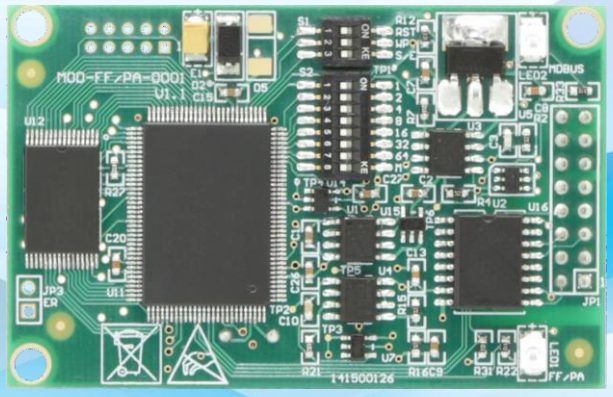
MICROCYBER

M0307

Modbus to PA Built-in Module

User Manual



Microcyber Corporation

Caution

1. Please don't take off/install components at random.
2. Please check if the power meets the power request in the User Manual.

Version

V2.0

Disclaimer of Liability

We have reviewed the contents of this publication to ensure consistency with the hardware and software described. Since variance cannot be precluded entirely, we cannot guarantee full consistency. However, the information in this publication is reviewed regularly and any necessary corrections are included in subsequent editions.

The technical data may change at any time.

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Chapter 1 Overview

M0307 Modbus to PA built-in module is one of the Microcyber M-series built-in modules developed by Microcyber Corporation. This series of built-in modules have features like same size, same interface, easy to upgrade, easy configuration and so on, and it is the ideal choice for users to quickly develop the fieldbus equipment. By embedding the M0307 into the users' equipments with Modbus-RTU communication capabilities, the user equipment can be changed to Profibus PA slave station. User can quickly achieve Profibus DP, FF, HART & etc. equipment by replacing other modules of M series. M0307 is shown as Figure 1.1.

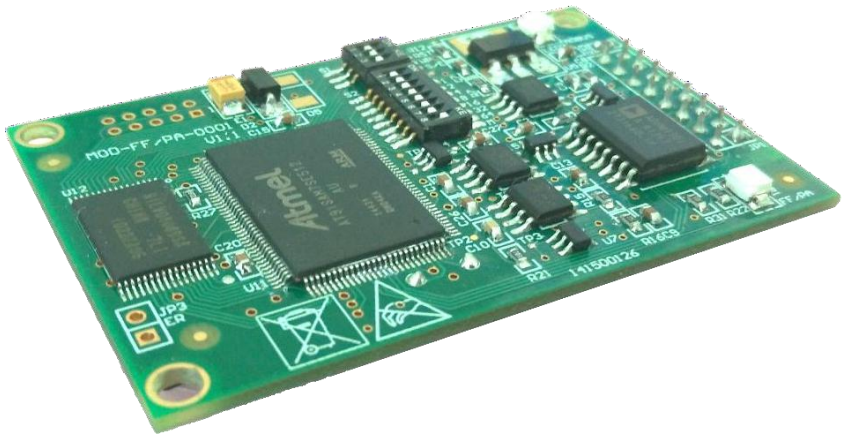

Figure 1.1 M0307 Modbus to PA built-in module

1.1 Features

1.1.1 Same size

Microcyber M-series built-in modules have the same size, 65mm（length）*42mm（width）.

1.1.2 Same interface

Microcyber M-series built-in modules adopt 2.54 spacing 16 pin connector, with compatible function.

1.1.3 Easy to upgrade

Replacement of Microcyber M-series different built-in modules can achieve different protocols of the device.

1.1.4 Simple configuration

Users can use Microcyber special configuration tool to configure, which is easy and convenient to operate.

1.2 Product development process

First step：Hardware design

We can redesign hardware schematic diagram and PCB diagram of the original users' products according to the module size and interface pin definition. If taking M-series products compatibility, we need to refer to all the M-series module interface pin definition and then design the hardware.

Second step：Software design

Besides the definition of the interface with the module, all other Software needs not to be modified. The Modbus-RTU protocol communication is adopted between the module and the user's products.

Third step：Module configuration

According to the users' requirement, we use the Modbus configuration tool to carry out necessary factory set for the module. After configuration, module will communicate with user's product with this

Fourth step：Serial port communication

Preliminary debugging of the serial data communication between the user's product and the module interface.

Fifth step：Revise GSD

We use Modbus configuration tool to revise the sample GSD file to user product GSD file by modifying the key parameters.

Sixth step：Installation, configuration and debugging

It is recommended to use SIEMENS equipment to build a debug experiment system for the detection of PROFIBUS communication, and product operation. Using the experimental system to connect user developed product and realize design function.

End

1.3 Outline dimensions

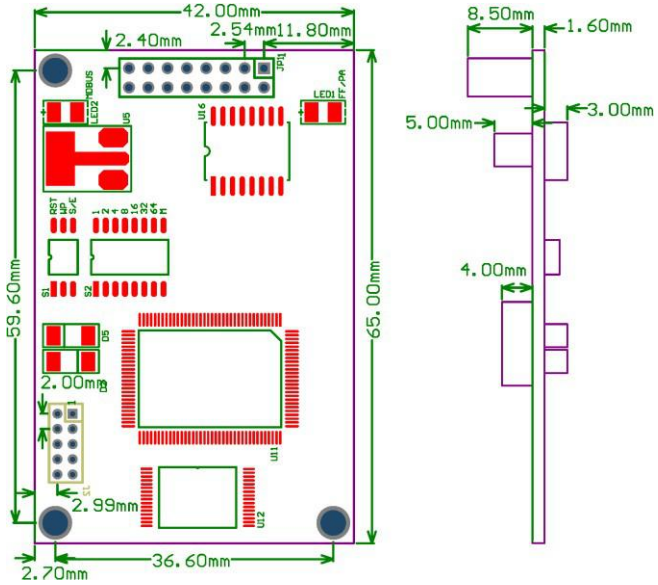

Figure 1.2 Built-in module device size（unit：mm）

1.4 Module structure

Figure1.3 Built-in module structure

1	Dial switch S1	2	Dial switch S2	3	LED2 Modbus communication indication
4	Communication interface	5	LED1 PA communication indication		

Chapter 2 Installation

2.1 Module external interface

The distribution and implication of the external interface of the M0307 Modbus to PA built-in module is shown in Figure 2.1：

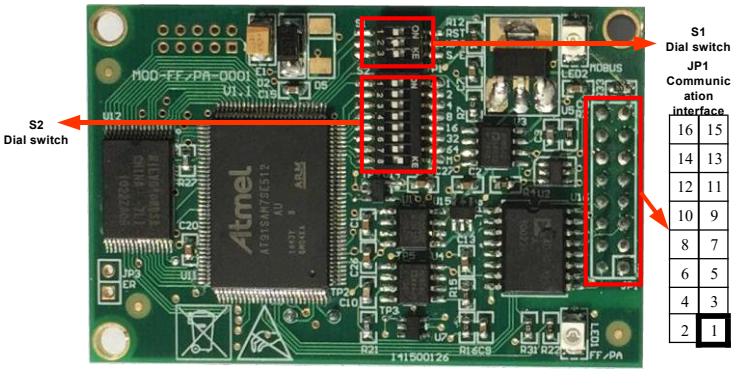

Figure 2.1 Communication interface definition

2.1.1 User interface JP1 pin definition and description (16 pin connector)

The user interface JP1 provides the module one way signal isolated DC power supply. Also it provides a serial interface between the two boards, as well as the indicator light and other functions, the specific description is shown in table below.

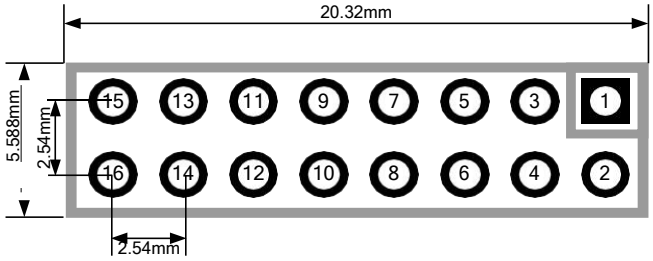

Figure 2.2 User interface pin definition and dimensions

As shown in FigureFigure 2.2, the user interface adopts 16 pin connector. The pins are defined as follows:

Table 2.1 User interface pin definition

Pin	I/O	Name	Description	Pin	I/O	Name	Description
1	I	VCC_IS	Signal isolated external power supply, provided by the user board	2	I	GND_IS	The signal is isolated from the external power supply, which is provided by the user board.
3	I	/RES	CPU reset, low effective	4	I/O	NC	Reserve
5	O	TXD	CPU serial data transmission	6	O	RTS-485	RS-485 control terminal*
7	I/O	NC	Reserve	8	I	RXD	CPU serial data receiving
9	O	NC	Reserve	10	I/O	Status	Communication status indicator
11	I/O	BUS+	Bus power supply positive pole	12	I/O	BUS-	Bus power supply negative pole
13	I/O	NC	Reserve	14	I/O	NC	Reserve
15	I/O	NC	Reserve	16	I/O	NC	Reserve

*： Used when connected with RS-485 communication chips.

2.1.2 Special function dial switch S1

Special function dial switch S1 contains hardware reset, write protection, enabling the hardware to dial address etc.

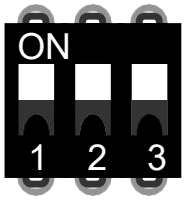

Figure 2.3 Special function dial switch S1

Table 2.2 Special function dial switch S1 description

Item	Name	Description
1	RST	Reset enabling, module data recovery to factory status. First module power off and dial ON. Module power on, recovery to factory status, and then dial to OFF.
2	WP	Write protection enable
3	S/E	Hardware dial address enable

2.1.3 Special function dial switch S2

Special function dial switch S2 contains set Profibus address and working mode options.

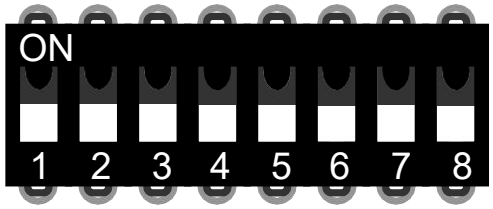

Figure 2.4 Special function dial switch S2

Table 2.3 Special function dial switch S2 description

Item	Name	Description
1	1	If it's ON, address +1. If not, address +0. It's valid only when S/E is ON.
2	2	If it's ON, address +2. If not, address +0. It's valid only when S/E is ON.
3	4	If it's ON, address +4. If not, address +0. It's valid only when S/E is ON.
4	8	If it's ON, address +8. If not, address +0. It's valid only when S/E is ON.
5	16	If it's ON, address +16. If not, address +0. It's valid only when S/E is ON.
6	32	If it's ON, address +32. If not, address +0. It's valid only when S/E is ON.
7	64	If it's ON, address +64. If not, address +0. It's valid only when S/E is ON.
8	M	Built-in modules working mode setting. ON is configuration mode and OFF is normal working mode.

2.2 Module installation

M0307 has three Φ3 positioning holes. User can use 3 hexagonal prism with height 11mm to fix it to user board.

Chapter 3 Working principle

M0307 Modbus to PA built-in module is only one to one conversion module between Modbus and Profibus PA protocol. As a PA device, it can communicate with the Modbus device. Through configuration, it can achieve the interaction between Modbus device data and PA device data.

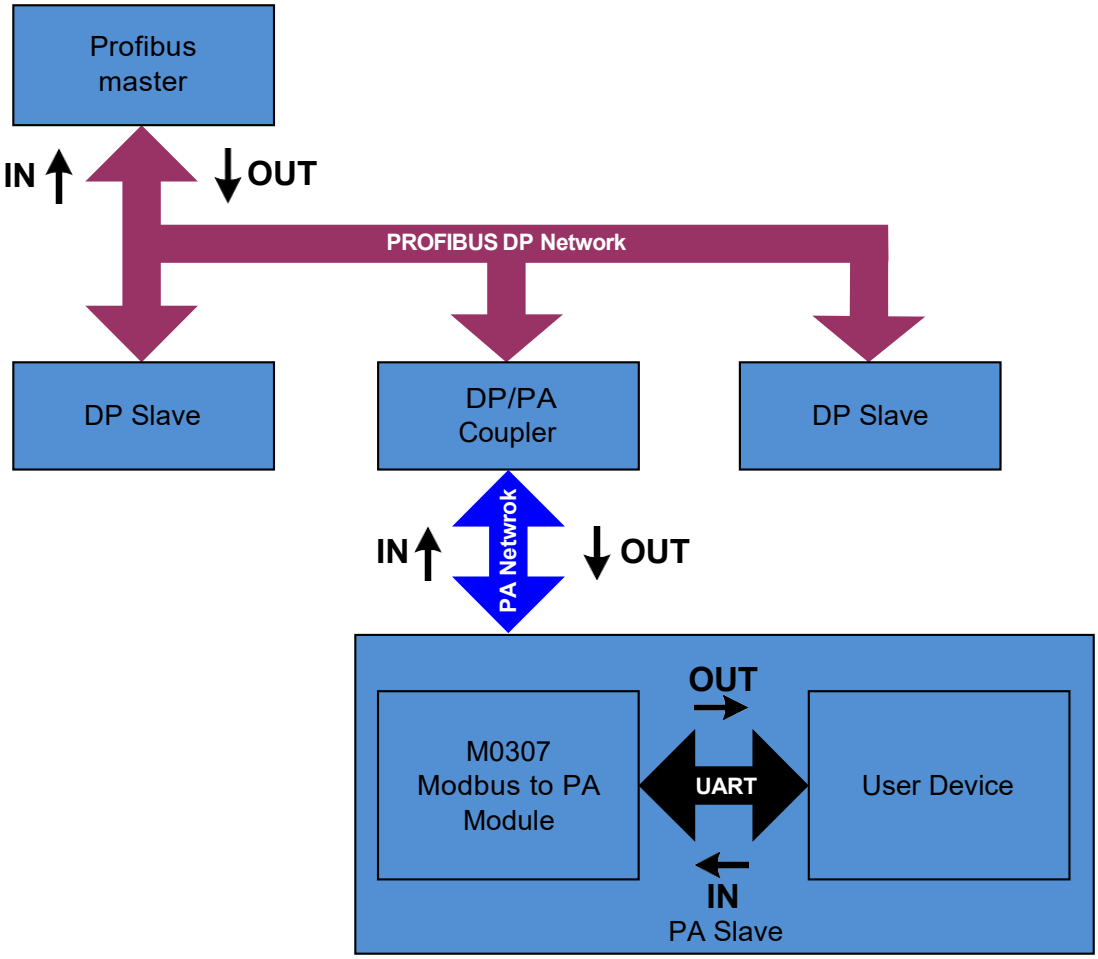

Figure 3.1 system connection chart

M0307 Modbus to PA built-in module contains 1 physical blocks, 1 transducer blocks, 16 function blocks, and only 1 Modbus slave station.

The transducer block includes 4 analog input channels, 4 analog output channels, 4 discrete input channels and 4 discrete output channels, totally 16 cyclic parameters. It also contains 10 floats, ten 32 bit integer, ten 16 bit integer, ten 8 bit integer and two 32 byte string, totally 42 acyclic parameters.

The main function of the transducer block is to interact with the Modbus device.

3.1 Working mode

M0307 can switch the two modes of operation by using the special function dial switch S2: configuration mode and normal mode. ON is for configuration mode, and OFF is for normal mode.

3.1.1 Configuration mode

When M0307 works in configuration mode, M0307 is used as the Modbus slave station, while the Modbus general configuration tool is used as the Modbus master station. Through the Modbus general configuration tool, besides the configuration of basic information such as manufacturer ID, device ID and device address sources, the main function is the configuration of 16 cyclic parameters and 42 acyclic parameters mentioned above, such as which MODBUS function code are used by parameters to read and write, what the register address is and so on. After the configuration, the information will be downloaded to the M0307.

3.1.2 Normal working mode

When M0307 works is in the normal operation mode, M0307 is used as the Modbus master station, and the user equipment is used as the Modbus slave station. M0307 sends the Modbus command to the user device to interact with the user device by configured working mechanism.

Through the read-write Modbus registers, data collected by Modbus equipment will be mapped to M0307 transducer block parameters and again through the transducer block to AI, AO, DI and DO function block's the channel access function, to provide data support for the Profibus system.

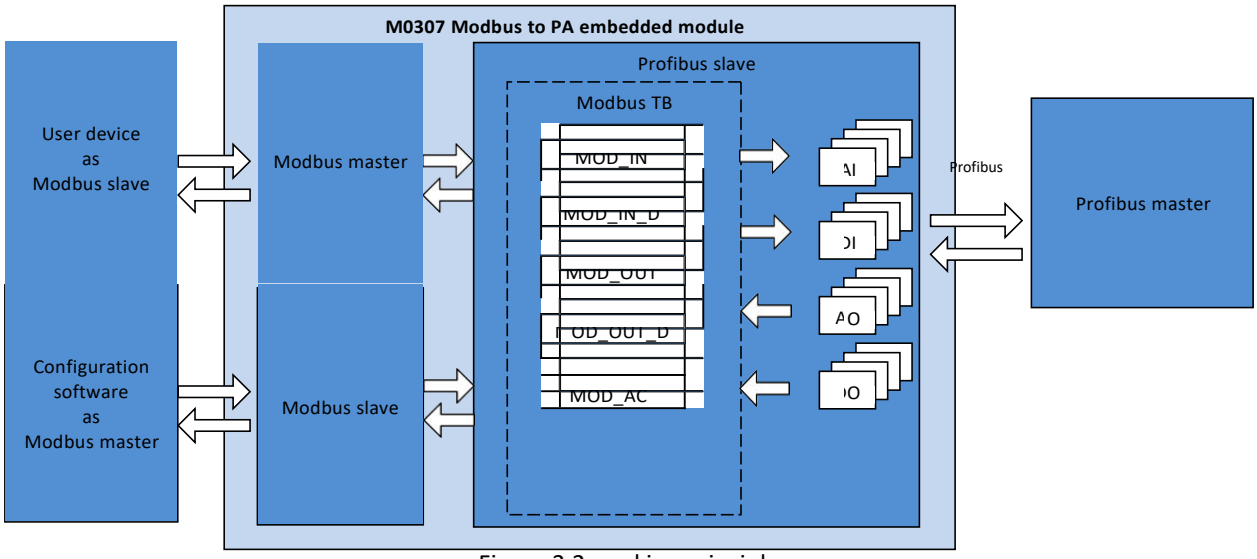

Figure 3.2 working principle

The working mechanism of the normal working mode is divided into three stages: initial stage, acyclic stage and cyclic stage.

3.1.2.1 Initialization phase

The main function of the initialization phase is to test if the Modbus communication is normal. This stage will choose to send a Modbus command based on the actual configuration. If it receives the right response, it will enter the next stage.

The priority of command selection is read the serial port address, read analog input and read the discrete input.

If the serial port address function is configured, then this stage will send serial port to read address command,

instead of sending read analog input or discrete input command. Without this function, it will to select command to send according to the number of analog input or discrete input. Analog input has higher priority than discrete input, namely, it will send read analog input instead of discrete input when analog input number is bigger than 0. The module also stipulates that the number of analog inputs and the number of discrete inputs have at least one non 0. If a continuous function is chose, it will send a continuous read command. If not, it will send the first analog input or discrete input command.

Please see table below for detailed rules.

Table 3.1 Initialization phase command selection rule

Serial port set address	Number of AI	AI register address Continuous	Number of DI	DI register address Continuous	Send command
√	*	*	*	*	Read serial address
×	4≥AI＞0	×	*	*	Read AI 1
×	4≥AI＞0	√	*	*	Real all AI
×	0	*	4≥DI＞0	×	Read DI 1
×	0	*	4≥DI＞0	√	Real all DI
* There is no effect, it can be arbitrary state.					

3.1.2.2 Acyclic phase

The acyclic stage mainly reads all the data. The order is analog input, discrete input, floating point data, USIGN32 data, USIGN16 data, USIGN8 data, and Octet String data.

Among them, the analog input and the discrete input may send the disposable reading order according to the configuration. And for other data, even if it's configured of the continuous function, it will also read each data respectively. At this time, the continuous function is only convenient for user configuration.

That is, continuous functions are divided into two kinds. The continuous function of the circulation parameters support sending one-time read and write commands, and the continuous function of the non-circular parameters is only to facilitate the user configuration.

When all the data are read correctly, it will step into the loop phase. Otherwise, the non-loop phase will be re executed until all data are read successfully.

3.1.2.3 Cyclic phase

There are two main functions in cyclic phase, namely circularly read cyclic input and output parameters and write acyclic parameters.

When the module enters this state, it will circularly send analog input, analog output, read discrete input and write discrete output commands in order. When the acyclic parameter changes, it will send write acyclic parameters command.

When continuous error occurs more than 10 times, it will jump back to the acyclic stage and read all of the data again.

If user configures the serial port to set the address, this phase it will send read the serial port address after sending write discrete output command.

Chapter 4 Module configuration

4.1 Topology Structure

PA device supports a variety of network topologies, as shown in figure 4.1. Figure 4.2 shows the bus connection of the PA device, and both terminals of the bus need to be connected to the terminal to ensure the quality of the signal. The maximum length of the bus is 1900 m, and the repeater can extend it to 10 km.

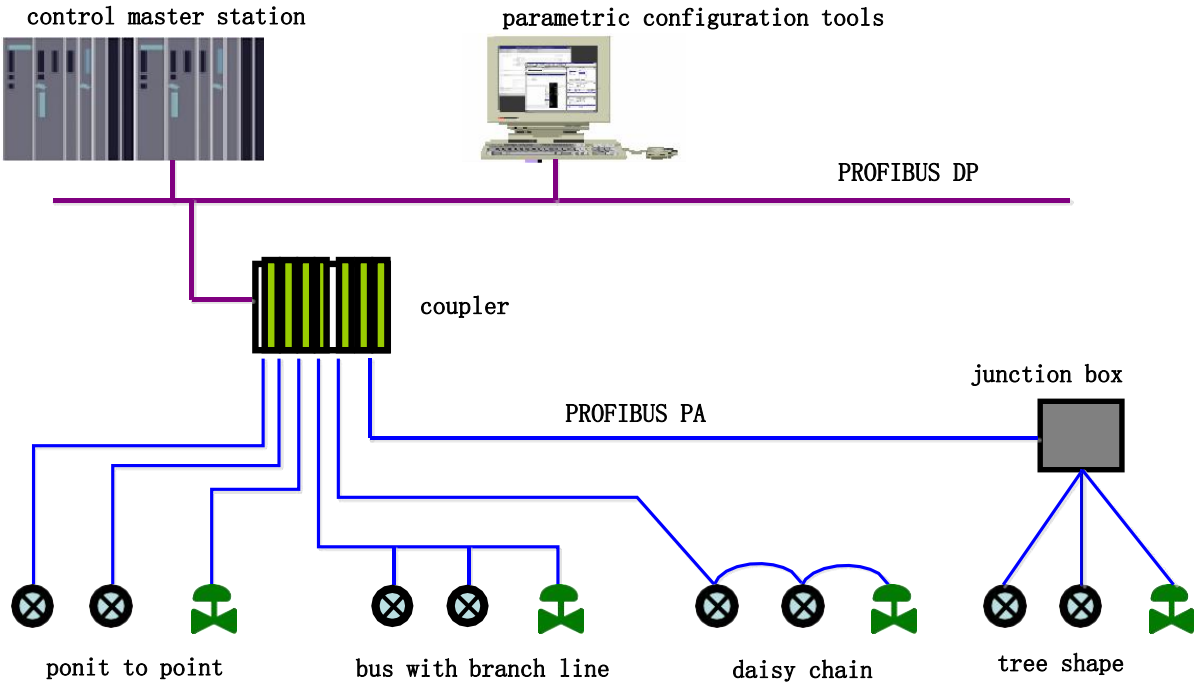

Figure 4.1 PA network topology

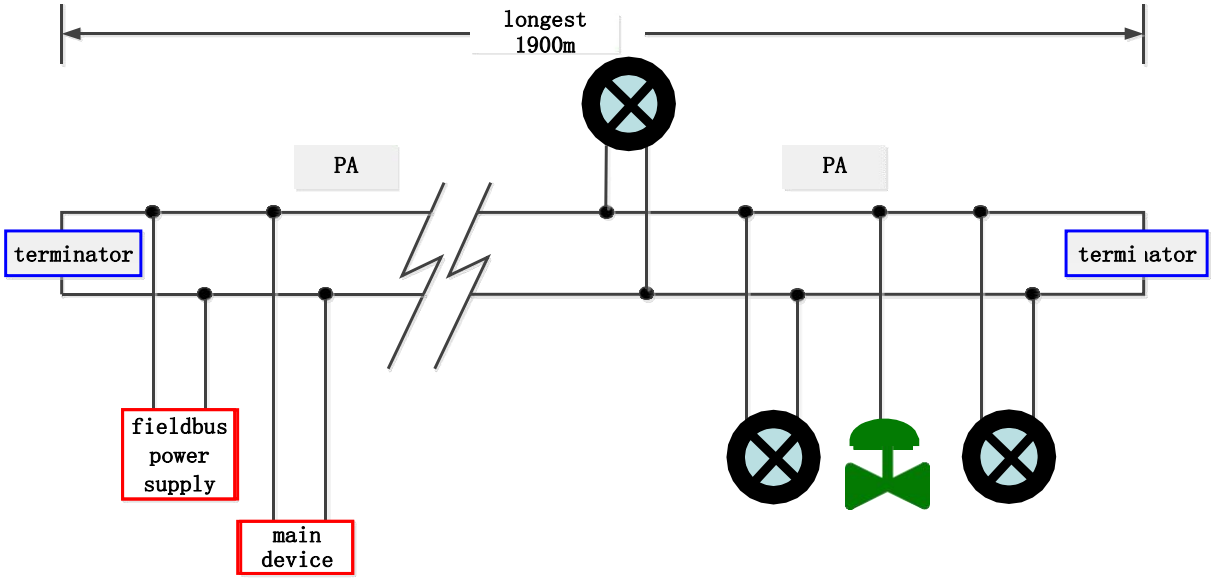

Figure 4.2 PA bus connection

4.2 Function block description

M0307 Modbus to PA built-in module has 1 physical block, 4 AI function blocks, 4 AO function blocks, 4 DI function blocks, 4 DO function blocks and 1 User transducer block. Among them, each AI, AO, DI, DO function block has 4 channels, respectively pointing to 4 analog input, 4 analog output, 4 discrete input and 4 discrete output of User transducer block.

Table 4.1 Function block description

Name	Function block description
Physical Block	Physical block (PB). It describes the equipment's specific hardware information and identification, diagnostic information, including the device number, software version, hardware version, installation date, etc.
User Transducer Block	Through the User transducer block, it can read and write Modbus parameters, such as the 4 analog input, 4 analog output, 4 discrete input and 4 discrete output, etc..
Analog Input Block	Analog input function block (AI). Through internal channels, it gets simulation process value from Modbus slave station from the transducer block, process it, and provide appropriate measurement to the master device by bus communication.
Analog Output Block	Analog output function block (AO), which is used to transfer the data from the main station device to the transducer block, acting on Modbus slave device.
Discrete Input Block	Discrete input function block (DI). Through internal channels, it gets input data from the Modbus slave device from the transducer block and provides it to the master station device by bus communication.
Discrete Output Block	Discrete output function block (DO). Through the internal channel, it transfers the discrete output data set by the master device to the transducer block, acting on Modbus slave device.

4.3 User Transducer block parameter

Before the configuration of the module, first have a look at the User transducer. The following table describes all the parameters of the block User transducer.

Table 4.2 Modbus Transducer block parameter table

Relative Index	Parameter name	Data type	Valid range	Default value	Transport Parameter Usage / Kind of	Function description
1	ST_REV	Unsigned16		0	S/RO	Static version
2	TAG_DESC	OctString(32)		Spaces	S	Bit number
3	STRATEGY	Unsigned16		0	S	Strategy
4	ALERT_KEY	Unsigned8	1-255	0	S	Alarm
5	TARGET_MODE	Unsigned8		AUTO	S	Ideal mode
6	MODE_BLK	DS-37			D	Current mode
7	ALARM_SUM	DS-42			D	Alarm summary
12	BAD_STATUS	Bitstring(4)			D/RO	16 the communication status of the input and output commands. That a certain bit is set to 1 means the corresponding command is not responding. See the description of the parameter in the following table.
13	ERR_LOOK_RESULT	Unsigned8(32)	0-255	0xFC	D/RO	16 input output command negative response exception code
14	MOD_IN1	101			D/RO	Analog input 1
15	MOD_IN2	101			D/RO	Analog input 2
16	MOD_IN3	101			D/RO	Analog input 3

17	MOD_IN4	101			D/RO	Analog input 4
22	MOD_OUT1	101			D/RO	Analog output 1
23	MOD_ OUT2	101			D/RO	Analog output 2
24	MOD_ OUT3	101			D/RO	Analog output 3
25	MOD_ OUT4	101			D/RO	Analog output 4
30	MOD_IN_D1	102			D/RO	Discrete input 1
31	MOD_IN_D2	102			D/RO	Discrete input 2
32	MOD_IN_D3	102			D/RO	Discrete input 3
33	MOD_IN_D4	102			D/RO	Discrete input 4
38	MOD_OUT_D1	102			D/RO	Discrete output 1
39	MOD_OUT_D2	102			D/RO	Discrete output 2
40	MOD_OUT_D3	102			D/RO	Discrete output 3
41	MOD_OUT_D4	102			D/RO	Discrete output 4
46	GENERIC_FLOAT_1	Float		0	S	General floating point variable 1
47	GENERIC_FLOAT_2	Float		0	S	General floating point variable 2
48	GENERIC_FLOAT_3	Float		0	S	General floating point variable 3
49	GENERIC_FLOAT_4	Float		0	S	General floating point variable 4
50	GENERIC_FLOAT_5	Float		0	S	General floating point variable 5
51	GENERIC_FLOAT_6	Float		0	S	General floating point variable 6
52	GENERIC_FLOAT_7	Float		0	S	General floating point variable 7
53	GENERIC_FLOAT_8	Float		0	S	General floating point variable 8
54	GENERIC_FLOAT_9	Float		0	S	General floating point variable 9
55	GENERIC_FLOAT_10	Float		0	S	General floating point variable 10
56	GENERIC_USIGN32_1	Unsigned32		0	S	General 32 bit unsigned integer variable 1
57	GENERIC_USIGN32_2	Unsigned32		0	S	General 32 bit unsigned integer variable 2
58	GENERIC_USIGN32_3	Unsigned32		0	S	General 32 bit unsigned integer variable 3
59	GENERIC_USIGN32_4	Unsigned32		0	S	General 32 bit unsigned integer variable 4
60	GENERIC_USIGN32_5	Unsigned32		0	S	General 32 bit unsigned integer variable 5
61	GENERIC_USIGN32_6	Unsigned32		0	S	General 32 bit unsigned integer variable 6
62	GENERIC_USIGN32_7	Unsigned32		0	S	General 32 bit unsigned integer variable 7
63	GENERIC_USIGN32_8	Unsigned32		0	S	General 32 bit unsigned integer variable 8
64	GENERIC_USIGN32_9	Unsigned32		0	S	General 32 bit unsigned integer variable 9
65	GENERIC_USIGN32_10	Unsigned32		0	S	General 32 bit unsigned integer variable 10
66	GENERIC_USIGN16_1	Unsigned16		0	S	General 16 bit unsigned integer variable 1
67	GENERIC_USIGN16_2	Unsigned16		0	S	General 16 bit unsigned integer variable 2
68	GENERIC_USIGN16_3	Unsigned16		0	S	General 16 bit unsigned integer variable 3
69	GENERIC_USIGN16_4	Unsigned16		0	S	General 16 bit unsigned integer variable 4
70	GENERIC_USIGN16_5	Unsigned16		0	S	General 16 bit unsigned integer variable 5
71	GENERIC_USIGN16_6	Unsigned16		0	S	General 16 bit unsigned integer variable 6
72	GENERIC_USIGN16_7	Unsigned16		0	S	General 16 bit unsigned integer variable 7
73	GENERIC_USIGN16_8	Unsigned16		0	S	General 16 bit unsigned integer variable 8
74	GENERIC_USIGN16_9	Unsigned16		0	S	General 16 bit unsigned integer variable 9
75	GENERIC_USIGN16_10	Unsigned16		0	S	General 16 bit unsigned integer variable 10
76	GENERIC_USIGN8_1	Unsigned8		0	S	General 8 bit unsigned integer variable 1
77	GENERIC_USIGN8_2	Unsigned8		0	S	General 8 bit unsigned integer variable 2
78	GENERIC_USIGN8_3	Unsigned8		0	S	General 8 bit unsigned integer variable 3
79	GENERIC_USIGN8_4	Unsigned8		0	S	General 8 bit unsigned integer variable 4
80	GENERIC_USIGN8_5	Unsigned8		0	S	General 8 bit unsigned integer variable 5
81	GENERIC_USIGN8_6	Unsigned8		0	S	General 8 bit unsigned integer variable 6
82	GENERIC_USIGN8_7	Unsigned8		0	S	General 8 bit unsigned integer variable 7
83	GENERIC_USIGN8_8	Unsigned8		0	S	General 8 bit unsigned integer variable 8
84	GENERIC_USIGN8_9	Unsigned8		0	S	General 8 bit unsigned integer variable 9

85	GENERIC_USIGN8_10	Unsigned8		0	S	General 8 bit unsigned integer variable 10
86	GENERIC_OCTET_1	OctString(32)			S	General 32 byte character string variable 1
87	GENERIC_OCTET_2	OctString(32)			S	General 32 byte character string variable 2
88	FLOAT_ERR_INFO	Unsigned8(10)	0-255	0xFC	S	General floating point number negative response exception code
89	USIGN32_ERR_INFO	Unsigned8(10)	0-255	0xFC	S	Generic 32 bit unsigned integer negative response exception code
90	USIGN16_ERR_INFO	Unsigned8(10)	0-255	0xFC	S	Generic 16 bit unsigned integer negative response exception code
91	USIGN8_ERR_INFO	Unsigned8(10)	0-255	0xFC	S	Generic 8 bit unsigned integer negative response exception code
92	OCTET _ERR_INFO	Unsigned8(10)	0-255	0xFC	S	General 32 byte character string negative response exception code

The index 1-7 is the standard parameter, which is not described in this manual. The rest of the parameters will be described in details.

4.3.1 BAD_STATUS Parameter description

The BAD_STATUS parameter is used to describe the cyclic input and output parameters of the communication state. If the communication fails, the corresponding bit is set to 1, otherwise it's 0. This parameter can view in DD Device->User Configuration->User Error Lookup menu.

Table 4.3 BAD_STATUS Parameter description table

Bit	Parameter	Bit	Parameter
0	MOD_IN1	16	MOD_IN_D1
1	MOD_IN2	17	MOD_IN_D2
2	MOD_IN3	18	MOD_IN_D3
3	MOD_IN4	19	MOD_IN_D4
4	——	20	——
5	——	21	——
6	——	22	——
7	——	23	——
8	MOD_OUT1	24	MOD_OUT_D1
9	MOD_ OUT2	25	MOD_ OUT_D2
10	MOD_ OUT3	26	MOD_ OUT_D3
11	MOD_ OUT4	27	MOD_ OUT_D4
12	——	28	——
13	——	29	——
14	——	30	——
15	——	31	——

4.3.2 Negative response detection parameter description

Negative response detection parameter provides a negative response data query function. User can query the response value of each data. The negative response detection parameter includes a ERR_LOOK_RESULT parameter、 FLOAT_ERR_INFO parameter、 USIGN32_ERR_INFO parameter、 USIGN16_ERR_INFO parameter、 USIGN8_ERR_INFO parameter、OCTET _ERR_INFO parameter。It can be viewed in User Error Lookup、User Generic Float、User Generic Usign32、User Generic Usign16、User Generic Usign8、User Generic Octet in Device->User Configuration menu in DD files.。

Table 4.4 ERR_LOOK_RESULT Parameter description table

Value	Parameter description

0x00	OK
0x01	Illegal Function
0x02	Illegal Data Address
0x03	Illegal Data Value
0x04	Slave Device Failure
0x05~0xFF	Unknown Exception Code
0xFC	No Communication
0xFD	Data Type Mismatch
0XFE	Function Code Mismatch
0xFF	Communication Failure

4.3.3 User Transducer block cyclic input and output parameter

The User transducer block provides 4 analog inputs, 4 analog outputs, 4 discrete inputs and 4 discrete output parameters. In the case of not modifying function block channels, each input and output parameters are as follows:

Table 4.5 Cyclic input and output parameter description table

Index	Parameter name	Data type	Description
14	MOD_IN1	101	Analog input, it transfers the value and status collected from the slave station to the AI function block 1
15	MOD_IN2	101	Analog input, it transfers the value and status collected from the slave station to the AI function block 2
16	MOD_IN3	101	Analog input, it transfers the value and status collected from the slave station to the AI function block 3
17	MOD_IN4	101	Analog input, it transfers the value and status collected from the slave station to the AI function block 4
22	MOD_OUT1	101	Analog output, it transfers set value and state from the AO function block 1 to Modbus slave station
23	MOD_OUT2	101	Analog output, it transfers set value and state from the AO function block 2 to Modbus slave station
24	MOD_OUT3	101	Analog output, it transfers set value and state from the AO function block 3 to Modbus slave station
25	MOD_OUT4	101	Analog output, it transfers set value and state from the AO function block 4 to Modbus slave station
30	MOD_IN_D1	102	Discrete input, it transfers value and state collected from Modbus slave station to DI function block 1
31	MOD_IN_D2	102	Discrete input, it transfers value and state collected from Modbus slave station to DI function block 2
32	MOD_IN_D3	102	Discrete input, it transfers value and state collected from Modbus slave station to DI function block 3
33	MOD_IN_D4	102	Discrete input, it transfers value and state collected from Modbus slave station to DI function block 4
38	MOD_OUT_D1	102	Discrete output, it transfers set value and state from DO function block 1 to Modbus slave station
39	MOD_OUT_D2	102	Discrete output, it transfers set value and state from DO function block 2 to Modbus slave station
40	MOD_OUT_D3	102	Discrete output, it transfers set value and state from DO function block 3 to Modbus slave station
41	MOD_OUT_D4	102	Discrete output, it transfers set value and state from DO function block 4 to Modbus slave station

Table 4.6 101 & 102 data type table

Data type	Data member	Member data type	Description
101	VALUE	Float	Floating point value
	STATUS	Unsigned8	Including quality and status
102	VALUE	Unsigned8	Discrete value

	STATUS	Unsigned8	Including quality and status

The parameter can be checked in Device->User Configuration in DD files.

4.3.4 User transducer block acyclic parameter

Besides providing the circular input and output parameters, the user transducer block also provides 5 non circular parameters, which are shown in the following table. These parameters can be used to store some auxiliary parameters, which can be used flexibly according to their own needs, such as the upper and lower limits of a certain cyclic parameter, unit code and etc. It will read data every time power on, and then write operation can be carried out at any time. These parameters can be read and wrote in the Configuration Device->User menu in DD.

Table 4.7 non circular parameter list

Index	Parameter name	Data type	Description
46~55	GENERIC_FLOAT	Float	10 general floating point variable, which can transmit any Modbus floating point data to Profibus PA.
56~65	GENERIC_USIGN32	Unsigned32	10 general 32 bit unsigned integer variable, which can transmit any Modbus floating point data to Profibus PA.
66~75	GENERIC_USIGN16	Unsigned16	10 general 16 bit unsigned integer variable, which can transmit any Modbus floating point data to Profibus PA.
76~85	GENERIC_USIGN8	Unsigned8	10 general 8 bit unsigned integer variable, which can transmit any Modbus floating point data to Profibus PA.
86~87	GENERIC_OCTET	OctString(32)	2 common string variables, which can transmit any Modbus floating point data to Profibus PA.

4.4 Module configuration

M0307 User transducer block contains many parameters, which are required to read from the user board or write to the user board. But what data should be read and write from the user board? Which register are these data stored in the user board? Thus, this requires a multi module initialization configuration.

First, the module S2.8 is set to ON, and the module enters configuration mode. The module is connected to the computer serial port through the bottom board.

Open Modbus configuration tool to add devices by adding the serial port.

After scanning the device, the basic parameters of the device will be read into the configuration tool. After that, the user can modify the module's initialization configuration parameters according to their own needs. Please see the manual for Modbus configuration tool.

4.4.1 Device initialization parameter configuration

The device initialization information includes manufacturers ID, device ID & etc. related parameter information. These parameters are products' specific information.

Table 4.8 Device initialization parameter list

Parameter	Description
Manufacturer ID	To develop PA device, user should first become a PI member, and then apply for manufacturer ID. Non-members are not allowed to apply it. Manufacturer ID is mainly used in the device description EDD.
Device ID	Device unique identification, to apply from PI organization. Different price for membership.
Profile ID	Profile specified identification
Device Type	To describe device type character string, length 16 bytes
Device Serial Number	To fill in device serial number, length 16 bytes
Device Certification	To fill in device certification information, length 32 bytes
Installation Date	To fill in time when device leaves factory, length 16 bytes

Serial port set address		Only valid when the hardware set address is forbidden 0：disable 1：enable
Bus address configuration information		The following is the bus address configuration information, only valid when the hardware set address is forbidden and the serial port is enabled.
Bus Address Attribute	**Read-write Attribute**	Read only
	Function Code	03，04
	Data Type	Unsigned8_0，Unsigned8_1
	Register Address	Register address to store bus address parameter.

4.4.2 Modbus communication parameter configuration

Modbus communication parameters is the most basic configuration parameters between the module and the user board. Only when the parameters are configured correctly, the module and the user board can communicate correctly.

Table 4.9 Modbus communication parameter table

Parameter name	Description
Baud rate	0：2400 1：4800 2：9600 3：14400 4：19200
Data bits	0：8 1：7
Parity	0：None 1：Even 2：Odd
Physical Standard	0：TTL 1：RS232 2：RS485
Stop bits	0：One Stop Bit 1：Two Stop Bits
Address	The address Modbus slave address under normal working mode, slave station address range：1~255。
CRC	CRC check order 0：Normal 1：Swapped
Timeout	Timeout range：300ms~1000ms。
Retry times	Retry times：1~10。

4.4.3 Cyclic input and output parameter configuration

As introduced, this module includes analog input, analog output, discrete input and discrete output parameters. The number of parameters are fixed as four, so this chapter will introduce how these parameters and Modbus slave station associates. These 4 parameters all have read and write, data type, register address, function code and other attributes, which can be configured through the Modbus configuration tool.

- **Read and write attribute**

  It describes if the parameters in the Modbus side are read-only, write only, or can be read and wrote.

- **Data format attributes**

  It describes the data type, format and etc. of the Modbus parameter.

Table 4.10 Data format attribute description table

Index	Name	Data type	Data length	Valid range
1	Float_0123	single precision floating point	4	
2	Float_1032	single precision floating point	4	
3	Float_3210	single precision floating point	4	
4	Float_2301	single precision floating point	4	

5	Unsigned8_0	unsigned integer	1	0 - 255
6	Unsigned8_1	unsigned integer	1	0 - 255
7	Unsigned16_01	unsigned short integer	2	0 - 65535
8	Unsigned16_10	unsigned short integer	2	0 - 65535
9	Unsigned32_0123	unsigned long integer	4	0 - 4294967295
10	Unsigned32_1032	unsigned long integer	4	0 - 4294967295
11	Unsigned32_3210	unsigned long integer	4	0 - 4294967295
12	Unsigned32_2301	unsigned long integer	4	0 - 4294967295
13	Signed8_0	signed integer	1	-128 - 127
14	Signed8_1	signed integer	1	-128 - 127
15	Signed16_01	signed short integer	2	-32768 - 32767
16	Signed16_10	signed short integer	2	-32768 - 32767
17	Signed32_0123	signed long integer	4	–2,147,483,648 - 2,147,483,647
18	Signed32_1032	signed long integer	4	–2,147,483,648 - 2,147,483,647
19	Signed32_3210	signed long integer	4	–2,147,483,648 - 2,147,483,647
20	Signed32_2301	signed long integer	4	–2,147,483,648 - 2,147,483,647

In the data format table above, the data type name DataType_abcd's suffix abcd represents the data's serial number in the Modbus slave station. 0 represents lower 8 bits data in the first register. 1 represents high 8 bits data in the first register. 2 represents lower 8 bits data in the second register. 3 represents high 8 bit data in the second register. The module uses little endian mode, so Unsigned32_0123 0123 means MODBUS slave station data in the register in accordance with the original order in turn assigned to long integer variables in the module, and Unsigned32_1032 1032 is the Modbus slave station of each register data exchange level byte after the assignment to long integer variable in the gateway.

- **Register address attribute**

  This property describes the location of the parameter in the Modbus store.

- **Function code attribute**

  This property describes what kind of function code is used to manipulate the parameters.

Table 4.11 Function code parameter description table

Function code	Name
1	FC01 Read Coils
2	FC02 Read Discrete Input
3	FC03 Read Holding Register
4	FC04 Read Input Register
5	FC05 Write Single Coils
6	FC06 Write Single Register
16	FC16 Write Multiple Register

Table 4.12 Cyclic input and output parameter configuration table

Data type	Read-write attribute	Available function code	Available data format	Whether Register address can be continuous
AI	Read only	03,04	Float_0123, Float_1032, Float_3210, Float_2301, Unsigned32_0123, Unsigned32_1032, Unsigned32_3210, Unsigned32_2301, Unsigned16_01, Unsigned16_10, Signed16_01, Signed16_10, Signed32_0123, Signed32_1032, Signed32_3210, Signed32_2301, Unsigned8_0, Unsigned8_1, Signed8_0, Signed8_1	Yes

AO	Write only	06	Unsigned16_01，Unsigned16_10, Signed16_01, Signed16_10, Unsigned8_0, Unsigned8_1, Signed8_0, Signed8_1	No
		16	Float_0123, Float_1032, Float_3210, Float_2301, Unsigned32_0123, Unsigned32_1032, Unsigned32_3210, Unsigned32_2301, Signed32_0123, Signed32_1032, Signed32_3210, Signed32_2301, Unsigned16_01, Unsigned16_10, Signed16_01, Signed16_10, Unsigned8_0, Unsigned8_1, Signed8_0, Signed8_1	Yes
DI	Read only	01,02	None	Yes
		03,04	Unsigned8_0, Unsigned 8_1	Yes
DO	Write only	05	None	No
		15	None	Yes
		06	Unsigned8_0，Unsigned8_1	No
		16	Unsigned8_0，Unsigned8_1	Yes

4.4.4 Acyclic parameter configuration

As described above, this module contains 5 acyclic parameters. Among them, there are 10 for each floating point data, USIGN32 data, USIGN16 data and USIGN8 data, and there are two 32 bytes Octet String data. The configuration method of these parameters is the same with the configuration method of the cyclic parameters. It also contains the read and write, data type, register address, function code and other properties, which can be configured through the Modbus configuration tool.

Table 4.13 Acyclic parameter configuration table

Data type	Read-write attribute	Available function code	Available data format	Whether Register address can be continuous
Floating point data	read-write	03,04,16	Float_0123, Float_1032, Float_3210, Float_2301	Yes
USIGN32 data	read-write	03,04,16	Unsigned32_0123, Unsigned32_1032, Unsigned32_3210, Unsigned32_2301	Yes
USIGN16 data	read-write	03,04,06,16	Unsigned16_01, Unsigned16_10	Yes
USIGN8 data	read-write	03,04,06,16	Unsigned8_0, Signed8_1	Yes
Octet String data	read-write	03,04,16	Unsigned16_01, Unsigned16_10	Yes

4.4.5 Generate GSD files

Through the Modbus configuration tool, user can configure some of the basic information in the GSD file and generate user proprietary GSD file. If the user is not satisfied with the generated GSD file, he can refer to the GSD specification or special tools to modify the generated GSD file.

When modifying the GSD file, user should pay attention to the following points:

1) Content after ";" is comment text, not the actual GSD file description. User can add comment text according to their need;
2) Bitmap Device picture has format requirements. File uses format Windows Bitmap (.bmp), pixels length 70* width 40, 16 bits. For compatibility reasons, user can also use the Device Indipendent Bitmap (.dib) format file;
3) Slave_Family is used to specify the slave station type of the product. PA device this parameter is fixed to 12. User can add @ behind 12 to increase the device directory. For example: 12@Microcyber@Module.

4.5 Device usage

When the configuration is completed, it switches back to normal working mode. It can be built-in into users' products to form Profibus PA slave station device.

4.5.1 Set slave station address

When using the device, user needs to pay attention to the way of device address setting. When using this module, there are 2 kinds of ways to set the address: hardware and software. The software address setting also includes by bus and by serial port.

- **Set address by hardware**

It enables the hardware address setting function when module's dial switch S1.3 is ON. At this time, the device can only set the slave station address through dial switch S2.1~S2.7.

- **Set address by software**

1) Set address by bus

It forbids the hardware address setting function when module's dial switch S1.3 is OFF. When configuring the module, set the "serial port address setting" to forbidden. At this point, user can set slave station address through the bus command.

2) Set address by serial port

It forbids the hardware address setting function when module's dial switch S1.3 is OFF. When configuring the module, set the serial set address parameter to enable. At this time, slave station device address is from Modbus register where" bus address register" parameters locates in. User can modify slave station address by modifying this register.

4.5.2 Device cyclic configuration

4.5.2.1 GSD File Introduction

PA device generally supports at least 2 GSD files, namely manufacture's GSD file and specification GSD file. Here it is manufacture's GSD file. 16 function blocks included in M0307 can do periodic data exchange service with 1 Class master. The user shall configure the function blocks.

Table 4.14 GSD Module

Function Block	Module Name	Module No.	Configuration Data
Empty Module	EMPTY_MODULE	1	0x00
AI Function Block	Analog Input (AI)	2	0x42,0x84,0x08,0x05
AO Function Block	SP	3	0x82,0x84,0x08,0x05
	SP+READBACK+POS_D	4	0xC6, 0x84, 0x86, 0x08, 0x05, 0x08, 0x05, 0x05, 0x05
	SP+CHECKBACK	5	0xC3, 0x84, 0x82, 0x08, 0x05, 0x0A
	SP+READBACK+POS_D+CHECKBACK	6	0xC7, 0x84, 0x89, 0x08, 0x05, 0x08, 0x05, 0x05, 0x05, 0x0A
	RC_IN+RC_OUT	7	0xC4, 0x84, 0x84, 0x08, 0x05, 0x08, 0x05
	RC_IN+RC_OUT+CHECKBACK	8	0xC5, 0x84, 0x87, 0x08, 0x05, 0x08, 0x05, 0x0A
	SP+RC_IN+RB+RC_OUT+POS_D+CB	9	0xCB, 0x89, 0x8E, 0x08, 0x05, 0x08, 0x05, 0x08, 0x05, 0x08,

			0x05, 0x05, 0x05, 0x0A
DI Function Block	OUT_D	10	0x91
DO Function Block	SP_D	11	0xA1
	SP_D+RB_D	12	0xC1, 0x81, 0x81, 0x83
	SP_D+CB_D	13	0xC1, 0x81, 0x82, 0x92
	SP_D+RB_D+CB_D	14	0xC1, 0x81, 0x84, 0x93
	RC_IN_D+RC_OUT_D	15	0xC1, 0x81, 0x81, 0x8C
	RC_IN_D+RC_OUT_D+CB_D	16	0xC1, 0x81, 0x84, 0x9C
	SP_D+RC_IN_D+RB_D+RC_OUT_D+CB_D	17	0xC1, 0x83, 0x86, 0x9F

Note： RB = READBACK, CB = CHECKBACK, RC_OUT = RCAS_OUT, RC_IN = RCAS_IN

Each function block occupies a slot, and each slot can be chosen by multiple modules.

Table 4.15 GSD Input Output Data Configuration List

Slot	Function Block	Default Module	Selective Module
1	AI function block 1	2	1,2
2	AI function block 2	2	1,2
3	AI function block 3	2	1,2
4	AI function block 4	2	1,2
5	AO function block 1	3	1,3,4,5,6,7,8,9
6	AO function block 2	3	1,3,4,5,6,7,8,9
7	AO function block 3	3	1,3,4,5,6,7,8,9
8	AO function block 4	3	1,3,4,5,6,7,8,9
9	DI function block 1	10	1,10
10	DI function block 2	10	1,10
11	DI function block 3	10	1,10
12	DI function block 4	10	1,10
13	DO function block 1	11	1,11,12,13,14,15,16,17
14	DO function block 2	11	1,11,12,13,14,15,16,17
15	DO function block 3	11	1,11,12,13,14,15,16,17
16	DO function block 4	11	1,11,12,13,14,15,16,17

4.5.2.2 Install GSD File

Take Siemens STEP 7 Software as an example, choose any project, open hardware configuration, choose "Options→Install GSD File…", and it will open the GSD file window.

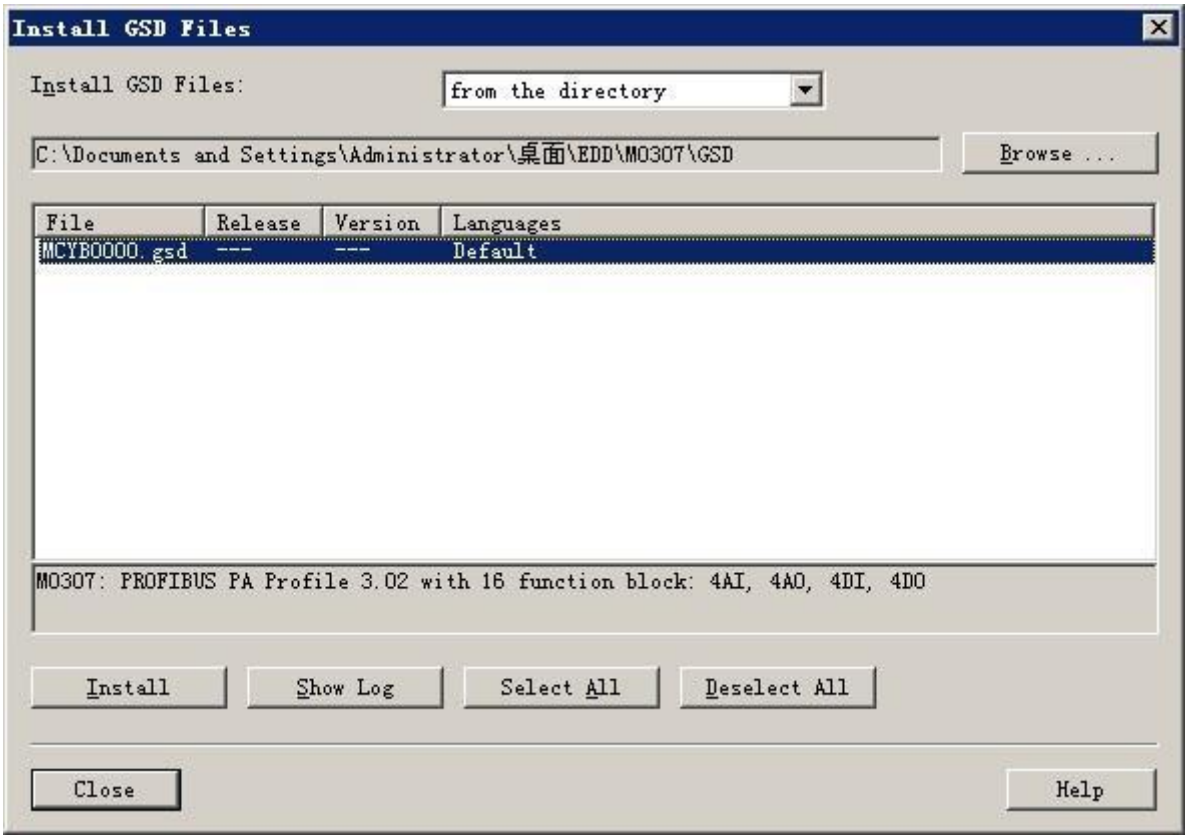

Figure 4.3 GSD file window

Click "Browse…" and choose the path for GSD file. It will list all the GSD files in the present path, choose the GSD file and click "Install". Keep clicking "Yes", until Figure 4.4 is shown.

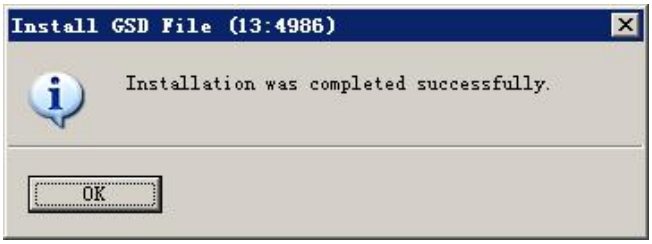

Figure 4.4 Successful Installation

4.5.2.4 Use GSD file

After successful installation for GSD, the gateway shall appear in the tree list at the right side of the hardware configuration window.

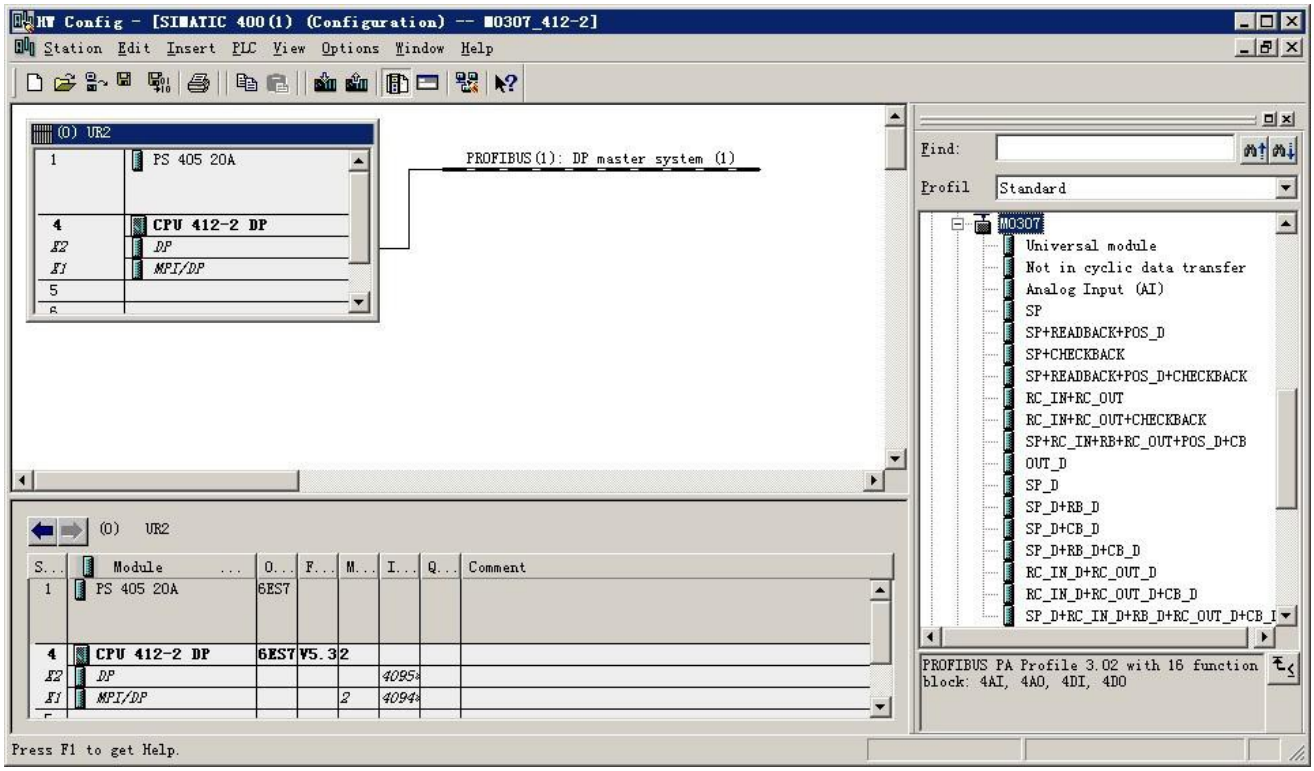

Figure 4.5 Correct Installed Devices

Drag gateway to DP bus, and it will show the prosperities window automatically. Here shall the user configure the requested address, and we choose address 85.

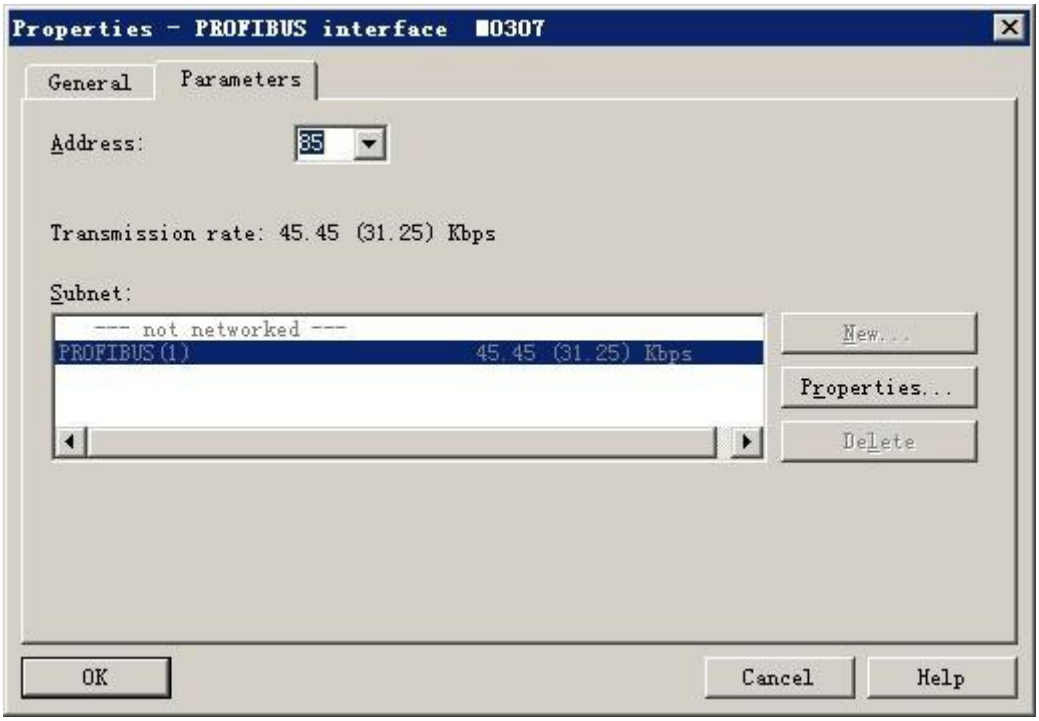

Figure 4.6 Device Prosperities Configuration

Click “OK” to finish adding gateway.

Choose the gateway in the configuration image, the device's configuration shall be shown in the left bottom side of the window, shown as following.

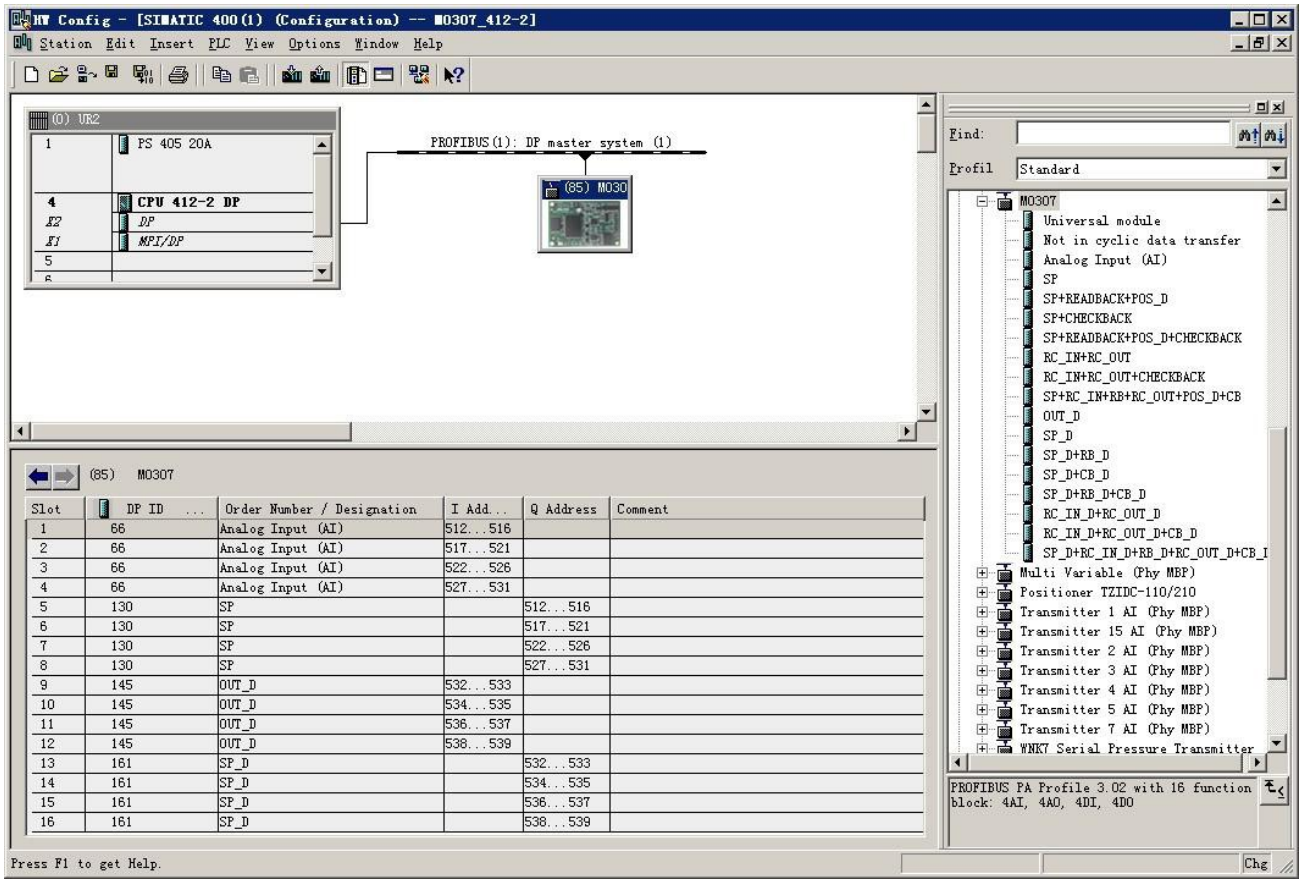

Figure 4.7 Device Configuration

In the hardware configuration, the configuration shall do related modify according to specific request, in order to form configuration information of gateway's input output data. The detailed introduction for each module is mentioned in **错误!未找到引用源。**.

4.5.2.5 Specification GSD File

Except the GSD file resigned by the gateway, the user shall use the specification GSD file: pa139760.gsd.

Because each slot for the module is ready (refer to tableTable 4.15), only when the configuration is right, the device shall work in normal.

Chapter 5 GSD file, ID and certification test

5.1 GSD file, ID and certification test

5.1.1 GSD file（Electronic Data Sheet）

Each PROFIBUS slave the station or primary master station has a device description file, called GSD file. This file is used to describe the characteristics of the PROFIBUS device.

The GSD file contains all device defined parameters, including:

- ✓ baud rate supported；
- ✓ message length supported；
- ✓ input / output data quantity；
- ✓ meaning of diagnostic information；
- ✓ optional module type etc..

GSD file is a text file that can be edited by Notepad software.

No matter what kind of system environment is used, device need configuring according to the GSD file.

International organization PROFIBUS PI provides GSD file editing software: GSD-Editor. The software can format in accordance with the technical standard of Profibus, checking the format of user's GSD file. The software's "help" is rich in content, which is a fast learning GSD file technology way. User must become members of the PI organization to download it.

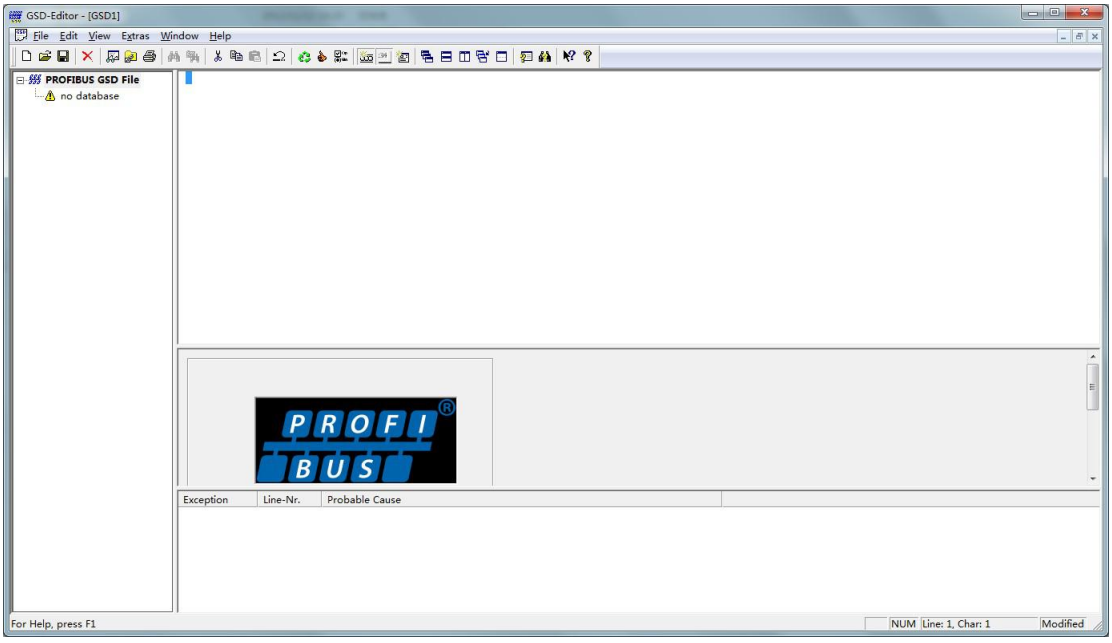

Figure 5.1 GSD-Editor open a vacant file

5.1.2 ID（Ident Number）

Each PROFIBUS device should have a unique ID number. The user can delegate "Chinese PROFIBUS CPA" to

apply product ID from the international PROFIBUS organization PI.

Each membership can also apply manufacturer ID, non-members shall not apply that.

CPA Tel：010-63405107 Contact：Wang Jing

CPA web http://www.pi-china.org/

5.1.3 Certification test

The PROFIBUS test certification is not mandatory. However, if the product pass certification test, the design institute can give more confidence to end-users, which can also facilitate the products involved in the project bidding and market development.

Product testing can be conducted by Chinese PROFIBUS CPA. After the test, it can be entrusted to apply PI certification from the international PROFIBUS organization PI.

CPA Tel：010- 63322089 Contact：Liu Dan

CPA web http://www.pi-china.org/

5.2 User product GSD file and ID

Since this module is sold in OEM mode, the users have independent intellectual property and brand of the PROFIBUS device developed with this module. Thus, users' products cannot use module ID module and GSD file name.

Based on this module, Users can replace the company name, product type, serial number etc. to users' products information to have their own GSD file.

The GSD file is named according to the following rules, consisting of 8 strings, 4 high representative manufacturers, and low 4 representative ID. For example: MCYB MCYB0001.gsd file is the abbreviation of Microcyber, and the 0001 is the ID of the product. High 4 manufacturer name abbreviation is generally defined by the users themselves when filling the form during application of ID.

It can be connected only when module ID is the same with GSD files ID.

5.3 Device description file

Mainstream device description file Profibus PA device has two kinds: EDD and device DTM.

Since these two kinds of files are complex to change, modification of the device description file is not described in this manual. This module provides EDD template file. User can modify the .device file according to their needs, to achieve the most basic function of EDD.

Modifying the number of parameters may lead to read failure of some EDD parameters. In this situation, user can solve it by making parameter in the EDD file and in configuration the same.

If there is any EDD file or DTM device needs, please contact us.

Chapter 6 Maintenance

- Simple maintenance

LED	color	Normal	Abnormal	Reason	Solution
PA communication	Green	Flicker	Off	No PA communication	Check PA master and PA interface device
				Power failure	Check power and connection
				Internal failure	Contact technical support
Modbus communication	Green	Flicker	Off	No connection with slave	Connect with slave correctly
				Slave device failure	Check slave and connection
				Internal failure	Contact technical support

- When switching normal working mode to configuration mode, user need to wait until normal working mode Modbus command queue sending is completed to complete the switch
- Daily maintenance is only for device cleansing.
- Failure maintenance: Please return to factory if there is failure.

Chapter 7 Technical Specification

7.1 Basic Parameter

Detection Object	Modbus RTU slave
Bus power	9～32VDC
Current	≤14mA
Protocol	Two-wire, PA
Isolation voltage	Modbus and PA interface, 500VAC
temperature range	-40℃～85℃
Humidity range	5～95%RH
Start-up time	≤5s
Update time	0.2s

7.2 Performance Index

EMC	GB/T 18268.1-2010 GB/T 18268.23-2010

7.3 Physical Characteristic

Weight	16 g
Structure Material	Coating: Polyester epoxy resin

7.4 Default Communication Parameter

Slave Address	1
Baud Rate	9600
Data Bit	8
Stop Bit	1
Check	EVEN
CRC Check	low byte is ahead

7.5 Support Modbus Function Code

1	Read coils
2	Read discrete inputs
3	Read holding registers
4	Read input registers
5	Write single coil
6	Write single register
15	Write multiple coils
16	Write multiple registers

Appendix 1 Model Selection

MOD-PA	M0307 Modbus to PA built-in module					
	Code	Master-slave				
	M	Master				
		Code	Module type			
		N	Common			
			Code	Hardware interface		
			T	TTL		
				Code	Software interface	
				M	Modbus RTU	
					Code	bus interface on Module
					N	No bus interface
MOD-PA-	M	N	T	M	N	—— Selection Example

MICROCYBER

YOUR FIELDBUS EXPERT

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