Electromagnetic Flowmeter Style 2
ModBUS Communication Protocol
V3

Contents

This file describes the MODBUS-RTU communication protocol of electromagnetic flowmeters.

1. MODBUS-RTU Protocol

The Electromagnetic flowmeter integrates the standard RS-485 interface and Modbus-RTU communication protocol.
Following is the protocol frame and data format:
The communication is asynchronous transfer mode in bytes. The data format between master and slave is 10-bit as following:

Data format	10-bit
Start bit	1 bit
Data bits	8 bits
Check bit	No
Stop bit	1 bit

Frame format:

Data format:	Address	Function	Data	CRC check
Data length:	1 byte	1 byte	N bytes	16-bit CRC(2 bytes)

1.1 Communication Process

Modbus protocol is a Master-Slave protocol (the flowmeter is the slave). The system has only one master node that issues explicit commands to one of the slave nodes and processes responses. Slave node will not typically transmit data without a request from the master node, and do not communicate with other slaves, and the master node initiates only one Modbus transaction at the same time.

The Slave will response to the master according to the data in the frame from the master.

1.2 Address Field

In the Modbus protocol, the address field only contains the slave address, in this version, the address rang is 1-255. Every slave in the same system must has different slave address. A master addresses a slave by placing the slave address in the address field of the message. When the slave returns its response, it places its own address in the response address field to let the master know which slave is responding.

1.3 Function Code

The function code indicates to the server what kind of action to perform. The function code can be followed by a data field that contains request and response parameters.in this file, the electromagnetic flowmeter only uses the '03' and '10' function codes, others are reserved:

Function code	Definition	Operation
03	Read multi-register	Read one or multi-register data
10	Write multi-register	Write one or multi-register data

1.4 Data Filed

The data filed contains the information which information the slave needs to response. For example: flow rate,velocity、totalized value of forward flow etc. Every register in slave is 16-bit format (2 bytes), high byte in front; master can read max 50 registers one time; Some register is 4-bytes, like forward flow. Master needs to read the high 2-bytes and low 2-bytes separately (2 registers).

2. MODBUS Function Code

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2.1 Function Code "03": Read Multi-Register

For example: Master needs to read 3 registers based from ''0x000E' from the Slave addressed '0x01':
the register in the slave is as following:

Register	Data	Variable
0x000E	0x0180	V1
0x000F	0x0180	V2
0x0010	0x0180	V3

Master will send the following frame:

	Bytes Number	Send Data	Note
Slave Address	1	0x01	Send the Slave Address
Function Code	1	0x03	Read Multi-Register
Register Start Address	2	0x000E	The start register address:0x000E
Register number	2	0x0003	Read 3 registers（6 bytes）
CRC Check	2	0x6408	The CRC Check code

Slave will response:

	Bytes Number	Send Data	Note
Slave Address	1	0x01	Send the Slave Address
Function Code	1	0x03	Read Multi-Register
Bytes response	1	0x06	The data contains 6 bytes
Register 1	2	0x0180	The 0x000E register data
Register 2	2	0x0180	The 0x000F register data
Register 3	2	0x0180	The 0x0010 register data
CRC Check	2	0x215E	The CRC Check code

2.2 **Function Code "10"**：**Write Multi-Register**

The master can use this function code to save the date into the target registers in slave.

For example: Master needs to save '0x0003' and '0x00FF' into the '0x003A' and '0x003B' registers in the Slave Addressed '0x01':

Master will send the following frame：

	Byte Number	Send Data	Note
Slave Address	1	0x01	Send the Slave Address
Function Code	1	0x10	Write Multi-Register
Register Start Address	2	0x003A	The Register Start Address
Register Number	2	0x0002	Register number
Data Length	1	0x04	Date Length in all registers
Register 1 Data	2	0x0003	The 0x003A register data
Register 2 Data	2	0x00FF	The 0x003B register data
CRC Check	2	0xC084	The CRC Check code

Slave will response

	Byte Number	Send Data	Note
Salve Address	1	0x01	Send the Slave Address
Function Code	1	0x10	Write Multi-Register
Register Start Address	2	0x003A	The Register Start Address
Register Number	2	0x0002	Register number
CRC Check	2	0x61C5	The CRC Check code

3. **Data Format and Special Parameters Description**

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3.1 **Data Format**

Authority:

RO Read Only；

RW Readable and Writable；

Format:

DW 4-bytes integer data;

W 2-bytes integer data;

B 1-byte integer, this parameter will be added to 2-bytes with the '0x00' high byte;

SF 4-bytes single-precision floating-point format data;

Fixed Point Data: For Example: DW*1000 means the parameter is amplified 1000-fold. If the real value is 0.123, in the Modbus, the slave will response the value as 123.

Float format：

The IEEE754 format is used for the 4-bytes float data as following:

Register 1		Register 2	
BYTE1	BYTE2	BYTE3	BYTE4
S EEEEEEE	E MMMMMMM	MMMMMMMM	MMMMMMMM

3.2 Special Parameters Description

Flow Rate Unit(Register 24 & Register 105):

0 : L/H
1 : L/M
2 : L/S
3 : M3/H
4 : M3/M
5 : M3/S
6 : KG/H
7 : KG/M
8 : KG/S
9 : T/H
10 : T/M
11 : T/S

Volume Unit(Register 25, for display):

0 : 0.001L
1 : 0.01L
2 : 0.1L
3 : 1L
4 : 0.001M3
5 : 0.01M3
6 : 0.1M3
7 : 1M3
8 : 1KG
9 : 1T

EPD: Empty Pipe Detecting

4. List of Modbus Registers

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4.1 Frequently-used Registers List

Register Address	PLC Address	Unit	Bytes	Authority	Format	Description
90	40091	M^3	4	RO	SF	Totalized Value of Forward flow
92	40093	M^3	4	RO	SF	Totalized Value of Reverse flow
94	40095	M^3	4	RO	SF	Flow Total Data (forward minus reverse)
96	40097		4	RW	DW	Totalizer Reset
98	40099	Refer to Register 105	4	RO	SF	Flow Rate
100	40101	m/s	4	RO	SF	Velocity
102	40103	%	4	RO	SF	Flow Ratio
104	40105	%	2	RO	W	EPD Value
105	40106		2	RO	W	Flow Rate Unit
106	40107		2	RO	W	EPD Alarm
107	40108		2	RO	W	Excitation Current Alarm

4.2 Full Registers List

Register Address	PLC Address	Unit	Bytes	Authority	Format	Description

0	40001	m/s	2	R0	DW*1000	Velocity--High bytes
1	40002		2	R0	DW*1000	Velocity--Low bytes
2	40003	Refer to Register 24	2	R0	DW*100	Flow Rate--High bytes
3	40004		2	R0	DW*100	Flow Rate--Low bytes
4	40005	%	2	R0	B*100	Flow Ratio
5	40006	%	2	R0	B*100	EPD Value
6	40007	M^3	2	R0	DW*1	Totalized Value of Forward Flow--High bytes
7	40008		2	RO	DW*1	Totalized Value of Forward Flow--Low bytes
8	40009	M^3	2	RO	DW*1	Totalized Value of Reverse Flow--High bytes
9	40010		2	RO	DW*1	Totalized Value of Reverse Flow--Low bytes
10	40011		2	RO	DW*1	Reserved
11	40012		2	RO	DW*1	Reserved
12	40013		2	RO	B*1	System Alarm
13	40014		2	RO	B*1	Flow Direction
14	40015		2	RO	DW	Reserved
15	40016		2	RO	DW	Reserved
16	40017		2	RO	B	Reserved
17	40018		2	RO	B	Reserved
18	40019		2	RO	B	Reserved
19	40020		2	RO	B	Reserved
20	40021		2	RO	B	Reserved
21	40022	mm	2	RW	W	Pipe Diameter
22	40023		2	RW	DW	Flow Rate Range--High bytes
23	40024		2	RW	DW	Flow Rate Range--Low bytes
24	40025		2	RW	B	Flow Rate Unit
25	40026		2	RW	B	Volume Unit
26	40027	S	2	RW	W*1	Damping Period
27	40028		2	RW	W*10000	Sensor Coefficient
28	40029	HZ	2	RW	B	Excitation Frequency
29	40030	%	2	RW	B	Excitation Current
30	40031		2	RW	B	Flow Direction Setting
31	40032	mm/s	2	RW	W	Zero Drift
32	40033	%	2	RW	W*100	Flow Rate Cut-off Percent

33	40034		2	RW	B	Flow Rate Cut-off Enable
34	40035		2	RW	B	Reverse Output Enable
35	40036		2	RW	B	EPD Enable
36	40037	%	2	RW	B	EPD Alarm Threshold
37	40038		2	RW	B	Flow Rate Upper Limit Alarm Enable
38	40039	%	2	RW	W*100	Flow Rate Upper Limit Alarm Threshold
39	40040		2	RW	B*1	Flow Rate Lower Limit Alarm Enable
40	40041	%	2	RW	W*100	Flow Rate Lower Limit Alarm Threshold
41	40042		2	RW	B	Reserved
42	40043		2	RW	W*100	Reserved
43	40044		2	RW	B	Excitation Current Alarm
44	40045		2	RW	B	Pulses or Frequency Output Select
45	40046	ml	2	RW	B	Pulse Unit
46	40047	HZ	2	RW	W	Frequency Output Range
47	40048		2	RW	W	Reserved
48	40049		2	RW	B	Reserved
49	40050		2	RW	B	Reserved
50	40051		2	RW	W	Reserved
51	40052		2	RW	B	Reserved
52	40053		2	RW	B	Reserved
53	40054		2	RW	W	Reserved
54	40055		2	RW	B	Reserved
55	40056		2	RW	B	Reserved
56	40057		2	RW	W	Reserved
57	40058		2	RW	B	Reserved
58	40059		2	RW	B	Reserved
59	40060		2	RW	DW*10000	Reserved
60	40061		2	RW	DW*10000	Reserved
61	40062		2	RW	W	Reserved
62	40063		2	RW	W	Reserved
63	40064		2	RW	W	Reserved

64	40065		2	RW	W	Reserved
65	40066		2	RW	W*10000	Reserved
66	40067		2	RW	B	Flow Filter Enable
67	40068		2	RW	W*10000	Flow Filter Coefficient
68	40069	Min	2	RO	DW*60	Reserved
69	40070	Min	2	RO	DW*60	Reserved
70	40071		2	RW	DW	Flow Correction Point 1--High bytes
71	40072		2	RW	DW	Flow Correction Point 1--Low bytes
72	40073		2	RW	DW	Flow Correction Point 2--High bytes
73	40074		2	RW	DW	Flow Correction Point 2--Low bytes
74	40075		2	RW	DW	Flow Correction Point 3--High bytes
75	40076		2	RW	DW	Flow Correction Point 3--Low bytes
76	40077		2	RW	DW	Flow Correction Point 4--High bytes
77	40078		2	RW	DW	Flow Correction Point 4--Low bytes
78	40079		2	RW	DW	Flow Correction Point 5--High bytes
79	40080		2	RW	DW	Flow Correction Point 5--Low bytes
80	40081		2	RW	DW	Standard Flow 1--High bytes
81	40082		2	RW	DW	Standard Flow 1--Low bytes
82	40083		2	RW	DW	Standard Flow 2--High bytes
83	40084		2	RW	DW	Standard Flow 2--High bytes
84	40085		2	RW	DW	Standard Flow 3--High bytes
85	40086		2	RW	DW	Standard Flow 3--High bytes
86	40087		2	RW	DW	Standard Flow 4--High bytes
87	40088		2	RW	DW	Standard Flow 4--High bytes
88	40089		2	RW	DW	Standard Flow 5--High bytes
89	40090		2	RW	DW	Standard Flow 5--High bytes
90	40091	M^3	2	RO	SF	Totalized value of forward flow--High bytes
91	40092		2	RO	SF	Totalized value of forward flow--Low bytes
92	40093	M^3	2	RO	SF	Totalized value of reverse flow--High bytes

93	40094		2	RO	SF	Totalized value of reverse flow--Low bytes
94	40095	M^3	2	RO	SF	Flow total data--High bytes
95	40096		2	RO	SF	Flow total data-- Low bytes
96	40097		2	RW	DW	Totalizer Reset--High bytes
97	40098		2	RW	DW	Totalizer Reset-- Low bytes
98	40099	Refer to Register 105	2	RO	SF	Flow Rate--High bytes
99	40100		2	RO	SF	Flow Rate--Low bytes
100	40101	m/s	2	RO	SF	Velocity--High bytes
101	40102	m/s	2	RO	SF	Velocity-- Low bytes
102	40103	%	2	RO	SF	Flow Ratio--High bytes
103	40104	%	2	RO	SF	Flow Ratio-- Low bytes
104	40105	%	2	RO	W	EPD Value
105	40106		2	RO	W	Flow Rate Unit
106	40107		2	RO	W	EPD Alarm
107	40108		2	RO	W	Excitation Current Alarm
108	40109		2	RO	W	Reserved
109	40110		2	RO	W	Reserved
110	40111		2	RO	W	Reserved
111	40112		2	RO	W	Reserved
112	40113		2	RO	W	Reserved
113	40114		2	RO	W	Protocol Version
114	40115		2	RO	W	Flow Rate Range Unit
115	40116		2	RO	W	Reserved

5. **Modbus Communication Examples**

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5.1 **How to read the totalized value of forward flow**

Register Address: 90(0x5A). PLC Address: 40091
Master Send : 01 03 00 5A 00 02 E4 18

	Data Length	Send Data
Slave Address	1	01

Function Code	1	03
Register Start Address	2	00 5A
Register Length	2	00 02
CRC Check	2	E4 18

Slave Response : 01 03 04 3F C1 97 4E 49 DF

	Data Length	Send Data
Slave Address	1	01
Function Code	1	03
Data Number	4	04
Register 1 Data	2	3F C1
Register 2 Data	2	97 4E
CRC Check	2	49 DF

The totalized value of forward flow is 1.51243 m3 (3F C1 97 4E convert to SF format)

5.2 **How to read the flow rate**

Register Address: 98(0x62). PLC Address: 40099
Master Send : 01 03 00 62 00 02 65 D5

	Data Length	Send Data
Slave Address	1	01
Function code	1	03
Register Start Address	2	00 62
Register Length	2	00 02
CRC Check	2	65 D5

Slave Response: 01 03 04 42 0C 00 00 2E 48

	Data Length	Send Data
Slave Address	1	01
Function Code	1	03
Data Number	4	04
Register 1 Data	2	42 0C
Register 2 Data	2	00 00
CRC码	2	2E 48

The flow rate is 35 (42 0C 00 00 converted to SF format).