



User Manual

Turbidity Sensor

DTS-210



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General Introduction

DTS-210 is a basic conventional water quality monitoring digital turbidity sensor, with mature 90° scattered light principle, infrared LED light source, optical fiber conduction path, and strong resistance to external optical interference. Built-in temperature sensor, can automatically temperature compensation, suitable for online long-term monitoring environment use.

Features:

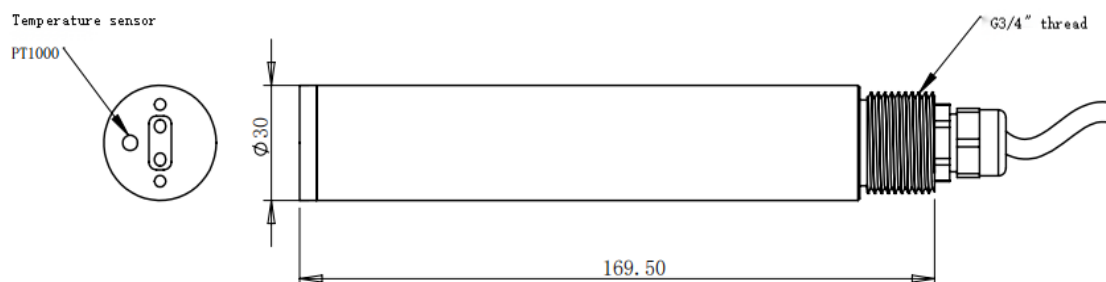
- Digital sensor, directly output Rs-485 digital signal and supports MODBUS / RTU
- 90° angular scattering light principle, the built-in temperature can be automatically compensated
- Optical fiber type structure, strong resistance to external light interference ability
- Infrared LED light source, increase the filter design, anti-light source interference, good stability
- The surface is treated with anticorrosion and passivation
- Sensor has low power consumption, internal circuit anti-interference design

Application:

Online monitoring of river water quality, industrial wastewater, environmental protection water treatment, beverage and food industry, pharmaceuticals and biotechnology, etc.;

Note: Different application fields, according to high temperature and pressure, strong acid-base, corrosive media, etc., different characteristics of electrode probes should be selected.

Dimensional drawing



Technical parameters

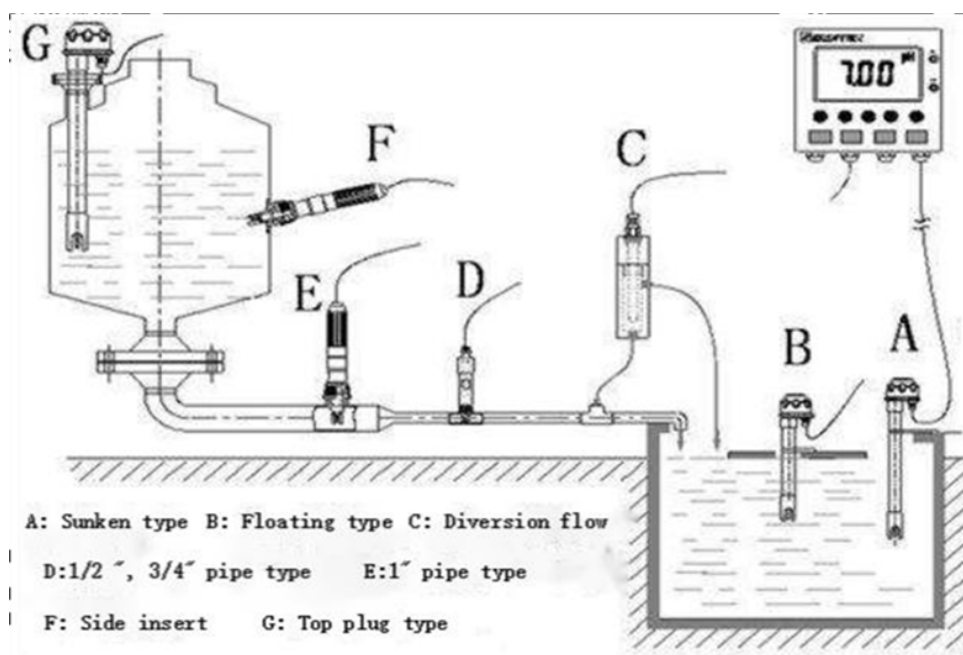
Name	Parameters
Output Signal	Support RS-485, MODBUS/RTU protocol
Measurement Method	90° scattered light method
Range	0-200NTU or 0-1000NTU or 0-3000NTU
Accuracy	$\pm 5\%$ or ± 3 NTU, whichever is larger (0-200 NTU) $\pm 5\%$ or ± 5 NTU, whichever is larger (0-1000 NTU) $\pm 5\%$ or ± 10 NTU, whichever is larger (0-3000 NTU) $\pm 0.5^{\circ}\text{C}$
Resolution	0.01 NTU, 0.1°C
Working Conditions	$0 \sim 50^{\circ}\text{C}$; <0.2 MPa
Calibration Mode	Two-point calibration
Response Time	30 seconds, T90
Temperature Compensation	Automatic temperature compensation (PT1000)
Power Supply	12 or 24 VDC $\pm 20\%$, 20 mA;
Dimensions	Diameter 30 mm; Length 169.5 mm;
Protection Grade	IP68; Water depth up to 20 depth
Lifespan	Sensor 2years
Cable Length	10 m (default), customizable
Sensor Housing Material	316L; customizable

Installation Notes and Wire Connection

1. Installation\

Below is a diagram for common installation ways for inline sensors.

Please note that DTS-110 is not applicable for Method D, because it applies 90° Scattered Light Principle for measurement, and needs certain distance with surrounding walls, at least 5cm.



Note: Install the sensor in an area with slow water flow and no bubbles.

2. Electrical connection

- Brown wire - power supply (12 or 24 VDC)
- Black wire - Ground
- Blue wire - 485A.
- White wire - 485B.
- Bare wire - shielding layer

Sensor cable: 4-wire AWG-24 or AWG-26 shielded wire.

Outer diameter: 6.0-6.2 mm;

Flexible twisted pair shielded cable.

Calibration

1. Zero calibration

Insert the sensor into a zero-turbidity standard buffer solution (distilled water). After the value stabilizes, send the zero calibration command. The value should stabilize for approximately 3 minutes.

2. Slope calibration

Insert the sensor into the slope standard buffer solution (e. g. 100 NTU) and send the slope calibration instruction until the value is stable for approximately 3 minutes.

Check the MODBUS RTU Communication Protocol Operating Manual for the calibration instructions.

Note: During calibration, keep the sensor probe at least 5 cm from the bottom of the container.

For calibration commands, please refer to the MODBUS RTU Communication Protocol Operation Manual.

Note: The sensor has been calibrated before leaving the factory. Do not calibrate arbitrarily unless the measurement error is exceeded.

Maintenance and precautions

1. Maintenance

- It is recommended to clean the sensor membrane attachments every 30 days; avoid scratches; please wipe with a soft wet cloth.
- It is recommended to clean the outer surface of the sensor with water flow. If there is still debris, wipe it with a wet soft cloth.

Matters need attentions

- Installation measurement: Avoid installation measurement in the rapid current, and reduce the impact of current bubbles on the measurement. Keep the measuring probe 5 cm away from the bottom.
- Suggestion: Select the company protective cover to prevent microbial attachment from affecting the measurement results.

Trouble shooting tips

Issue	Cause	Tips
Operation interface cannot connect or does not display measurement results	Incorrect cable wiring	Check the wiring diagram
	Incorrect sensor address	Check / find the address via our tool
Measurement value too high, too low, or continuously unstable.	Sensor window is attached by foreign matter.	Clean the sensor window surface.
	Bubbles at the measurement point	Remove bubbles.
	Measure is influences by air bubble.	Clear the air bubble.

Quality and Service

Thank you for choosing our product.

Shanghai ChiMay provides after-sales service of the machine within one year from the date of sale but does not include the damage caused by improper use. If you need repair or adjustment, please send it back, but the freight must be paid for by yourself.

Accessories and spare parts

Item	QTY (pcs)
Sensor	1
User Manual	1
Certificate of Conformity	1
Boot	1 (optional)

Data Communication

1. Introduction to Modbus protocol

Modbus protocol is a general communication protocol which has been widely used in the field of industrial control. Through this protocol, controllers can communicate with each other or with other devices over a network, such as Ethernet. Modbus protocol uses the master-slave communication technology, that is, the master device actively queries and operates the slave device.

- a. The master device sends requests to the slave device
- b. The slave device analyzes and processes the request of the master device, and then sends the result to the master device
- c. If anything goes wrong, an exception function code will be returned from the device Modbus RTU

Communication mode Frame format

Device Address	Function code	Data	CRC is eight digits lower	CRC is eight places higher
8bit	8bit	n * 8bit	8bit	8bit

- In RTU mode, the transmission of a message must commence with a pause interval of at least 3.5-character times. The first field to be transmitted is the device address. Network devices continuously monitor the network bus, including during the pause intervals. Upon receiving the first field (the address field), each device decodes it to determine if the message is intended for itself. Following the last transmitted character, a pause of at least 3.5 character times signifies the end of the message. A new message may then begin after this pause.
- The entire message frame must be transmitted as a continuous stream. If there is a pause of more than 1.5 character times before the frame is completed, the receiving device will flush the incomplete message and assume that the next byte is the address field of a new message.

2. Information frame format

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

MODBUS-RTU	
Baud rate	9600 (by default)
Device address	1 (by default)
Data bit	8-bit
Parity check	N/A
Stop bit	1-bit

a. Function code 03H: read the register value

Host sending

1	2	3	4	5	6	7	8
ADR	03H	Start register high byte	Start register low bytes	Start register high byte	Start register low bytes	CRC lower byte	CRC high byte

Byte 1 ADR: Slave address code (= 001~254)

Byte 2 03H: Read register value function code

Bytes 3, 4: Starting address of the register to be read

(For reading instruments connected under the FCC)

Bytes 5, 6: Number of registers to be read

Bytes 7, 8: CRC16 checksum from Byte 1 to Byte 6

Host sending:

1	2	3	4、5	6、7		M-1、M	M+1	M+2
ADR	03H	Total bytes	data register 1	data register 2	...	data register M	CRC low byte	CRC high byte

Byte 1 ADR: Address code of the slave machine (=001~254)

Byte 2 03H: Read register value function code

Byte 3: The total number of bytes from 4 to M(including 4 and M)

Bytes 4 to M: data registers

Bytes M+1、M+2 : CRC 16 checksum from Byte 1 to ByteM

When an error is received from the slave, send it back from the slave:

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

Byte 1 ADR: Address code of the slave machine (=001~254)

Byte 2 83H: Error reading register value

Byte 3 information code: 01 – Function code wrong

03 – DATA ERR

Bytes 4、5 : CRC 16 checksums from Byte 1 to Byte 3

b) Function Code 06H: Write a single register value

Host sending:

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

When the slave receives an error, the slave sends back:

1	2	3	4	5
ADR	86H	Error code information code	CRC Code the low byte	CRC Code the high byte

Byte 1 ADR: Address code of the slave machine (=001~254)

Byte 2 86H: Write register value error function code

Byte 3 Error code information code: 01 – Function code wrong

03 – DATA ERR

Bytes 4、5 : CRC checksums from Byte 1 to Byte 3

3. Data structure types

Integer

unsigned short

The data consists of two integers

XXXX XXXX	XXXX XXXX
Byte1	Byte0

Float

Floating-point type, conform to IEEE 754 (single precision);

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

XXXX XXXX	XXXX XXXX	XXXX XXXX	XXXX XXXX
Byte3	Byte2	Byte1	Byte0
sign bit	Exp Index place	F decimal place	

4. Register address

Register address	Name	Read/Write	Instruction	Number of registers (byte)	Data type
0x0100	Temperature value	R	°C x 10 (e.g. 25.6°C temperature shows 256, default: 1 decimal place)	1 (2 Bytes)	unsigned short
0x0101	Turbidity value	R	NTU value x 10 (e.g. 10 NTU turbidity is shown as 100, default: 1 decimal place)	1 (2 Bytes)	unsigned short
0x1000	Temperature calibration	R/W	Temperature calibration: the written data is the actual temperature value x10; the readout data is the temperature calibration offset x10.	1 (2 Bytes)	unsigned short
0x1001	Zero-point calibration	R/W	Calibrate in zero-turbidity water or distilled water with an input value of 0. Alternatively, calibration can be performed in a 0–10 NTU turbidity standard solution, where the input value should be the actual standard value × 10.	1 (2 Bytes)	unsigned short
0x1003	Slope calibration	R/W	Calibrated in the value known standard solution. Write data with standard solution value x 10 during calibration.	1 (2 Bytes)	unsigned short
0x2000	Sensor address	R/W	Default is 1, and the data range is 1-127.	1 (2 Bytes)	unsigned short
0x2003	Baud rate setting	R/W	Default is 9600. Write 0 is 4800; write 1 is 9600 and write 2 is 19200.	1 (2 Bytes)	unsigned short
0x2020	Factory data reset	W	Restores the default calibration value, and the written data is 0. Note that the sensor must be calibrated again if the sensor is reset to factory data.	1 (2 Bytes)	unsigned short

5. Example command

Default register:

a) Change slave address:

Address: 0x2000

Number of registers: 1

Function Code: 0x06

Default sensor address: 01

Change the Modbus device address of the sensor and change the device address 01 to 06, as show below:

Send instruction: 01 06 20 00 00 06 02 08

Response: 01 06 20 00 00 06 02 08;

Note: Change the address to 06 to save, then power off.

b) Baud:

Address: 0x2003

Number of registers: 1

Function Code: 0x06

Default: 1 (9600bps)

Support value: 0-2 (4800-19200bps)

The port rate can be changed on the computer setting, after the port rate change, power off and power on save setting. Porter rate supports 4800,9600,19200. The port rate assigned to the integer values is as follows

Integer	Baud
0	4800 bps
1	9600 bps
2	19200 bps

Send instructions: 01 06 20 03 00 02 F3 CB

Response: 01 06 20 03 00 02 F3 CB

Note: Change the rate to 19200bps to save, then power off.

FR Function Register:

a) Temperature instructions

Address: 0x0100

Number of registers: 1

Function Code: 0x03

Read sample values: 19.2°C

Send instructions: 01 03 01 00 00 01 85 F6

Response: 01 03 02 00 C0 B8 14

Register returns hexadecimal unsigned integer data, Temperature value=Integer/10, keep 1 decimal place.

b) Turbidity instruction:

Address: 0x0101

Number of registers: 1

Function Code: 0x03

Read the sample values: 98.5NTU

Send instruction: 01 03 01 01 00 01 D4 36

Response: 01 03 02 03 D9 79 2E

The register returns hexadecimal unsigned integer data, with a turbidity value =Integer / 10, and retains 2 decimal places.

c) Continuous reading of temperature and turbidity value instruction:

Address: 0x0100

Number of registers: 2

Function Code: 0x03

Read sample values: 19.2°C and turbidity value 98.5NTU

Send instructions: 01 03 01 00 00 02 C5 F7

Response: 01 03 04 00 C0 03 D9 3B 65

The register returns hex unsigned integer data with temperature value =Integer / 10 and retains 1 decimal place.

The register returns hex unsigned integer data with turbidity value =Integer / 10 and retains 1 decimal place.

d) Calibration instructions:

temperature correction

Address: 0x1000

Number of registers: 1

Function Code: 0x06

Calibration sample: Calibration at 25.8°C

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

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

The sensor needs to be calibrated in a constant temperature environment without temperature fluctuation.

Zero point calibration

Address: 0x1001

Number of registers: 1

Function Code: 0x06

Calibration sample: calibration in distilled water or deionized water with
zero turbidity

Send instructions: 01 06 10 01 00 00 DC CA

Response: 01 06 10 01 00 00 DC CA

Slope calibration

Address: 0x1003

Number of registers: 1

Function Code: 0x06

Calibration sample: Calibration in 100 NTU turbidity solution

Send instructions: 01 06 10 03 03 E8 7D B4

Response: 01 06 10 03 03 E8 7D B4



For other question, feel free to contact us.
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