbus gateway devices, including PM-125,, PM-126A and MPC-125. It can set related parameters and commands of Modbus and other bus.

The document mainly introduces the use method of PM-125.

Double-click the icon to enter the main interface of the software:



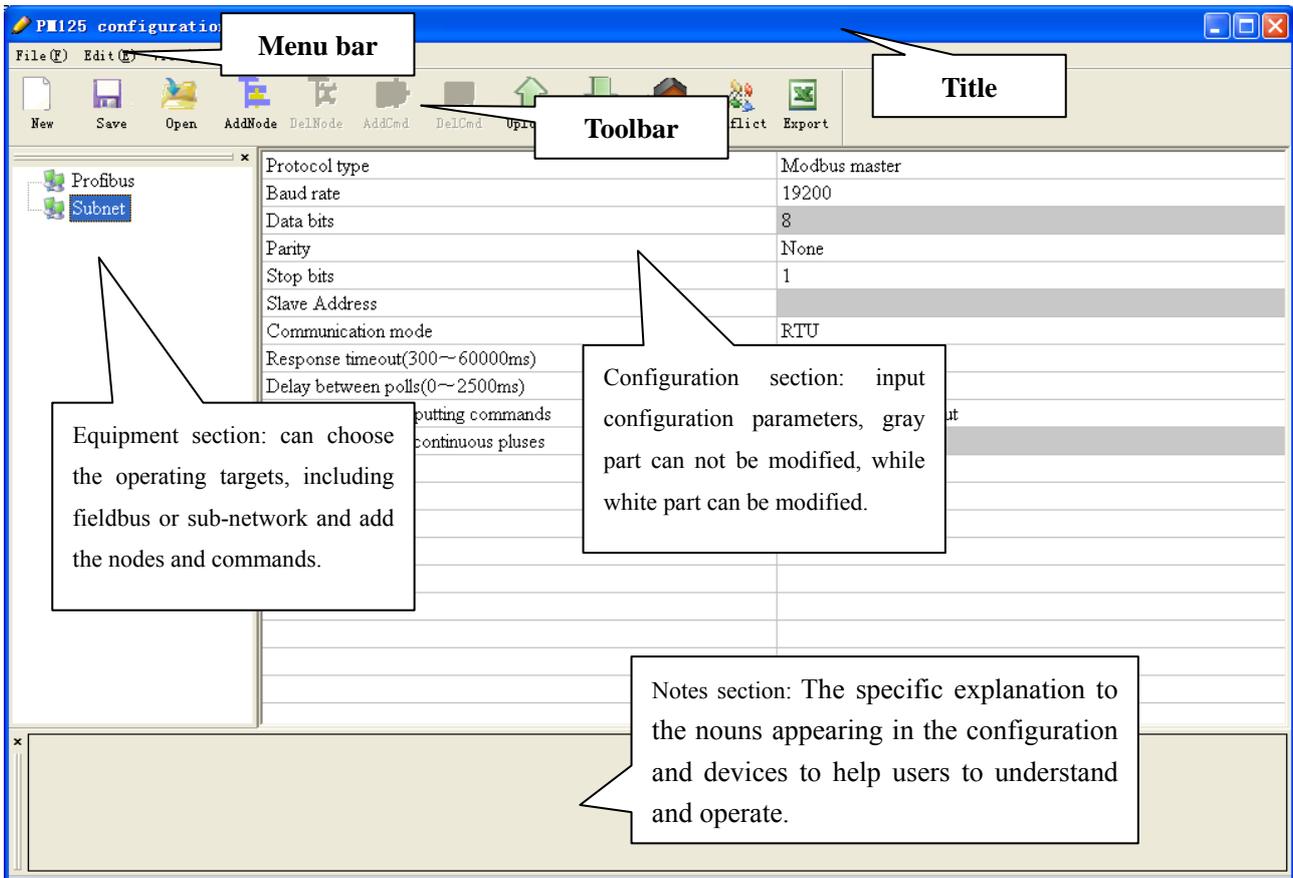
Choose "PM-125" to enter configuration interface:



5.2 User Interface

PMA-123 interface include: title, menu bar, toolbar, status bar, equipment section, configuration section and notes section.

Note: All the gray part in the software can not be changed.



Toolbar is shown as below:



Functions separately from left to right are: new, open, save, add nodes, delete nodes, add commands, delete commands, upload configuration, download configuration, Auto mapping, conflict detect, and Export Excel.



New New: Create a new configuration project



Save Save: Save the current configuration



Open Open: Open a configuration project



AddNode Add nodes: Add a Modbus slave node



DelNode Delete nodes: Delete a Modbus slave node



AddCmd Add commands: Add a Modbus command



DelCmd Delete commands: Delete a Modbus command



Upload Upload configuration: Read the configuration from the module and show it in the software



Down Download configuration: Download the configuration from the software to the module



Map Auto Mapping: Automatically computing mapping address



Conflict Conflict Detect: Detect whether there is conflict in memory data buffer of the gateway

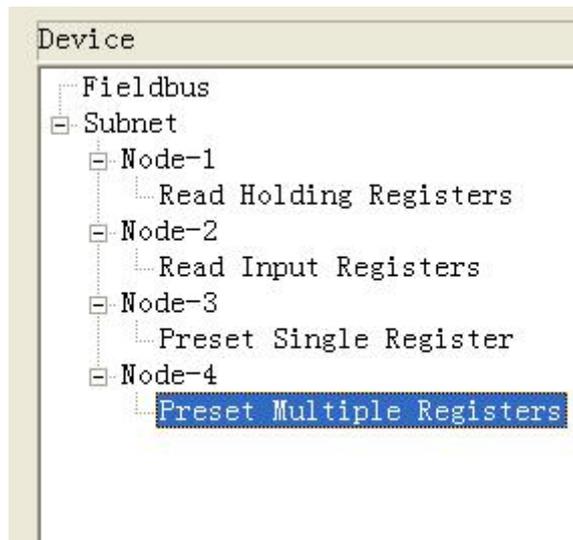


Export Output Excel document: Output the current configuration to local hard disk and save it as .xls file



5.3 The operation of equipment view

5.3.1 Equipment interface



5.3.2 Operation of equipment view

The equipment view supports three types of operation: Edit Menu, Edit Toolbar and Right click edit Menu.



5.3.3 Operation types of equipment view

1) Add nodes: Right click on subnet or existing nodes, and then perform the operation of adding a new node.



Then there is a new node named "new node" under subnet. **Note: PM-125 only supports configuring a Modbus node.**

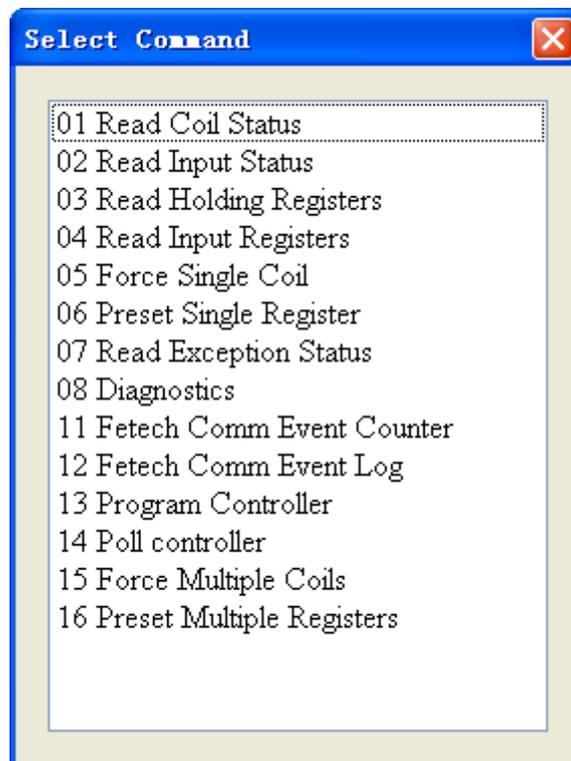
2) Delete nodes: Right click on the node to be deleted, and then perform the operation of deleting the node.

The node and its all commands will be deleted.

3) Add commands: Right click on the node, and then perform the operation of adding command to add an command for the node. The dialog box will be shown as follow:

Currently, it supports the commands: 01, 02, 03, 04, 05, 06, 15 and 16.

Select the command: Double click the command



4) Delete commands: Right-click on the command and then perform the operation of deleting the command.

5) Rename nodes: Left click on the node to be renamed, and then the edit status will be shown and you can rename it.



Response timeout: When the Modbus master send commands, the time waiting for response from the slave, the range is 300~60000ms.

Delay between polls: After an command of Modbus having been sent and having received correct response, the time before next command being sent, the range is: 0 ~ 2500ms.

Polling mode of outputting command:

Modbus writing command (output command) has 3 kinds of outputting modes: Continuous output, Output disable, Change-of-state output,

Continuous output: The same with Modbus read command, and output according to the scanning ratio.

Output disable: Prohibit outputting Modbus write command.

Change of state output: When the output data has changed, it output the write command and stop outputting after receiving correct response.

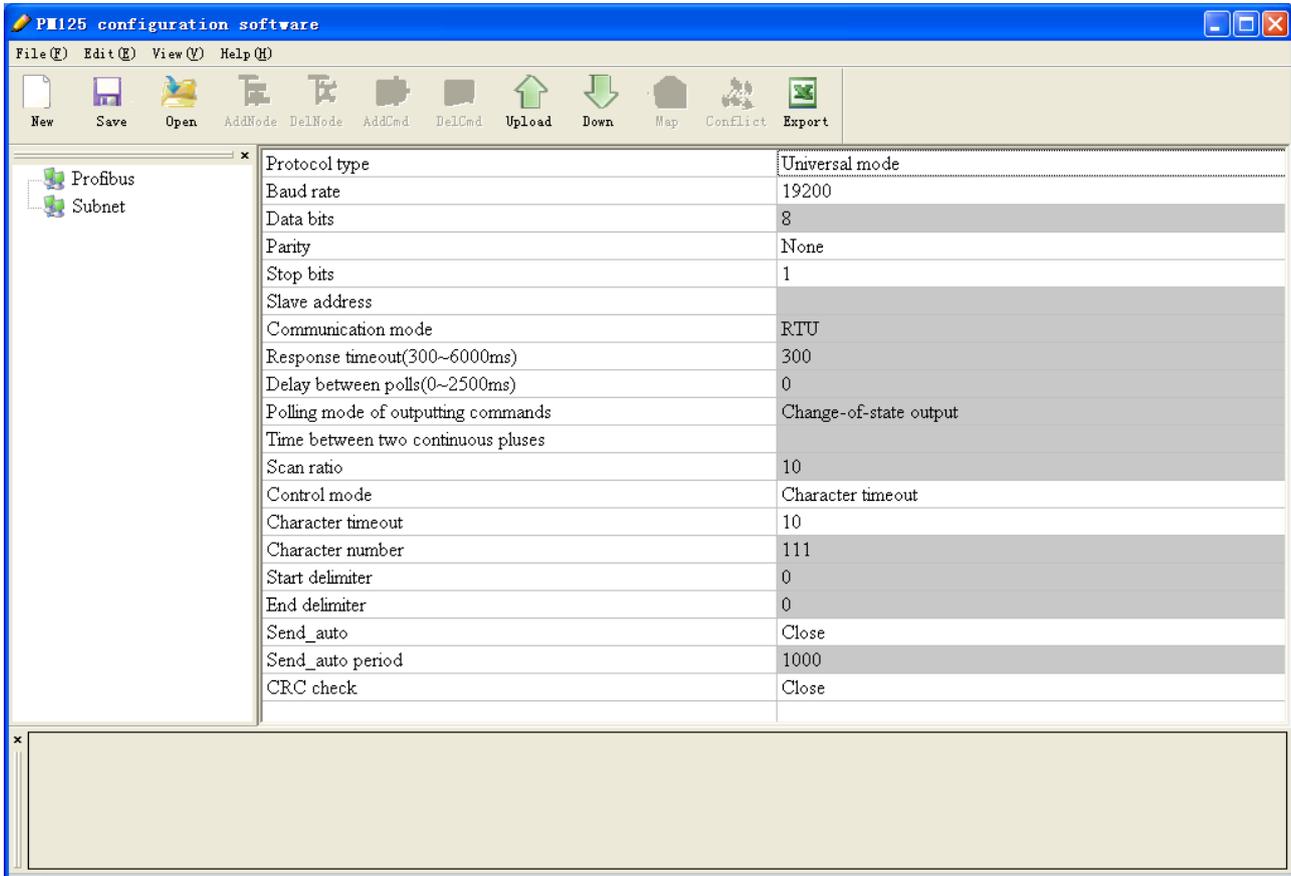
Scan ratio: Ratio of slow-scan and quick-scan. If the quick-scan command sends 10 times, slow-scan command sends 1 time.

2 Choose “Universal mode” in protocol type

Configurable parameters are shown as follows:

Baud rate, Data bits, Parity mode, Stop bits, Control mode, Character timeout, Character number, Start delimiter, End delimiter, Send_auto, Send_auto period, CRC

Interface of configuration view is shown as follow:



Communication baud rate: There are 300, 600, 1200, 2400, 9600, 19200, 38400, 57600 and 115200bps to be selected.

Data bits: 8 bits

Parity check mode: There are none, odd, even, mark and space to be selected.

Stop bits: There are 1 and 2 to be selected.

Control mode: There are Character timeout, Character number and Delimiter to be selected.

Character timeout: User input, the default is 10, and the range is 10 ~ 60000ms

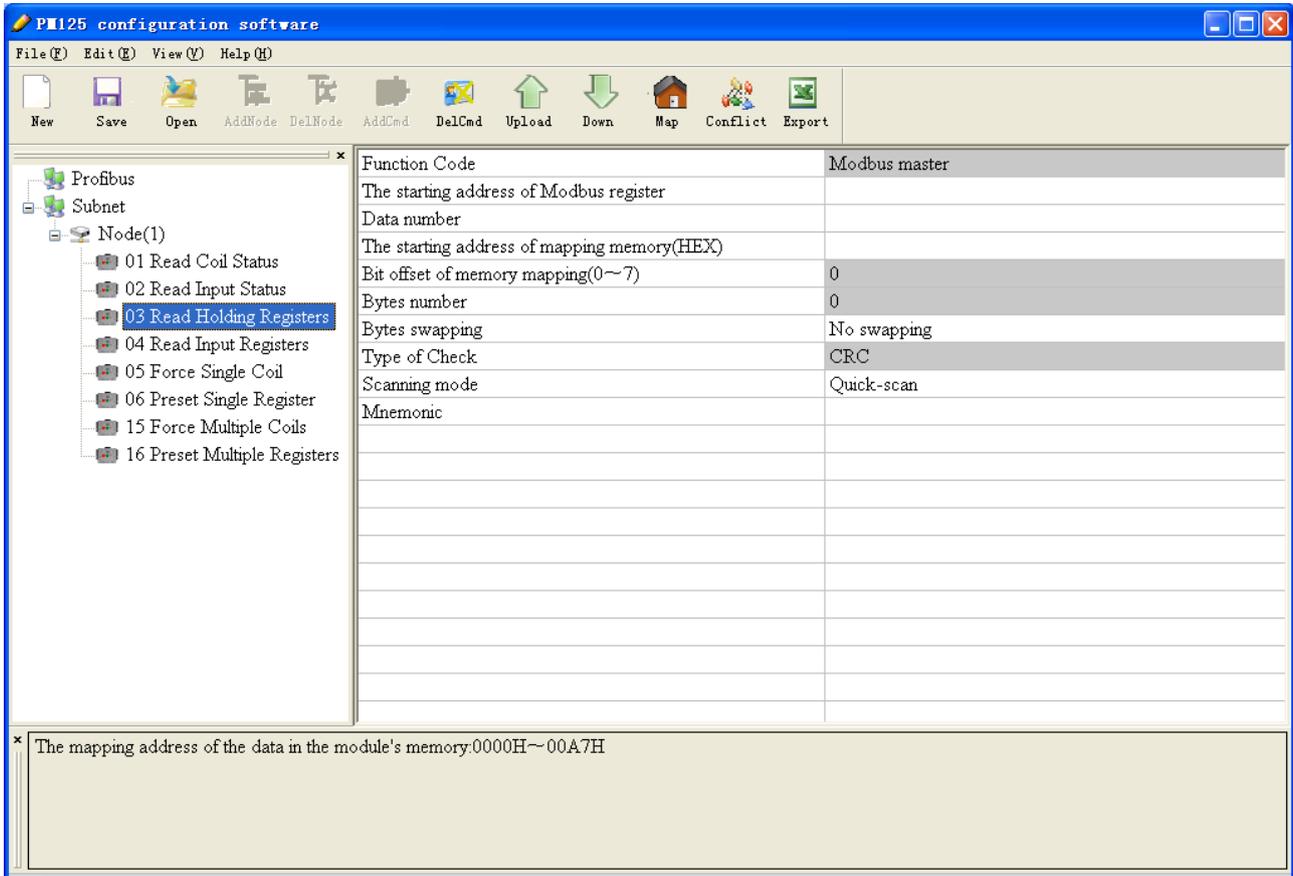
Character number: User input, the range is 1~ 166, only when the control mode is character number, it can be effective.

Start delimiter: When the "Delimiter" control mode is selected, it can be effective. The range is 0 ~ 255.

End delimiter: When the "Delimiter" control mode is selected, it can be effective. The range is 0 ~ 255.

Send_auto: There are open and close to be selected.

Send_auto period: User input, the default is 1000 and the range is 10 ~ 6000ms.



The starting address of Modbus register: The starting address of register or switching value or loop and so on in Modbus slave and the range is 0~65535.

Note: The maximum number of read/write registers is 45 at ASCII mode.

The starting address of memory mapping (hexadecimal): The starting address of data in memory buffer of the module.

The address range of data mapping in the module memory:

Read command: 0x0000 ~ 0x00A7

Write command: 0x4000 ~ 0x40A7

The address can calculate by software through “calculate mapping address automatically”.

Bit offset of memory mapping (0 ~ 7): For the bit operation commands, the position range of start-bit byte is 0 ~ 7.

Bytes swapping: There are three kinds of type: No swapping, two bytes swapping, four bytes swapping. The byte display order of Modbus and Profibus-DP is MSB being preferential; the byte display order of DeviceNet is

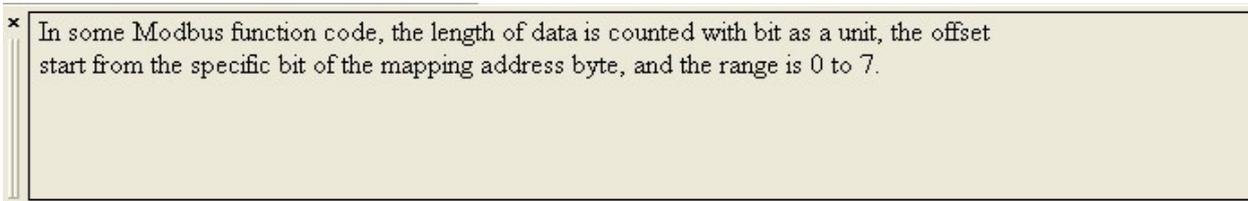


LSB being preferential. Users can exchange the byte display order to get correct value.

Scanning mode: There are two kinds of scanning mode: quick-scan and slow-scan. It is fit for requests of user about quick-scan or slow-scan of different commands. Slow-scan is equal to quick-scan being multiplied by scan ratio. (Configure it in the interface of subnet configuration interface)

5.4.5 Notes View

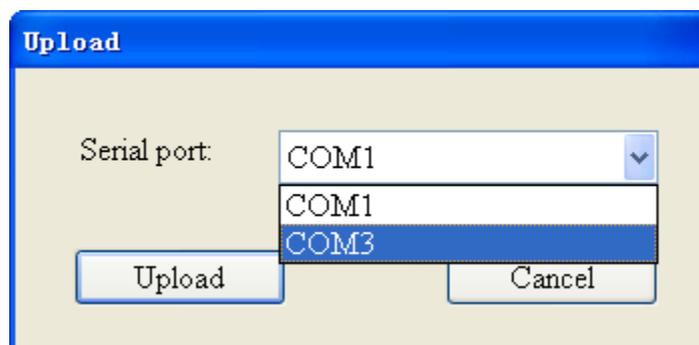
Notes view displays the explanation of configuration. The notes that show how to configure the starting address of memory mapping is shown as follow:



5.5 Upload and Download configuration

5.5.1 Upload configuration

Choose upload configuration, upload the configuration from gateway to the software, the display interface is shown as follow:



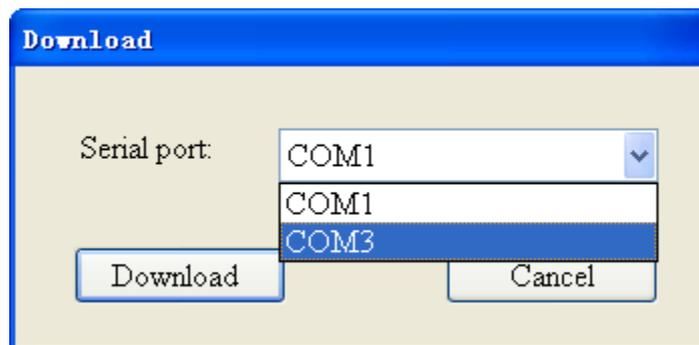
If upload successfully, the display interface is as follows:



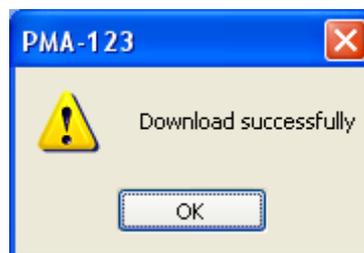
Note: Before uploading the configuration, please check whether the “serial port configuration” is the available port.

5.5.2 Download configuration

Choose download configuration, download the configuration from software to the gateway, the display interface is shown as follow:



If download successfully, the display interface is as follows:



Note1: Before downloading the configuration, please check whether the “serial port configuration” is the available port.

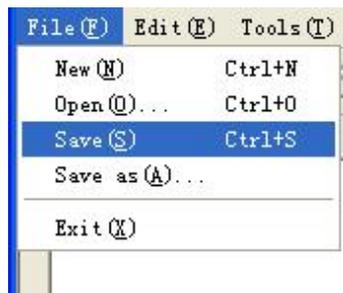
Note2: Before downloading the configuration, make sure that all configurations have been completed.



5.6 Load and save configuration

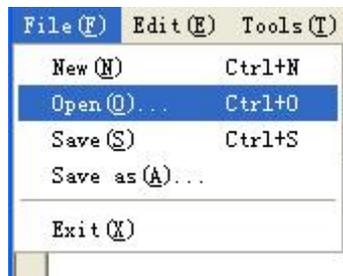
5.6.1 Save configuration project

Choosing “Save” can save the configuration project as .xml document.



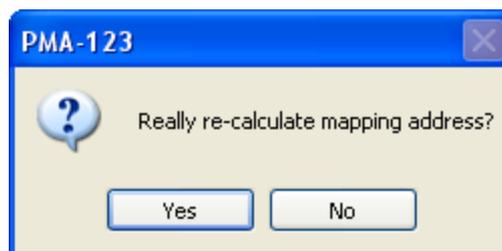
5.6.2 Load configuration project

Choosing “Open” can open a saved project before.



5.7 Auto mapping

The function helps user configure “The starting address of mapping memory”. Click the icon  Map :

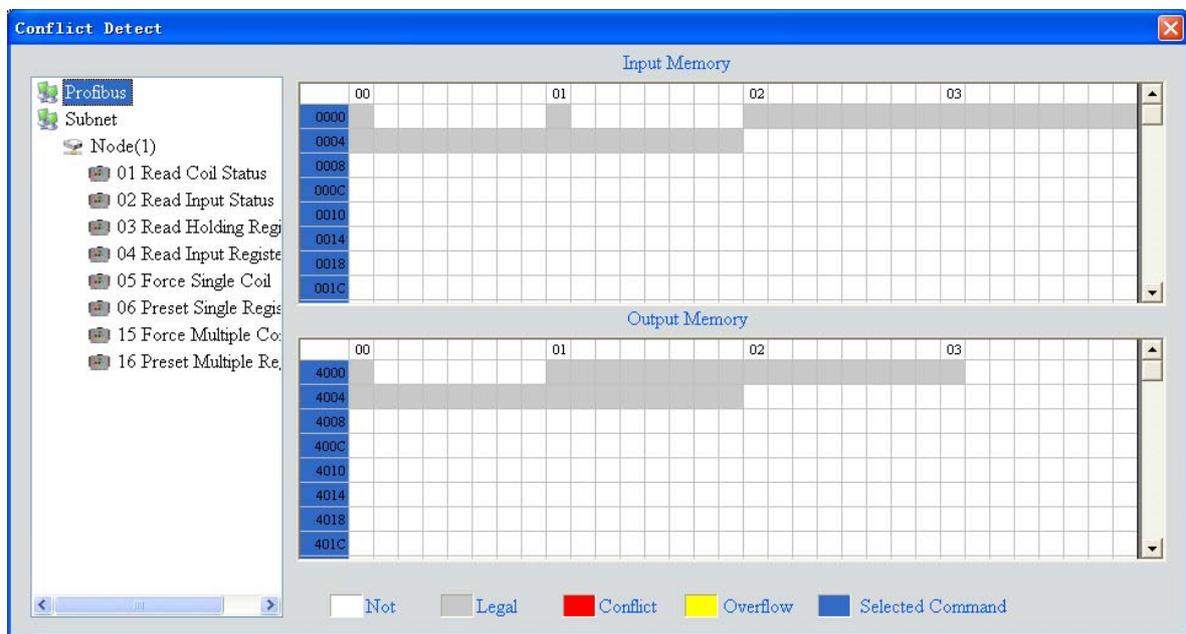


Click “Yes”, and PMA-123 will calculate the parameter automatically.

5.8 Conflict detect



The function helps user check memory. Click the icon

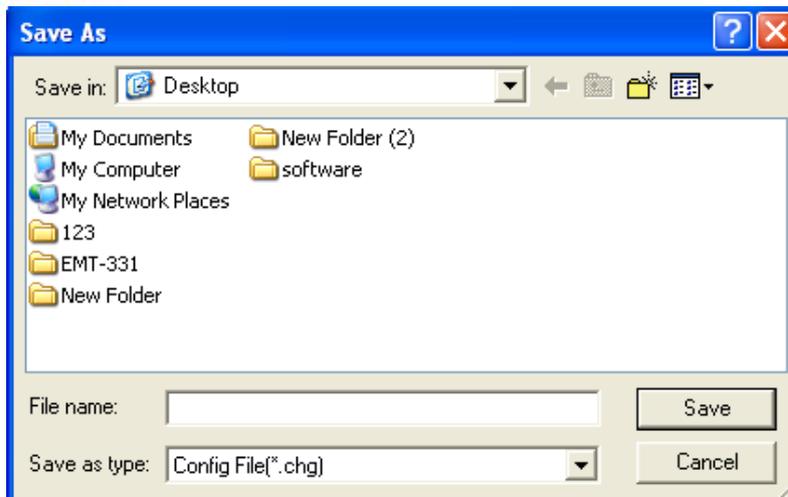


5.9 Export excel document

Excel document helps users to examine the configuration related.



Choose the icon **Export**, save the configuration as excel document and choose the right path.



Double click the .xls document and open it: “Order List”, “Profibus” and “Subnet”.

Order List: orders list, as follow:

A	B	C	D	E
Number	Function code	Starting address	Data number	The starting address of memory mapping
1	1	0	10	0H

Profibus: Protocol type and relevant parameters, as follow:

A	B
Protocol type	Input bytes
Profibus	Through the Profibus master configuration software to set

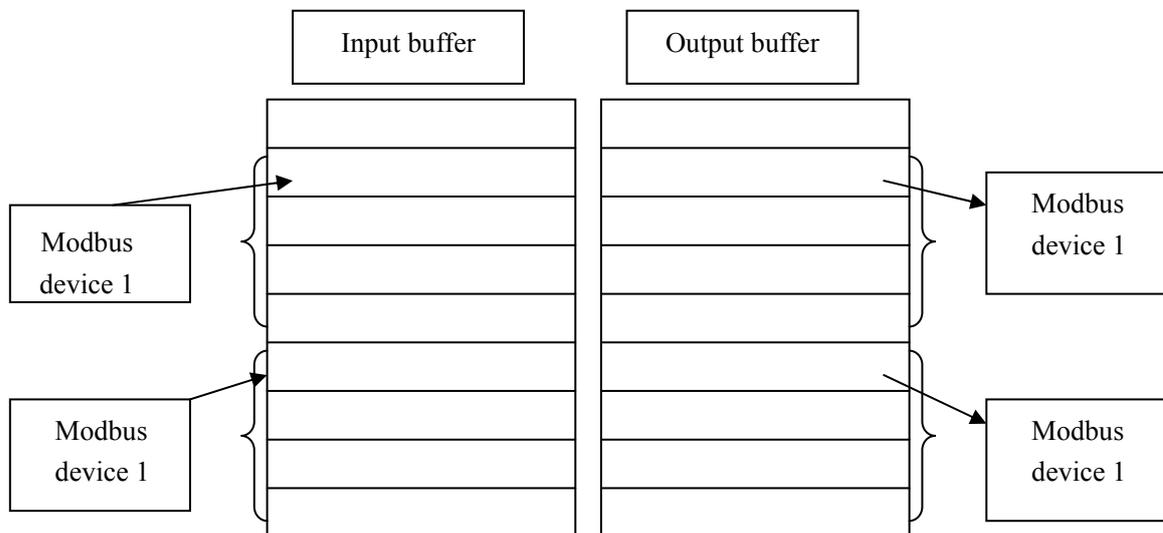
Subnet: Modbus subnet parameters, as follow:

A	B	C	D	E	F	G
Protocol type	Baud rate	Data bits	Parity	Stop bits	Slave address	Communication mode
Modbus master	19200	8	None	1		RTU



6 Working Principle of Modbus Master

The data transmitting between PM-125 Modbus and Profibus is established by mapping. PM-125 has two data buffers, one is Profibus network input buffer, the other is Profibus network output buffer. Modbus read commands write the reading data into network buffer for Profibus network reading. Get data from network output buffer by Modbus write commands, and transmit to relevant Modbus device through write commands.



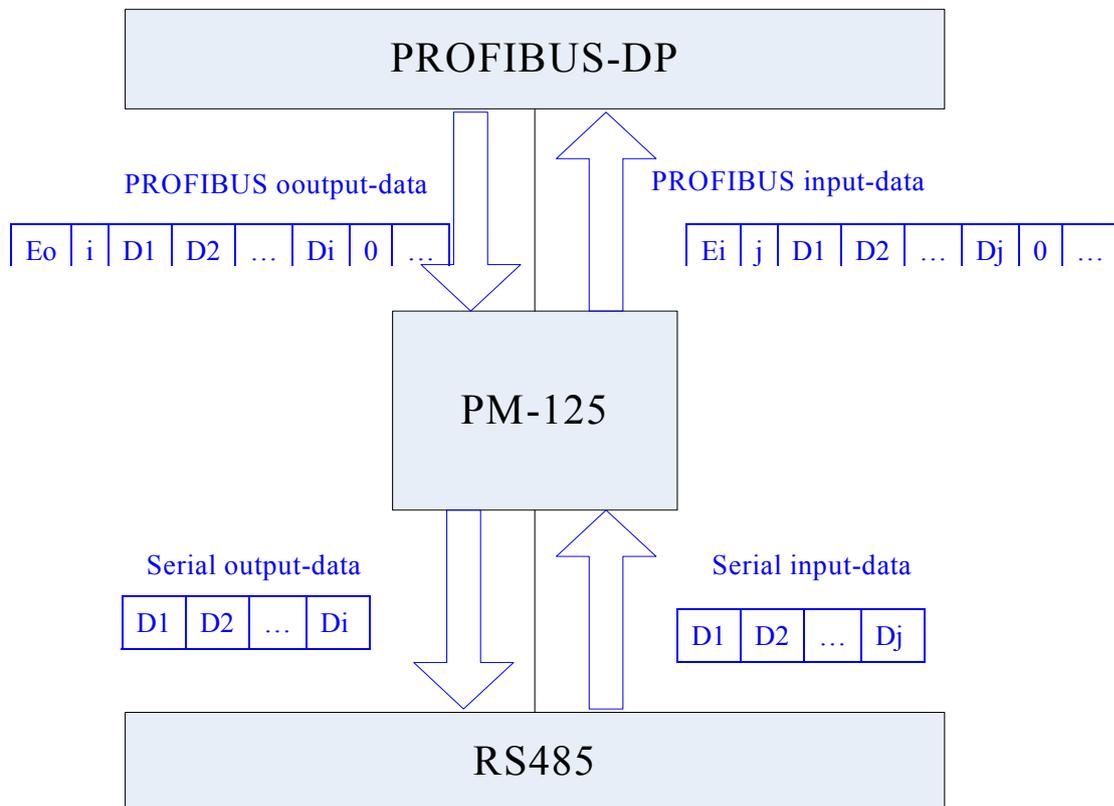
Users can configure 48 commands, every command can read a set of continuous registers.



7 Universal mode

7.1 Data exchange

This product provides the communication between Profibus-DP and RS485. The communication between Profibus-DP and RS485 is bidirectional. The output-data of Profibus-DP can be sent to RS485 fieldbus through the interface of RS485 and the data received from RS485 is put into input-data of Profibus-DP. Data exchange is shown as follows:



7.2 Universal Protocol

Profibus-DP output-data format:

[Transaction Number][Length of serial output-data n][Serial output-data 1]...[Serial output-data n] [0x00] ... [0x00]



Remark:



The number of Profibus-DP output-byte should be greater than or equal to $n + 1$;

M 0x00 are filling data (also for arbitrary number), $n + m + 1$ should be equal to the number of Profibus-DP output-byte.

Transaction Number: The “transaction number” must add 1 if Profibus-dp master output one new data frame.

Example:

If users select the number of Profibus-DP input-byte and output-byte is 8-byte input and 8-byte output, length of serial output-data is 3, data are 01 02 03. The current transaction number is 0.

The format of output-data is:

[01][03][01][02][03][00][00][00][00]

Profibus-DP input-data format:

[Transaction Number][Length of serial input-data n] [Serial input-data 1] ... [Serial input-data n] [0x00] ... [0x00]



Remark:

The number of Profibus-DP input-byte should be greater than or equal to $n + 1$;

M 0x00 are filling data (also for arbitrary number), $n + m + 1$ should be equal to the number of Profibus-DP input-byte.

Transaction Number: The “transaction number” must add 1 show that there is new input-data frame.

Example:

If users select the number of Profibus-DP input-byte and output-byte is 8-byte input and 8-byte output, length of serial input-data is 3, data are 04 05 06. The current transaction number is 0.

The format of input-data is:

[01][03][04][05][06][00][00][00]

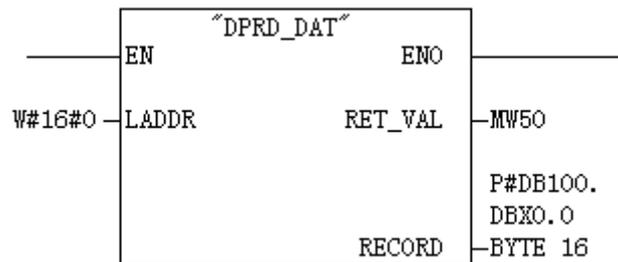


8 How Step7 Read and Write Gateway Data

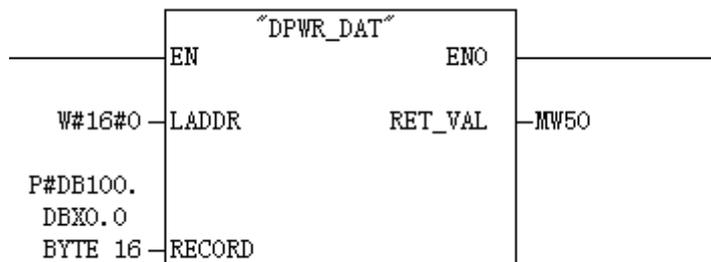
Data modules supported by PM-125 with total length as consistent are shown as follow:

- 2 Words Input Consistent
- 4 Words Input Consistent
- 8Words Input Consistent
- 16 Words Input Consistent
- 2 Words Output Consistent
- 4 Words Output Consistent
- 8 Words Input Consistent
- 16 Words Input Consistent

Users must apply “SFC 14” read data and “SFC 15” write data in Setp7 programming.

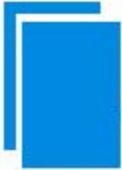


SFC14



SFC15

Data modules supported by PM-125 with word as consistent are shown as follow:



- 4 Words Input, 4 Words Output
- 8 Words Input, 8 Words Output
- 16 Words Input, 16 Words Output
- 32 Words Input, 32 Words Output
- 64 Words Input, 64 Words Output
- 1 Word Input
- 8 Words Input
- 1 Word Output
- 8 Words Output

Users can apply “MOVE” command read and write data in Step7 programming.

Data modules of PM-125 that with byte as consistent are shown as follow:

- Status/ Control (Optional)
- 1 Byte Input
- 1 Byte Output

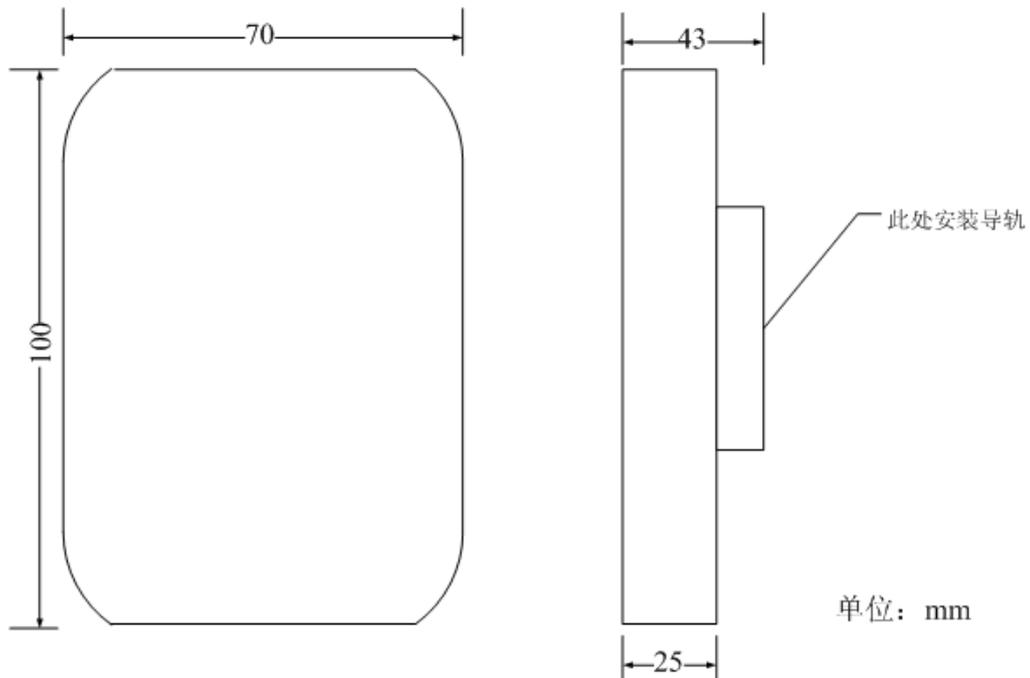
Users can apply “MOVE” command read and write data in Step7 programming.



9 Installation

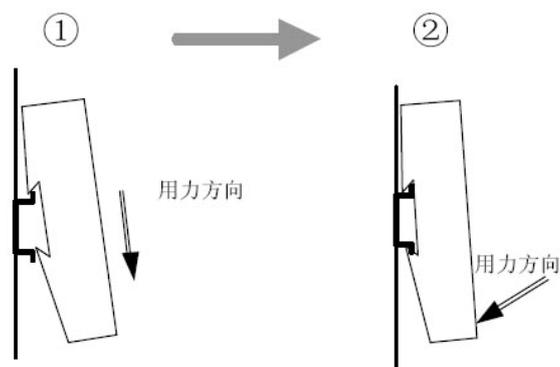
9.1 Machine Dimension

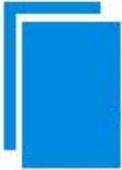
Size: 70mm (width)*100mm (height)*25mm (depth)



9.2 Installation Method

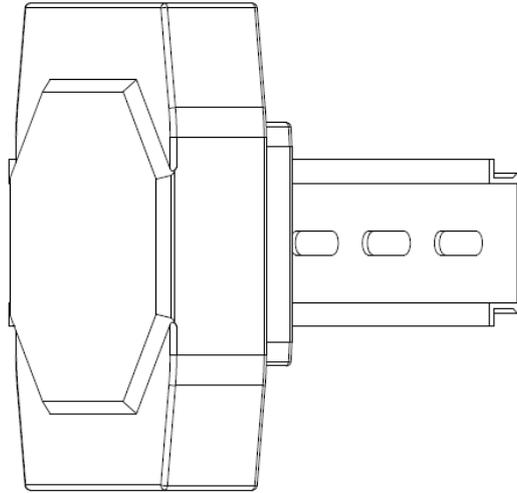
Using 35mm DIN RALL install.





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10 Optional Device

RS25——RS232/RS485 Isolation Converter

RS25 is one kind of Sibotech, it is an RS232/485 converter.



Function: RS-25 achieve the converter between RS232 and RS485, it can establish the communication between them.

Feature: 3000V photoelectric isolation and be suitable to the industry field with variable environment.

More information: www.sibotech.net/en



Appendix A: Using STEP 7 Set Profibus- DP

The following show how to use STEP7 to configure PM-125:

First of all, copy *. gsd file to the following path: *Step7\S7data\gsd*



1. Open SIMATIC Manager :

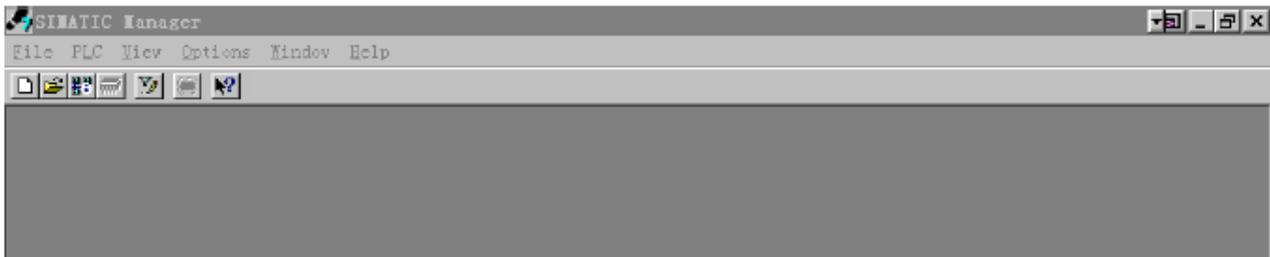


Figure 1

2. File->New, create a new file:

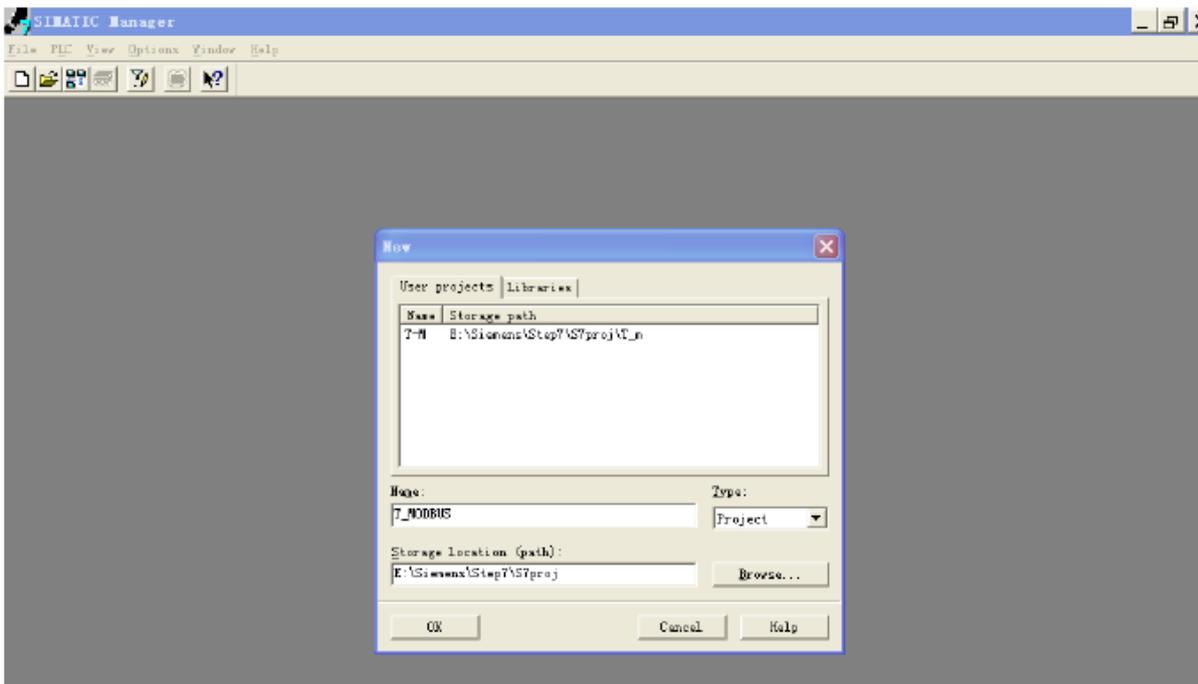


Figure 2

3. Insert->Station->SIMATIC 300 Station:

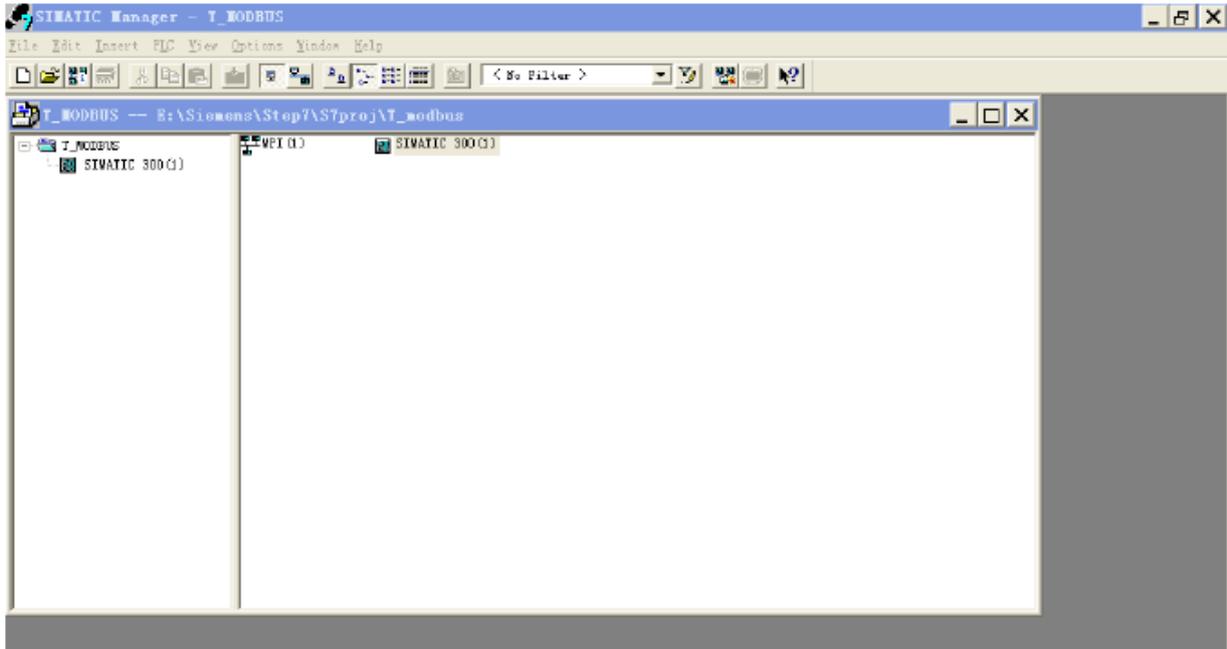


Figure 3

4. Open S7 PLC hardware configuration: SIMATIC 300(1) ->Hardware, double-click:

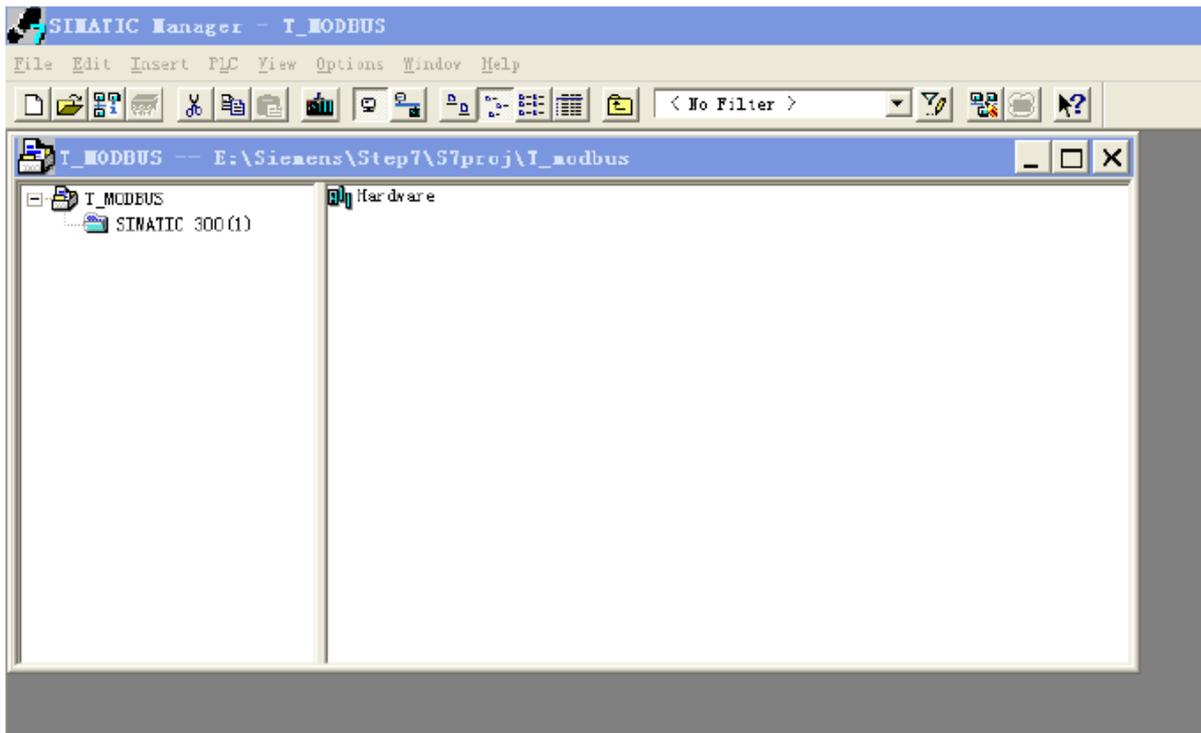


Figure 4

5. Choose Option->Update Catalog in the menu, refresh GSD in Device catalog

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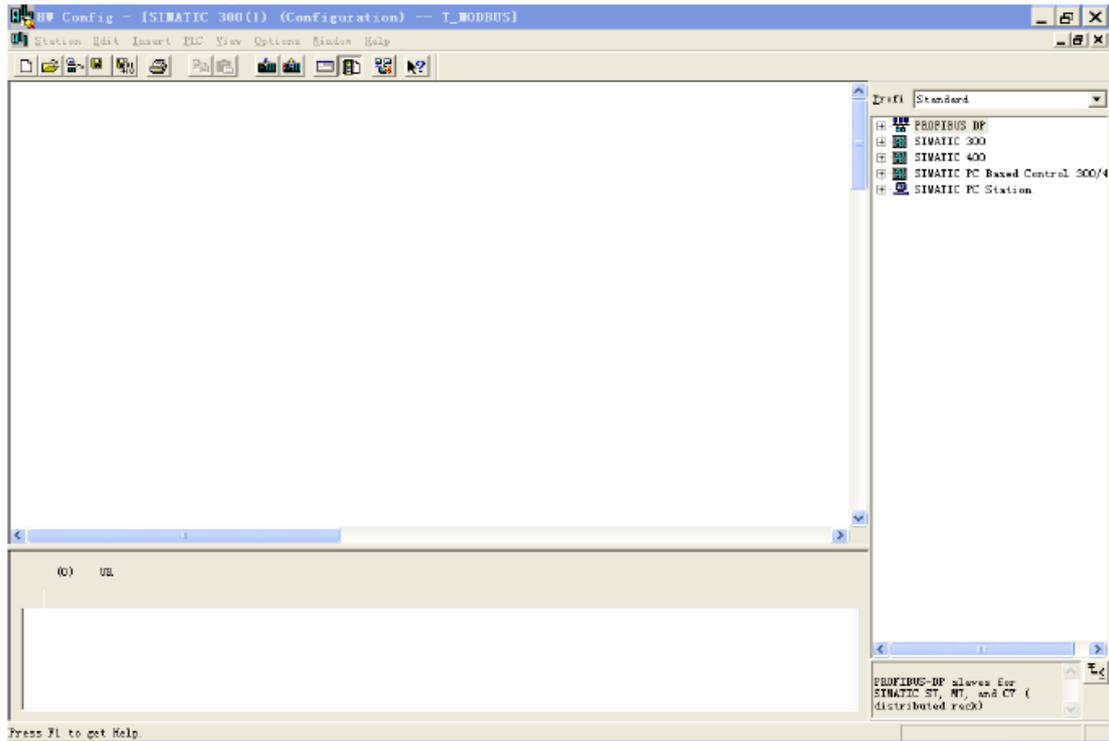


Figure 5

6 Here you can find your equipment in the right side of the window /Profibus DP/Additional Field Devices/Converter/PM125/, Figure 6:

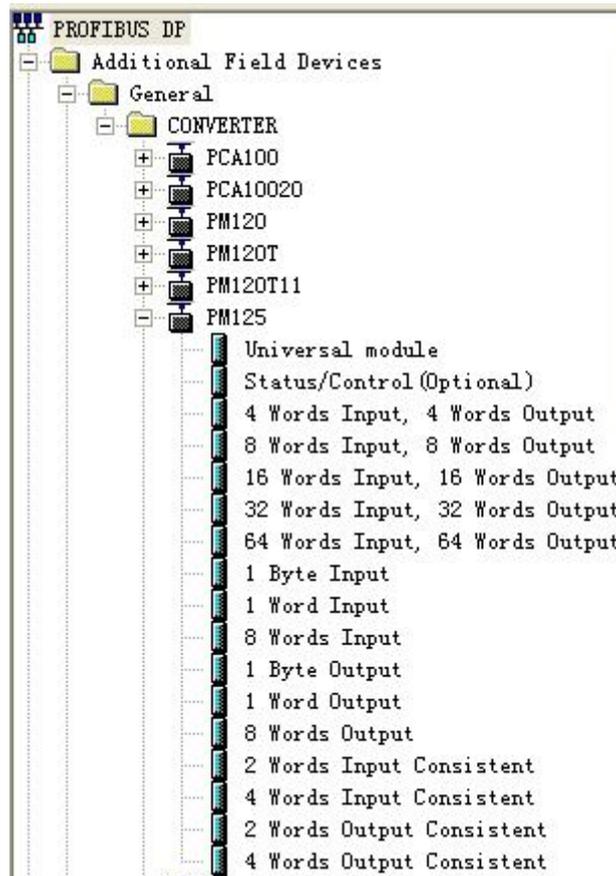


Figure 6

7 Set PLC rack, click the “Hardware Catalog \ SIMATIC 300 \ RACK-300 \ Rail”, Figure 7:

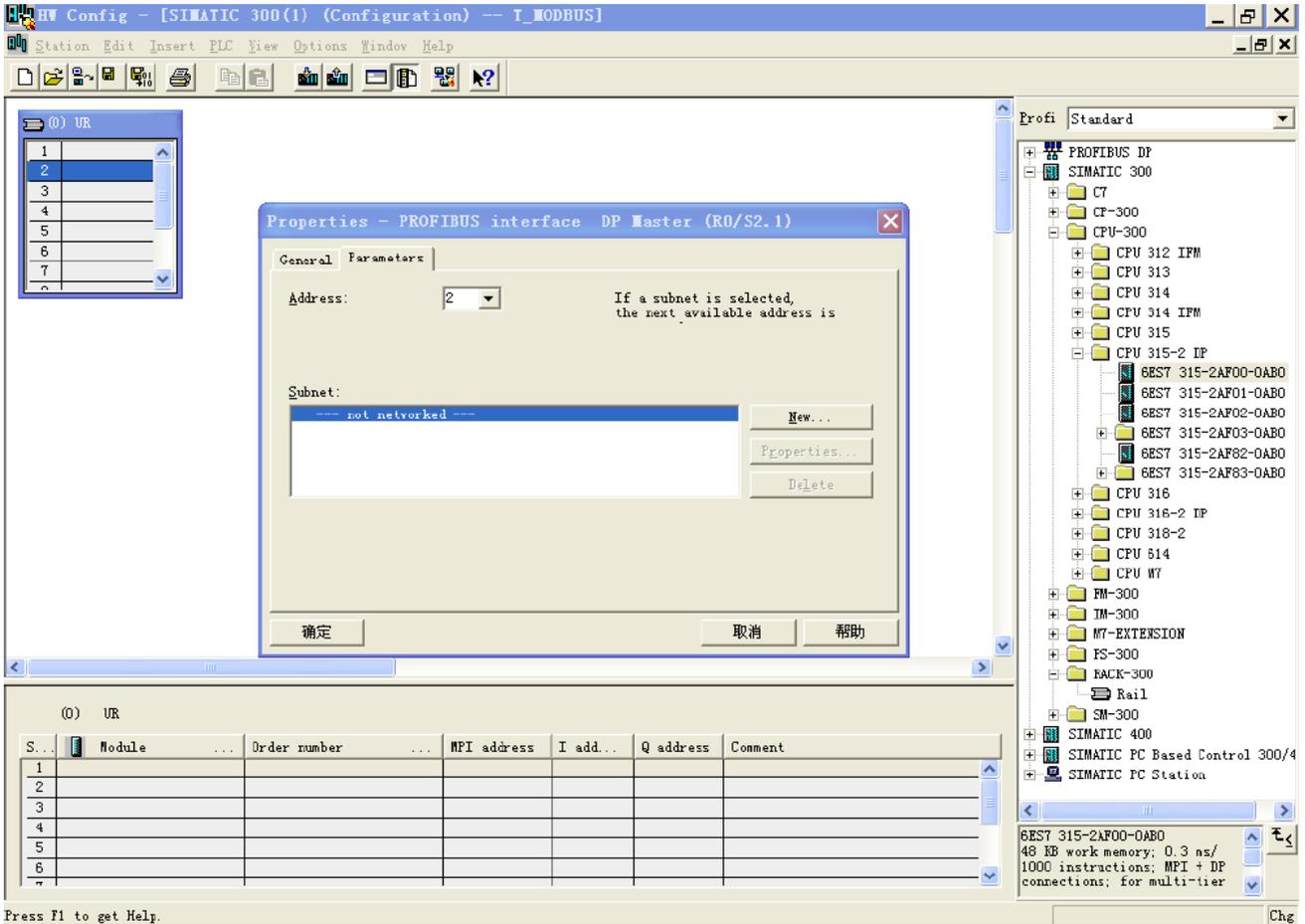


Figure 7

8 Set CPU module and select the corresponding device type and the occupied slots.

9 Create Profibus-DP network and set Profibus-DP: Click New and then Network settings, select DP; select a baud rate such as 187.5Kbps, then “OK”. Double-click it; Figure 8:

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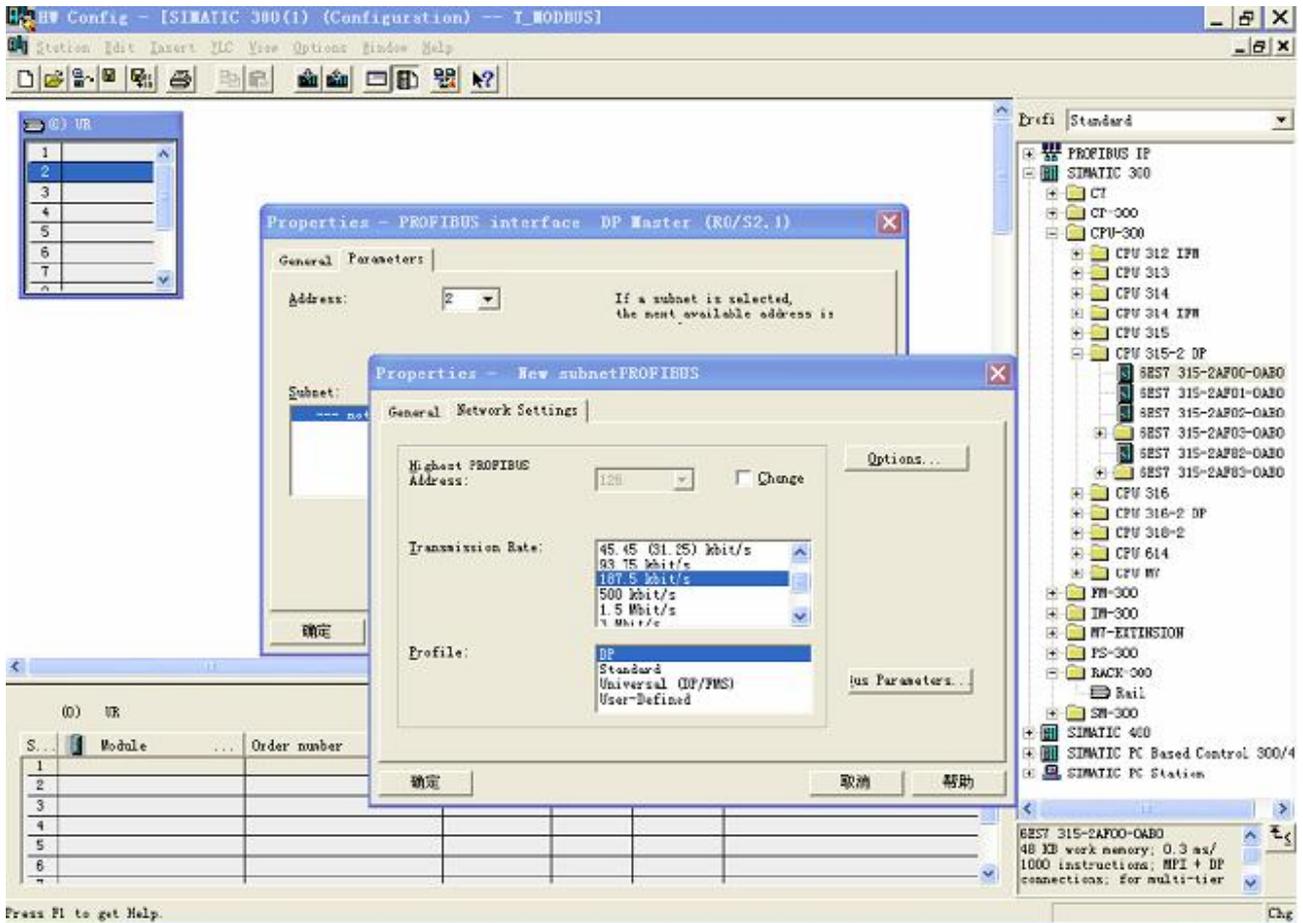


Figure 8

10 Select Profibus-DP Master address; Figure 9:

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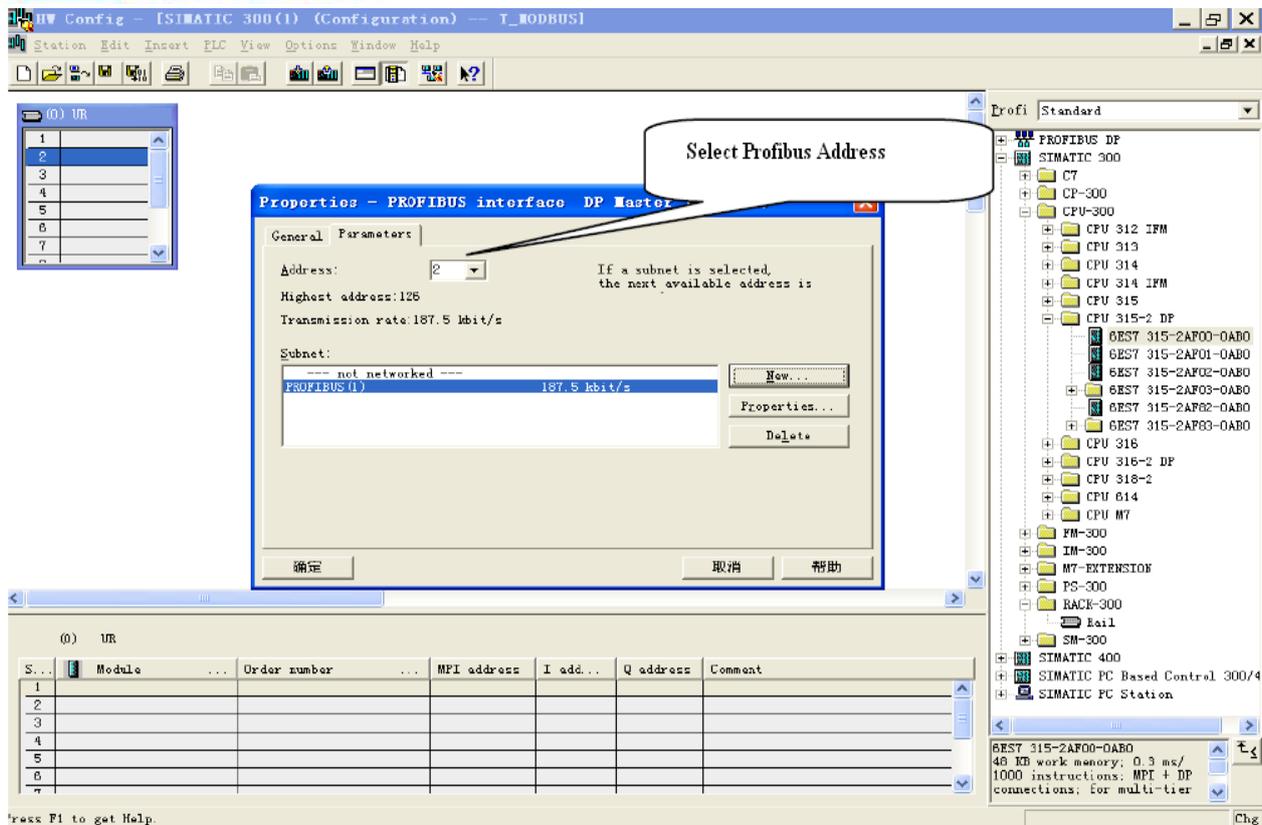


Figure 9

11 Put configuration into Profibus-DP network, and map the input and output data block into other controller's memory, Figure 10:

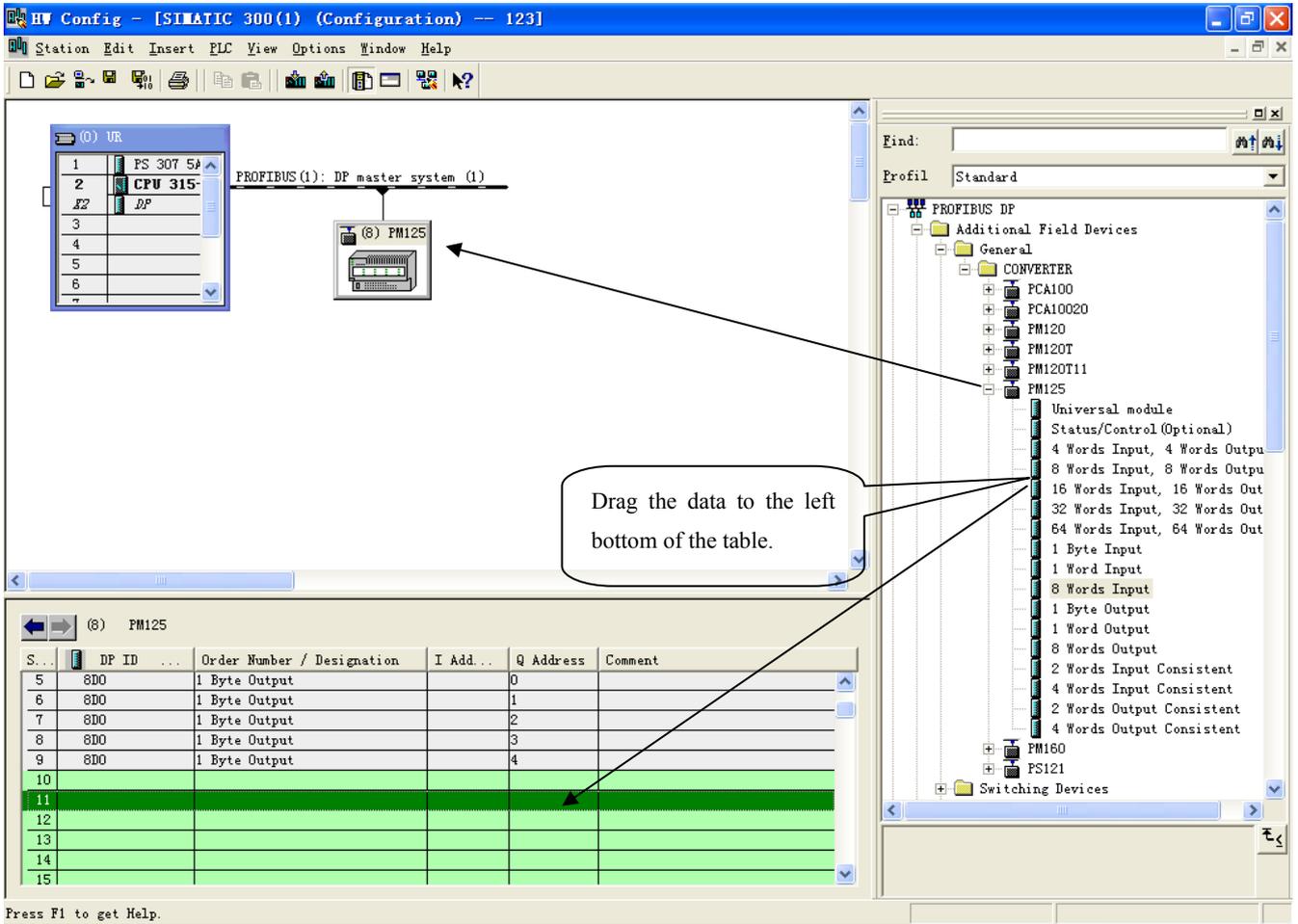


Figure 10

Operation is divided into two steps, the first step is dragging PM-125 into the network configuration on the upper left, the mouse will change shape, and that is to say it can be placed. The second step is dragging data block into the data mapping table at the bottom left, the table will change to green, and that is to say it can be places, mapping to the PLC memory.

Note1: When require full word, drag data module to the left bottom of table where the full word data module placed, and the place should be paid attention to, the location must to corresponding to gateway memory area where need full word in PMA-123.

Note2: The address must be the same with the settings of module switches!

12 Compiler and download into PLC



Appendix B: Modbus Protocol

Modbus-RTU Protocol:

Note: The equipments being connected with this product must have Modbus interface, and Modbus protocol of the equipments must be in line with the following rules. Our company provides customer-oriented services.

1 Description of protocol

Physical layer: transmission mode: RS485

Address: 0-247

Baud rate: Can be configured

Medium: STP

Transmission mode: Half-duplex mode

The connection is established through one line with half-duplex mode, and that is to say that signals transmit through the only one line with opposite directions. Firstly, host computer find the only terminal and then the terminal transmits response signals on the opposite direction.

Protocol only allows the communication between host computers and terminals, while the communications between terminals are not allowed. Thus, they will not occupy communication line when they are in the status of being initialized and respond the polling signals which are transmitted to the local terminal only.

Format of a data frame: 1 bit start bit, 8 bits data and 1 bit stop bit.

Format of a data packet

Address	Function Code	Data	check code
8-Bits	8-Bits	N x 8-Bits	16-Bits

The protocol defines check code, data serial and so on in details, which are important contents when communicating specific data.

When data frames reach terminal, they access to the equipment through a simple entrance. The equipment delete the “envelop” of the data frame, and read the data. If there are no faults, the required tasks are executed.

Then, it adds the data being generated by itself to the obtained “envelop”, and return the data frame to the sender. The response data include: the address of terminal, the executed function, and the required data and a check code by executing the command. Any faults won’t lead to respond successfully.

Address field

Address field is located at the beginning, composed of 8 bits (0-255). These bits indicate the address of the terminal being specified by users. The equipment will receive data from the host computer being connected with it. Every address of terminal must be the only one. Only the terminal being addressed will respond the polling with its address. when the terminal transmit a response, the response tell the host computer the terminal which is communicating with it.

Function field

Codes of function field show the function being executed by terminals which are addressed. Figure 1-1 lists all the function codes, their meanings and their initial functions.

Figure1-1 Function codes

code	meaning	action
03	Read data	obtain current binary value of single or multiple registers
06	Preset single register	Place one specific binary value into the single register
16	Preset multiple registers	Place specific binary values to a series of multiple registers

Data field

Data field includes data when specific functions are executed by terminals or data being collected when the terminal responds to query. The content of these data may be value of number, reference address or limit value. For instance, functional code indicates terminals read a register, data field, on the other hand, clearly show the register and the number of data to be read, the inside address, the type of data and different capacity of different computers.

Fault check code

The field allows checking the fault in the transmission between host computer and terminals. Sometimes, due to electrical noise and other interference, a set of data may change when transmitting from one equipment to another. The fault checking code can guarantee that host computer don’t respond to the changed data in the



transmission, which improves safety and efficiency of the system. The fault code apply 16 bit CRC.

Note: The transmitting serial is always the same- address, functional code, data and the fault checking code relating to direction.

The fault checking

CRC field occupy 2 bytes, including 16 bits binary value. The value of CRC is calculated by transmitting equipment, and then added to the data frame, the receiving equipment calculate the CRC value again while receiving data. Then it is compared with receiving CRC value. If the two values are not the same, the fault occurs.

When calculating CRC, preset a 16-bit register to one firstly, and then calculate 8-bit bytes in the data frame with the current value of the register. Only 8 data bits of each byte participate in the generation of CRC. The initial bit, final bit and occasional odd and even bit don't influence the value of CRC.

The process of generating a CRC:

Preset a 16-bit register to 0FFFFH, and the register is named CRC register.

When generating CRC, exclusive each 8 bit with the content of the register, and then shift result to the low byte, the high bit is filled with zero, the LSB is shifted out and checked. If it is one, the register exclusives with a presetting fixed value. If the lowest bit is zero, there is no settlement.

The above settlement is repeated before executing the shifting 8 times. After finishing shifting the last bit, the next 8-bit byte has the same exclusive calculation with the register, and the another 8-time shifting is carried out. When all the bytes are settled, the final value is CRC value.

The process of generating a CRC:

Preset a 16-bit register 0FFFFH(all one), and name it CRC register.

Exclusive the first 8-bit byte in the data frame with the low byte in the CRC register, and restore CRC register. Shift CRC register to the right bit, fill the highest bit with zero, shift the lowest bit out and check them.

If the lowest bit is zero, repeat the third step (next shift)

If the lowest if one, exclusive CRC register with a presetting fixed value (0A001H).

Repeat the third step and the fourth step until shifting eight times, which settle the entire eight bit down.

Repeat the second step to the fifth step to deal with the next eight-bit until all the bytes are settled down.

In the end, CRC register value is the CRC value.

2 Functions of application layer



The first chapter has described the protocol and data frame. The processors of the software can use the following methods establish their specific application program via protocols without fault.

The protocol in this chapter use the follow format as many as possible, the format is shown as table 2-1(digital is set in hexadecimal)

Address	Function code	The high byte of the starting address of the variable	The low byte of the starting address of the variable	The high byte of the number of the variable	The low byte of the number of the variable	The low byte of the checking code	The high byte of the checking code
03H	03H	00H	01H	00H	03H	55H	E9H

Table 2-1

Read Holding Registers (Function code 03)

Query

The Table 2-2 is an example that reading there collected data U1, U2, and U3 to the slave. The address of U1 is 0001H, the address of U2 is 0002H, and the address of U3 is 0003H.

Address	Functional code	The high byte of the starting address of the variable	The low byte of the starting address of the variable	The high byte of the number of the variable	The low byte of the number of the variable	The low byte of the checking code	The high byte of the checking code
03H	03H	00H	01H	00H	03H	55H	E9H

Table 2-2

Response

The response include: the address of slave, functional code, the number of the data and the CRC check.

The example table 2-3 is reading the response of U1, U2, and U3.

Address	Functional code	The high byte of the variable	The low byte of the variable	The low byte of the variable	The high byte of the variable	The low byte of the variable	The high byte of the variable	The low byte of the variable	The low byte of the variable	The high byte of the variable
03H	03H	06H	01H	7CH	01H	7DH	01H	7CH	F9H	9BH

Table 2-3

2.2 Preset Multiple Registers (Functional code 10)

Query

The functional code 10 allows users changing the content of multiple registers. The device can be set 16 values from any starting address. The controller work with the mode of dynamic scanning, and it can change the content of the register anytime.

The Table 2-4 is an example changing the action and delay setting values of the monitor 1 and monitor 2 of the slave. The address of the action setting value of the monitor 1 is 2AH, and the delay setting value is 2BH. The address of the action setting value of the monitor 2 is 2CH, and the delay setting value is 2DH

Address	Functional code	The high byte of the starting address of the variable	The low byte of the starting address of the variable	The high byte of the number of the variable	The low byte of the number of the variable	The high byte of the variable	The low byte of the variable	The high byte of the variable	The low byte of the variable	The high byte of the variable	The low byte of the variable	The high byte of the variable	The low byte of the variable	The high byte of the variable	The low byte of the variable	The high byte of the variable
2AH	10H	06H	01H	01H	01H	01H	01H	01H	01H	01H	01H	01H	01H	01H	01H	01H
2BH	10H	06H	01H	01H	01H	01H	01H	01H	01H	01H	01H	01H	01H	01H	01H	01H
2CH	10H	06H	01H	01H	01H	01H	01H	01H	01H	01H	01H	01H	01H	01H	01H	01H
2DH	10H	06H	01H	01H	01H	01H	01H	01H	01H	01H	01H	01H	01H	01H	01H	01H



03H	10H	00H	2AH	00H	04H	08H	07H	D0H	00H	0AH	07H	0D0H	00H	0AH	25H	7CH
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	------	-----	-----	-----	-----

Table 2-4

Response

The Table 2-5 is the response of changing the action and delay setting values of the monitor 1 and monitor 2.

Address	Function code	The high byte of the starting address of the variable	The low byte of the starting address of the variable	The high byte of the number of the variable	The low byte of the number of the variable	The low byte of checking code	The high byte of checking code
03	10H	00H	2AH	00H	04H	EBH	8DH

Table 2-5

2.3 Preset Single Register (Functional code 06)

Query

The functional code 06 allows users changing the content of single register. Any single register of DAE system can use the command change the value. The controller work with the mode of dynamic scanning, and it can change the content of the register anytime.

The following example is changing the overload-action value Ir1. The address of Ir1 is 002EH.

Addr	Function code	The high byte of the starting address of the variable	The low byte of the starting address of the variable	The high byte of the variable	The low byte of the variable	The low byte of checking code	The high byte of checking code
03H	06H	00H	2EH	07H	0D0H	EBH	8DH

Table 2-6

Response

The normal response of preset single register is transmitting the receiving data after changing the value of



the register.

Addr ess	Functio nal code	The high byte of the starting address of the variable	The low byte of the starting address of the variable	The high byte of the variable	The low byte of the variable	The low byte of checking code	The high byte of checking code
03H	06H	00H	2EH	07H	0D0H	EBH	8DH

Table 2-7