Intelligent Grating MODBUS-RTU Communication Protocol

Ⅰ. Product Overview

1. Default Configuration:
    1. A. Address 15.
    2. B. Baud rate 19200BPS.
    3. C. Data byte format - 1 start bit, 8 data bits, even parity, 1 stop bit, as shown below:

Start	0b	1b	2b	3b	4b	5b	6b	7b	Even Parity	Stop

1. Physical Characteristics:
    1. A. Communication type: RS485.
    2. B. Transmission medium: Twisted pair.
    3. C. Communication mode: Asynchronous master-slave half-duplex mode, with the intelligent grating as the slave station.
    4. D. Communication address: 1-247 (slave station).
    5. E. Communication baud rate: No more than 1000000BPS, can be set arbitrarily, and a common baud rate is recommended.
1. Data Layer:

The communication protocol adopts the standard ModBus protocol, supports unicast mode and broadcast mode, and uses RTU type transmission.

Ⅱ. Changing Configuration (all commands are sent in hexadecimal)

Using function code 06, there are 4 registers inside the grating device for changing the configuration, which are mapped to addresses FFF1H-FFF4H, and are respectively used for modifying the local address, baud rate, parity bit, and restoring the default configuration. After sending the configuration modification instruction, wait about 0.5 seconds for the configuration to take effect, and do not send the instruction repeatedly during this period.

1. Changing the grating device address: The grating address can be set arbitrarily between 1 and 247. The register with the internal mapping address FFF1H is used to modify the grating device address, and the corresponding value is written into it. For example, the following example changes the grating device address from 15 to 29.
    1. Sent RTU frame:

Device Address	Function Code	Address High	Address Low	Data High	Data Low	CRC Checksum
0F	06	FF	F0	00	1D	78CA

2. Acknowledged RTU frame:

Device Address	Function Code	Address High	Address Low	Data High	Data Low	CRC Checksum
0F	06	FF	F0	00	1D	78CA

1. Changing the communication baud rate: The communication baud rate can be arbitrarily set as a multiple of 100 within no more than 1000KBPS. The register with the internal mapping address FFF2 is used to change the baud rate, and the corresponding value is written into it. The value = baud rate ÷ 100. For example, the following example sets the baud rate of the grating device with address 15 to 115200BPS (the written value is: 115200 ÷ 100 = 1152 (0480 H)).

    1. Sent RTU frame:

Device Address	Function Code	Address High	Address Low	Data High	Data Low	CRC Checksum
0F	06	FF	F1	04	80	EA63

2. Acknowledged RTU frame:

Device Address	Function Code	Address High	Address Low	Data High	Data Low	CRC Checksum
0F	06	FF	F1	04	80	EA63

1. Changing the parity bit: The parity bit can be set to no parity, odd parity, or even parity. The register with the internal mapping address FFF3 is used to modify the parity bit, and the corresponding value is written into it. 00 - no parity, 01 - odd parity, 02 - even parity. For example, the following example sets the parity bit to odd parity.

    1. Sent RTU frame:

Device Address	Function Code	Address High	Address Low	Data High	Data Low	CRC Checksum
0F	06	FF	F2	00	01	D8C3

2. Acknowledged RTU frame:

Device Address	Function Code	Address High	Address Low	Data High	Data Low	CRC Checksum
0F	06	FF	F2	00	01	D8C3

1. Restoring the default settings: Use the broadcast mode to restore the grating device configuration to the initial state. The register with the internal mapping address FFF4 is used to restore the default configuration, and the value 1111 is written into it. The following example is shown (no return).
    1. Sent RTU frame:

Device Address	Function Code	Address High	Address Low	Data High	Data Low	CRC Checksum
00	06	FF	F3	11	11	8460

Ⅲ. Reading Grating Data

This 485 light curtain can provide the following information to the upper computer:

1. The lowest position value where the light curtain is blocked, which is stored in the holding register 0040 (i.e., PLC register 40065), is a 16-bit hexadecimal number, with the high byte first and the low byte second.
2. The highest position value where the light curtain is blocked, which is stored in the holding register 0041 (i.e., PLC register 40066), is a 16-bit hexadecimal number, with the high byte first and the low byte second.
3. The number of blocked points of the light curtain, which is stored in the holding register 0042 (i.e., PLC register 40067), is a 16-bit hexadecimal number, with the high byte first and the low byte second.
4. The status values of all light points in the light curtain are stored in the address starting from the holding register 0000 (i.e., PLC register 40001). A holding register is a 16-bit data (i.e., 2 bytes) containing the information of 16 light points, and two holding registers contain the information of 32 light points, and so on. If the total number of light points is not an integer multiple of 16, the extra light point information

is arranged in the next holding register in order from low to high, and the insufficient part is filled with 0. A detailed explanation is given in the following example.

A complete query information frame is as follows:

Station address + query command + holding register address + number of holding registers + CRC

The upper computer can read the holding registers of the 485 light curtain in the following ways:

5. Reading the light-shielding lowest point data of the 485 light curtain with the station address of 0x0F and the number of light points of 80.
    1. Reading the light-shielding lowest point data
        1. Sent RTU frame:

Device Address	Function Code	Address High	Address Low	Data High	Data Low	CRC Checksum
0F	03	00	40	00	01	84F0

6. Acknowledged RTU frame:

Device Address	Function Code	Total Bytes	Light-shielding Lowest Point Data		CRC Checksum
0F	03	02	XX (High 8 Bits)	XX (Low 8 Bits)	XXXX

Where 0x0F is the station address of the light curtain, 0x03 is the command to read the holding register, 0x00 0x40 is the address of the light-shielding lowest point data in the holding register (i.e., the PLC register 40065), 0x00 0x01 is the number of holding registers to read (the data length of the lowest blocked position value is 1 word, 2 bytes, occupying the space of 1 holding register), and 0x84 0xF0 is the CRC check code of this command.

7. Reading the light-shielding highest point data
    1. Sent RTU frame:

Device Address	Function Code	Address High	Address Low	Data High	Data Low	CRC Checksum

0F	03	00	41	00	01	D530

8. Acknowledged RTU frame:

Device Address	Function Code	Total Bytes	Light-shielding Highest Point Data		CRC Checksum
0F	03	02	XX (High 8 Bits)	XX (Low 8 Bits)	XXXX

Where 0x0F is the station address of the light curtain, 0x03 is the command to read the holding register, 0x00 0x41 is the address of the light-shielding highest point data in the holding register (i.e., the PLC register 40066), 0x00 0x01 is the number of holding registers to read (the data length of the highest blocked position value is 1 word, 2 bytes, occupying the space of 1 holding register), and 0xD5 0x30 is the CRC check code of this command.

9. Reading the light-shielding quantity data

    1. Sent RTU frame:

Device Address	Function Code	Address High	Address Low	Data High	Data Low	CRC Checksum
0F	03	00	42	00	01	2530

10. Acknowledged RTU frame:

Device Address	Function Code	Total Bytes	Light-shielding Quantity Data		CRC Checksum
0F	03	02	XX (High 8 Bits)	XX (Low 8 Bits)	XXXX

Where 0x0F is the station address of the light curtain, 0x03 is the command to read the holding register, 0x00 0x42 is the address of the light-shielding quantity data in the holding register (i.e., the PLC register 40067), 0x00 0x01 is the number of holding registers to read (the data length of the highest blocked position value is 1 word, 2 bytes, occupying the space of 1 holding register), and 0x25 0x30 is the CRC check code of this command.

11. Reading the light-shielding lowest and highest point data

    1. Sent RTU frame:

Device Address	Function Code	Address High	Address Low	Data High	Data Low	CRC Checksum
0F	03	00	40	00	02	C4F1

12. Acknowledged RTU frame:

Device Address	Function Code	Total Bytes	Light-shielding Lowest and Highest Point Data		CRC Checksum
0F	03	04	XX XX	XX XX	XXXX

Where 0x0F is the station address of the light curtain, 0x03 is the command to read the holding register, 0x00 0x40 is the starting address (i.e., the PLC register 40065), 0x00 0x02 is the number of holding registers to read (the data length of the lowest and highest blocked position values is 2 words, 4 bytes, occupying the space of 2 holding registers).

Note: If you want to include reading the light-shielding quantity together, you only need to change the number of holding registers to 0003, and the checksum 0531 0xC4 0xF1 is the CRC check code of this command.

13. Reading the status data of all light points with 80 light points

    1. Sent RTU frame:

Device Address	Function Code	Address High	Address Low	Data High	Data Low	CRC Checksum
0F	03	00	00	00	05	84E7

14. Acknowledged RTU frame:

Device Address	Function Code	Total Bytes	Status Data of All Light Points	CRC Checksum

0F	03	0A	XX XX XX XX XX XX XX XX XX XX	XXXX

Where 0x0F is the station address of the light curtain, 0x03 is the command to read the holding register, 0x00 0x00 is the starting address of the holding register (i.e., the PLC register 40001), 0x00 0x05 is the number of holding registers to read (the data length of the status of all light points (80) is 5 words, 10 bytes, occupying the space of 5 holding registers), and 0x84 0xE7 is the CRC check code of this command.

15. Description:
    1. A. The optical axis data is arranged in the order from the low byte to the high byte from left to right. Each bit of the optical axis data corresponds to an optical axis, which is arranged in order from low to high by byte and bit. The storage position corresponding to each optical axis is: the byte where it is located = the optical axis number ÷ 8, and the result is rounded down. The bit where it is located = the optical axis number - the byte where it is located × 8 - 1. For example, the 28th optical axis, the byte where it is located = 28 ÷ 8 = 3.5, and rounding down gives 3. The bit where it is located = 28 - 3 × 8 - 1 = 3. That is, the status information of the 28th optical axis is located at the 3rd bit of the 3rd byte of the optical axis data. (Note: the data is calculated from 0.)
    2. B. For the optical axis bit data, the light-shielding state is "1", the light-passing state is "0", and the invalid optical axis bit data (corresponding to no optical axis) is always "0".

Example

Correspondence between data Byte, data Bit, and optical axis

Example:

16. When the grating with 80 light points is fully passing light, the status data of all light points is: 0F 03 0A 00 00 00 00 00 00 00 00 00 00 32 38.
17. When the grating with 80 light points is fully blocked, the status data of all light points is: 0F 03 0A FF FF FF FF FF FF FF FF FF FF 03 BB.
18. When only the 1-10 light points of the grating with 80 light points are blocked, the status data is: 0F 03 0A FF 03 00 00 00 00 00 00 00 00 13 3B.

Wiring Diagram

	Receiver	Transmitter	Use	Description

1	Brown	Brown	V+	Connect to the positive terminal of the power supply
2	Blue	Blue	V-	Connect to the negative terminal of the power supply
3	Black	Black	CP	Connect to each other, no external connection
4	Green	/	A	Connect to the A terminal (D+) of the 485 communication port
5	Yellow	/	B	Connect to the B terminal (D-) of the 485 communication port

△ Note: Do not short-circuit the lines! Power on after checking that there is no error!!!