



Baoding Shenchen Precision Pump Co., Ltd.

Add: No.103, Building 2, ZhiDian Industrial Park, FuXing East Road 999, Baoding, China.

Tel: 0086-312-5958380 Fax: 0086-312-6780636

Website: www.innofluid.com Email: amy@good-pump.com

LabN/N6 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:** Host control peristaltic pump address No.. The pump address No. should not be same when they are in the same 485 line. The address No. range is 1~247, 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 the 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 The first byte(Low bit)

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



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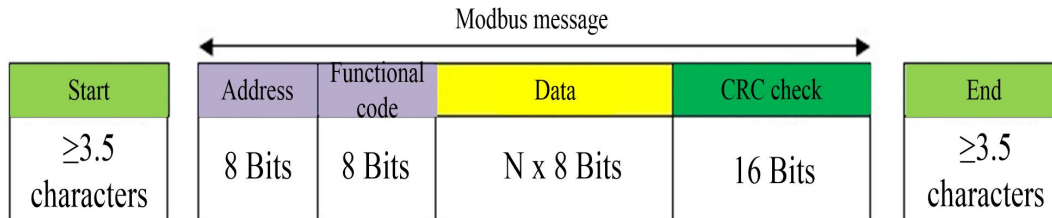
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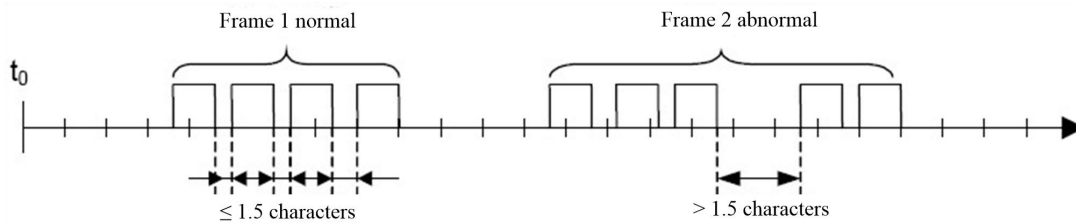
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3. MODBUS Message RTU Frame Format

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 data abnormal, it should have abnormal reaction. 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 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.



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5. Holding register address and contents

Basic Parameters Setting

| Address (Decimal) | Name | Range | Data Type |
|----------------------|--------------------|--|------------------------------|
| 1000 | Pump head type | Refer to chart 1 <Number of pump head & tubing> | unsigned short int (2 Bytes) |
| 1001 | Tubing size | | unsigned short int (2 Bytes) |
| 1002 | Motor speed | 0.1-600rpm | Float (4 Bytes) |
| 1004 | Flow rate | 0-99999mL | Float |
| 1006 | Running mode | 0: Transmission 1: Timing test | unsigned short int (2 Bytes) |
| 1007 | Timing | 0.1-9999 | Float (4 Bytes) |
| 1009 | Timing unit | 0: second 1: minute 2: hour | unsigned short int (2 Bytes) |
| 1010 | Start/stop control | 1: Start 0: Stop | unsigned short int (2 Bytes) |
| 1011 | Direction control | 1: clockwise 0: counterclockwise | unsigned short int (2 Bytes) |
| 1012 | Full speed to run | 1: start full speed 0: stop full speed | unsigned short int (2 Bytes) |
| 1013 | Back suction angle | 0-360° | unsigned short int (2 Bytes) |

Note: Please set register parameters according to the chart, multiple registers are set continuously without receiving an instruction.

6. Sending Data format

Unsigned short int format

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

Float format

| Pump address | Function code | Register address | | The number of register | | The number of byte | | Data (Float) | | | | CRC check | |
|-----------------|------------------|---------------------|---|---------------------------|-----|-----------------------|----|-----------------|----|----|---|-----------|--|
| | 10H | H | L | 00H | 02H | 04H | H2 | H1 | L2 | L1 | L | H | |
| | | | | | | | | | | | | | |

Read Register Format

| Peristaltic address | Function code | Register start address | | The number of register | | CRC | |
|------------------------|------------------|------------------------|-----------|------------------------|--------|-----|---|
| | 03H | Address H | Address L | Data H | Data L | L | H |
| | | | | | | | |

(1) Set pump head type

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



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Send: 01 06 03 E8 00 00 09 BA

Back: 01 06 03 E8 00 00 09 BA

(2) Set tubing size

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) Set motor speed

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

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

Back: 01 10 03 EA 00 02 60 78

(4) Set flow rate

The peristaltic pump address is 1, set the flow rate 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) Set running mode

The peristaltic pump address is 1, the transmission mode: 00H , the timing test mode: 01H

Send: 01 06 03 EE 00 00 E9 **BB (transmission mode)**

Back: 01 06 03 EE 00 00 E9 BB

(6) Set timing time

The peristaltic pump address is 1, set timing time to 5s.

Send: 01 10 03 EF 00 02 04 40 A0 00 00 BC B5

Back: 01 10 03 EF 00 02 70 79

(7) Set time unit

The peristaltic pump address is 1, set timing time unit in second.

Send: 01 06 03 F1 00 00 D8 7D

Back: 01 06 03 F1 00 00 D8 7D

(8) Start/stop control

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



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Send start: **01 06 03 F2 00 01 E9 BD**

Send stop: **01 06 03 F2 00 00 28 7D**

(9) Direction control

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

Send: **01 06 03 F3 00 01 B8 7D (clockwise)**

Back: **01 06 03 F3 00 01 B8 7D**

(10) Set full speed

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

Send: **01 06 03 F4 00 01 09 BC**

Back: **01 06 03 F4 00 01 09 BC**

(11) Set back suction angle

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

Send: **01 06 03 F5 00 3C 99 AD**

Back: **01 06 03 F5 00 3C 99 AD**

Chart 1 Number of Pump head & tubing

| Pump head name | Pump head type | 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# |
| | | 14 | 14# |
| | | 19 | 19# |
| | | 16 | 16# |
| | | 25 | 25# |



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| | | | |
|---------------|---|----|-----|
| | | 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# |
| 2*EasyPumpIV | 9 | 15 | 15# |
| | | 24 | 24# |
| | | 35 | 35# |
| | | 36 | 36# |



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| | | | |
|----------|-----------|---------|-----------|
| | | 14 | 14# |
| | | 19 | 19# |
| | | 16 | 16# |
| | | 25 | 25# |
| 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# |
| | | 24 | 24# |



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| | | | |
|-----------|----|-----|-----------|
| 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*0.86 |
| | | 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 |
| MCn(6) | 17 | 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 |
| DZ25-3L | 18 | 15 | 15# |
| | | 24 | 24# |
| | | 35 | 35# |
| | | 36 | 36# |
| 2*DZ25-3L | 19 | 15 | 15# |
| | | 24 | 24# |



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| | | | |
|--------------|----|-----|---------|
| | | 35 | 35# |
| | | 36 | 36# |
| UC15 | 20 | 19 | 19# |
| | | 16 | 16# |
| | | 25 | 25# |
| | | 17 | 17# |
| | | 18 | 18# |
| | | 24 | 24# |
| UC25 | 21 | 35 | 35# |
| | | 36 | 36# |
| | | 14 | 14# |
| SN15 | 22 | 16 | 16# |
| | | 24 | 24# |
| 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# |

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 with 16 CRC register low bytes XOR, 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.



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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++)
    {
        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);
    }
}
```