# User manual


## Turbidity Sensor

## DTS-210

Dear customers:

Welcome to use our products!

In order to make you have a general understanding of our products and facilitate your use, we have specially configured this user manual for you. The content includes the characteristics of the product, Size drawing, technical parameters, installation attention and cable definition, product calibration, maintenance and precautions, quality assurance, etc., are your essential guidelines when using this product.

Before use, please read the user manual carefully, I believe it will be of great help to you to use the product effectively. In addition, in the process of use, if you have any problems, please call, letter to consult, we will be dedicated to your service.
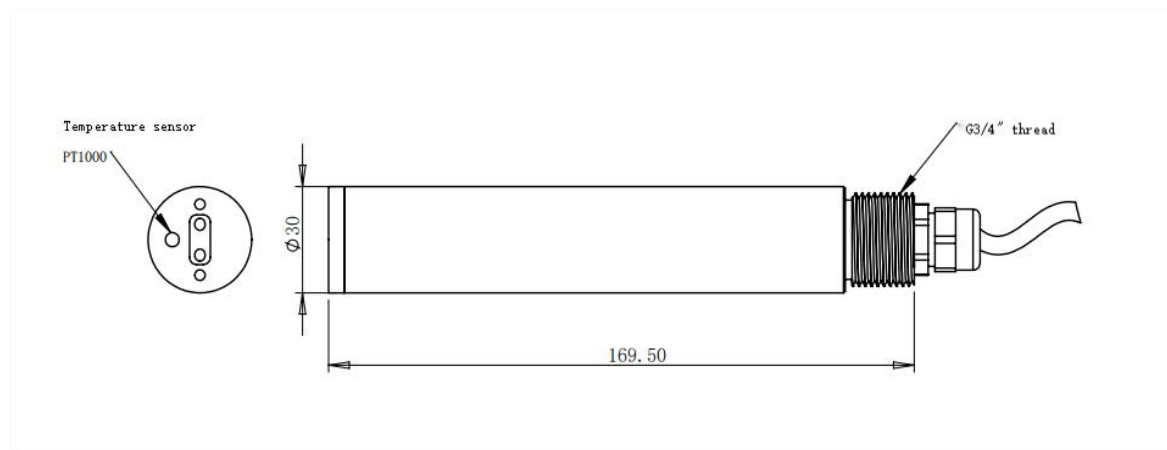
# Product characteristics



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.

## Characteristic:

1. Digital sensor, directly output Rs-485 digital signal and supports MODBUS / RTU

2. 90° angular scattering light principle, the built-in temperature can be automatically compensated

3. Optical fiber type structure, strong resistance to external light interference ability

4. Infrared LED light source, increase the filter design, anti-light source interference, good stability

5. The surface is treated with anticorrosion and passivation

6. Sensor has low power consumption, internal circuit anti-interference design
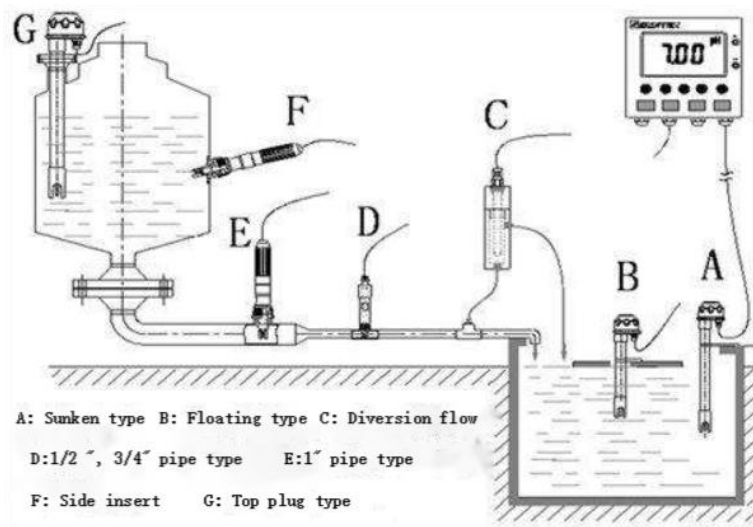
# Dimensional drawing



Temperature sensor

PT1000

Ø30

G3/4″ thread

169.50

# Technical parameter

| Name | Parameter |
|---|---|
| Output signal | Rs-485, MODBUS / RTU protocol |
| Measuring method | 90° scattered light method |
| Range | 0-200NTU or 0-1000NTU or 0-3000NTU |
| Accuracy | ± 5% or ± 3 NTU, whichever is larger (0-200 NTU)<br><br>± 5% or ± 5 NTU, whichever is larger (0-1000 NTU)<br><br>± 5% or ± 10 NTU, whichever is larger (0-3000 NTU)<br><br>±0.5℃ |
| Resolution ratio | 0.1NTU, 0.1℃ |
| Going | 0 ~ 50℃, <0.2MPa |
| Calibration method | Two-point calibration |
| Response time | 30s (t90) |
| Temperature compensation | Automatic compensation (Pt1000) |
| Source | 12 or 24VDC±20%, 20 mA; |
| Size | Diameter: 30mm; length: 169.5mm |
| levels of protection | IP68; 20m of water depth |
| life length | Sensors for 3 years or more |
| Cable length | 10 m (default), customizable |
| Sensor housing material | 316L (Other) |

# Installation attention and cable definition

1. **Install**



A: Sunken type  B: Floating type  C: Diversion flow

D:1/2″, 3/4″ pipe type     E:1″ pipe type

F: Side insert     G: Top plug type

● Note: The sensor is installed in the area without slow water flow; the sensor is maintained 5 cm from the surrounding wall

2. **Electrical connection**

● Brown wire-Power cord (12 or 24VDC)

● Black line – Ground wire (GND)

● Blue line - - 485A

● White line- -485B

● Bare line - - shielding layer

**Sensor cables: 4-wire AWG-24 or AWG-26 shielding wire.**

Outer diameter: 6.0-6.2mm; flexible twisted pair shielding cable.

# Calibration

a) Zero-point calibration:

Insert the sensor into the zero-value turbidity standard buffer solution (distilled water), and send the zero-point calibration instruction until the value is stabilized for approximately 3 minutes.

B) 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.

Note that the sensor measurement probe remains at least 5cm from the bottom of the container during calibration.

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

**Note: The sensor has been calibrated before leaving the factory. If the measurement error is not exceeded, it should not be calibrated.**

# Maintenance and precautions

## 1. Maintenance

- It is recommended to clean the sensor every 30 days; avoid scratching the sensor during cleaning; 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.

## 2. Matters need attention

- 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.

## 3. Other

| Question | Probable cause | Resolvent |
|---|---|---|
| The operation interface cannot | Cable wiring mode is wrong | Check the wiring mode |
| be connected or does not | Incorrect sensor address | Check that the address |
| The measurements are too | The sensor window is | Clean the sensor |
| high, too low, or continuously unstable | Measure the air bubble | Clear the bubble |

# Quality and service

## 1. Quality assurance

Thank you for choosing our product!

Since its production, our company has been the core of the company to participate in the market competition.

According to the product quality requirements, the company has established a strict quality inspection system. The company has strictly controlled and managed all the links related to product quality, established scientific inspection procedures, and quantified the inspection indicators, and assigned the responsibility to the people to ensure the company continuous and stable production of qualified products. The company strictly checks the raw materials, puts an end to the three no products, selects the products of domestic and foreign famous brand manufacturers, establishes strict product process indicators, and establishes a good supply and demand relationship with the supplier.

Our company has established a regular staff quality training system, learn new knowledge and information of quality management, establish the quality awareness of each employee, standardize their own behavior, from a solder joint, a wire, to a whole machine to do meticulous, excellence. The quality inspection department has established standard inspection procedures, with advanced and perfect testing equipment and means, and strictly in accordance with the procedures of inspection, make every link of product quality testing, do not let a unqualified product leave the factory.

Our company provides the local after-sales service within one year from the sales date, but it does not include the damage caused by improper use. For maintenance or adjustment, please send it back,

but the freight should be paid by yourself.

## 2. Accessories and spare parts

| Explain | Quantity (pcs) |
|---|---|
| Sensor | 1 |
| Instructions | 1 |
| Certificate | 1 |
| Boot | 1 (Optional) |

# Data communication

## 1. Modbus Agreement profile

Modbus Protocol is a general communication protocol which has been widely used in the field of industrial control today. By this protocol, controllers can communicate with each other, or via a network (such as Ethernet). Modbus The protocol uses the master and slave communication technology, that is, the master device actively queries and operates the slave device

A) The main device sends requests to the slave device

B) Analyze and process the primary device requests from the device and then send the results to the primary device

C) If any error occurs, the slave device will return an abnormal function code

Modbus RTU Communication mode frame format

| Device address | FC | Data | CRC is eight places lower | CRC is eight places tall |
|---|---|---|---|---|
| 8bit | 8bit | n*8bit | 8bit | 8bit |

● In RTU mode, message sending starts at a minimum of 3.5 characters. The first domain to transport is the device address. The network device constantly detects the network bus, including during the pause interval. When the first domain (address domain) receives, each device decodes to determine whether it is sent to it. After the last transfer character, a pause of at least 3.5 characters time calibrates the end of the message. A new message can start after this pause.

● The entire message frame must be transferred as a continuous stream. If there is a pause time of more than 1.5 characters before the frame completes, the receiving device will refresh the incomplete message and assume that the next byte is the address domain of a new message.

## 2. Information frame format

The default data format for this sensor Modbus communication is:

| MODBUS-RTU | |
|---|---|
| Baud rate | 9600 (by default) |
| Device address | 1 (Default) |
| Data bit | Eight |
| Even-odd check | Not have |
| Stop bit | One |

a)  Function code 03H: Read the register value

Host sent

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|
| ADR | 03H | Start register high byte | Start register is low bytes | Register number of high bytes | Register number is low in bytes | CRC lower byte | CRC high byte |

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

Byte 203H: Read the register value function code

3,4: the start register address to read

To read the FCC,

5 bytes 6: Number of registers to read

Byte 7,8: CRC 16 checksum from byte 1 to 6

Return from the machine:

| 1 | 2 | 3 | 4、5 | 6、7 | | M-1、M | M+1 | M+2 |
|---|---|---|---|---|---|---|---|---|
| ADR | 03H | Total number of bytes | Register data 1 | Register data 2 | ...... | Register data M | CRC lower byte | CRC high byte |

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

Byte 203H: Return to the read function code

3rd byte: Total number of bytes from 4 to M (including 4 and M)

4th to M bytes: Register data

M + 1, M + 2 bytes: CRC 16 checksum from byte 1 to M

When the slave accepts an error, return it to:

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| ADR | 83H | information code | CRC lower byte | CRC high byte |

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

Byte 283H: Read register value error

Byte 3 information code: 01 function code error

   03 Data error

Bytes 4 and 5: CRC 16 checksum from byte 1 to 3

b)  Function code 06H:, write a single register value

Host sent

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|
| ADR | 06 | Register the high-byte address | Register the low-byte address | Data high bytes | Data low bytes | CRC a sign or object indicating number lower byte | CRC a sign or object indicating number high byte |

When the correct receipt is, the slave return is:

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|
| ADR | 06 | Register the high-byte address | Register the low-byte address | Data high bytes | Data low bytes | CRC a sign or object indicating number lower byte | CRC a sign or object indicating number high byte |

When receiving receives error, return back:

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| ADR | 86H | Error code information code | CRC a sign or object indicating number lower byte | CRC a sign or object indicating number high byte |

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

Byte 286H: Write register value error function code

Byte 3 error code information code: 01 function code error

03 Data error

## 3. Data structure type

**integer**

Unsigned integer type (unsigned short)

The data consists of two integers.

| XXXX XXXX | XXXX XXXX |
|-----------|-----------|
| Byte1 | Byte0 |

**Floating-point**                       **type (float)**

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

Data include 1 symbol bit, 8-bit index, and a 23-bit mantissa.

| XXXX XXXX | | XXXX XXXX | XXXX XXXX | XXXX XXXX |
|-----------|---|-----------|-----------|-----------|
| Byte3 | | Byte2 | Byte1 | Byte0 |
| sign bit | Exp index position | | f decimal place | |

# 4. Register address

# Register address

| Register address | Name | Read / write | Explain | Number of registers (byte) | Data type |
|---|---|---|---|---|---|
| 0x0100 | Temperature value | R Read only | Temp Value x 10 (e.g. 25.6 ℃ temperature shows 256, default: 1 decimal place) | 1 (2 Bytes) | unsigned short |
| 0X0101 | Turbidity value | R Read only | Turbidity 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 Read / write | 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 Read / write | Calibrate in zero turbidity water, with data 0 written during calibration. (Can also be calibrated in turbidity standard solution of 0-10 NTU) | 1 (2 Bytes) | unsigned short |
| 0x1003 | Slope | R/W | Calibrated in the value known | 1 (2 Bytes) | unsigned |

| | calibration | Read / write | standard solution. Write data with standard solution value x 10 during calibration. | | short |
|---|---|---|---|---|---|
| 0x2000 | Sensor address | R/W Read / write | Default is 1, and the data range is 1-127. | 1 (2 Bytes) | unsigned short |
| 0x2003 | Baud rate setting | R/W Read / write | 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 Write only | 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 the slave address:**

**Address: 0x2000**
**Number of registers: 1**
**Function code: 0x06**
**Default sensor address: 01**

Change the Modbus device address of the sensor, change the device address 01 to 06, with the following example:

Send instruction: 01 06 20 00 00 06 02 08

Response: 01 06 20 00 00 06 02 08; Note: The address is changed to 06 and the power is saved.

b) **Baud rate:**

    **Address: 0x2003**

    **Number of registers: 1**

    **Function code: 0x06**

    **Default: 1 (9600bps)**

    **Supported values: 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 rate |
|---------|-----------|
| 0 | 4800 bps |
| 1 | 9600 bps |
| 2 | 19200 bps |

Send instruction: 01 06 20 03 00 02 F3 CB

Response: 01 06 20 03 00 02 F3 CB Note: Porter rate changed to 19200bps, power out saved.

## Functional register:

a) **Temperature command:**

    **Address: 0x0100**

    **Number of registers: 1**

    **Function code: 0x03**

    **Read the sample value: 19.2℃**

    Send instruction: 01 03 01 00 00 01 85 F6

        Response: 01 03 02 00 C0 B8 14

Return hex unsigned integer data, temperature value =Integer / 10, keep 1 decimal place.

b) **Measure the 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

Return hex unsigned integer data, turbidity value =Integer / 10, retain 1 decimal place.

c) **Continuous reading of the temperature and turbidity values instructions:**

      **Address: 0x0100**

      **Number of registers: 2**

      **Function code: 0x03**

      **Read the sample values: temperature 19.2℃ and turbidity value 98.5NTU**

      Send instruction: 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 Directive:**

      **temperature correction**

      **Address: 0x1000**

      **Number of registers: 1**

      **Function code: 0x06**

      Calibration example: Calibration at a temperature of 25.8℃

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

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

The sensor needs to be calibrated at a constant temperature environment, when the temperature number no longer fluctuates.

### Turnout zero point calibration

**Address: 0x1001**
**Number of registers: 1**
**Function code: 0x06**
Calibration example: calibration in distilled water or deionized water with zero turbidity
Send the instruction: 01 06 10 01 00 00   DCCA
Response: 01 06 10 01 00 00   DCCA

### Polity slope calibration

**Address: 0x1003**
**Number of registers: 1**
**Function code: 0x06**
Calibration example: Calibrated in 100 NTU turbidity solution
Send instruction: 01 06 10 03 03 E8 7D B4
Response: 01 06 10 03 03 E8 7D B4