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LabQ 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 controls 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 holding register

Data area: Specific information instructions that 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)=X16+X15+X2+1**.**

CRC check C language code please refer to Appendix 1.

2. Communication Setting

(1) Communication baud rate: 9600 and 19200 for option.

(2) Check bits: even check, no check.

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

1 start bit + 8 data bits +1 stop bit

(4) 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**

(5) 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):

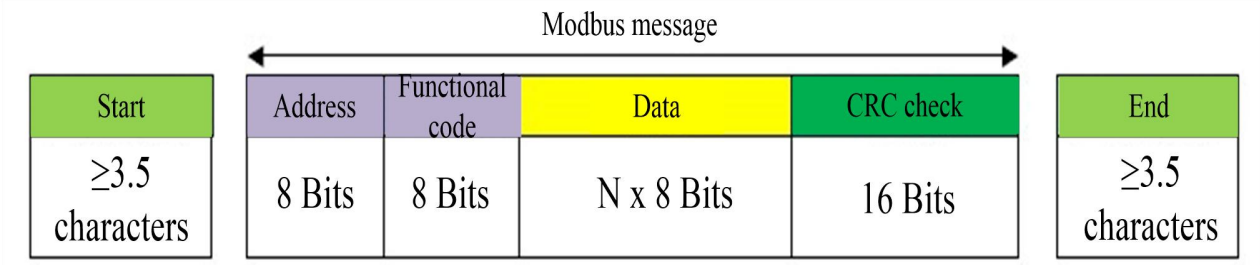
Data: (High bit) The fourth byte The third byte The second byte The first byte (Low bit)

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

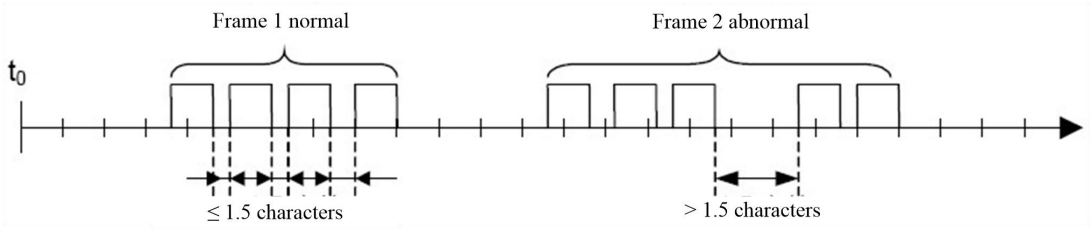
For example: 8.9 send 41H 0EH 66H 66H

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.

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	0.1-350rpm	float (4 Bytes)
1004	Flow rate	0-99999mL	Float
1006	Start/stop control	1: Start 0: Stop	unsigned short int (2 Bytes)
1007	Direction control	1: clockwise 0: counterclockwise	unsigned short int (2 Bytes)
1008	Full speed to run	1: start full speed 0: stop full speed	unsigned short int (2 Bytes)
1009	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	
	06H	Address H	Address L	Data H	Data L	L	H

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	L1	L2	H1	H2	L	H

(1) Set pump head type

The peristaltic pump address is 1, set the pump head to KT15, the number is 0000H.

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) Control start/stop

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

Send start: **01 06 03 EE 00 01 28 7B**

Send stop: **01 06 03 EE 00 01 28 7B**

(6) Direction control

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

Send: **01 06 03 EF 00 01 79 BB** (clockwise)

Back: **01 06 03 EF 00 01 79 BB**

(7) Set full speed

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

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

Back: **01 06 03 F0 00 01 48 7D**

(8) Set back suction angle

The peristaltic pump address is 1, set back suction angle to 100°

Send: **01 06 03 F1 00 64 D9 96**

Back: **01 06 03 F1 00 64 D9 96**

Chart 1 Number of Pump head & tubing

Pump head	Head Type	Tubing type	Tubing size
KT15	0	13	13#
		14	14#
		19	19#
		16	16#
		25	25#

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.
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);
}
```