

MODBUS protocol

Both formats of the MODBUS protocol (MODBUS-RTU and MODBUS-ASCII) are supported. In the menu window M63, choose whether to use MODBUS-RTU or MODBUS-ASCII format. The MODBUS-ASCII format is supported by default.

The EF40 series ultrasonic flowmeter/heat meter can only support MODBUS function codes 03 and 06 and 16 three function codes, which are read register and write single register and data block write function.

For example, in the RTU mode, the flow rate of the No. 1 device is read, that is, the registers 5 and 6 are read in two registers, and the commands are as follows:

01 03 00 04 00 02 85 CA (Hexadecimal number)

Device No function Start register Number of registers Validation and

Among them, 85 CA is a hexadecimal value, which is obtained by the CRC-16 (BISYNCH, polynomial is $x^{16} + x^{15} + x^2 + 1$ mask word is 0A001H) cyclic redundancy algorithm. Please refer to the MODBUS documentation for further algorithms.

The returned data should be (set state to simulated running state, flow rate = 1.2345678m/s):

01 03 04 06 51 3F 9E 3B 32 (Hexadecimal number)

Device number Function Data byte number Data=1.234567 Validation and

The 3F 9E 06 51 four bytes are the IEEE754 format single precision floating point form of 1.2345678.

For another example, read the net cumulative flow, REG25, REG26 two register commands are as follows:

01 03 00 04 00 18 00 02 44 0C (Hexadecimal number)

The return data should be (set net accumulator = 802609, its 4-byte hexadecimal notation is 00 0C 3F 31)

01 03 04 3F 31 00 0C A7 ED (Hexadecimal number)

Please note the order in which the data is stored in the example above. When using C language to interpret the value, you can use the pointer to directly put the required data into the corresponding variable address. The commonly used storage order is the low byte first. For example, in the above 1.23456m/s example, 3F 9E 06 51 The data is stored in the order 51 06 9E 3F.

The command to read the 10 registers starting from register 1 of device No. 1 in ASCII mode is as follows

: 010300000000AF2 (Carriage return)

Where ":" is the leader in ASCII mode and "F2" is the double-byte checksum. The method is to binary add the binary ASCII code values of all characters except ":" and carriage return.

In the MODBUS-RTU state, up to 125 registers can be read at a time. In the MODBUS-ASCII state, only 61 registers can be read at a time. If more than these numbers, the flowmeter will return an error message.

Please refer to the relevant information for details of the MODBUS protocol.

When debugging the MODBUS protocol, we recommended using a free debugger like MODSCAN, which can be searched on the Internet. When a problem occurs, if the validation and the correct data package are accepted, then the communication itself is not problematic.

In the default state, the setting rate of communication is generally 9600, invalid check, 8 data bits, and 1 stop bit.

§1.1 MODBUS register address table

(Note the difference between the agreement with the water meter)

register	Number of registers	Variable name	Type of data	Description
0001-0002	2	Instantaneous flow	REAL4	Unit: cubic meters / hour
0003-0004	2	Instantaneous heat flow	REAL4	Unit: GJ/hour
0005-0006	2	Fluid velocity	REAL4	Unit: m / s
0007-0008	2	Measuring fluid sound velocity	REAL4	Unit: m / s
0009-0010	2	Positive cumulative flow	LONG	All flow accumulators using long integers whose unit of measure is controlled by M32 (ie REG1438)
0011-0012	2	Positive cumulative flow fraction	REAL4	REAL4 is a standard IEEE-754 format single precision floating point number. This format data is also commonly referred to as the FLOAT format.
0013-0014	2	Negative cumulative flow	LONG	LONG is a low word in front of the symbol long integer
0015-0016	2	Negative cumulative flow fraction	REAL4	
0017-0018	2	Positive heat accumulation	LONG	All heat accumulators using long integers whose unit of measure is controlled by M84 (ie REG1441)
0019-0020	2	Positive calorific fraction	REAL4	
0021-0022	2	Negative cumulative heat	LONG	
0023-0024	2	Negative cumulative calorie fraction	REAL4	
0025-0026	2	Net cumulative flow	LONG	
0027-0028	2	Net cumulative flow fraction	REAL4	
0029-0030	2	Net cumulative heat	LONG	
0031-0032	2	Net cumulative calorie fraction	REAL4	
0033-0034	2	Temperature 1 / water supply temperature	REAL4	unit: °C

0035-0036	2	Temperature 2 / return water temperature	REAL4	unit: °C
0037-0038	2	Analog input AI3 amount	REAL4	Unconstrained steel data after conversion
0039-0040	2	Analog input AI4 amount	REAL4	Unconstrained steel data after conversion
0041-0042	2	Analog input AI5 amount	REAL4	Unconstrained steel data after conversion
0043-0044	2	Analog input AI3 current value	REAL4	Unit: milliampere
0045-0046	2	Analog input AI4 current value	REAL4	Unit: milliampere
0047-0048	2	Analog input AI5 current value	REAL4	Unit: milliampere
0049-0050	2	System setup password	BCD	Writable. 00H means cancel password setting
0051	1	Hardware setup password	BCD	Writable. "A55Ah" means open
0053-0055	3	Instrument date and time	BCD	Writable. The 6-byte BCD number indicates the time of day, month, and year, respectively.
0056	1	Automatic data storage hour	BCD	Writable. Two bytes indicate the time and day when the data is stored periodically. For example, 0312H indicates that the data is stored at 12 o'clock on the 3rd of each month. 0012H indicates that the data is stored at 12 o'clock every day.
0059	1	Enter key value (can simulate keyboard)	INTEGER	Writable. See manual key table
0060	1	Make the display show the x menu	INTEGER	Writable.
0061	1	Input backlight lighting time	INTEGER	Writable. Unit seconds
0062	1	Buzzer remaining sounds	INTEGER	Writable. Up to 255 times
0062	1	OCT residual pulse number	INTEGER	Writable. Up to 65536
0072	1	Meter work error code	BIT	The 16-bit bits indicate the meanings respectively. See Note 4
0077-0078	2	Number of water supply resistors	REAL4	Unit ohm
0079-0080	2	Backwater resistance	REAL4	Unit ohm

0081-0082	2	Ultrasonic total propagation time	REAL4	Unit microsecond
0083-0084	2	Ultrasonic propagation time difference	REAL4	Unit nanosecond
0085-0086	2	Ultrasonic upstream propagation time	REAL4	Unit microsecond
0087-0088	2	Ultrasonic downstream propagation time	REAL4	Unit microsecond
0089-0090	2	Current loop output current value	REAL4	Unit mAh
0092	1	Work steps and signal quality	INTEGER	High byte indicates signal adjustment steps The bottom byte indicates the signal quality, the value range is 0-9, and the large value indicates that the signal is good.
0093	1	Upstream signal strength	INTEGER	Value range 0-4095
0094	1	Downstream signal strength	INTEGER	Value range 0-4095
0096	1	Operator interface language type	INTEGER	0 means Chinese, 1 means English
0097-0098	2	Ultrasonic signal transmission ratio	REAL4	Normal range 100+-3%
0099-0100	2	Current Reynolds number	REAL4	
0101-0102	2	Current Renault correction factor	REAL4	
0103-0104	2	Work timer time	LONG	Unsigned, in seconds
0105-0106	2	Total working time	LONG	Unsigned, in seconds
0105-0106	2	Total power-on times	LONG	Unsigned
0113-0114	2	Net cumulative flow (floating point form)	REAL4	The unit is cubic meters, 7 effective figures
0115-0116	2	Positive cumulative flow (floating point form)	REAL4	The unit is cubic meters, 7 effective figures
0117-0118	2	Negative cumulative flow (floating point form)	REAL4	The unit is cubic meters, 7 effective figures
0119-0120	2	Net accumulated heat (floating point form)	REAL4	Unit is GJ, 7 significant figures
0121-0122	2	Positive heat accumulation (floating point form)	REAL4	Unit is GJ, 7 significant figures
0123-0124	2	Negative cumulative	REAL4	Unit is GJ, 7 significant figures

		heat (floating point form)		
0125-0126	2	Cumulative traffic today (floating point form)	REAL4	The unit is cubic meters, 7 effective figures
0127-0128	2	Cumulative flow this month (floating point form)	REAL4	The unit is cubic meters, 7 effective figures
0129-0130	2	Manual accumulator flow	LONG	
0131-0132	2	Manual accumulator fractional part	REAL4	
0133-0134	2	Batch controller cumulative traffic	LONG	
0135-0136	2	Batch controller fractional part	REAL4	
0137-0138	2	Cumulative traffic today	LONG	
0139-0140	2	Today's cumulative flow fraction	REAL4	
0141-0142	2	Cumulative traffic this month	LONG	
0143-0144	2	This month's cumulative flow fraction	REAL4	
0145-0146	2	Cumulative traffic this year	LONG	
0147-0148	2	This year's cumulative flow fraction	REAL4	
0158	1	Current display menu	INTEGER	
0165-0166	2	Fault running time	LONG	Unit: second
0173-0174	2	Current frequency output value	REAL4	unit: Hz
0175-0176	2	Current current loop output value	REAL4	unit: mA
0181-0182	2	Current temperature difference	REAL4	unit: °C
0183-0184	2	The traffic added by this power-on	REAL4	Unit: cubic meter
0185-0186	2	Frequency coefficient	REAL4	Should be less than 0.1
0187-0188	2	Automatic storage time	LONG	Storage time is determined by register 0056
0189-0190	2	Automatically store positive cumulative traffic	REAL4	Storage time is determined by register 0056
0191-0192	2	Automatically store	REAL4	Storage time is determined by

		instantaneous flow		register 0056
0221-0222	2	Inner pipeline	REAL4	Unit mm
0229-0230	2	Upstream propagation delay	REAL4	Unit microsecond
0231-0232	2	Downstream propagation delay	REAL4	Unit microsecond
0233-0234	2	Estimated total propagation time	REAL4	Unit microsecond
0257-0288	32	Display buffer	BCD	Readable
0289	1	Display buffer storage pointer	INTEGER	
0311	2	Working time today	LONG	Unsigned, in seconds
0313	2	Working hours this month	LONG	Unsigned, in seconds
0315	2	Maximum instantaneous flow today	INTEGER	unit: m ³ /h
0317	2	Maximum instantaneous flow rate for the month	INTEGER	unit: m ³ /h
1437	1	Current instantaneous flow measurement unit	INTEGER	Value 0-31 See Note 5
1438	1	Current cumulative flow meter unit	INTEGER	Value 0-7 see note 1
1439	1	Current cumulative flow multiplier	INTEGER	n takes the value 0-7, see note 1
1440	1	Current cumulative heat multiplier	INTEGER	n takes the value 0-10, see note 1
1441	1	Current thermal energy measurement unit	INTEGER	Value 0~3. 0=GJ, 1=Kcal 2=KWh, 3=BTU
1442	1	Instrument communication address number	INTEGER	
1491	1	Instrument type	INTEGER	BIT0=0 means flowmeter BIT0=1 indicates that the heat meter is BIT3=1 means the heat meter is installed in the water supply port. BIT3=0 means the heat meter is installed in the water return
1451	2	User scale factor	REAL4	
1521	2	Manufacturer scale factor	REAL4	Unrewriteable
1529	2	Device electronic serial	BCD	Electronic serial number of

		number		this device 请注意高位在前
--	--	--------	--	---------------------

Note: (1) The internal cumulant uses a combination of long integers and decimals. In general use, the read-only integer part can be used, and the fractional part can be ignored. The size of the cumulant is related to the cumulative unit and the multiplication factor. The exact relationship between them is that the cumulative integer part N (the value in the register 0009, 0010 for the positive accumulation, the 32-bit signed long integer), cumulative The fractional part is Nf (the contents of registers 0101, 0012 for the positive accumulation, 4 bytes of floating point number), and the cumulative flow multiplication factor is n (register 1439)

Then the cumulative flow = $(N + Nf) \times 10n^{-3}$ (the unit is determined in the cumulative flow unit 1438 register).

The value 0-7 in register 1438 has the following meaning

- 0 cubic meters (m³)
- 1 liter (L)
- 2 US gallons (GAL)
- 3 inch gallons (IGL)
- 4 US Mega Gallons (MGL)
- 5 cubic feet (CF)
- 6 US oil barrels [42] (OB)
- 7 Imperial Oil Barrels (IB)

Cumulative heat = $(N + Nf) \times 10n^{-4}$

Where: For net heat, the N value is in register 0029,0030

For net heat, the Nf value is in registers 0031,0032

The value of n is determined in register 1440,

The accumulated heat unit is determined in register 1441.

(2) Other variables are no longer given. If you have any requirements, please consult our company.

(3) Please note that many of the data in the above table is not valid for non-thermal meters. When using the flowmeter alone, the irrelevant items can be ignored. These irrelevant items are mainly to make the communication protocol of our products uniform and easy for users to use.

(4) The error code is 16 bits and its meaning is as follows

- Bit0 did not receive a signal error
- Bit1 signal is too low error
- Bit2 signal difference error
- Bit3 pipe empty error
- Bit4 circuit hardware error
- Bit5 is adjusting circuit gain
- Bit6 frequency output over range error
- Bit7 current loop output current over-range error (in general, the maximum range needs to be set)
- Bit8 internal data register validation error
- Bit9 main oscillator frequency or clock frequency is wrong
- Bit10 parameter area has validation and error
- Bit11 program memory data validation and error
- Bit12 temperature measurement circuit may have errors
- Bit13 Reserved? ?
- Bit14 internal timer overflow error

Bit15 analog input circuit has an error

Note If you are using this code for the flowmeter, be careful to mask out the bits associated with the heat measurement because the status of those bits is not certain. (5) The instantaneous flow unit code is as follows

0	Cubic meters per second	1	Cubic meters / minute	2	Cubic meter / hour	3	Cubic meter / day
4	Litres per second	5	Litre / min	6	Litre / hour	7	Litre / day
8	US gallon / sec	9	US gallon / min	10	US gallon / hour	11	US gallon / day
12	Inch gallon / sec	13	Inch gallon / min	14	Inch gallon / hour	15	Inch gallon / day
16	US megagallons per second	17	US megagallons per min	18	US megagallons per hour	19	US megagallons per day
20	Cubic feet per second	21	Cubic feet per min	22	Cubic feet per hour	23	Cubic feet per day
24	US oil barrels / sec	25	US oil barrels / min	26	US oil barrels / hour	27	US oil barrels / day
28	Inch oil barrel / sec	29	Inch oil barrel / min	30	Inch oil barrel / hour	31	Inch oil barrel / day

§1.2 Year, month and day cumulative data MODBUS address table

(1) Daily accumulated data (note that the address of the other version of the flowmeter is different)

The daily accumulated data is stored in a 32-byte data block cyclic queue with a total of 512 data blocks. The current data block pointer address is in register 0162, and its value ranges from 0 to 511. The current pointer points to the data of "yesterday", and the current pointer minus 1 points to the data of "the day before yesterday". When the data pointer is equal to 0, then subtracting 1 points to the data block 511. Let the number of 0162 be 1, then yesterday's accumulated data is in the registers 10257-10272, the previous day's data is in 10241-10256, and the big day's data is in 18417-18432.

Note: In the configuration software, the reading of variables such as floating-point data needs to add "4" in the front. This may be written as "410241" when filling the register address in such software.

The address table is as follows

data Block number	Register address	register Number	Variable name	type of data	Description
n/a	0162	1	Daily cumulative data pointer	Integer	Value range 0-127
0	10241	1	Status byte and day	BCD	In the low byte is the status, the high byte is the day
	10242	1	Month and year	BCD	The low byte is the month

					and the high byte is the year.
	10243-10244	2	Total working time	LONG	Used to check the working hours of the whole day
	10245-10246	2	Net cumulative flow throughout the day	REAL4	Total amount of the day
	10247-10248	2	Net cumulative heat flow value	REAL4	23:59:59 second moment accumulator value
	10249-10250	2	Positive accumulator value	LONG	23:59:59 second moment accumulator value
	10251-10252	2	Negative accumulator value	LONG	23:59:59 second moment accumulator value
	10253-10254	2	thermal positive accumulator value	LONG	23:59:59 second moment accumulator value
	10255-10256	2	Thermal negative accumulator value	LONG	23:59:59 second moment accumulator value
1	10257	1	Status byte and day	BCD	In the low byte is the status, the high byte is the day
	10258	1	Month and year	BCD	The low byte is the month and the high byte is the year.
	10259-10260	2	Total working time	LONG	Used to check the working hours of the whole day
	10261-10262	2	Net cumulative flow throughout the day	REAL4	Total amount of the day
	10263-10264	2	Net cumulative heat flow value	REAL4	23:59:59 second moment accumulator value
	10265-10266	2	Positive accumulator value	LONG	23:59:59 second moment accumulator value
	10267-10268	2	Negative accumulator value	LONG	23:59:59 second moment accumulator value
	10269-10270	2	Thermal positive accumulator value	LONG	23:59:59 second moment accumulator value
	10271-10272	2	Thermal negative accumulator value	LONG	23:59:59 second moment accumulator value
o o o	oooooooooooo	oooo	oooooooooooooooooooo	oooooo	oooooooooooooooooooooooooooo

°					
511	18417-18432	16			Block 511 data block

Note: 1. The meaning of the status byte can be found in the meaning of the status word.
2. If the data read is all 0FFH, this register is empty.

(1) Monthly accumulated data (note that the address of the other version of the flowmeter is different)

The monthly accumulated data has the same structure as the daily accumulated data, please refer to the daily cumulative data description. In particular, the date byte always takes a value of zero and has only 128 data blocks.

The address table is as follows

data Block number	Register address	register Number	Variable name	type of data	Description
n/a	0163	1	Monthly cumulative data pointer	Integer	Value range 0-127
0	8193	1	Status byte	BCD	The low byte is the status, high byte = 0
	8194	1	Month and year	BCD	The low byte is the month and the high byte is the year.
	8195-8196	2	Total working time	LONG	Used to check the working hours of the whole month
	8197-8198	2	Net cumulative flow throughout the month	REAL4	Total amount of the month
	8199-8200	2	Net cumulative heat flow value	REAL4	Accumulator value at the last second of the month
	8201-8202	2	Positive accumulator value	LONG	Accumulator value at the last second of the month
	8203-8204	2	Negative accumulator value	LONG	Accumulator value at the last second of the month
	8205-8206	2	Calorie positive accumulator value	LONG	Accumulator value at the last second of the month
	8207-8208	2	Thermal negative accumulator value	LONG	Accumulator value at the last second of the month
	8209	1	Status byte	BCD	Low byte is the status
	8210	1	Month and year	BCD	The low byte is the month

			pointer		
0	6145	1	Power-on seconds and minutes	BCD	In the low byte is the second, the high byte is the minute
	6146	1	Power-on hours and days	BCD	In the low byte is the hour, the high byte is the day
	6147	1	Power-on month and year	BCD	The low byte is the month and the high byte is the year.
	6148	1	Power-on status word	BIT	The B13 flag has been added. For other bits, see the status word description.
	6149	1	Power off seconds and minutes	BCD	In the low byte is the second, the high byte is the minute
	6150	1	Power outage hours and days	BCD	Low byte is hour high byte
	6151	1	Power outage month and year	BCD	The low byte is the month and the high byte is the year.
	6152	1	Power outage status word	BIT	See status word description
	6153	1	Current window number	Integer	The low byte is the main window number when the power is off, and the high byte is the local LCD menu number.
	6154	1	Power-on times	Integer	
	6155-6156	2	Total flow meter working time	LONG	In seconds
	6157-6158	2	Positive cumulative flow	LONG	The unit depends on M32, M33
	6159-6160	2	Positive cumulative flow fraction	REAL4	The unit depends on M32, M33
	6161-6162	2	Negative cumulative flow value	LONG	The unit depends on M32, M33
	6163-6164	2	Negative cumulative flow fraction	REAL4	The unit depends on M32, M33
	6165-6166	2	Thermal accumulating	LONG	The unit depends on M32, M33
	6167-6168	2	Thermal accumulating decimals	REAL4	The unit depends on M32, M33

6169-6170	2	Heat negative cumulative value	LONG	The unit depends on M32, M33
6171-6172	2	Heat negative cumulative fraction	REAL4	The unit depends on M32, M33
6173-6174	2	Net cumulative flow	LONG	The unit depends on M32, M33
6175-6176	2	Net cumulative flow fraction	REAL4	The unit depends on M32, M33
6177-6178	2	Net accumulation of heat	LONG	The unit depends on M32, M33
6179-6180	2	Net heat accumulation fraction	REAL4	The unit depends on M32, M33
6181-6182	2	Daily cumulative flow	LONG	The unit depends on M32, M33
6183-6184	2	Daily cumulative flow fraction	REAL4	The unit depends on M32, M33
6185-6186	2	Monthly cumulative flow	LONG	The unit depends on M32, M33
6187-6188	2	Monthly cumulative flow fraction	REAL4	The unit depends on M32, M33
6189-6190	2	Annual cumulative flow	LONG	The unit depends on M32, M33
6191-6192	2	Annual cumulative flow fraction	REAL4	The unit depends on M32, M33
6193-6194	2	Instantaneous flow when power is off	REAL4	Unit: cubic meters / second
6195-6196	2	Fault running time	LONG	Unit seconds
6197-6198	2	Total daily work time	LONG	Unit seconds
6199-6200	2	Total monthly work time	LONG	Unit seconds
6201-6202	2	M47 password	BCD	
6203-6204	2	Duration during power outage	LONG	Unit seconds
6205-6206	2	Instantaneous flow at the last power-on	REAL4	Unit: cubic meters / second
6207-6208	2	Last power outage should be supplemented with	REAL4	Unit: cubic meters

[illegible]