USER GUIDE FOR TURBIDITY SENSOR WITH MODBUS RTU OUTPUT MBRTU-TBD

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This document is applied for the following products

1. Introduction

MBRTU-TBD is an advanced digital turbidity sensor for water quality monitoring, adopt the principle of scattered light, the design method of using infrared LED light source and optical fiber conduction light path. The filter design is added inside, which has strong anti-interference ability. Built in temperature sensor, automatic temperature compensation, suitable for online long-term monitoring of the environment.

MBRTU-TBD-H1.PNG

2. Specification

Features

1. Digital sensor, direct output RS-485 digital signal, support Modbus / RTU
2. Principle of 90° Angle Scattering Light, the built-in temperature can be compensated automatically;
3. Optical fiber structure, strong resistance to external light interference
4. Infrared LED light source, add filter design, anti light interference, good stability
5. The surface shall be treated with anti-corrosion and passivation
6. Low power consumption and anti-interference design of internal circuit

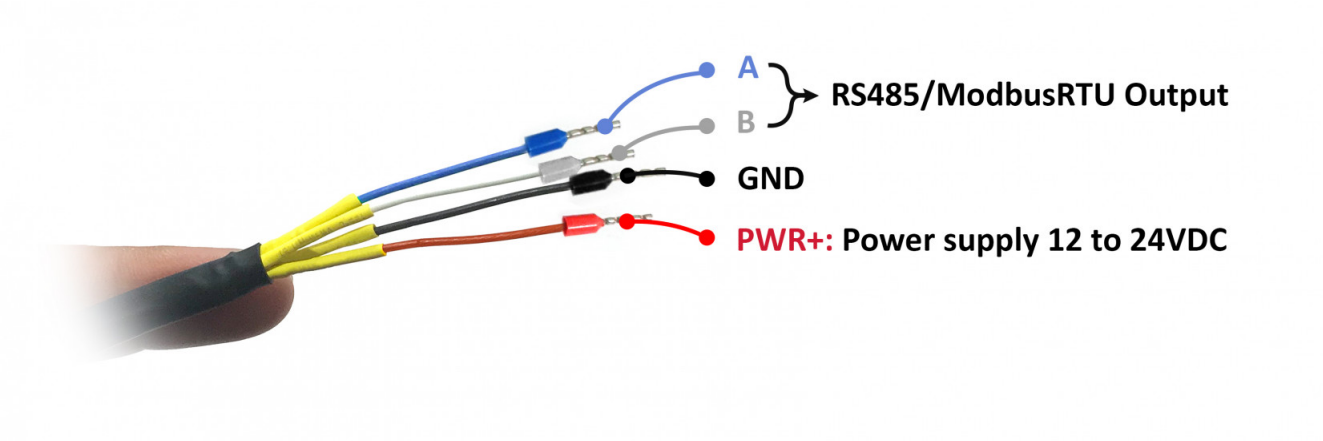
Technical Data

Item	Specifications
Output	RS-485,MODBUS/RTU
Measuring method	90° scattered light method

Range	0 ~ 1000NTU or 0 ~ 100NTU
Accuracy	±5% indication value or ±3NTU, choose the greater (0 ~ 1000NTU) ± 3% indication or ± 2 NTU, choose is greater (0-100 NTU) ±0.5℃
Resolution	0.1NTU, 0.1℃
Working environment	0 ~ 50℃, <0.6MPa
Calibration method	Two-point calibration
Response time	30s T90
Temperature Compensation	Automatic temperature compensation (Pt1000)
Power Supply	12-24VDC±10%, 10mA;
Size	Diameter 30mm; Length 166.5mm;
Protection level	IP68 ; The water depth is 20 meters;
Service life	3 years or above
Cable length	5m
Sensor housing material	PVC

4. Wiring

Please wiring as shown below:



Wire color	Description
Brown	Power (12-24VDC)
Black	GND
Blue	RS485A
White	RS485B
Bare line	Shielding Layer

Cable line : 4 line AWG-24 or AWG-26 Shielding Wire.

5. Maintenance and Precautions

5.1 Maintenance

- Inductive electrode is basically maintenance free; It is recommended to clean up the sensor probe attachment

every 30 days; Avoid the use of hard objects to cause the damage of the light guide part of the measuring probe during cleaning; Please wipe with a soft damp cloth.
- It is recommended to clean the outer surface of the sensor with water flow. If there is still debris residue, please wipe it with a wet soft cloth.

5.2 Note

- Installation measurement: avoid the installation measurement at the place where the water flow is turbulent, and reduce the influence of water bubbles on the measurement. Keep the measuring probe 2cm away from the bottom.
- The probe of the sensor is fouling or attached with more organisms, so the cleaning force can be increased appropriately. Slight scratch on the probe surface does not affect the normal use of the sensor. But pay attention not to penetrate the shell of the probe.
- Suggestion: the protective cover of our company should be selected to prevent the influence of microbial attachment on the measurement results.

5.3 Other

Problem	Possible Causes	Solution
The operation interface cannot be connected or the measurement results are not displayed	Wrong cable connection	Check the wiring mode
	Wrong sensor address	Check the address for errors
The measured value is too high, too low or the value is continuously unstable	The sensor probe is attached by foreign objects	Clean the sensor probe surface
	Other	Contact after sales

6. Modbus RTU Protocol

6.1 Information frame format

The default data format for Modbus communication of this sensor is:

MODBUS-RTU	
Baud rate	9600 (default)
Device address	1 (default)
Data bits	8 bit
Parity check	None
Stop bit	1bit

- **Function code 03:** Read (R) register value
- **Function code 06:** Write (W) single register value

6.2 Register Address:

Register Address (hex)	Name	R/W	Introductions	Number of registers (byte)	Data type

0x0100	Temperature value	R	℃ value x10 (for example: the temperature of 25.6℃ is displayed as 256, the default is 1 decimal.)	1 (2 bytes)	unsigned short
0x0101	Turbidity value	R	NTU value x10 (for example, the turbidity value of 15.1ntu is displayed as 151, with 1 decimal place by default.)	1 (2 bytes)	unsigned short
0x1000	Temperature calibration	R/W	Temperature calibration: the written data is the actual temperature value X10; Read out data is temperature calibration offset X10.	1 (2 bytes)	unsigned short
0x1001	Zero point calibration	R/W	Zero point calibration in air. The data written during calibration is 0.	1 (2 bytes)	unsigned short
0x1003	Slope calibration	R/W	Calibrate in the known standard solution (50% - 100% range), and write the data as the actual value of the standard solution × 10.	1 (2 bytes)	unsigned short
0x2000	Sensor address	R/W	The default is 1, and the data range is 1-127.	1 (2 bytes)	unsigned short
0x2003	Baud rate setting	R/W	The default is 9600. Write 0 is 4800; Write 1 is 9600; Write 2 is 19200.	1 (2 bytes)	unsigned short
0x2020	Restore factory settings	W	The calibration value is restored to the default value and the written data is 0. Note that the sensor needs to be calibrated again after reset.	1 (2 bytes)	unsigned short

6.3 Data structure type

Integer

unsigned int (unsigned short)

The data consists of two integers.

XXXX XXXX	XXXX XXXX
Byte1	Byte0

Float

Float, According to IEEE 754 (single precision);

The data consists of 1 sign bit, 8-bit exponent, and a 23 bit mantissa .

XXXX XXXX	XXXX XXXX	XXXX XXXX	XXXX XXXX
Byte3	Byte2	Byte1	Byte0
Sign bit	Exp digit	F decimal	

6.4 Modbus RTU command:

6.4.1 Function code 03h: read register value

Host send:

1	2	3	4	5	6	7	8
ADR	03H	Start register high byte	Start register low byte	Register number high byte	Number of registers low byte	CRC low byte	CRC high byte

The first byte ADR: slave address code (= 001 ~ 254)

Byte 2 03h: read register value function code

Byte 3 and 4: start address of register to be read

To read the FCC instrument,

Bytes 5 and 6: number of registers to read

Bytes 7 and 8: CRC16 checksums from bytes 1 to 6

Slave return:

1	2	3	4 , 5	6 , 7		M-1 , M	M+1	M+2
ADR	03H	total bytes	Register data 1	Register data 2	.....	Register data M	CRC low byte	CRC high byte

The first byte ADR: slave address code (= 001 ~ 254)

Byte 2 03h: return to read function code

The third byte: the total number of bytes from 4 to m (including 4 and m)

Bytes 4 to m: register data

Byte m + 1, M + 2: CRC16 check sum from byte 1 to M

When the slave receives an error, the slave returns the error:

1	2	3	4	5
ADR	83H	Information code	CRC low byte	CRC high byte

The first byte ADR: slave address code (= 001 ~ 254)

Byte 2 83h: error reading register value

Byte 3 information code: 01 - function code error

03 - data error

Bytes 4 and 5: CRC16 checksums from bytes 1 to 3

6.4.2 Function code 06h: write single register value

Host send

1	2	3	4	5	6	7	8
ADR	06	Register high byte address	Register low byte address	Data high byte	Data low byte	CRC code Low byte	CRC code High byte

When the slave receives correctly, the slave sends back:

1	2	3	4	5	6	7	8
ADR	06	Register high byte address	Register low byte address	Data high byte	Data low byte	CRC code Low byte	CRC code High byte

When the slave receives an error, the slave returns:

1	2	3	4	5
ADR	86H	Error code information code	CRC code Low byte	CRC code High byte

The first byte ADR: slave address code (= 001 ~ 254)

The second byte 86h: write register value error function code

Byte 3 error code information code: 01 - function code error

03 - data error

Byte 4 and 5: CRC check sum from byte 1 to 3

6.5 Command example

6.5.1 Default register

a) Change slave address:

Address:0x2000 (42001)

Number of registers: 1

Function code: 0x06

Default sensor address: 01

Change the Modbus device address of the sensor, and change the device address from 01 to 06. The example is as follows:

Send command: 01 06 20 00 00 06 02 08

Respond: 01 06 20 00 00 06 02 08; Note: the address is changed to 06 and stored after power failure.

b) Baud rate:

Address: 0x2003 (42004)

Number of registers: 1

Function code: 0x06

Default value: 1 (9600bps)

Supported values: 0-2 (4800-19200bps)

The baud rate can be changed by the upper computer setting, and it can work without restart after the change. The baud rate saves the upper computer setting after power failure. Baud rate support 4800960019200. The baud rate of integer value allocation is as follows:

Integer	Baud rate
0	4800 bps
1	9600 bps
2	19200 bps

Send command: 01 06 20 03 00 02 F3 CB

Respond: 01 06 20 03 00 02 F3 CB Note: the baud rate is changed to 19200bps and saved after power failure.

6.5.2 Function register

a) Measuring temperature command:

Address: 0x0100 (40101)

Number of registers: 1

Function code: 0x03

Read sample values: 19.2℃

Send command: 01 03 01 00 00 01 85 F6

Respond: 01 03 02 00 C0 B8 14

Returns hexadecimal unsigned integer data, temperature value = integer / 10, 1 bit decimal place is reserved.

b) Turbidity measurement instruction:

Address: 0x0101 (0x40102)

Number of registers: 1

Function code: 0x03

Read sample values: 9.1 NTU

Send command: 01 03 01 01 00 01 D4 36

Respond: 01 03 02 00 5B F9 BF

Register returns hexadecimal unsigned integer data, turbidity value = integer / 10, 1 decimal place reserved.

c) Continuous reading of temperature and turbidity instructions:

Address: 0x0100 (40101)

Number of registers: 2

Function code: 0x03

Read sample values: Temperature 19.2 ℃ and turbidity 9.1 NTU

Send command: 01 03 01 00 00 02 C5 F7

Respond: 01 03 04 00 C0 00 5B BB F4

Register returns hexadecimal unsigned integer data, temperature value = integer / 10, 1 decimal place reserved

Register returns hexadecimal unsigned integer data, turbidity value = integer / 10, 1 decimal place reserved.

d) Humidity measurement command:

Address: 0x0107 (40108)

Number of registers: 1

Function code: 0x03

Read sample values: relative humidity 40%

Send command: 01 03 01 07 00 01 34 37

Respond: 01 03 02 01 90 B9 B8

Register returns hexadecimal unsigned integer data, humidity value = integer / 10, 1 decimal place reserved.

6.5.3 Calibration instruction

a) Temperature calibration

Address: 0x1000 (41001)

Number of registers: 1

Function code: 0x06

Calibration example: calibration at 25.8 ° C

Send command: 01 06 10 00 01 02 0D 5B

Respond: 01 06 10 00 01 02 0D 5B

The sensor needs to be calibrated in a constant temperature environment after the temperature indication no longer fluctuates.

b) Turbidity zero calibration

Address: 0x1001 (41002)

Number of registers: 1

Function code: 0x06

Calibration example: calibration in air

Send command: 01 06 10 01 00 00 DC CA

Respond: 01 06 10 01 00 00 DC CA

c) Turbidity slope calibration

Address: 0x1003 (41004)

Number of registers: 1

Function code: 0x06

Calibration example: calibration in 50NTU turbidity solution

Send command: 01 06 10 03 01 F4 7D 1D

Respond: 01 06 10 03 01 F4 7D 1D

7. Dimensions

DIMENSION DRAWING OF MBRTU-TBD
(Unit: mm)

MBRTU-TBD-H2.PNG

8. Contact

Manufacturer
Daviteq Technologies Inc

No.11 Street 2G, Nam Hung Vuong Res., An Lac Ward, Binh Tan Dist., Ho Chi Minh City, Vietnam.
Tel: +84-28-6268.2523/4 (ext.122)
Email: info@daviteq.com | www.daviteq.com

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