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 1~32, 0 means broadcast.

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

03H: Read holding registers

06H: Write single register

10H: Write multiple registers

02H: Read discrete inputs (Read bits of data)

05H: Write single bit to register

(3) **Data area**: The detailed information command that the peristaltic pumps need to follow, such as start/stop, change direction, increase/decrease speed..and so on.

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

Polynomial: G(X)=X16+X15+X2+1**.**

CRC check C language code please refer to Appendix 1.

2. Communication Setting

(1) Communication boudrate: 1200, 2400, 4800, 9600 optional

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

(3) Bit serial sending order: The least significant big(**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: (HSB)The second byte The first byte(LSB)

Send: The second byte The first byte

For example: 1234H send 12H 34H

Float (4 bytes):

Data: (HSB)The fourth byte The third byte The second byte The first byte(LSB)

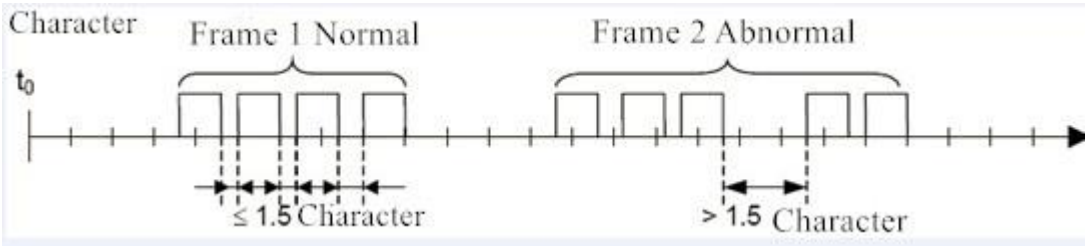
Send: The fourth byte The third byte The second byte The first byte

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

3. MODBUS Message RTU Frame Format

← MODBUS Message →					
Start	Address	Function Code	Data	CRC Check Code	End
⩾3.5 characters	8 Bits	8 Bits	N x 8 Bits	16 Bits	⩾3.5 characters

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 reaction

When host sending request data, slave receiving 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 reaction process.

Function code area: Abnormal reaction function code is normal reaction function code +80H.

Data area: Return 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.

5. Holding register address and content

Address（Decimal）	Name	Range	Data Type
1000	Start/stop control	0：Stop 1：Running	unsigned short int（2 Bytes）
1001	Running direction	0：Counterclockwise 1：Clockwise	unsigned short int（2 Bytes）
1002	Speed	0.1-600rpm	Float（4 Bytes）

6. Data format

unsigned short int format

Pump address	Function Code	register address		Data (unsigned short int)		CRC	
	06H	H	L	H	L	L	H

Float format

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

For example：The pump address is 01

a、Start/Stop

Start：01 06 03 E8 00 01 C8 7A

Stop： 01 06 03 E8 00 00 09 BA

b、CW/CCW

CW：01 06 03 E9 00 01 99 BA

CCW：01 06 03 E9 00 00 58 7A

c、Set the speed

For example：Set the speed for the address 01 pump to 58.8rpm

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

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. Detection CRC register LSB

   (If LSB is 0): Move CRC register 1 bit to right, MSB zeroing.

   (If LDB is 1): Move CRC register 1 bit to right, MSB zeroing ,XOR register for CRC polynomial

value 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.

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);
}
```