



LabV Series MODBUS Communication Protocol

Note: The hexadecimal numbers are expressed by 'XXXXH' or 'XXH' in the below description.

1. MODBUS-RTU Standard Communication Format

This communication use MODBUS RTU mode, message frame as below:

Slave address	Function code	Data area	CRC Check (Cyclic Redundancy Check)	
1 Byte	1 Byte	0 or up to 252 bytes	2 Bytes	
			CRC low	CRC high

(1) **Slave address:** The peristaltic pump address No. is controlled by host. The pump address No. should not be same when they are in the same 485 line. The address No. range is 1~32, 0 means broadcast.

(2) **Function code:** The protocol use 2 common function codes which defined by MODBUS protocol.

03H: Read the contents of holding register

06H: Write a word to the holding register

10H: Write a long type to holding register

Data zone: Specific information instructions that the peristaltic pump needs to execute, such as start/stop, direction, accelerate/decelerate etc.

(3) **CRC check:** CRC code is 2 bytes, 16 check codes. Use CRC-16 (which used in American binary synchronous system).

Polynomial: $G(X)=X^{16}+X^{15}+X^2+1$.

CRC check C language code please refer to Appendix 1.

2. Communication Setting

(1) **Communication baud rate: 1200, 2400, 4800, 9600 optional**

(2) **Byte structure:** 1 start bit + 8 data bits + 1 even parity bit + 1 stop bit

(3) **Bit sequence sending order:** The least significant bit(LSB)..... The most significant bit (MSB)

Start	1	2	3	4	5	6	7	8	Check	Stop
-------	---	---	---	---	---	---	---	---	-------	------

(4) **Data transferring format:**

Integer (2 bytes):

Data: (High bit) The second byte
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The first byte (Low bit)



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Send: The second byte The first byte

For example: 1234H send 12H 34H

Floating-point type (4 bytes):

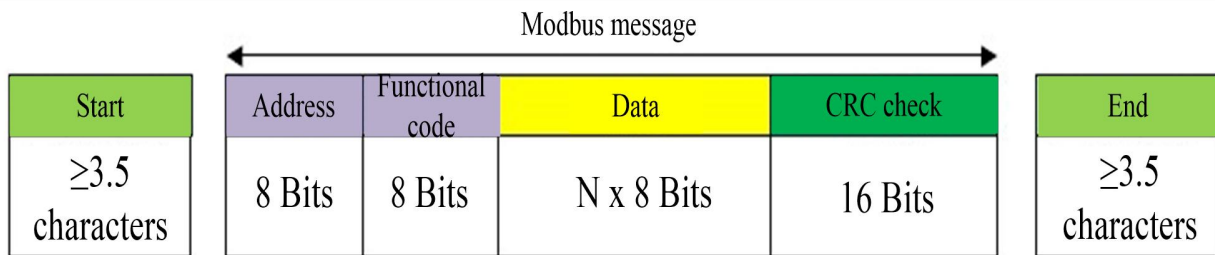
Data: (High bit) The fourth byte The third byte The second byte The first byte(Low bit)

Send: The fourth byte The third byte The second byte The first byte

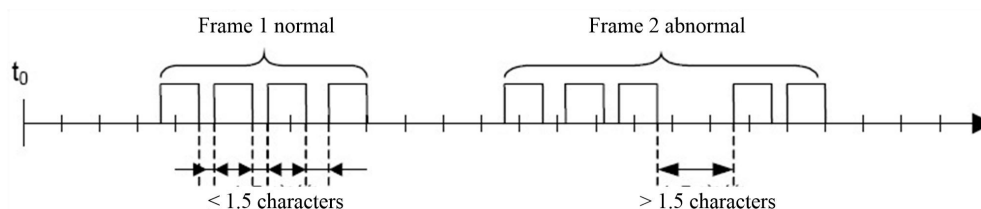
For example: 8.9 send 41H 0EH 66H 66H

3. MODBUS Message RTU Frame Format

In RTU mode, the message frames are distinguished by idle intervals with a duration of at least 3.5 characters. As the follow picture:



The entire message frame must be sent in a continuous stream of characters. If the idle space between two characters is greater than 1.5 character times, the message frame is considered as incomplete, should be discarded by receiving node. As below:



4. Abnormal Response

When host sending request data, the slave receives abnormal data, an abnormal response is required. If the address code sent from host is wrong, there is no this address code between slaves or the data received by slave is wrong when CRC check, no abnormal code return, the host should have super response



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mechanism.

Function code domain: Abnormal response function code is normal response function code +80H.

Data domain: Return to abnormal code, define as below:

Chart 1: Abnormal code definition

Code	Name	Meaning
01H	Illegal function code	The function code received by peristaltic pump except 03H/06H/10H.
02H	Illegal data address	This abnormal code means the register address is not allowed data which received by peristaltic pump.
03H	Illegal data value	Written data does not meet the operating range.
06H	Slave (peristaltic pump) busy	The current state of the peristaltic pump conflict with the command received, unable to complete the command.

Peristaltic Pump only receive MODBUS command with the Main Interface, other interface do not receive message.

5. Holding Register Address And Content

Basic Parameters Setting

Address (Decimal)	Name	Range	Data Type
1000	Pump Head Type	Relative data refer to Chart 1	unsigned short int (2 Bytes)
1001	Tubing Size	Relative data refer to Chart 1	unsigned short int (2 Bytes)
1002	Motor Speed	0.1-600rpm	float (4 Bytes)
1004	Flow Rate	0.1-99999 mL	float (4 Bytes)
1007	Back Suction Angle	0-360°	unsigned short int (2 Bytes)
1008	Start/Stop Control	1: Start 0: Stop	unsigned short int (2 Bytes)
1009	Direction Control	1: Clockwise 0: Anticlockwise	unsigned short int (2 Bytes)
1010	Full Speed Running	1: Start full speed 0: Stop full speed	unsigned short int (2 Bytes)
1015	Set Flow Volume	0-99999 mL	Float (4 Bytes)
1018	Working Time	0.1-9999 (s)	Float (4 Bytes)
1020	Working Mode	0: Transferring 1: Fixed volume measurement 2: Fixed time and volume	unsigned short int (2 Bytes)



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1021	Pause Time	0.1-9999 (s)	Float (4 Bytes)
1023	Copy Numbers	0-9999 times. 0 means infinite	unsigned short int (2 Bytes)

Note:

- 1) When working mode is transferring, setting up register 1015 and 1018 is invalid.
- 2) When working mode is Fixed volume measurement, setting up register 1018 and 2001 is invalid.
- 3) When working mode is Fixed time and volume, set up register 1002, 1004 and 2001 is invalid.
- 4) Please set up the register data refer to the chart, do not receive one instruction to set multiple registers consecutively.

Calibration Parameters Setting Up

Address (Decimal)	Name	Range	Data Type
2001	Testing time	0.5-9999s	Float (4 Bytes)
2003	Testing start	1: Start 0: Stop	unsigned short int (2 Bytes)
2004	Actual volume	0-9999 mL	float (4 Bytes)
2006	Restore Defaults	1: Restore calibration	unsigned short int (2 Bytes)
2007	Micro Adjustment	1: Increase 0: Decrease	unsigned short int (2 Bytes)

Chart 1 Pump Head & Tubing No.

V series Pump Head and Tubing Table

Pump Head	Pump Head Model	Tubing Size	Tubing Specific
EasyPumpI	0	13	13#
		14	14#
		19	19#
		16	16#
		25	25#
		17	17#
		18	18#
EasyPumpII	1	15	15#
		24	24#
		35	35#
		36	36#
EasyPumpIII	2	13	13#



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		14	14#
		19	19#
		16	16#
		25	25#
		17	17#
		18	18#
EasyPumpIV	3	15	15#
		24	24#
		35	35#
		36	36#
EasyPumpV	4	13	13#
		14	14#
		19	19#
		16	16#
		25	25#
EasyPumpVI	5	13	13#
		14	14#
		19	19#
		16	16#
		25	25#
2*EasyPumpI	6	13	13#
		14	14#
		19	19#
		16	16#
		25	25#
		17	17#
		18	18#
2*EasyPumpII	7	15	15#
		24	24#
		35	35#
		36	36#
2*EasyPumpIII	8	13	13#
		14	14#
		19	19#
		16	16#
		25	25#
		17	17#
		18	18#



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2*EasyPumpIV	9	15	15#
		24	24#
		35	35#
		36	36#
AMC_(10)	10	101	1*1
		102	2*1
		103	2.4*0.86
		104	2.79*0.86
		105	3*1
		106	0.19*0.86
		107	0.25*0.86
		108	0.51*0.86
		109	0.89*0.86
		110	1.14*0.86
		111	1.42*0.86
		112	2.06*0.86
		114	0.13*0.86
		AMC_(6)	11
102	2*1		
103	2.4*0.86		
104	2.79*0.86		
105	3*1		
106	0.19*0.86		
107	0.25*0.86		
108	0.51*0.86		
109	0.89*0.86		
110	1.14*0.86		
111	1.42*0.86		
112	2.06*0.86		
114	0.13*0.86		
YZ1515x	12		
		14	14#
		19	19#
		16	16#
		25	25#
		17	17#
		18	18#
YZ2515x	13	15	15#



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		24	24#
2*YZ1515x	14	13	13#
		14	14#
		19	19#
		16	16#
		25	25#
		17	17#
		18	18#
2*YZ2515x	15	15	15#
		24	24#
MCn(10)	16	101	1*1
		102	2*1
		103	2.4*0.8
		104	2.79*0.9
		105	3*1
MCn(6)	17	101	1*1
		102	2*1
		103	2.4*0.8
		104	2.79*0.9
		105	3*1
DZ25-3L	18	15	15#
		24	24#
		35	35#
		36	36#
2*DZ25-3L	19	15	15#
		24	24#
		35	35#
		36	36#
DZ25-6L	20	15	15#
		24	24#
		35	35#
		36	36#
2*DZ25-6L	21	15	15#
		24	24#
		35	35#
		36	36#
YZ35	22	73	73#
		82	82#



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2*YZ35	23	73	73#
		82	82#
DY15	24	13	13#
		14	14#
		19	19#
		16	16#
		25	25#
		17	17#
		18	18#
		15	15#
DY25	25	24	24#
		35	35#
		36	36#
		19	19#
UC15	26	16	16#
		25	25#
		17	17#
		18	18#
		15	15#
UC25	27	24	24#
		35	35#
		36	36#
		14	14#
SN15	28	16	16#
		24	24#
SN25	29	24	24#
EasyPumpV-Y	30	115	0.5*1.6
		13	13#
		14	14#
		19	19#
		16	16#
EasyPumpVI-Y	31	115	0.5*1.6
		13	13#
		14	14#
		19	19#
		16	16#



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		14	14#
		19	19#
		16	16#
		25	25#
		17	17#
		18	18#
EasyPumpII	1	15	15#
		24	24#
		35	35#
		36	36#
EasyPumpIII	2	13	13#
		14	14#
		19	19#
		16	16#
		25	25#
		17	17#
		18	18#
EasyPumpIV	3	15	15#
		24	24#
		35	35#
		36	36#
EasyPumpV	4	13	13#
		14	14#
		19	19#
		16	16#
		25	25#
EasyPumpVI	5	13	13#
		14	14#
		19	19#
		16	16#
		25	25#
2*EasyPumpI	6	13	13#
		14	14#
		19	19#
		16	16#



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		25	25#
		17	17#
		18	18#
2*EasyPumpII	7	15	15#
		24	24#
		35	35#
		36	36#
2*EasyPumpIII	8	13	13#
		14	14#
		19	19#
		16	16#
		25	25#
		17	17#
		18	18#
2*EasyPumpIV	9	15	15#
		24	24#
		35	35#
		36	36#
AMC_(10)	10	101	1*1
		102	2*1
		103	2.4*0.86
		104	2.79*0.86
		105	3*1
		106	0.19*0.86
		107	0.25*0.86
		108	0.51*0.86
		109	0.89*0.86
		110	1.14*0.86
		111	1.42*0.86
		112	2.06*0.86
		114	0.13*0.86
AMC_(6)	11	101	1*1
		102	2*1
		103	2.4*0.86
		104	2.79*0.86
		105	3*1
		106	0.19*0.86
		107	0.25*0.86



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		108	0.51*0.86
		109	0.89*0.86
		110	1.14*0.86
		111	1.42*0.86
		112	2.06*0.86
		114	0.13*0.86
YZ1515x	12	13	13#
		14	14#
		19	19#
		16	16#
		25	25#
		17	17#
		18	18#
YZ2515x	13	15	15#
		24	24#
2*YZ1515x	14	13	13#
		14	14#
		19	19#
		16	16#
		25	25#
		17	17#
		18	18#
2*YZ2515x	15	15	15#
		24	24#
MCn(10)	16	101	1*1
		102	2*1
		103	2.4*0.8
		104	2.79*0.9
		105	3*1
MCn(6)	17	101	1*1
		102	2*1
		103	2.4*0.8
		104	2.79*0.9
		105	3*1
DZ25-3L	18	15	15#
		24	24#
		35	35#
		36	36#



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2*DZ25-3L	19	15	15#
		24	24#
		35	35#
		36	36#
UC15	20	19	19#
		16	16#
		25	25#
		17	17#
		18	18#
UC25	21	15	15#
		24	24#
		35	35#
		36	36#
SN15	22	14	14#
		16	16#
SN25	23	24	24#
EasyPumpV-Y	24	115	0.5*1.6
		13	13#
		14	14#
		19	19#
		16	16#
EasyPumpVI-Y	25	115	0.5*1.6
		13	13#
		14	14#
		19	19#
		16	16#
EasyPumpI-S	26	13	13#
		14	14#
		19	19#
		16	16#
		25	25#
		17	17#
		18	18#
EasyPumpII-S	27	15	15#
		24	24#
		35	35#
		36	36#
EasyPumpIII-S	28	13	13#



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		14	14#
		19	19#
		16	16#
		25	25#
		17	17#
		18	18#
EasyPumpIV-S	29	15	15#
		24	24#
		35	35#
		36	36#
EasyPumpV-S	30	13	13#
		14	14#
		19	19#
		16	16#
		25	25#
EasyPumpVI-S	31	13	13#
		14	14#
		19	19#
		16	16#
		25	25#
EasyPumpV-YS	32	115	0.5*1.6
		13	13#
		14	14#
		19	19#
		16	16#
EasyPumpVI-YS	33	115	0.5*1.6
		13	13#
		14	14#
		19	19#
		16	16#

6. Send Data Format

Unsigned short int format

Peristaltic pump address	Function code	Register address		Data (unsigned short int)		CRC check	
		Address H	Address L	Data H	Data L	L	H
	06H						



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Float format

Peristaltic pump address	Function code	Register address		Register quantity		The number of bytes	Data (Float)				CRC check		
		H	L	00H	02H		04H	H2	H1	L2	L1	L	H
	10H												

Read Register Format

Peristaltic pump address	Function code	Register Start Address		Register quantity		CRC check	
		Address H	Address L	Data H	Data L	L	H
	03H						

(1) Setting pump head type

The peristaltic pump address is 1, set the pump head to EasyPump, the number is 0000H.

Send: 01 06 03 E8 00 00 09 BA

Back: 01 06 03 E8 00 00 09 BA

(2) Setting tubing type

The peristaltic pump address is 1, set the tubing type to 16#, the number is 0010H.

Send: 01 06 03 E9 00 10 59 B6

Back: 01 06 03 E9 00 10 59 B6

(3) Setting the motor speed

The peristaltic pump address is 1, set the motor speed to 58.8 rpm.

Send: 01 10 03 EA 00 02 04 42 6B 33 33 58 29

Back: 01 10 03 EA 00 02 60 78

(4) Setting flow

The peristaltic pump address is 1, set the flow to 50ml/min.

Send: 01 10 03 EC 00 02 04 42 48 00 00 7D 2C

Back: 01 10 03 EC 00 02 80 79

(5) Setting back suction angle

The peristaltic pump address is 1, set the back suction angle to 60°.

Send: 01 06 03 EF 00 3C B8 6A



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Back: 01 06 03 EF 00 3C B8 6A

(6) Start/stop control

The peristaltic pump address is 1, 0001H to control start, 0000H to control stop.

Send start: 01 06 03 F0 00 01 48 7D

Back: 01 06 03 F0 00 01 48 7D

Send stop: 01 06 03 F0 00 00 89 BD

Back: 01 06 03 F0 00 00 89 BD

(7) Direction control

The peristaltic pump address is 1, clockwise is 0001H, counterclockwise is 0000H.

Send: 01 06 03 F1 00 01 19 BD (Clockwise)

Back: 01 06 03 F1 00 01 19 BD

(8) Full speed

The peristaltic pump address is 1, full speed is 0001H.

Send: 01 06 03 F2 00 01 E9 BD

Back: 01 06 03 F2 00 01 E9 BD

(9) Setting volume

The peristaltic pump address is 1, set volume at 100.00mL.

Send: 01 10 03 F7 00 02 04 42 C8 00 00 3C 7B

Back: 01 10 03 F7 00 02 F0 7E

(10) Setting running time

The peristaltic pump address is 1, set running time to 10.00s.

Send: 01 10 03 FA 00 02 04 41 20 00 00 7D 92

Back: 01 10 03 FA 00 02 61 BD

(11) Setting running mode

The peristaltic pump address is 1, set running mode to transmission.

Send: 01 06 03 FC 00 00 49 BE

Back: 01 06 03 FC 00 00 49 BE

(12) Setting interval time



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The peristaltic pump address is 1, set interval time to 1s.

Send: 01 10 03 FD 00 02 04 3F 80 00 00 24 7E

Back: 01 10 03 FD 00 02 D0 7C

(13) Setting repetitive time

The peristaltic pump address is 1, set repetitive time to 100 times.

Send: 01 06 03 FF 00 64 B8 55

Back: 01 06 03 FF 00 64 B8 55

7. Appendix 1——CRC Check C Language Code

CRC generation process:

- 1) Put one 16 bits register into hexadecimal FFFF(all 1), we call it CRC register.
- 2) Make the first 8 bytes of the message with low bytes XOR of 16 CRC register , the result put in CRC register.
- 3) Detect LSB of CRC register
If LSB is 0, move CRC register 1 bit to right (towards to direction of LSB) , MSB zeroing.
If LSB is 1, move CRC register 1 bit to right (towards to direction of LSB), MSB zeroing, then XOR the polynomial value of the CRC register 0xA001 (1010 0000 0000 0001).
- 4) Repeat Step 3, until finish 8 shifts. After finish this operation, will finish the complete operation for 8 Bytes.
- 5) Repeat Step 2 to Step 5 for the next Bytes in message. Continue this operation till all the message be deal with finished.
- 6) The final content in CRC register is CRC value.
- 7) When put CRC value in message, high and low Bytes must be exchanged, described as below: C language code:

```
void CRCVerify(char *rec,char CRClen,char CRCdata[2])  
{  
    char i1,j;  
    unsigned int crc_data=0xffff;  
    for(i1=0; i1<CRClen; i1++)
```




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```
{
    crc_data=crc_data^rec[i1];
    for(j=0; j<8; j++)
    {
        if(crc_data&0x0001)
        {
            crc_data>>=1;
            crc_data^=0xA001;
        }
        else
        {
            crc_data>>=1;
        }
    }
    CRCdata[0]=(char)(crc_data);
    CRCdata[1]=(char)(crc_data>>8);
}
```