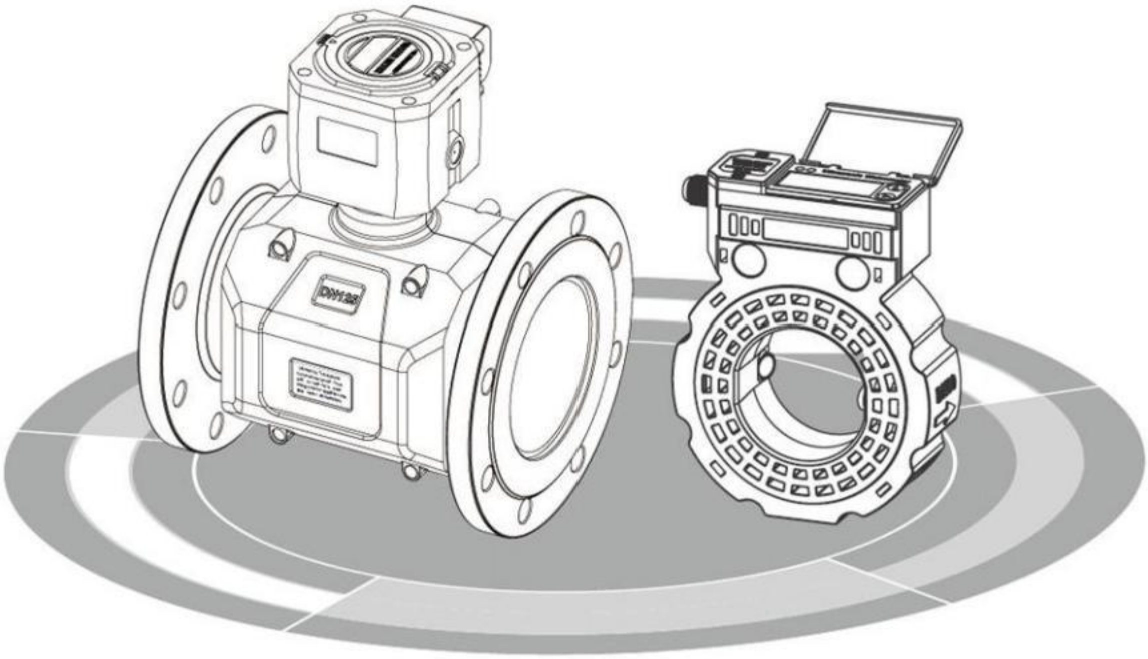
Ultrasonic Water Meter/Heat Meter

Communication Protocol Ver 0.1

-For V00 / V01



Release date:Feb. 2025

Catalog

Part I

Firmware version overview and serial communication interface description

1.1. Overview

This series of ultrasonic water meters has the ability to support multi-protocol communication at the same time. For example, in the same application, the above-mentioned multiple protocols can be used together, mixed use. And do not make any firmware or parameter changes

1.2. Introduction of serial communication interface

The ultrasonic water meter is equipped with 3 physical serial communication interfaces, an IR communication interface, a TTL/USART level interface and a RS485/MBUS parallel dual interface.

USART is a logic level serial interface suitable for direct connection to other external MCUs, such as communication modules such as NB-iot, Lora, etc., and pressure and temperature modules such as SPI interfaces, with low power consumption.

IR meters, which meets the standard stipulated by CJ188.

The IR communication interface automatically enters a low-power state within 300 seconds of no communication. The IR interface can be woken up by the touch of a button; the three physical serial communication interfaces are independent of each other, allowing the three serial ports to be accessed simultaneously without interfering with each other.

1.3. Serial communication interface default settings

RS485/MBUS	9600,N,8,1
IR	9600,N,8,1
TTL/USART	Fixed to 9600,N,8,1

1.4. Changing the default settings of the serial port

The serial port parameters can be set via a PC-based software named V00_SETUP. The current serial port parameters are displayed in the M26 menu

1.5. Communication protocols supported

a. MODBUS
b. M-BUS
c. CJ188

Several of the above protocols can be supported simultaneously. Some of the protocols are cross-supported at the same time.

Part 2

MODBUS Protocol

2.1. MODBUS Factory default settings

2.1.1 RS485/MBUS interface

Baud rate	9600	(can be set to 300,600,1200,2400,4800,9600)
Checksum	None	(can be set None, Even, Odd)
Address	1	

The above parameters are displayed on the M25 menu

2.1.2 IR infrared communication

Baud rate	9600	(Fixed)
Checksum	None	(Fixed)
Address	1	

2.1.3 TTL/USART logic level interface

Baud rate	9600	(Fixed)
Checksum	None	(Fixed)
Address	1	

2.2. Communication test special registers and communication instructions

REG361 is designed for communication testing, which is a single-precision floating-point number, if the value read from the REG361 is not 361.0, but "0" or "250.264", then the address of the reading is wrong, you can add 1 or subtract 1 to the address and then try to read the test. Please refer to the standard for MODBUS protocol. Detailed information can be found on the Internet.

Read the two registers starting from REG0361 hex instruction as 01 03 01 68 00 02 44 2B
Read the two registers starting from REG0362 hex instruction as 01 03 01 69 00 02 15 EB
Read REG0053 start of the three registers of hours, minutes and seconds hexadecimal instruction for 01 03 00 34 00 03 44 05

When reading a register using the hexadecimal instruction, you need to first subtract one from the register number and then convert it to hexadecimal. For example, register 00053 is 52 after subtracting 1, and the hexadecimal number corresponding to 52 is 0x34.

The V60 version of the ultrasonic water/heat meter can only support MODBUS function codes 03 and 06 and 16, which are read and write single registers and data block writing functions respectively.

For example, to read the flow rate of device No. 1 in RTU mode, i.e., to read registers 5 and 6, the command is as follows: 01 03 00 04 00 02 85 CA (Hexadec i ma l n u m ber)

Device number Function Start register Number of registers Checksum

Where 85 CA is a hexadecimal value, obtained according to the CRC-16 (BISYNCH, polynomial is x16 + x15 + x2 + 1 mask word is 0A001H) cyclic redundancy algorithm. Please refer to the MODBUS documentation for further algorithms.

The returned data should be (set state is simulated running state, flow rate = 1 .2345678m/s

01 03 04 0651 3F 9E 3B 32 (hexadecimal digits)
Device number Function Number of data bytes Data = 1.234567
Checksum

The four bytes of 3F 9E 06 51 are the single-precision floating-point form of IEEE754 format of 1.2345678. For example, read the net cumulative flow, REG25 and REG26 registers as follows.

01 03 00 18 00 02 44 0 C (Hexadecimal digits)

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

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

Please note the order in which the data is stored in the above example. For example, in the 1.23456m/s example above, the order of storing the data is 51 06 9E 3F 9E 3F.

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

: 01030000000AF2 (carriage return for line)

Where ":" is the ASCII bootstrap and "F2" is the double-byte validation sum. It is obtained by adding the binary ASCII values of all characters except ":" and carriage return.

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

For details on the MODBUS protocol, please refer to the relevant literature.

When debugging MODBUS protocol, it is recommended to use a free debugging software MODSCAN, which can be searched on the Internet. In case of problems, if the validated and correct packets are accepted, the communication itself is not faulty.

2.3. MODBUS water meter application scenario register address table

Using the following continuous register address table, you can read out all the registers commonly used in water meter applications with one command. For example, starting from REG1442 to REG1469 total of 28 registers in hexadecimal command as follows

01 03 05 A1 00 1C 15 2D

Register Address	Register Number	Data Grid Style	Register contents	Description
1437	1	Integer	Current instantaneous flow units	0 indicates cubic meters per second
1438	1	Integer	Current cumulative flow units	0 for cubic meters, 1 for liters, 2 for U.S. gallons
1439	1	Integer	the current cumulative flow decimal position.	Same as REG1439, taking the value n: {-4..3}
1440	1	Integer	Not used (heat accumulation decimal point position)	
1441	1	Integer	Not used (heat unit selection)	

1442	1	Integer	Correspondence address	
1443	2	LONG	Net cumulative flow, see Note 5	Need to multiply by n-3 powers of 10 in 1445
1445	1	Integer	Current cumulative flow decimal point position	Same as REG1439, taking the value n: {-4..3}
1446	1	Integer	Current cumulative flow units	Same as REG1438
1447	2	IEEE754	Instantaneous flow	Unit: cubic meter
1449	2	IEEE754	Flow Rate	Unit: meters per second
1451	2	IEEE754	User Scale Factor	Generally 1.0
1453	2	IEEE754	Floating-point net accumulation	Decimal point independent accumulation, low accuracy, for reference purposes
1455	2	IEEE754	Battery voltage	Floating point battery voltage
1457	1	Integer	Upstream signal strength (channel 1)	
1458	1	Integer	Downstream signal strength (channel 2)	
1459	1	Integer	Work / Adjustment Status	
1460	2	BIN32	32-bit operating status code	Refer to Section 7 Error Code Meanings for per-bit meanings
1462	2	BIN32	Work Timer	
1464	2	LONG	See Note 5 for positive cumulative flow	Need to multiply by n-3 powers of 10 in 1445
1466	2	BCD	ESN Electronic Serial Number	(valid for versions after V60.05)
1468	2	ASCII	Software Version Information	(valid for versions after V60.05)

Notes:

(1) Integer is a 16-bit signed integer quantity

(2) IEEE754 is the standard single-precision floating-point number, which follows the principle of lower low byte first emission.

(3) BIN32 is a 32-bit unsigned integer quantity, or bit variable

(4) BCD is the variable of the BCD code

(5) LONG is a signed 32-bit integer variable, in general, the variable needs to be adjusted according to the position of the decimal point to get the real value. The formula of the operation is N × 10m-3, where N represents the value of LONG and m is the value of the decimal point position in REG1445. The unit of the accumulated amount is determined by the value in REG1446.

For example, let REG1443, REG1444 in the value of 123456789 (hexadecimal number 075BCD15), REG1445 in the value of 2 (indicating that there is a decimal), then the final net accumulation of 123456789x102-3 = 12345678.9.

If the value of REG1446 is 0, then the net cumulative result is 12345678.9 cubic meters. If the value of REG1446 is 1, then the net accumulation result is 12345678.9 liters.

It can be seen that by processing the information of the decimal point position of the accumulated amount and the accumulated amount unit information, it is possible to read out the result independent of the decimal point position setting. This means that the correct result is always obtained regardless of the number of decimal places set in the LCD display.

The decimal point position information is handled so that it is not affected by the cumulative amount decimal point setting.

If the upper computer software uses long integer operation, the accumulated amount can be directly turned into BCD code and then the decimal point position can be adjusted according to the decimal point position information.

For example, the cumulative amount displayed is 987654321, the value in REG1445 is -3, then the integer has - (-3-3) = 6 decimal places, the correct display result is 987.654321, the value in REG1446 is 0, then the cumulative amount is 987.654321 liters.

（6） If negative cumulative flow data is required, it can be obtained by subtracting the net cumulative from the positive cumulative.

2.4. MODBUS **Thermal Meter Application Scenario Address List**

Register Addre ss	Register Number	Data Grid style	Register contents	Description
1491	1	Integ er	Instrument Type	
1492	1	Integ er	Current instantaneous flow unit, 0 for cubic meters.	Same as REG1437
1493	1	Integ er	The current cumulative flow unit, 0 for cubic meters, is	Same as REG1438
1494	1	Integ er	Current cumulative flow decimal point position	Same as REG1439，valid values n: {-4..3}
1495	1	Integ er	Current heat accumulation decimal point position	Same as REG1440. valid values n: {-3..4}
1496	1	Integ er	Heat unit selection	SAME AS REG1441.0 MEANS KWH,1 MEANS GJ
1497	2	LONG	Negative heat accumulation See Note 6	Need to multiply by the n-4th power of 10 in REG1495
1499	2	LONG	Positive heat accumulation See Note 6	Need to multiply by the n-4th power of 10 in REG1495
1501	2	IEEE75 4	Instantaneous heat, thermal power	Unit fixed in KW
1503	2	LONG	Net cumulative flow See Note 5	Need to multiply by n-3 powers of 10 in 1494
1505	2	IEEE75 4	Instantaneous flow	Unit:cubic meter
1507	2	BIN32	Cumulative working hours	Unit in seconds
1509	2	IEEE75 4	Water supply temperature, T1	Unit. ℃
1511	2	IEEE75 4	Return water temperature, T2	Unit. ℃
1513	2	BIN32	32-bit operating status code	
1515	3	BCD	6 bytes of datetime	Seconds, minutes, hours, days, months, years
1518	1	Integ er	Work / Adjustment Status	
1519	2	IEEE75 4	Battery voltage	(valid for versions after V60.07)
1521	2	IEEE75 4	Manufacturer's correction factor	
1523	2	LONG	Positive cumulative flow See Note 5	Need to multiply by n-3 powers of 10 in 1445
1525	2	IEEE75 4	User correction factor	
1527	2	AS CII	Software Version Information	(valid for versions after V60.07)

1529	2	BCD	ESN Electronic Serial Number	
1531	2			

Notes:

（1） Integer is a 16-bit signed integer quantity

（2） IEEE754 is the standard single-precision floating-point number, which follows the principle of lower low byte first emission.

（3） BIN32 is a 32-bit unsigned integer quantity, or bit variable

（4） BCD is the variable of the BCD code

（5） LONG is a signed 32-bit integer variable, in general, the variable needs to be adjusted according to the position of the decimal point to get the real value. The formula for the operation is N × 10m-3, where N represents the value of LONG and m is the value of the location of the decimal point of REG1494. The unit of the cumulative amount is determined by the value in REG1493.

For example, let REG1503, REG1504 in the value of 123456789 (hexadecimal number 075BCD15), REG1494 in the value of 2 (indicating that there is a decimal), then the final net accumulation of 123456789x102-3 = 12345678.9.

If the value in REG1493 is 0, then the net accumulation result is 12345678.9 cubic meters. If the value of REG1493 is 1, then the net accumulation result is 12345678.9 liters.

It can be seen that by processing the information of the decimal point position of the accumulated amount and the accumulated amount unit information, it is possible to read out the result independent of the decimal point position setting. That is, the correct result is always obtained regardless of the decimal point setting of the LCD display.

The decimal point position information is handled so that it is not affected by the cumulative amount decimal point setting.

If the upper computer software uses long integer operation, the accumulated amount can be directly turned into BCD code and then the decimal point position can be adjusted according to the decimal point position information.

For example, the cumulative amount displayed is 987654321, the value in REG1494 is -3, then the integer has - (-3-3) = 6 decimal places, the correct display result is 987.654321, the value in REG1493 is 0, then the cumulative amount is 987.654321 liters.

（6） For the cumulative heat integer variable, the same treatment as in note (5) is applied, and the formula is N × 10m-4

（7） If negative accumulation data is required, it can be obtained by subtracting the net accumulation from the positive accumulation.

2.5. MODBUS **Compatible Flow Meters and Common**

Registers Address Table

Register Address	Number	Register Name	Data Format	Description
0001-0002	2	Instantaneous flow	IEEE754	Unit: m3/h
0003-0004	2	Instantaneous heat	IEEE754	Unit. kW
0005-0006	2	Fluid velocity	IEEE754	Unit: m/s
0007-0008	2	Pressure (standby)	IEEE754	
0009-0010	2	Positive cumulative flow See Note 1	LONG	Units are determined by REG1438
0011-0012	2	Positive cumulative flow decimal fraction	IEEE754	
0013-0014	2	Negative cumulative flow	LONG	Units are determined by REG1438
0015-0016	2	Negative cumulative flow decimal part	IEEE754	Single-precision floating-point numbers, also known as for FLOAT format
0017-0018	2	Positive heat accumulation	LONG	Units are determined by REG1441
0019-0020	2	Positive Accumulated Heat Decimal Part	IEEE754	
0021-0022	2	Negative heat accumulation	LONG	Units are determined by REG1441
0023-0024	2	Negative accumulated heat fraction	IEEE754	
0025-0026	2	Net cumulative flow	LONG	Units are determined by REG1438
0027-0028	2	Net cumulative flow fractional part	IEEE754	
0029-0030	2	Net accumulated heat	LONG	Units are determined by REG1441
0031-0032	2	Net accumulated heat fraction	IEEE754	
0033-0034	2	Supply pipe temperature T1	IEEE754	Unit. ℃
0035-0036	2	Return pipe temperature T2	IEEE754	Unit. ℃
0052	1	Week	Integer	Valid after version 60.10

0053-0055	3	Calendar (date and time)	BCD	Writable. 6 bytes BCD Indicates SMHDMY, low character Festival in front
0056	1	Automatic date and time saving	BCD	can be written. For example, 0512H means 12:00 on the 5th 0012H indicates 12:00 a.m. daily
0057	1	Write protection status password	Integer	Writable
0058	1	Code to enter sleep state	Integer	Writable. Write to 0x5A58 Will go to sleep mode
0059	1	Key Write	Integer	Writable
0060	1	Access to the display menu number	Integer	Writable
0061	1	Current display menu number	Integer	Writable
0062	1	Main mailing address	Integer	Writable, maximum 255
0063	1	Batch controller runtime	Integer	Write 0 Start BC
0064	1	OCT Pulse 1 Number of remaining pulses	Integer	
0065	1	OCT Pulse 2 Number of remaining pulses	Integer	
0071	1	Error Code 34	Bits	Refer to Part V
0072	1	Error code 12	Bits	Refer to Part V
0077-0078	2	T1 Temperature resistance value	IEEE754	Unit: Ω
0079-0080	2	T2 Temperature resistance value	IEEE754	Unit: Ω
0081-0082	2	Total propagation time difference	IEEE754	Unit: uS
0083-0084	2	Propagation time lag	IEEE754	Unit: nS
0092	1	Signal Quality	Integer	Channel 1 in low position
0093	1	#1 Sound channel signal strength	Integer	Range:0~4095
0094	1	#2 Sound channel signal strength	Integer	Range:0~4095
0095	1	Battery power	Integer	V=REG95*(2.5/4096)
0099-0100	2	Reynolds number	IEEE754	

0101-0102	2	Reynolds correction factor	IEEE754	
0103-0104	2	Total normal working time	BIN32	Unit: second
0105-0106	2	Total working hours	BIN32	Unit: second
0107-0108	2	Number of power-ups	BIN32	
0109-0110	2	CPU Temperature	IEEE754	Unit. ℃
0111	1	#3 Sound channel signal strength	Integer	
0112	1	#4 channel signal strength	Integer	
0113-0114	2	Net cumulative flow (floating point format)	IEEE754	The use of these registers is generally not recommended, as the numerical accuracy is only 6 bits
0115-0116	2	Positive cumulative flow (floating point format)	IEEE754	
0117-0118	2	Negative cumulative flow (floating point format)	IEEE754	The use of these registers is generally not recommended, as the numerical accuracy is only 6 bits
0119-0120	2	Net accumulated heat (floating point format)	IEEE754	
0121-0122	2	Positive heat accumulation (floating point format)	IEEE754	
0123-0124	2	Negative cumulative heat (floating point format)	IEEE754	
0125-0126	2	Net cumulative flow today (floating point format)	IEEE754	
0127-0128	2	Net cumulative traffic for this month (floating point format)	IEEE754	
0129-0130	2	Time-sharing accumulator Tariff2	LONG	
0131-0132	2	Fractional accumulator Tariff 2 fractional part	IEEE754	
0133-0134	2	Time-sharing accumulator Tariff3	LONG	
0135-0136	2	Fractional accumulator Tariff 3 fractional part	IEEE754	
0137-0138	2	Today's cumulative traffic	LONG	Decimal 9 digits long
0139-0140	2	Today's cumulative traffic decimal part	IEEE754	
0141-0142	2	Accumulated traffic for this month	LONG	
0143-0144	2	Decimal part of this month's accumulated traffic	IEEE754	
0144-0145	2	Cumulative traffic this year	LONG	
0147-0148	2	Accumulated traffic fractions this year	IEEE754	
0149-0150	2	Today's accumulated heat	LONG	
0151-0152	2	Today's cumulative heat decimal fraction	IEEE754	
0153-0154	2	Accumulated heat for this month	LONG	
0155-0156	2	Decimal part of accumulated heat for this month	IEEE754	

0162	1	Daily cumulative data pointer	Integer	Pointing to the day
0163	1	Monthly Cumulative Data Pointer	Integer	Pointing to the current month
0165-0166		Fault run time	BIN32	Unit: second
0167-0172	6	Power-up time	BCD	
0174	2	Battery voltage	IEEE754	Floating point battery voltage
0181-0182	2	Temperature difference	IEEE754	Unit. ℃
0187-0188		Automatic storage of total time	IEEE754	Unit: Hour
0189-0190		Automatic storage of positive cumulative flow	Long	
0193-0194		Automatic storage of instantaneous flow	IEEE754	
0195-0196		Automatic storage of total negative flow operating time	BIN32	Unit: second
0197-0198		Automatic storage of negative cumulative flow	Long	
0201-0202	2	Calibration of heat accumulators	Long	Unit:m3,GAL,ft3,L
0203-0204	2	Checking the decimal places of the heat accumulator	IEEE754	
0205-0206	2	Checking flow accumulator	long	Units: kWh, GJ, KBTU
0207-0208	2	Checking flow accumulator decimal places	IEEE754	
0209	1	Checking time	integer	Unit: 250mS
0221-0222	2	Pipe inner diameter	IEEE754	Unit:mm
0259-0260	2	Monthly maximum instantaneous flow	IEEE754	Unit: m3/h
0261-0262	2	Monthly maximum instantaneous heat	IEEE754	Unit. kW
0263-0264	2	Monthly maximum inlet water temperature	IEEE754	
0265-0266	2	Monthly maximum water discharge temperature	IEEE754	
0267-0268	2			
0269	1			
0270	1			
0271-0272	2	Time lag	IEEE754	In unit nS
0273-0274	2	M-bus Second Address	BCD	
0275-0276	2	Negative flow metering time	BIN32	Unit: second
0277-0280	4			
0281-0282	2			
0283-0284	2			
0285-0286	2	Maximum daily instantaneous flow	IEEE754	Unit: m3/h
0287-0288	2	Maximum daily instantaneous heat	IEEE754	Unit. kW

0289-0290	2	Maximum daily water intake temperature	IEEE754	Unit. ℃
0291-0292	2	Maximum daily return water temperature	IEEE754	Unit. ℃
0293-0294	2			
0295-0296	2	MBUS User Code	BCD	
0297-0298	2	Time-sharing accumulator stop working moment	BCD	
0299-0300	2	Time-sharing accumulator tariff2 Start working moment	BCD	
0301-0302	2	Time-sharing accumulator tariff3 Startup working moment	BCD	
0303	0.5	Time-sharing accumulator and dosing controller status	BCD	Low byte
0303-0304	1.5	#1 Moment of quantitative controller startup	BCD	
0305-0306	1,5	#2 Moment of quantitative controller startup	BCD	
0306-0307	1,5	#3 Moment of quantitative controller startup	BCD	
0307-0308	1,5	#5 Moment of quantitative controller startup	BCD	
0309-0310	1,5	#5 Moment of quantitative controller startup	BCD	
0311-0312	2	Quantitative controller set quantitative	IEEE754	
0361-0362	2	Always read out 361.00 See section 2.2 for description	IEEE754	For testing
0363-0364	2	Always read out 363348858	long	
0365-0366	2	Always read out -987654321	long	
1438	1	Cumulative flow unit code	INTEGER	0 = cubic meter 1 = liter 2=gallon 5=cubic foot
1439	1	Accumulated flow decimal point position	Integer	n:(-4..3), see Note 1
1440	1	Accumulated heat decimal point position	Integer	n:(-3..4), see Note 1
1441	1	Accumulated heat unit code	Integer	2 = gigajoules , 0 = kilowatt hours 1=Kilo BTU
1491	1	Instrument Type	Integer	EN1434-3
1527	2	Software Version See Note 2	ASCII	
1529	2	ESN	BCD	MSB first

Note

(1) All cumulative quantities are internally represented by a long integer for the integer part and a real number for the fractional part. In most applications, the user only needs to read out the long integer part and not the fractional part.

Assuming that N denotes a long integer value (e.g. for positive cumulative traffic, the 32-bit value in REG 0009, 0010 is a long integer)

Nf denotes the fractional part (e.g., 32-bit floating point number in REG 0011, 0012 for positive cumulative flow) n indicates the decimal position (e.g., for cumulative traffic, REG 1439).

Then

Final total cumulative flow =

$(N+Nf) \times 10^{n-3}$

REG 1438 Value range 0~7, determine the unit of cumulative flow

0	cubic meters	(m3)
1	Gong Sheng	(L)
2	U.S. Gallons	(GAL)
3	cubic feet	(CF)
4	Acre-feet (Acre)	Feet)

For example, if REG0009-0010=1(2A3F4)56789, REG0011-0012=0.123456, REG1439=3, REG1438=0

Then the total traffic is equal to (valid bits are 15 bits)

123456.789123456 m^3

For heat accumulators:

Total heat =

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

determined by

REG01440

The accumulated heat units are determined by REG 1441.

Note (3) The use of version registers allows you to distinguish the differences in identifying different versions of registers.

2.6. MODBUS **Monthly Cumulative Traffic Address Table**

A total of 32 data blocks are available for cyclic storage of monthly cumulative data. 32 months of historical data can be stored.

The variable located in REG0163 is used as a pointer to the data block of the current month. If you want to read out the data of the current month, you need to read out the value of REG0163 first, multiply by 8 (each data block occupies 8 registers), and then add the base register, you can get the relative register relative position of the current month.

Data Block number	Register Address		Register Number	Variable Name	Data Format	Description
n/a	0163		1	Monthly Cumulative Data Pointer	Integer	Range: 0-31
0	0	513	1	Data blocks	Integer	0~65535
	1	514	1	Status	Integer	
	2	515	1	Empty	BCD	
	3	516	1	Year and month	BCD	Month in low bytes
	4	517	2	Monthly cumulative traffic	LONG	Decimal point position in REG1439
	6	519	2	Monthly accumulated calories	LONG	Decimal point position in REG1440
1	0	521	1	Data blocks	Integer	0~65535
	1	522	1	Status	Integer	
	2	523	1	Empty	BCD	
	3	524	1	Year and month	BCD	Month in low bytes
	4	525	2	Monthly cumulative traffic	LONG	Decimal point position in REG1439
	6	527	2	Monthly accumulated calories	LONG	Decimal point position in REG1440
n	Monthly cumulative data blocks n					
31	0	761	1	Data blocks	Integer	0~65535
	1	762	1	Status	Integer	
	...	......	......	......	......	......
	6	767	2	Monthly accumulated calories	LONG	Decimal point position in REG1440

2.7. MODBUS **Daily Cumulative Traffic Address Table**

A total of 32 data blocks are available for cyclic storage of daily accumulated data. 32 days of historical data can be stored.

The variable located in REG0162 is used as a pointer to the data block of the day. If you want to read out the data of the current day, you need to read out the value of REG0162 first, multiply by 8 (each data block occupies 8 registers), and then add the base register, you can get the relative register relative position of the day.

Data Block number	Register Address		Register Number	Variable Name	Data Format	Description
n/a	0162		1	Daily pointer	Integer	Range 0-511
1	0	769	1	Data blocks	Integer	0~65535
	1	770	1	Status	Integer	
	2	771	1	Day	BCD	Day in high byte, low byte empty
	3	772	1	Year and month	BCD	Month in low bytes
	4	773	2	Monthly cumulative traffic	LONG	Decimal point position in REG1439

	6	775	2	Monthly accumulated calories	LONG	Decimal point position in REG1440
2	0	777	1	Data blocks	Integer	0~65535
	1	779	1	Status	Integer	
	2	780	1	Empty	Integer	
	...	......	......	…….	......	
n	Daily cumulative data blocks n					
31	0	1017	1	Data blocks	Integer	0~65535
	1	1018	1	Status	Integer	
	...	......	......	…….	......	

6 1023 2 Monthly Heat Accumulation LONG Decimal point position in REG1440

2.8. MODBUS power-up time

The last power-up moment is recorded in REG0167-0172.

2.9. Questions and answers about communication issues

(1) Q: Why can't I connect the water meter? It doesn't do anything after connecting? A: A. Check whether the serial port parameters match;

B. Whether the communication symbol on the LCD display flashes C. Check whether the physical connection is connected properly

D. Whether the address in the M24 window is set correctly

(2) Q: Why the MODBUS readings are messed up and do not match the displayed values at all?

A: Generally speaking, if the MODBUS protocol can read the data, it means that the protocol itself is not a problem. The messed up data is due to the following errors:

A. Incorrect data format;

B. There is an error in the register address, which causes the data to be shifted and generates an error.

For example, REAL4, a real variable (single-precision floating-point number in IEEE754 format), has 4 different arrangements by word and byte, and TDS100 uses the most common one, i.e. low word and high byte in front format. You can modify the data storage format of your software to solve this problem. If you use a generic configuration software, the configuration software usually has a method to select the format.

(3) Q: Why does the value read out through the protocol and the meter display not match?

A. A. Confirm that the variable address is the one you requested? Because there are so many variables inside the flow meter, is it confusing? Note that when reading data, REG 0001 is represented in the command string as 0000, not 0001. 0001 is represented in the command string as reading REG 0002.

B. Only 7-digit decimal numbers can be displayed for cumulative quantities, while 9-digit decimal numbers can be read out via MODBUS protocol

word. In this case, the last 7 bits of the value read out are the same.

(4) Q: My system cannot support long integers and real variable formats, what should I do? A: You need to use the numeric conversion method, or find a new driver to solve it.

(5) Q: Is there a test program for MODBUS?

A: Yes! We recommend using MThings, a software that can be searched online. This program is very handy and helps to easily check the read out data and understand the meaning of various types of data.

Part 3
M-BUS communication protocol

1. Interface

(A) RS-485
(B) IR
(C) logic level USART

2. Default Settings

Message format.	IEC 870-5-1, DIN EN1434-3
Baud Rate	IR 2400
	RS-485, USART: 9600
Parity test:	Even
Number of data bits:	8 bits

3. References

"The M-BUS: A Documentation" can be downloaded from the following link
www.m-bus.com "TKB3417 Description of the MBUS module for Ultraheat "

4. Special Features

* Date and time can be set
* Baud rate can be modified
* Master address can be set
* There is a second address operation
* Options for lifting
* Data messages can be set on request

Table 1 Master=>Slave telegrams

Host request command	Format									Note	Slave Answer
		C Domain	A	CS						C domain = control domain A domain is the address domain CS is the validation sum, CI domain	
Initialization (SEND_NKE)	10h	40h	A	CS	16h					Release public address, set to normal state, default baud rate	E5h
Request data (SEND_UD2)	10h	5Bh/7Bh	A	CS	16h					Slave user data requesting the slave to transmit an answer	RSP_UD
Remove the use of public addresses	10h	40h	FDh	CS	16h					All slaves release the common address FDh for later use by other slaves	E5h
Alarm protocol (SEND_UD1)	10h	5Ah/7Ah	A	CS	16h					The fastest corresponding host alarm inspection	E5h
Communication test	10h	4Ah/6Ah	A	CS	16h					Test if the communication link is normal	E5h
Query the main address	10h	49h	FDh	CS	16h					Answer the main address	
		L	L		C Domain	A	CI domain		CS		
Select a second address	68h	0Bh	0Bh	68h	53h/73h	FDh	52h	ID1-4 M1-2 G Med	CS 16h	ID1-4 are 4-byte IDs, M1-2=88h,11h G=1 Med=4 Return heat meters Position in front *	E5h
Select a second address	68h	0Bh	0Bh	68h	53h/73h	FDh	56h	ID4-1 M2-1 G Med	CS 16h	High in front, other same as the previous message (Med=0Ch for the incoming water heat meter) *	E5h
Enhancement of the selected second address	68h	11h	11h	68h	53h/73h	FDh	52h	ID1-4 M1-2 G Med 0CH 78H SN1-4	CS 16h	Add 0Ch 78h +4 bytes sequence number than the above two messages *	E5h
Modify first address	68h	06h	06h	68h	53h/73h	A	51h	01h 7Ah NN	CS 16h	NN is a single-byte new address in the range of 1 to 250	E5h
Modify second address	68h	09h	06h	68h	53h/73h	A	51h	0Ch 79h SA1-4	CS 16h	SA1-4 is a new 4-byte second address to avoid having two identical second addresses in the same system	E5h
Modify second address	68h	0Dh	0Dh	68h	53h/73h	A	51h	07h 79h SA1-4 xxh,xxh,xxh,xxh	CS 16h	SA1-4 is the new 4-byte second address	E5h
Set the second address to ESN	68h	09h	06h	68h	53h/73h	A	51h	0Ch 79h 00h 00h 00h 00h 00h	CS 16h	The M-BUS second address is set to the ESN of the instrument by factory default, the second address can be modified	E5h
Set the second address to ESN	68h	0Dh	0Dh	68h	53h/73h	A	51h	07h 79h 00h 00h 00h 00h xxh,xxh,xxh,xxh	CS 16h	Can solve the problem of the same second address.	E5h
	L	L	C Domain	A	CI domain	CS				Note: The slave responds to the baud rate modification command at the original baud rate and then changes it.	
Changing the baud rate	68h 03h	03h 68h	53h/73h	A	B8h	CS	16h			Change the baud rate to 300 Change to system default after re-powering	E5h
Changing the baud rate	68h 03h	03h 68h	53h/73h	A	B9h	CS	16h			Change the baud rate to 600 Change to system default after re-powering	E5h
Changing the baud rate	68h 03h	03h 68h	53h/73h	A	BAh	CS	16h			Change the baud rate to 1200 and re-power to the system default value	E5h
Changing the baud rate	68h 03h	03h 68h	53h/73h	A	BBh	CS	16h			Change the baud rate to 2400 and re-power to the system default value	E5h
Changing the baud rate	68h 03h	03h 68h	53h/73h	A	BCh	CS	16h			Change the baud rate to 4800 and change to the system default after re-powering	E5h

Changing the baud rate	68h 03h	03h 68h	53h/73h	A	BDh	CS	16h		Change the baud rate to 9600 and re-power to the system default	E5h
Changing the baud rate	68h 03h	03h 68h	53h/73h	A	B7h	CS	16h		Restore baud rate to system default	E5h

Predefined message types		L	L		C Domain	A	CI domain	Prefabricated data content code			CS				
Scheduled regular format	68h	03h	03h	68h	53h/73h	A	50h				CS	16h		Request all data, the reply message format is shown in Table 2 (All)	E5h
Scheduled regular format	68h	04h	04h	68h	53h/73h	A	50h	00			CS	16h		Request all data, the reply message format is shown in Table 2 (All)	E5h
Scheduled fast format	68h	04h	04h	68h	53h/73h	A	50h	51h			CS	16h		Requesting Quick Readout Data (QUICK READOUT)	E5h
Predefined user data format	68h	04h	04h	68h	53h/73h	A	50h	10h			CS	16h		Request accumulated heat W, accumulated flow V (User Data)	E5h
Scheduled simple billing model	68h	04h	04h	68h	53h/73h	A	50h	20h			CS	16h		Request W,V Previous year's W,V and running time BT Fault time FT (Simple Billing)	E5h
Scheduled full billing model	68h	04h	04h	68h	53h/73h	A	50h	30h			CS	16h		Request W,V Previous Year's W,V Maximum Flow/Hot Flow, BT, FT (Enhanced Billing)	E5h
Scheduled current data	68h	04h	04h	68h	53h/73h	A	50h	50h			CS	16h		Request W, V Instantaneous Flow/Hot Flow, Inlet and Return Temperature (Instantaneous Values)	E5h
Scheduled current data	68h	04h	04h	68h	53h/73h	A	50h	80h			CS	16h		Request meter serial number, heating settlement date	E5h
Switching to the fast way	68h	05h	05h	68h	53h/73h	A	51h	0Fh	A1h		CS	16h		Fast readout format, the message format is shown in Table 3	E5h
Switch to regular mode	68h	05h	05h	68h	53h/73h	A	51h	0Fh	A0h		CS	16h		and book all output data	E5h
Switching to the fast way	68h	03h	03h	68h	53h/73h	A	A1h				CS	16h		This message is not recommended and is set for compatibility.	E5h
Switch to regular mode	68h	03h	03h	68h	53h/73h	A	A0h				CS	16h		This message is not recommended and is set for compatibility.	E5h
Scheduled all data 1	68h	04h	04h	68h	53h/73h	A	51h	7Fh			CS	16h		The message format is shown in Table 2	E5h
Scheduled all data 2	68h	06h	06h	68h	53h/73h	A	51h	C8h	3Fh	7Eh	CS	16h		The message format is shown in Table 2	E5h
Scheduled empty message	68h	06h	06h	68h	53h/73h	A	51h	7Fh	FEh	0Dh	CS	16h			E5h
Scheduled heat data	68h	06h	06h	68h	53h/73h	A	51h	08h	05h		CS	16h		Essentially a generic data selection message	E5h
Scheduled last year's calories	68h	06h	06h	68h	53h/73h	A	51h	48h	05h		CS	16h		Essentially a generic data selection message	E5h
Universal Selection Data Message	68h	L	L	68h	53h/73h	A	51h	Pick a code (combination)			CS	16h		Limit L<240, set to all selected state after power-on initialization	E5h

The selection code (combination) allows you to select any of the following codes for predetermined data and any combination thereof (e.g. to read out the accumulated heat and accumulated flow, the message format would be as follows 68 L L 68 53/73 A 51 08 14 08 2D CS 16)

Update cycle 08h 74h
Average cycle time 08h 70h
All update cycles C8h 3Fh 74h
All average cycles C8h 3Fh 70h
Accumulated heat of the previous year 48h 00h...0Fh
Cumulative flow of the previous year 48h 10h...17h

Accumulated heat 08h 00h...0Fh All accumulated heat C8h 3Fh 00h...0Fh Annual billing date
48h 6Ch
Cumulative flow rate 08h 10h...17h All cumulative flow rates C8h 3Fh 10h...17h Fault time 38h 20h...23h
Instantaneous heat 08h 28h...37h All instantaneous heat C8h 3Fh 28h...37h Last year downtime 78h 20h...23h
Instantaneous flow rate 08h 38h...4Fh All instantaneous flow rates C8h 3Fh
38h... 4FhMaximum average period 88h 10h 70h...73h inlet water temperature
08h 58h...5Bh all inlet water temperatures C8h 3Fh 58h...5Bh Maximum
instantaneous heat flow in the previous year D8h 10h 28h...37h Return water temperature 08h 5Ch...5Fh All return water
temperatures C8h 3Fh 5Ch... 5FhCurrent maximum instantaneous heat
flow rate 98h 10h 28h...37h Temperature difference 08h 60h...63h All temperature differences C8h 3Fh 60h... 63hCurrent maximum
instantaneous flow rate 98h 10h 38h...4Fh
Serial number 08h 78h All serial numbers C8h 3Fh 78h Current maximum inlet water
temperature 98h 10h 5Bh Run time 08h 20h...23h All run times C8h 3Fh 20h...23h Current maximum return water
temperature 98h 10h 5Fh Date time 08h 6Ch All times Flags C8h 3Fh 6Ch

Note: "..." in the code means between, for example, 00h...0Fh means any number between can be. That is, code 08h 00h has the same function as code 08h0Dh

Start flow calibration	68h	0Ah	0Ah	68h	53h/73h	A	51h	2Fh	0Fh	04h	00h,04h,00h,01h		CS	16h	Manufacturers with debugging equipment to use the function	E5h
Exit heat calibration	68h	0Ah	0Ah	68h	53h/73h	A	51h	2Fh	0Fh	04h	00h,04h,00h,00h		CS	16h	Manufacturers with debugging equipment to use the function	E5h
Clear the first error	68h	0Ah	0Ah	68h	53h/73h	A	51h	2Fh	0Fh	04h	00h,04h,00h,02h		CS	16h	Execute this command in a fault-free condition	E5h
Go to sleep	68h	0Ah	0Ah	68h	53h/73h	A	51h	2Fh	0Fh	04h	00h,04h,00h,03h		CS	16h	If sleep enable is set, sleep state is entered	E5h
Exit sleep state	68h	0Ah	0Ah	68h	53h/73h	A	51h	2Fh	0Fh	04h	00h,04h,00h,04h		CS	16h	Exit sleep state	E5h
Setting the OCT Output	68h	0Ah	0Ah	68h	53h/73h	A	51h	04h	FFh	15h	OCT1,OCT2,XX,XX		CS	16h	Set OCT output, 0 unchanged 1 on 2 off	E5h
Clear the maximum and minimum values	68h	07h	07h	68h	53h/73h	A	51h	01h	FFh	14h	01		CS	16h	Clear the max/min register	E5h
Close TARIFF	68h	07h	07h	68h	53h/73h	A	51h	01h	FFh	13h	00		CS	16h	Close TARIFF 2 and TARIFF 3	E5h
Start TARIFF 2	68h	07h	07h	68h	53h/73h	A	51h	01h	FFh	13h	02h		CS	16h	Start TARIFF 2	
Start TARIFF 3	68h	07h	07h	68h	53h/73h	A	51h	01h	FFh	13h	03h		CS	16h	Start TARIFF 3	
Close TARIFF	68h	05h	05h	68h	53h/73h	A	51h	0Fh	B0h				CS	16h	Close TARIFF 2 and TARIFF 3	E5h
Close TARIFF	68h	05h	05h	68h	53h/73h	A	51h	0Fh	B1h				CS	16h	Close TARIFF 2 and TARIFF 3	E5h
Start TARIFF 2	68h	05h	05h	68h	53h/73h	A	51h	0Fh	B2h				CS	16h	Start TARIFF 2	E5h
Start TARIFF 3	68h	05h	05h	68h	53h/73h	A	51h	0Fh	B3h				CS	16h	Start TARIFF 3	E5h
TARIFF Close time	68h	0Ah	0Ah	68h	53h/73h	A	51h	04h/44h		FD	30	Date + Time	CS	16h	Date + Time by TYPE_F format	E5h
TARIFF Close time	68h	0Bh	0Bh	68h	53h/73h	A	51h	84h/C4h	10	FD	30	Date + Time	CS	16h	Date + Time by TYPE_F format	E5h
TARIFF2Opening time	68h	0Bh	0Bh	68h	53h/73h	A	51h	84h/C4h	20	FD	30	Date + Time	CS	16h	Date + Time by TYPE_F format	E5h
TARIFF3Opening time	68h	0Bh	0Bh	68h	53h/73h	A	51h	84h/C4h	30	FD	30	Date + Time	CS	16h	Date + Time by TYPE_F format	E5h
		L	L		C Domain	A	CI domain	DIF					CS			
Setting time method 1	68h	0Dh	0Dh	68h	53h/73h	A	51h	2Fh	0Fh	04h	58h	SSMMHHDDMMYY	CS	16h	Set date and time Recommended method Parameters are seconds, minutes, days, months, years	E5h
Setting time method 2	68h	0Ah	0Ah	68h	53h/73h	A	51h	04h	EDh 00h		DATE/TIME		CS	16h	** Set the date and time, DATE/TIME in standard TYPE F format	E5h
Setting time method 3	68h	09h	09h	68h	53h/73h	A	51h	04h	6Dh		DATE/TIME		CS	16h	** Set the date and time, DATE/TIME in standard TYPE F format	E5h

Note: * The second address is selected and wildcards can be used. The wildcard character works so that the master can quickly find all slaves on the bus

** The TYPE F format is the time and date format specified in M-BUS.

Part 4

CJ-188-2004 Communication protocol

CJ-188-2004 is a Chinese protocol for accessing thermal energy meters

The following protocol is compatible with Weihai Tiangang protocol. Tiangang's thermal energy meter has good market recognition, so it is compatible with it to facilitate the user's use. The **command to read the meter number (=ESN) 17312151 is as follows**

FE FE FE FE FE FE FE FE 68 20 51 21 31 17 00 11 11 01 03 1F 90 12 29 16

All values are in hexadecimal format. The top 11 FEs are the leading symbols specified by the CJ188 protocol. 68(0x68) CJ188 protocol start symbol
20(0x20) Thermal Meter Meter Type
51(0x51) Address A0. If address A0-A6 are all 0xAA, it indicates that the command is a broadcast command. After receiving the broadcast command, all the lower units will answer and the answer message contains the table number (ESN) of the lower unit. If there is only one hot meter on the bus, you can use the full 0xAA address to get the table number (address, or ESN) of the hot meter
21(0x21) Address A1
31(0x31) Address A2
17(0x17) Address A3 (A0, A1, A2, A3 are the ESN numbers with the lower byte first)
00(0x00) Address A4, always 0x00 or 0xAA in the broadcast command
11(0x11) Address A5, always 0x11 0xAA in the broadcast command
11(0x11) Address A6, always 0x11 0xAA in the broadcast command
01(0x01) Control character
03(0x03) Data length
1F(0x1F) Data identifier 0
90(0x90) Data identifier 1
12(0x12) Sequential bytes
29(0x29) checks the sum, which is the arithmetic sum of all data except the leading character (68 20 51 21 31 17 00 11 11 01 03 1F)
90 12, the arithmetic sum is 0x29)
16(0x16) terminator
Except for A0, A1, A2, A3, and CS, which vary according to the table number, the rest are fixed.

User reply message:
FE FE FE FE FE FE FE FE 68 20 51 21 31 17 00 11 11 81 2E 1F 90 12 00 00 00 00 00 05 00 00 00 00 05 00 00 00 00 14 00 00 00 00 00 35 19 00 00 00 2C 76 30 00 68 30 00 73 02 00 32 41 11 12 09 07 20 04 00 e9 16

68 is the start of the frame 68H
20 for meter type T
51 for address A0
21 for address A1
31 for address A2
17 for address A3 (A0, A1, A2, A3 are the meter numbers of the heat meters read, from low to high)

00 is address A4
11 for address A5
11 for address A6
81 is the control code C
2E is the data length field L (1F 90 12 00 00 00 00 05 00 00 00 00 05 00 00 00 00 00 14 00 00 00 00 00 00 35

19 00 00 00 2C 76 30 00 68 30 00 73 02 00 32 41 11 12 09 07 20 04 00 Total 2E characters)

1F is the data identifier DI0

90 is the data identifier DI1

12 for serial number SER

00 00 00 00 is the current cooling capacity, 05 is the current cooling unit code for kWh (Table 1)

00 00 00 00 is the current heat, 05 is the current heat unit code for kWh (Table 1)

00 00 00 00 is the thermal power, 14 is the thermal power unit code indicated W (Table 1)

00 00 00 00 is the instantaneous flow rate, 35 is the instantaneous flow unit code for m³/h (Table 1)

19 00 00 00 is the cumulative flow rate, 2C is the cumulative flow rate unit code for m³ (Table 1)

76 30 00 For water supply temperature 0030.76℃

68 30 00 For the return water temperature 0030.68℃

73 02 00 For a total of 000273 hours of work

32 41 11 12 09 07 20 is the real-time time of September 12, 2007 11:41:32

04 00 is the status word (see Table 2 and Table 3 for specific definitions) battery voltage undervoltage, flow sensor is normal, inlet and return water temperature sensor is normal, integrator is normal

E9 is the check digit CS (68 20 51 21 31 17 00 11 11 81 2E 1F 90 12 00 00 00 00 00 05 00 00 00 00 00 05 00 00 00 00 14 00 00 00 00 00 35 19 00 00 00 2C 76 30 00 68 30 00 73 02 00 32 41 11 12 (09 07 20 04 00 for binary arithmetic accumulation, not counting overflow values over FFH)

16 is the terminator 16H

The frame starts at 68H and ends at 16H when the heat meter answers normally, A4, A5 and A6 are fixed at 00H 11H 11H, the control code is fixed at 81H, the data length field is fixed at 2EH, the data identifier and sequence number are the same as the data identifier and sequence number when it is sent, and the other bytes vary according to the specific heat meter.

Add CJ188 class protocol at the request of customers

1) Individual read address instruction Instrument type: T=10H~29H Control code CTRL0=03H, Slave answer control code CTRL1= 83H Data identification (D1, D0) = 810AH Slave answer: 3 bytes in length, data identification DI, serial number SER Example (n FEs) 68 10 AA AA AA AA AA AA 03 03 0A 81 05 B4 16 Received (11 FEs) 68 10 21 00 00 13 00 11 11 83 03 0A

81 05 E4 16 w h e r e 13000021 indicates the slave address

2) Read water meter command Meter type: T=10H Control code CTRL0=01H, Slave answer control code CTRL1= 81H Data identification

(D1, D0) = 901FH Slave answer data, in the order of current instantaneous flow, current cumulative amount, daily cumulative amount, monthly cumulative amount, daily cumulative maximum amount, monthly cumulative maximum amount, all of the above amounts are 5 bytes in length, real-time time, ST, total 42 bytes in length

For example (n FEs) 68 10 AA AA AA AA AA AA AA AA 01 03 1F 90 12 E3 16 The following answer is received: (11 FEs)

68 10 21 00 00 13 00 11 11 81 2A 1F 90 12 00 00 00 00 35 64 08 57 01 2C 79 65 00 00 2C 58 31 01 00 2C 74 56 34 12 2C 20 43 65 87 2C 37 36 12 20 02 16 20 00 08 B5 16 of which 35 00 00 00 00 00

indicates that the current instantaneous flow is 0000.0000 cubic meters per hour 2C 01 57 08 64 indicates a cumulative net accumulation of 15708.64 cubic meters

2C 00 00 65 79 indicates a cumulative daily total of 65.79 cubic meters

2C 00 01 31 58 means the cumulative monthly total is 65.79 cubic meters 2C 12 34 56 78 means the current total

The set daily upper limit value is 1234.5678 m3 2C 87 65 43 20 indicates that the currently set daily upper limit value is 8765.4321 Cubic meter 20 16 02 20 12 36 37indicates the time 0008 indicates the current status and will be flagged in this previous byte when the day-month accumulation is greater than the set upper limit value.

3) Write daily and monthly accumulation upper limit function (factory-defined command) Meter type: T=10H Control code CTRL3=24H, slave answer control code CTRL4= 0A4H Data identification (D1, D0) = 801BH Host data: two 4-byte single-precision floating-point numbers of daily and monthly accumulation upper limit value, the default unit is cubic meters, the data order is low byte, the low word first, the upper limit value can be verified by reading the water meter command to see if it is set correctly. Please note that the upper limit value will be lost when the battery is disconnected and needs to be rewritten by the host computer. The power-up default value is 100 m3. Slave answer: 3 bytes long, data identifier DI, serial number SER Example: (n FE) 68 10 AA AA AA AA AA AA AA 24 0B 1B 80 12 2B 52 9A 44 BA F5 08 46 52 16 will set the daily accumulation limit to 1234.5678 m3 (2B 52 9A 44 for (single-precision representation of this value) Set the monthly accumulation limit to 8765.4321 m3 (BA F5 08 46 expressed as a single precision of this value)

4) Write standard time Instrument type: T=10H-29H Control code CTRL3=04H, Slave answer control code CTRL4= 84H Data identification (D1, D0) = 8015H Host data: standard time represented by 7 bytes in length Slave answer: 3 bytes in length, data identification

DI, serial number SER

Example (n FEs) 68 10 AA AA AA AA AA AA AA 04 0A 15 80 12 56 34 12 20 02 16 20 C7 16 would Set the standard time of the water meter on the bus to 2016-02-20 12:34:56, and receive an answer from the slave.

5) Capable of supporting Henan Xintian's CJ188 protocol (set SER=0 to distinguish other compatible manufacturers' protocols) Meter type: T=10H Control code CTRL3=01H, Slave answer control code CTRL4= 81H Data identification (D1, D0) = 901FH Host SER fixed equal to 0 to distinguish Weihai Tiangang heat meter protocol Host data: None Slave data: 22 Byte length, contains data identification DI, serial number SER, accumulated flow, instantaneous flow, real time time, status code Example (n FEs) 68 10 AA AA AA AA AA AA AA 01 03 1F 90
00 D1 16 The following answer was received: (11 FEs) 68 10 21 00 00 13 AA AA AA 81 16 1F 90 00 64 08 57 01 2C
00 00 00 00 00 2C 54 48 13 20 02 16 20 00 08 1B 16 where 13 00 00 21 (original order was 21 00 00 13) Table
The slave number indicating the answer AAAAAA is copied from the command sent by the host, and no meaning is given for the time being.

2C 01 57 08 64 indicates a cumulative net accumulation of 15708.64 m3 2C 00 00 00 00 indicates instantaneous flow = 0 per
Hour cubic meters 54 48 13 20 02 16 20 indicates February 20, 2016 at 13:48 minutes and 50 seconds 00 08 indicates status, example shows flow meter failure because no probe is connected 1B is checksum

Table 1 Unit code

Unit Unit	Generation No.	Unit Unit	Generation No.
Wh	02H	GJ×100	13H
kWh	05H	W	14H
MWh	08H	kW	17H
MWh×100	0AH	MW	1AH
J	01H	L	29H
kJ	0BH	m^3	2CH
MJ	0EH	L/h	32H
GJ	11H	m^3/h	35H

Table 2 Status ST First Byte Definition Table

	D0	D1	D2	D3	D4	D5	D6	D7
Definition	--		Battery voltage	Reserved	Reserved	Reserved	Reserved	Reserved
Description	--		0: Normal 1: Undervoltage	Reserved	Reserved	Reserved	Reserved	Reserved

Table 3 Status ST Second Byte Definition Table

	D0	D1	D2	D3	D4	D5	D6	D7
Definition	Integrator failure	Water inlet temperature sensor failure	Return water temperature sensor failure	Flow sensor failure	Reserved	Reserved	Reserved	Reserved

Description	0: Normal 1: Failure	0: Normal 1: Failure	0: Normal 1: Failure	0: Normal 1: Failure	Reserved	Reserved	Reserved	Reserved

Part 5

V00,V01,V10

The signal strength is indicated by a number between 50 and 100, the larger the number the greater the signal. Generally, the signal strength of new machines between 55~90 can work well.

The battery voltage works well above 3V. The ultimate operating voltage is 2 .7V. The 32-bit error code is also represented in hexadecimal. Each number Contains 4 bits, labeled from left to right in order BIT31...BIT1,BIT0 tota l 32 bits, the specific meaning of each bit is as follows:

```
X.XX XX XX XX
|     |     |     |     |
|     |     |     |     BIT 0 Heat Integrator Error
|     |     |     |     BIT1 Water supply temperature sensor error
|     |     |     |     BIT2 Return water temperature sensor error
|     |     |     |     BIT3 Flow meter measurement error
|     |     |     |     BIT4 Wate r flow di rectio n reve rsa l
|     |     |     |     BIT5 Ultrasonic signal difference error
|     |     |     |     BIT6 low-speed operating state, in the absence of received signals or a long period
                          of low flow rate state that enters this state.
|     |     |     |BIT7   BIT7 The flowmeter is not calibrated incorrectly. Indicates that the meter has not been calibrated
|     |BIT8   | BIT8 channel 1 is not normal
|     |BIT9   | BIT9 channel 2 not normal
|     |BIT10          | BIT10 Channel 3 not normal
|     |BIT11          | BIT11 channel 4 not normal
|      |BIT12          | BIT12 Low battery voltage error. Occurs when the battery voltage is below 3 .2V
|| BIT13               || BIT13 Detected inlet water temperature lower than return water temperature error
|| BIT14               || BIT14 Sampled ultrasonic signal amplitude is too low and too high error
|     |     | BIT15 Ultrasonic acquisition
            circuit is faulty
|     |     BIT16 Inlet water temperature probe
            open circuit error
|     |     BIT17 Return water temperature
            probe open circuit error
|     |      BIT18 Standard resistor 1 open
            circuit error
|     |      BIT19 Standard resistor 2 open
            circuit error
|     |     BIT20 Inlet water temperature probe
            short circuit error
|     |     BIT21 Return water temperature
            probe short circuit error
|     |      BIT22 Standard resistor 1 Short
            circuit error
|     |      BIT23 Standard Resistor 2 Short
            Circuit Error
| BIT24 Parameter area checksum error
| BIT25 Program code verification error
| BIT26 No blown fuse error
| BIT27 Low Frequency Clock Oscillator Error
| BIT28 Capacitive key error
| BIT29 Clock frequency out of range error
| BIT30 Wireless Communication Module Error
| BIT31 Spare bit
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