Ultrasonic Doppler Flowmeter

Version V1.9.1

MODBUS—RTU communication protocol

1、The hardware is adopted with RS-485, master-slave half-duplex communication, that is, the host calls the slave address, and the slave answers.

2、Data frame: 10 digits, 1 start bit, 8 data bits and 1 stop bit, without verification.
Baud rate: 1200, 2400, 4800 and 9600 (9600 by default).

3、Function code 03H: Read register value
Data sent by the host:

1	2	3	4	5	6	7	8
ADR	03H	High-order byte of initial register	Low-order byte of initial register	High-order byte of register number	Low-order byte of register number	Low-order byte of CRC code	High-order byte of CRC code

The first byte, ADR: address of slave machine (=001~254)
The second byte 03H: Read the register value function code
The third and fourth bytes: the start address of the register to be read
The fifth and sixth bytes: the number of the register to be read
The seventh and eighth bytes: CRC16 verification from byte 1 to byte 6

When the slave machine receives correctly, it will send back following values:

1	2	3	4、5	6、7		M-1、M	M+1	M+2
ADR	03H	Total number of bytes	Register data 1	Register data 2	。。。	Register data M	Low-order byte of CRC code	High-order byte of CRC code

The first byte, ADR: address of slave machine (=001~254)
The second byte 03H: Return to read function code
The third byte: Total number of bytes from 4 to M (included)
Byte from 4 to M: Register data
The M+1 and M+2 bytes: CRC16 verification from byte 1 to byte M

When the slave machine does not receive correctly, it will send back following values:

1	2	3	4	5
ADR	83H	Information code	Low-order byte of CRC code	High-order byte of CRC code

The first byte, ADR: address of slave machine (=001~254)

The first byte 83H: Register value reading error
The third byte information code: See the table of information code
The fourth and fifth bytes: CRC16 verification from byte 1 to byte 3

4、Function code 06H: Write a single register data
Data sent by the host:

1	2	3	4	5	6	7	8
ADR	06	High-order byte of register address	Low-order byte of register address	High-order byte of data	Low-order byte of data	Low-order byte of CRC code	High-order byte of CRC code

When the slave machine receives correctly, it will send back following values:

1	2	3	4	5	6	7	8
ADR	06	High-order byte of register	Low-order byte of register	High-order byte of data	Low-order byte of data	Low-order byte of CRC code	High-rder byte of CRC code

When the slave machine does not receive correctly, it will send back following values:

1	2	3	4	5
ADR	86H	Error information code	Low-order byte of CRC code	High-order byte of CRC code

The first byte, ADR: address of slave machine (=001~254)
The first byte 86H: function code of writing error of register number
The third byte information code: See the table of information code
The fourth and fifth bytes: CRC16 verification from byte 1 to byte 3

5、Function code 10H: Write multiple register numbers in succession
Data sent by the host:

1	2	3	4	5	6	7
ADR	10H	High-order byte of initial register address	Low-order byte of initial register address	High-order byte of register number	Low-order byte of register number	Total number of data bytes

8、9	10、11	N、N+1	N+2	N+3
Register data 1	Register data 2	Register data M	Low-order byte of CRC code	High-order byte of CRC code

When the slave machine receives correctly, it will send back following values:

1	2	3	4	5	6	7	8
ADR	10H	High-order byte of initial register address	Low-order byte of initial register address	High-order byte of register number	Low-order byte of register number	Low-order byte of CRC code	High-order byte of CRC code

When the slave machine does not receive correctly, it will send back following values:

1	2	3	4	5
ADR	90H	Error information code	Low-order byte of CRC code	High-order byte of CRC code

The first byte, ADR: address of slave machine (=001~254)
The first byte 90H: function code of writing error of register number
The third byte information code: See the table of information code
The fourth and fifth bytes: CRC16 verification from byte 1 to byte 3

6、Register Definition Table: (Note: Register address coding adopts hexadecimal system.)

Register address	Description	Read Only	Register address	Description	Read Only
0000	Level instantaneous value (4-byte floating number, 2 high-order bytes)	√	0001	Level instantaneous value (4-byte floating number, 2 low-order bytes)	√
0002	Instantaneous flow value (4-byte floating number, 2 high-order bytes)	√	0003	Instantaneous flow value (4-byte floating number, 2 low-order bytes)	√
0004	Integral part of the cumulative flow value (4-byte long integer number, 2 high-order bytes)	√	0005	Integral part of the cumulative flow value (4-byte long integer number, 2 low-order bytes)	√
0006	Decimal part of the cumulative flow value (4-byte floating number, 2 high-order bytes)	√	0007	Decimal part of the cumulative flow value (4-byte floating number, 2 low-order bytes)	√
0008	Analog output instantaneous value (4-byte floating number, 2 high-order bytes)	√	0009	Analog output instantaneous value (4-byte floating number, 2 low-order bytes)	√
000A	Instantaneous temperature value (4-byte floating number, 2 high-order bytes)	√	000B	Instantaneous temperature value (4-byte floating number, 2 high-order bytes)	√
000C	Instantaneous value of velocity (4-byte floating number, 2 high-order bytes)		000D	Instantaneous value of velocity (4-byte floating number, 2 high-order bytes)	
000E	Supply Voltage (4-byte floating number, 2 high-order bytes)		000F	Supply Voltage (4-byte floating number, 2 high-order bytes)	
0012	Reserved		0013	Reserved	
0014	Reserved		0015	Reserved	
0016	Reserved		0017	Reserved	
0018	Reserved		0019	Reserved	
001A	Reserved		001B	Reserved	
001C	Reserved		001D	Reserved	
001E	Reserved		001F	Reserved	
0020	Reserved		0021	Reserved	
0022	IF alarm value (4-byte floating number, 2 high-order bytes)		0023	IF alarm value (4-byte floating number, 2 low-order bytes)	
0024	IF reset value (4-byte floating number, 2 high-order bytes)		0025	IF reset value(4-byte floating number, 2 low-order bytes)	
0026	Preset Value (4-byte floating number, 2 high-order bytes)		0027	Preset Value (4-byte floating number, 2 low-order bytes)	
0028	Side length (4-byte floating number, 2 high-order bytes)		0029	Side length (4-byte floating number, 2 low-order bytes)	
002A	Width (4-byte floating number, 2 high-order		002B	Width (4-byte floating number, 2 low-order	

	bytes)			bytes)	
002C	Height (4-byte floating number, 2 high-order bytes)		002D	Height (4-byte floating number, 2 low-order bytes)	
002E	Top edge length (4-byte floating number, 2 high-order bytes)		002F	Top edge length (4-byte floating number, 2 low-order bytes)	
0030	Bottom edge-L (4-byte floating number, 2 high-order bytes)		0031	Bottom edge-L (4-byte floating number, 2 low-order bytes)	
0032	Trapezoidal-H (4-byte floating number, 2 high-order bytes)		0033	Trapezoidal-H (4-byte floating number, 2 low-order bytes)	
0034	Radius (4-byte floating number, 2 high-order bytes)		0035	Radius (4-byte floating number, 2 low-order bytes)	
0036	Long Radius (4-byte floating number, 2 high-order bytes)		0037	Long Radius (4-byte floating number, 2 low-order bytes)	
0038	Short Radius (4-byte floating number, 2 high-order bytes)		0039	Short Radius (4-byte floating number, 2 low-order bytes)	
003A	River channel-W (4-byte floating number, 2 high-order bytes)		003B	River channel-W (4-byte floating number, 2 low-order bytes)	
003C	Channel BTM.-W (4-byte floating number, 2 high-order bytes)		003D	Channel BTM.-W (4-byte floating number, 2 low-order bytes)	
003E	Channel CEN.-H (4-byte floating number, 2 high-order bytes)		003F	Channel CEN.-H (4-byte floating number, 2 low-order bytes)	
0040	20mA flow value (4-byte floating number, 2 high-order bytes)		0041	20mA flow value (4-byte floating number, 2 low-order bytes)	
0042	4mA flow value (4-byte floating number, 2 high-order bytes)		0043	4mA flow value (4-byte floating number, 2 low-order bytes)	
0044	Integral part of the cumulative flow value (4-byte long integer number, 2 high-order bytes)		0045	Integral part of the cumulative flow value (4-byte long integer number, 2 low-order bytes)	
0046	Decimal part of the cumulative flow value (4-byte floating number, 2 high-order bytes)		0047	Decimal part of the cumulative flow value (4-byte floating number, 2 low-order bytes)	
0048	Offset Amount (4-byte floating number, 2 high-order bytes)		0049	Offset Amount (4-byte floating number, 2 low-order bytes)	
004A	SS excision (4-byte floating number, 2 high-order bytes)		004B	SS excision (4-byte floating number, 2 low-order bytes)	
004C			004D		
004E			004F		
0050	Reserved		0051	Reserved	
0052	Reserved		0053	Reserved	
0054	Reserved		0055	Reserved	
0056	Reserved		0057	Reserved	
0058	Reserved		0059	Reserved	
005A	Reserved		005B	Reserved	
005C	IF alarm mode CF ratio output		005D	Channel type Baud Rate	
005E	Cum. flow reset Flow unit		005F	Ex. level gauge Sensor Qty.	
0060	Interface switch Cum. unit		0061	Factory Reset System Reset	
0062			0063		
0064			0065		
0066			0067	Reserved	
0068	Reserved		0069	Reserved	
006A	Reserved		006B	Reserved Address	

Remarks:

①

4-byte floating number: it conforms to the single-precision floating number upon IEEE - 754 standard.

Byte address	+3	+2	+1	+0
Floating number	SEEEEEEE	EMMMMMMM	MMMMMMMM	MMMMMMMM

S - sign bit, "1" indicates negative and "0" indicates positive.

E - expoent

M - the decimal part of mantissa

For example: floating number 124.75 = 42F98000H. The storage format in memory is:

Byte address	+3	+2	+1	+0
Floating number	0 1000010	1 1111001	01000000	00000000

8-byte double-precision (double type): it conforms to the IEEE—754 standard.

For example: floating number 38414.4 =40E2C1CCCCCCCCCD H. The storage format in memory is:

Byte address	+7	+6	+5	+4	+3	+2	+1	+0
Floating number	SEEEEEEE	EEEEMMM M	MMMM MMMM	MMMM MMMM	MMMM MMMM	MMMM MMMM	MMMM MMMM	MMMM MMMM

②

IF alarm mode: 0 – close；1 -- low alarm；2 -- high alarm
CF ratio output: = 0， Close； = 1，Open cm
Channel type:=0， Square pipe；=1，Rectangular pipe；=2，Trapezoidal pipe；=3，Circular pipe；=4，Oval pipe；=5，River channel；
Baud rate： 0-2400； 1-4800；2-9600；3-19200
Cum. flow reset：= 0，No； = 1，Yes
Flow unit: =0，t/h；=1，l/s；=2，t/s
x. level gauge：=0，NO；=1，Ultrasonic l/s；=2，Radart/s
Sensor Qty.：1-9（0-8）
Factory reset: 0-No; 1-Yes;
System reset: 0-No; 1-Yes;
Address：1-254

③
Regional read-write operation of register
The first region: 0000 — 0021 read only
The second region: 0022 — 005B read-write
The third region: 005C— 006B read-write
Within the same region, a parameter can be read (or write) at a time, and all parameters in the region can be read (or write) in batch. It is not allowed to read and write parameters cross regions.

④ All reserved registers are currently undefined, reserved for upgrade compatibility.

7、Information code table

Information code	Indication
01H	Invalid function code
02H	Invalid data address
03H	Invalid data value
04H	CRC16 verification error
05H	Correct reception
06H	Reception error
07H	Parameter error

8、Example of Serial Port Data Frame Acquisition Communication Protocol

Data sent by the host

Station number	Function code	Initial address	Point number reading	Check code	Indication
01	03	0000	0002	C40B	Read water level value, single precision floating number
01	03	0002	0002	65CB	Read instantaneous flow value, single precision floating number
01	03	0004	0002	85CA	Read the integral part of the accumulative flow value, long integer
01	03	0006	0002	240A	Read the decimal part of accumulative flow value, single-precision floating number

9、PLC address setting (Example: Siemens S7-200 PLC)

If there is no function code setting item during the PLC setting, the base address of modbus RTU register corresponding to the function code 03 is 40001.

Therefore, the register address of PLC shall be added with 1 during the register address setting.

Examples:

The MODBUS register address of ultrasonic open channel flowmeter is 2 (0x0002), and when the MODBUS function code is 3, the PLC register address is 40003.

Reading table of PLC address

Function code: 03

Description: Read and hold register values.

Address	Description	Remark
40001	Instantaneous value of distance/material level	Single-precision floating number
40003	Instantaneous flow rate	Single-precision floating number
40005	Integral part of the cumulative flow value	Long integer
40007	Decimal part of the cumulative flow value	Single-precision floating number
40009	Simulated output instantaneous value	Single-precision floating number
40011	Instantaneous temperature value	Single-precision floating number