MODBUS RTU Electromagnetic Flowmeter Protocol

1. Suitable

MFE600 Electromagnetic Flowmeter, MFE600E Electromagnetic Flowmeter

2. Communication protocol

2.1 Communication connection RS485 or RS232, Baud rate range 600-9600, communication parameter: Baud rate, N, 8, 1.

2.2 Instrument terminal T+（A）, T-（B）and COM.

2.3 Communication protocol conforms to MODBUS RTU protocol. In instruction table register number is register address.

2.4 Composition of communication information: Address code - Function code - Data segment - CRC, A message is sent and received continuously, and the character interval cannot be greater than one character, otherwise it is regarded as the beginning of a new message or the end of the previous message. The message body consists of hexadecimal numbers.

2.5 Data definition: The cumulative amount is a 16-byte hexadecimal fixed point number, and the instantaneous amount (including flow, velocity, etc.) is a 4-byte IEEE 754 single-precision floating point number.

2.6 Communication command: Function code 03（or 04）- reading display data

Send		**Receive**	
01	Address	01	Address
03	Function code	03	Function code
00	Register address high	04	Byte numbers
00	Register address low (display address)	80	Data 1
00	Register numbers high	04	Data 2

02	Register numbers low	80	Data 3
CRCH	CRC Check code is high	80	Data 4
CRCL	CRC Check code is low	CRCH	CRC Check code is high
		CRCL	CRC Check code is low

For a multi-byte number transmission, use the BIG-ENDIAN format, that is, use the format with high-weight bytes first and low-weight bytes after transmission. For example, a four-byte number ABCDEF12H, the transfer order is: D0= ABH, D1=CDH, D2=EFH, D3=12H.

For a two-byte number such as 12ABH, then D0=12H, D1=ABH.

For floating-point numbers, the format is IEEE 754 single-precision, and the transmission order is the high byte first and then the low byte. The high byte is the byte where the sign bit and exponent bit in the floating-point number are located, and the low byte is the byte where the mantissa is located.

Above D0, D1, D2, and D3 respectively correspond to D0, D1, D2, and D3 in the transmission data sequence described later.

According to the MODBUS RTU protocol specification, the maximum number of data bytes allowed to be transmitted in one communication is 250 (125 × 2).

Register address table:

Parameter storage TPTR	Explanation	Data type	Data length (**byte**)
00	Instantaneous flow information	FLOAT	4
02	Instantaneous flow unit	SHORT	2
03	Positive total integer low	LONG	4
05	Positive total decimal place	FLOAT	4
07	Positive total unit	SHORT	2
08	Reverse total integer low	LONG	4
0A	Reverse total decimal places	FLOAT	4
0C	Reverse total unit	SHORT	2
0D	Excitation alarm	SHORT	2
0E	Electrode alarm	SHORT	2
0F	Empty pipe alarm	SHORT	2

10	Upper limit alarm	SHORT	2
11	Lower limit alarm	SHORT	2
12	Flow rate message	FLOAT	4
14	Flow percentage	FLOAT	4
16	Electrode resistance	FLOAT	4
18	Instrument diameter	FLOAT	4
1A	Positive total integer high	LONG	4
1C	Reverse total integer high	LONG	4
1E	Two-way total cumulative algebra and integers	Long Long	8
22	Two-way total cumulative algebra and decimal numbers	Float	4
24	Two-way cumulative algebra and symbols	Int	2

For example:

1） Definition of instantaneous flow information（FLOAT）

Host sends: 01 03 00 00 00 02 C4 0B

Slave response: 01 03 04 D0 D1 D2 D3 CRCL CRCH

2）Definition of unit instantaneous flow information （SHORT/ List type）

Host sends: 01 03 00 02 00 01 25 CA

Slave response: 01 03 02 00 **D0** CRCL CRCH

D0 Definition:

D0	0	1	2	3	4	5	6	7
Unit	m^3/s	m^3/min	m^3/h	L/s	L/min	L/h	g/m	g/h
D0	8	9	10	11	12	13	14	15
Unit	ig/m	ig/h	t/s	t/min	t/h	kg/s	kg/min	kg/h
D0	16	17						
Unit	g/s	ig/s						

3）Positive total integer low 4 byte message definition （LONG）

Host sends: 01 03 00 03 00 02 34 0B

Slave response: 01 03 04 **D0 D1 D2 D3** CRCL CRCH

4）Positive total decimal place message definition （FLOAT）

Host sends: 01 03 00 05 00 02 D4 0A

Slave response: 01 03 04 D0 D1 D2 D3 CRCL CRCH

5）Positive total unit message definition（SHORT/ List type，Same as reverse unit message）

Host sends: 01 03 00 07 00 01 35 CB

Slave response: 01 03 04 **D0** CRCL CRCH

D0 Definition:

D0	0	1	2	3	4	5
Unit	L	m^3	gal	igal	kg	t

6）Reverse total integer low 4 byte message definition （LONG）

Host sends: 01 03 00 08 00 02 45 C9

Slave response: 01 03 04 D0 D1 D2 D3 CRCL CRCH

7）Reverse total decimal places message definition （FLOAT）

Host sends: 01 03 00 0A 00 02 E4 09

Slave response: 01 03 04 D0 D1 D2 D3 CRCL CRCH

8）Reverse total unit message definition （SHORT/ List type）

Host sends: 01 03 00 0C 00 01 44 09

Slave response: 01 03 04 **D0** CRCL CRCH

D0 Definition**:**

D0	0	1	2	3	4	5
Unit	m^3	L	t	kg	gal	igal

9）Excitation alarm （SHORT）

Host sends: 01 03 00 0D 00 01 15 C9

Slave response: 01 03 02 **00 T/F** CRCL CRCH

10）Electrode alarm （SHORT）

Host sends: 01 03 00 0E 00 01 E5 C9

Slave response: 01 03 02 00 T/F CRCL CRCH

11）Empty pipe alarm （SHORT）

Host sends: 01 03 00 0F 00 01 B4 09

Slave response: 01 03 02 00 T/F CRCL CRCH

12）Upper limit alarm （SHORT）

Host sends: 01 03 00 10 00 01 85 CF

Slave response: 01 03 02 00 T/F CRCL CRCH

13）Lower limit alarm （SHORT）

Host sends: 01 03 00 11 00 01 D4 0F

Slave response: 01 03 02 00 T/F CRCL CRCH

14）Flow rate message definition （FLOAT）

Host sends: 01 03 00 12 00 02 64 0E

Slave response: 01 03 04 D0 D1 D2 D3 CRCL CRCH

Unit defult as m/s

15）Definition of flow percentage message（FLOAT）

Host sends: 01 03 00 14 00 02 84 0F

Slave response: 01 03 04 **D0 D1 D2 D3** CRCL CRCH

The data are percentages, such as 100 for 100% and 1 for 1%

16）Electrode resistance message definition （FLOAT）

Host sends: 01 03 00 16 00 02 25 CF

Slave response: 01 03 04 D0 D1 D2 D3 CRCL CRCH

Electrode resistance unit defult as KΩ

17）Instrument diameter message definition（FLOAT）

Host sends: 01 03 00 18 00 02 44 C0

Slave response: 01 03 04 D0 D1 D2 D3 CRCL CRCH

18）Read total data

Host sends: 01 03 00 00 00 1A C4 01

19）Positive total integer high message definition （LONG）

Host sends: 01 03 00 1A 00 02 E5 CC

Slave response: 01 03 04 D0 D1 D2 D3 CRCL CRCH

20）Reverse total integer high message definition （LONG）

Host sends: 01 03 00 1C 00 02 05 CD

Slave response: 01 03 04 **D0 D1 D2 D3** CRCL CRCH

Total cumulative value calculation method:

The integer part is a binary number, divided into two parts, the upper four bytes and the lower four bytes. Set the upper four bytes as X, the lower four bytes as Y, and the fractional part as Z, then the accumulated value SUM:

SUM = X * 1E9 + Y + Z.

For example: the high part of the data is CD00EFH, the low part is 1234AB67H, and the decimal part is 0.567f, then

1234AB67H =305,441,639

CD00EFH =13,435,119

For the cumulative value result SUM, there are:

SUM = CD00EFH * 1E9 + 1234AB67H + 0.567f = 13,435,119,305,441,639.567

If only the low bit of the integer are used, the maximum value of the integer is 999,999,999H

Instrument diameter unit defult as mm.

D0, D1, D2, D3 data rule:

eg: 0x44,0xc8,0x00,0x00---------（FLOAT）number represent 1600

0x00,0x00,0x06,0x40---------（LONG）number represent 1600

0x06,0x40----------（SHORT）number represent 1600

eg:（FLOAT）（Number: -0.25）

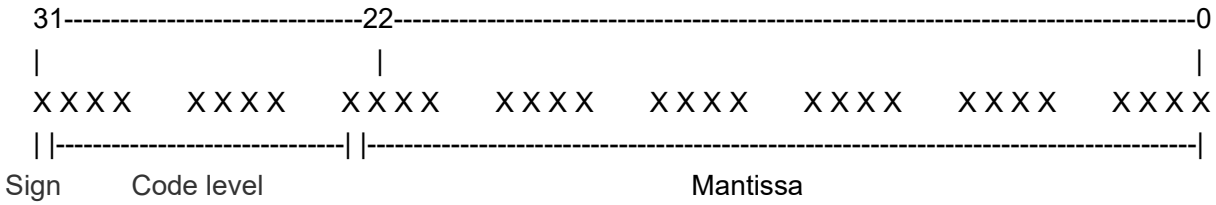
Host sends: 01 03 00 02 00 02 65 CB

Slave response: 01 03 04 **BE 80 00 00** DF F3

0xBE,0x80,0x00,0x00---------（FLOAT）number represent（-0.25）

Appendix: IEEE 754 Single -Precision Format

The length of the single-precision floating-point number defined by the IEEE 754 standard is 32 bits, and can be divided into: sign bit, order code bit and mantissa bit according to the bit field, as follows:



The sign bit is 0 for positive numbers, and 1 for negative numbers.

Code level is 8. It should be noted that the exponent n of 2n cannot be directly treated as an order code, it needs to be added to 127 (7FH) to get the order code representation of 2n.

The bit field length of the mantissa is 23 bits in the figure, but it is actually24 bits. This bit is 'invisible' and its value is fixed at 1, which means that the effective digits of floating-point numbers defined by the IEEE 754 standard are decimals between 1 and 2.

In the process of data transmission, data is transmitted in the order from left (high byte) to right (low byte) as described above.

MD register address of instrument setting parameters

The access base address of each setting parameter of the instrument is 200, and this base address must be added to the address of the register when accessing.
That is, the access target register address is: 200 + access register address, such as the register address of the flow unit is 1, and the access address is 201. Data transmission: High-weight bytes first, low-weight bytes last.

Access register address	Register address definition	Explanation										
0	Diameter (mm)	Number	0	1	2	3	4	5	6	7	8	9
		Diameter	3	6	8	10	15	20	25	32	40	50
		Number	10	11	12	13	14	15	16	17	18	19
		Diameter	65	80	100	125	150	200	250	300	350	400
		Number	20	21	22	23	24	25	26	27	28	29
		Diameter	450	500	600	700	800	900	1000	1100	1200	1300
		Number	30	31	32	33	34	35	36	37	38	
		Diameter	1400	1600	1800	2000	2200	2400	2600	2800	3000	
1	Flow unit	Number	0	1	2	3	4	5				
		Flow unit	m^3/s	m^3/min	m^3/h	L/s	L/min	L/h				
		Number	6	7	8	9	10	11				
		Flow unit	ig/s	ig/min	ig/h	g/s	g/min	g/h				
		Number	12	13	14	15	16	17				
		Flow unit	t/s	t/min	t/h	kg/s	kg/min	kg/h				
2	Cumulant value unit	Number	0	1	2	3	4	5	6	7		
		Cumulant value unit	m^3	$0.1m^3$	$0.01m^3$	$0.001m^3$	L	0.1L	0.01L	0.001L		
		Number	8	9	10	11	12	13	14	15		
		Cumulant value unit	t	0.1t	0.01t	0.001t	kg	0.1kg	0.01kg	0.001kg		
		Number	16	17	18	19	20	21	22	23		
		Cumulant value	gal	0.1ga	0.	0.001g	igal	0.1i	0.01igal	0.00		

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		unit		l	01 gal	al		gal		1igal

3	Small signal excision	Number	0		1			
		Small signal excision	No		Yes			
4	Damping time（s）	0—0.2s, 1—0.5s, 2—0.8s, 3—1s, 4—2s, 5—3s, 6—4s, 7—5s, 8—6s, 9—8s, 10—10s, 11—20s, 12—30s, 13—50s, 14—100s						
5	Pulse output mode	0—Frequency output, 1—Equivalent output						
6	Pulse equivalent value	0—0.001L, 1—0.01L, 2—0.1L, 3—1L, 4—2L, 5—5L, 6—10L, 7—100L, 8—1m^3, 9—10m^3, 10—100m^3, 11—1000m^3, 12—1kg, 13—1t						
7	Output test	10H—20mA/2000Hz,11H—10mA/1000Hz,12H—4.16mA/20Hz,13H—0mA/0Hz, other— exit test; After entering the test state, an exit test instruction needs to be issued, otherwise the system will remain in the test state. It is invalid in multi-register transfer, and it is valid when only one register is written when using single register access or multi-byte access.						
8	Empty pipe test enable	0—Yes , 1—No						
9	Current mode	0—0～10mA, 1—4～20mA						
10	Flow direction	0—Positive, 1—Reverse						
11	Reverse output enable	0—No , 1—Yes						
12	Excitation mode	0— Mode 1, 1— Mode 2, 2— Mode 3, 3— Mode 4, 4— Mode 5, 5— Mode 6						
13	Upper limit alarm enable	0—No, 1—Yes						
14	Nonlinear calibration enable	0—No, 1—Yes						

15	External input mode	Number	0	1	2	3
		Function	Prohibit external input control function	On/Off current frequency output	On/Off cumulate	External clear accumulation

16	Baud rate	Number	0	1	2	3	4	5

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<table>
<tr><td></td><td></td><td colspan="2">Baud rate bps</td><td>600</td><td>1200</td><td>2400</td><td>4800</td><td>9600</td><td>14400</td></tr>
<tr><td>17</td><td>Lower limit alarm enable</td><td colspan="9">0—Yes, 1—No</td></tr>
<tr><td rowspan="3">18</td><td rowspan="3">Excitation test</td><td colspan="2">Test function</td><td>Register value</td><td colspan="6" rowspan="3">It is invalid in multi-register transfer, and it is valid when only one register is written when using single register access or multi-byte access. After entering the test state, an exit test instruction needs to be issued, otherwise the system will remain in the test state.</td></tr>
<tr><td colspan="2">Excitation enable</td><td>11H</td></tr>
<tr><td colspan="2">Exit test</td><td>Other</td></tr>
<tr><td>19</td><td>Excitation interval</td><td colspan="9">Unused</td></tr>
<tr><td>20、21</td><td>Diameter arbitrary value setting</td><td colspan="9">Unused</td></tr>
<tr><td>22、23</td><td>Instrument calibration</td><td colspan="9">Input floating-point numbers</td></tr>
<tr><td>24、25</td><td>Full scale value</td><td colspan="9">Input floating-point numbers</td></tr>
<tr><td>26、27</td><td>Current zero calibration</td><td colspan="9">Input floating-point numbers</td></tr>
<tr><td>28、29</td><td>Full scale current adjust</td><td colspan="9">Input floating-point numbers</td></tr>
<tr><td>30、31</td><td>Zero setting</td><td colspan="9">Input floating-point numbers, unit m/s</td></tr>
<tr><td rowspan="8">32、33、34、35</td><td rowspan="8">Positive cumulate value setting</td><td colspan="9">Import 8 byte long long integers. The cumulative value setting needs to be executed separately, and cannot be set in the same communication with other parameters. When written together with other registers, the data is ignored.</td></tr>
<tr><td>Display cumulate value unit</td><td>m^3</td><td>0.1 m^3</td><td>0.01 m^3</td><td>0.001m^3</td><td>L</td><td>0.1 L</td><td>0.01L</td><td>0.001L</td></tr>
<tr><td>Input data unit</td><td colspan="4">m^3</td><td colspan="4">L</td></tr>
<tr><td>Display cumulate value unit</td><td>t</td><td>0.1 t</td><td>0.01t</td><td>0.001t</td><td>kg</td><td>0.1 kg</td><td>0.01kg</td><td>0.001kg</td></tr>
<tr><td>Input data unit</td><td colspan="4">t</td><td colspan="4">kg</td></tr>
<tr><td>Display cumulate value unit</td><td>gal</td><td>0.1 gal</td><td>0.01 gal</td><td>0.001gal</td><td>igal</td><td>0.1igal</td><td>0.01igal</td><td>0.001igal</td></tr>
</table>

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		Input data unit	gal	igal
36、37、38、39	Reverse cumulate value setting	Input 8 byte long long integers, The data unit is the same as the positive accumulation setting.		
40、41	Small signal excision	Input floating-point numbers, input xx.xx as xx.xx%		
42、43	Full scale output frequency	Input floating-point numbers, unit Hz		
44、45	Empty Pipe threshold	Input floating-point numbers, input xx.xx as xx.xx%		
46、47	Converter coefficient	Input floating-point numbers		
48、49	Sensor coefficient	Input floating-point numbers		
50、51	Conductivity coefficient	Input floating-point numbers		
52、53	Additional coefficient	Input floating-point numbers		
54、55	Upper limit alarm value	Input floating-point numbers, input xx.xx as xx.xx%		
56、57	Lower limit alarm value	Input floating-point numbers, input xx.xx as xx.xx%		
58、59	Nonlinear calibration 1	Input floating-point numbers, unit m/s		
60、61	Nonlinear coefficient 1	Input floating-point numbers		
62、63	Nonlinear calibration 2	Input floating-point numbers, unit m/s		
64、65	Nonlinear coefficient 2	Input floating-point numbers		
66、67	Nonlinear calibration point 3	Input floating-point numbers, unit m/s		
68、69	Nonlinear coefficient 3	Input floating-point numbers		
70、71	Nonlinear calibration point 4	Input floating-point numbers, unit m/s		
72、73	Nonlinear coefficient 4	Input floating-point numbers		

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74、75	Nonlinear calibration point 5	Input floating-point numbers, unit m/s
76、77	Nonlinear coefficient 5	Input floating-point numbers
78、79	Gradient limit value	Input floating-point numbers, input xx.xx as xx.xx%
80、81	Insensitive time	Input floating-point numbers
82、83	Density	Input floating-point numbers
84	Density unit	Unit defult as t/m^3
85	Extension communication address	Input value: 0-99
86、87	Cumulate clear code	Modify clear code ,long integers
88、89	Converter code 1	Input long integers
90、91	Converter code 2	Input long integers
92、93	Sensor code	Input long integers
94、95	Sensor code	Input long integers
96	Buffer size	Input value:4-64
97、98	Electrode threshold	Input floating-point numbers, input xx as xx%
99、100	Factory calibration factor	Input floating-point numbers, unused
101	Language	0—中文, 1—English
102	Pulse duration（ms）	Number 0 1 2 3 4 5 6 7 8 Pulse duration (ms) 10 20 50 100 150 200 300 500 2000
103	Write parameter operation code	Input long integers
104	Access code control	1— Revise operation enable. 0— Prohibit revise parameters of the operation, any parameters can be read.

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		Write permission control: When entering the write parameter operation, you need to enter the correct system 4th level password first, and then write 1 to the register. Revise parameter method: 1 Enter the operation password, which is the fourth level password of the system; 2 Write 1 to the write operation permission register, and write 1 only when the password is correct; 3 Read and write other parameters; 4 After the operation is completed, clear the write permission register and clear the operation password; 5 When there is no read or write operation for 30 minutes, the system will clear the operation password and write permission register to zero; Note: The password is set by the local keyboard operation, and the upper computer cannot change the password.

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