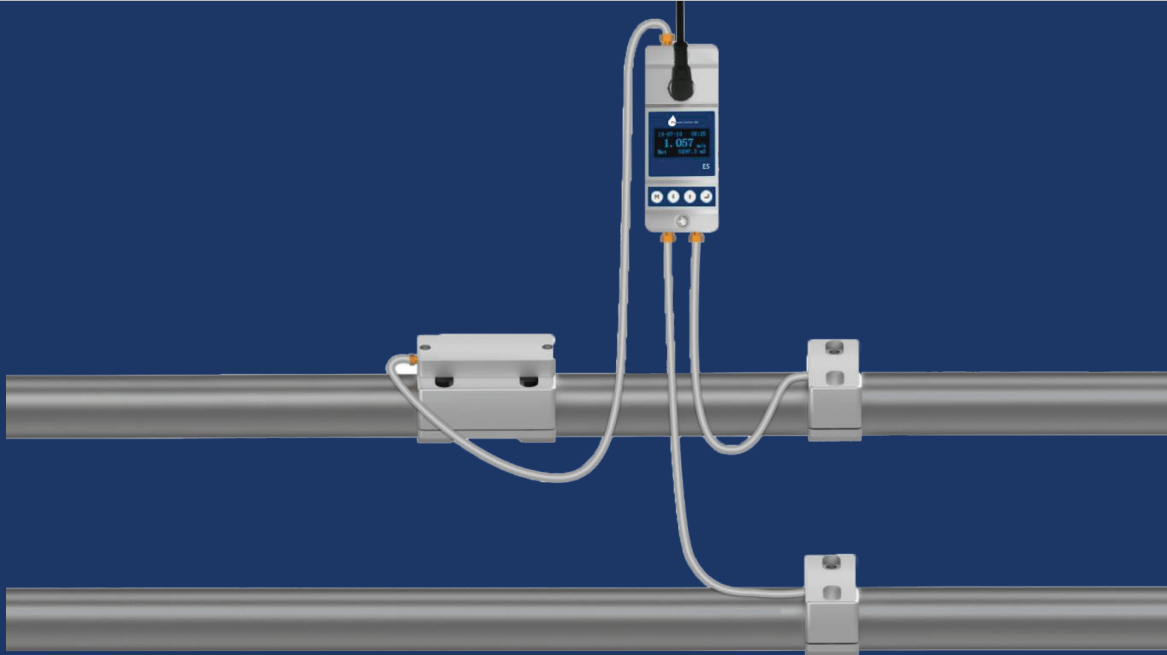


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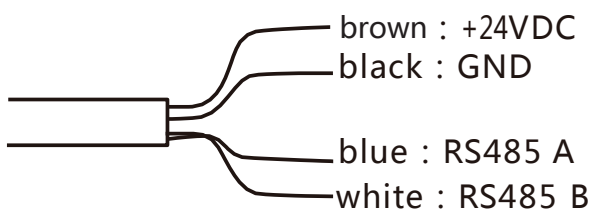


Protocol Specification

The flow meter has communications protocol. Its hardware directly supports a modem, a composition of flow data monitoring system that is economical, reliable and based on telephone line transmission. It can also be connected to a RS-485 bus through a RS232-RS485 change-over panel.

Two basic schemes can be chosen for networking, i.e. the analog current output method only using the flow meter or the RS232 communication method via serial port directly using the flow meter. The former is suitable to replace dated instruments in old monitoring networks. The later is used in new monitoring network systems. It has advantages such as low hardware investment and reliable system operation.

The output cable wiring is:



The host device requests the flow meter to answer by sending a "command". The baud rate of asynchronous communications (Primary station: computer system; Secondary station: ultrasonic flow meter) is generally 9600bit/s. A single byte data format (10 bits): one start bit, one stop bit and 8 data bits. Check bit: none.

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Communications Protocol

This instrument protocol supports the following function codes of MODBUS protocol:

| Function Code | Performance Data |
|---------------|------------------|
| 0x03 | Read Register |
| 0x06 | Write Register |

1. MODBUS Protocol function code 0x03 usage

The host sends out the read register information frame format:

| Slave Address | Operation Function Code | First Address Register | Register Number | Register Number |
|---------------|-------------------------|------------------------|-----------------|-----------------|
| 1 byte | 1 byte | 2 byte | 2 byte | 2 byte |
| 0x01~0xF9 | 0x03 | 0x0000~0xFFFF | 0x0000~0x7D | CRC(Verify) |

Frame format of data returned from machine:

| Slave Address | Operation Function Code | First Address Register | Register Number | Register Number |
|---------------|-------------------------|------------------------|-----------------|-----------------|
| 1 byte | 1 byte | 1 byte | N*x2byte | 2 byte |
| 0x01~0xF9 | 0x03 | 2xN* | N*x2Data | CRC(Verify) |

N* = Data register number.

The range of flow meter addresses 1 to 249 (Hexadecimal: 0x01 ~ 0xF9), and can be checked in the Menu Network addr. For example, decimal number "12" displayed on Menu Network addr means the address of the flow meter in the MODBUS protocol is 0x0C.

The CRC Verify Code adopts CRC-16-IBM (polynomial is $X^{16}+X^{15}+X^2+1$, shield character is 0xA001) which is gained by the cyclic redundancy algorithm method. Low byte of the verify code is at the beginning while the high byte is at the end. For example: set the address of the instrument as 1, read the current instantaneous flow, send the command as 01 03 00 02 00 02 65 CB, return the data as 01 03 04 04 6E 98 3F A2 F7 7D, the identified data as 1.269m /h.

2. MODBUS Register Address List

The flowmeter MODBUS Register has a read register and a write single register.

a) Read Register Address List (use 0x03 function code to read)

| Register Address | Register | Read | Write | Type | No.registers* |
|------------------|----------|-----------------------|--------------|------|---------------|
| \$0000 | 40001 | Velocity - low word | 32 bits real | 2 | Unit: m/s |
| \$0001 | 40002 | Velocity - high word | | | |
| \$0002 | 40003 | Flow/h - low word | 32 bits real | 2 | |
| \$0003 | 40004 | Flow/h - high word | | | |
| \$0004 | 40005 | Net total - low word | 32 bits real | 2 | |
| \$0005 | 40006 | Net total - high word | | | |
| \$0006 | 40007 | Net total int - low | 32 bits int. | 2 | |
| \$0007 | 40008 | Net total int - high | | | |



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| | | | | | |
|--------|-------|--|--------------|---|---------------------------------------|
| \$0008 | 40009 | Net total dec - low | 32 bits real | 2 | |
| \$0009 | 40010 | Net total dec - high | | | |
| \$000A | 40011 | Day total int - low | 32 bits int. | 2 | |
| \$000B | 40012 | Day total int - high | | | |
| \$000C | 40013 | Day total dec - low | 32 bits real | 2 | |
| \$000D | 40014 | Day total dec - high | | | |
| \$000E | 40015 | Month total - low | 32 bits real | 2 | |
| \$000F | 40016 | Month total - high | | | |
| \$0010 | 40017 | Year total - low word | 32 bits real | 2 | |
| \$0011 | 40018 | Year total - high word | | | |
| \$0012 | 40019 | 4-20mA analog output | 32 bits real | 2 | |
| \$0013 | 40020 | 4-20mA analog output | | | |
| \$0014 | 40021 | Runtime - low word | 32 bits int | 2 | Unit: h |
| \$0015 | 40022 | Runtime - high word | | | |
| \$0016 | 40023 | Serial number – char | String | 4 | |
| \$0017 | 40024 | Serial number – char | | | |
| \$0018 | 40025 | Serial number – char | | | |
| \$0019 | 40026 | Serial number – char | | | |
| \$001A | 40027 | Date Time | | 3 | Year, month, day, hour, minute,second |
| \$001B | 40028 | | | | |
| \$001C | 40029 | | | | |
| \$001D | 40030 | Quality | 16 bits int | 1 | |
| \$001E | 40031 | Running state | 16 bits int | 1 | |
| \$001F | 40032 | Flowmeter address | 16 bits int | | |
| \$0020 | 40033 | Communication Baud Rate0=2400,1=4800, 2=9600,3=19200 | 16 bits int | | |
| \$0021 | 40034 | Velocity unit | String | 2 | m/s or f/s |
| \$0022 | 40035 | | | | |
| \$0023 | 40036 | Flow unit | String | 2 | |
| \$0024 | 40037 | | | | |
| \$0025 | 40038 | Total unit | String | 2 | |
| \$0026 | 40039 | | | | |
| \$002F | 40048 | Instantaneous energy - low word | 32 bits real | 2 | |
| \$0030 | 40049 | Instantaneous energy - high word | | | |
| \$0031 | 40050 | Heat accumulation integer - low word | 32 bits int | 2 | |

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| | | | | | |
|--------|-------|---------------------------------------|--------------|---|-------------------------------|
| \$0032 | 40051 | Heat accumulation integer - high word | | | |
| \$0033 | 40052 | Heat accumulation decimal - low word | 32 bits real | 2 | |
| \$0034 | 40053 | Heat accumulation decimal - high word | | | |
| \$0035 | 40054 | Cold accumulator integer - low word | 32 bits int | 2 | |
| \$0036 | 40055 | Cold cumulant integer - high word | | | |
| \$0037 | 40056 | Cold accumulative quantity decimal - | 32 bits real | 2 | |
| \$0038 | 40057 | Cold quantity cumulative quantity | | | |
| \$0039 | 40058 | | 32 bits real | 2 | |
| \$003A | 40059 | Cold volume monthly | | | |
| \$003B | 40060 | Heat accumulated in | 32 bits real | 2 | |
| \$003C | 40061 | | | | |
| \$003D | 40062 | Water inlet temperature | 16 bits int | 1 | Temperature amplification 100 |
| \$003E | 40063 | Return water | 16 bits int | 1 | |
| \$003F | 40064 | Energy unit | String | 2 | |
| \$0040 | 40065 | | | | |
| \$0041 | 40066 | temperature unit | String | 1 | |

b) Single Write Register Address List (use 0x06 performance code to write)

| Register Address | Register | Description | Read/Write | Type | No. registers * |
|------------------|----------|---|------------|-------------|-----------------|
| \$1003 | 44100 | Flowmeter address(1- | R/W | 16 bits int | 1 |
| \$1004 | 44101 | Communication Baud Rate 0 =2400, 1 = 4800, 2 = 9600, 3 = 192002 = | R/W | 16 bits int | 1 |
| \$1005 | 44102 | Flow unit | R/W | 16 bits int | 1 |
| \$1006 | 44103 | Total unit | R/W | 16 bits int | 1 |
| \$1007 | 44104 | Energy unit | R/W | 16 bits int | 1 |
| \$1008 | 44105 | Installation location of | R/W | 16 bits int | 1 |
| \$1009 | 44106 | temperature unit | R/W | 16 bits int | 1 |



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Notes:

1. The following flow rate units are available: 0— m³/h; 1— LPM; 2— GPM
2. The following Total flow rate units are available: 0 — m³; 1— L; 2 — GAL
3. When the flowmeter address or communication baud rate change, the meter will work under the new address or communication baud rate after the communication baud rate responded with returned primary address and communication baud rate.
16 bits int—short integer, 32 bits int – long integer, 32 bits real—floating point number,
String—alphabetic string.BCD-represents decimal number.