

# WQS-LB -- LoRaWAN Water Quality Sensor Transmitter User Manual

Last modified by Karry Zhuang (/xwiki/bin/view/XWiki/karry) on 2024/10/16 09:13



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([https://wiki.dragino.com/xwiki/bin/dLB--LoRaWAN\\_Water\\_Quality\\_Serrev=1.1](https://wiki.dragino.com/xwiki/bin/dLB--LoRaWAN_Water_Quality_Serrev=1.1))

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# 1. Introduction

## 1.1 Overview

The Dragino WQS-LB is a Main Unit is advanced instruments designed for comprehensive **water quality monitoring across various applications**. They are ideal for **monitoring tap water, industrial water, environmental water, and wastewater**,etc,which offer precise and reliable measurements to ensure water quality standards are met.

The Dragino WQS-LB is a **Main Unit supports 1-3 probes**. supports connecting 1 to 3 water quality probes, including EC, pH, DO, ORP, and TS probes.

It **detects water quality parameters**, and uploads the value via wireless to LoRaWAN Server.

WQS-LB supports **BLE configure and wireless OTA update** which makes user easy to use.

WQS-LB is powered by **8500mAh Li-SOCI2 battery** , it is designed for long-term use up to several years.

## 1.2 Specifications

### Common DC Characteristics:

- Supply Voltage: Built-in Battery , 2.5v ~ 3.6v
- Operating Temperature: -40 ~ 85°C

### I/O Interface:

- Battery controllable output (2.6v ~ 3.6v depends on battery)
- +12v controllable output
- 1 x RS485 Interface
- 1 x UART Interface , 3.3v or 5v or 12v
- 1 x Interrupt or Digital IN pins
- 1 x I2C Interface
- 1 x one wire interface

### LoRa Spec:

- Frequency Range, Band 1 (HF): 862 ~ 1020 Mhz
- Max +22 dBm constant RF output vs.

- RX sensitivity: down to -139 dBm.
- Excellent blocking immunity

**Battery:**

- Li/SOCI2 un-chargeable battery
- Capacity: 8500mAh
- Self-Discharge: <1% / Year @ 25°C
- Max continuously current: 130mA
- Max boost current: 2A, 1 second

**Power Consumption**

- Sleep Mode: 5uA @ 3.3v
- LoRa Transmit Mode: 125mA @ 20dBm, 82mA @ 14dBm

### 1.3 Features

- LoRaWAN 1.0.3 Class A
- Frequency Bands: CN470/EU433/KR920/US915/EU868/AS923/AU915/IN865/RU864/MA869
- Ultra-low power consumption
- Measure water quality and provide information for water quality conditions
- Support EC / PH / DO / ORP/ TS Type Water Quality Probe
- Support 1 ~ 3 probes
- Support Bluetooth v5.1 and LoRaWAN remote configure
- Support wireless OTA update firmware
- AT Commands to change parameters
- Uplink on periodically
- Downlink to change configure
- 8500mAh Li/SOCI2 Battery

### 1.4 Applications

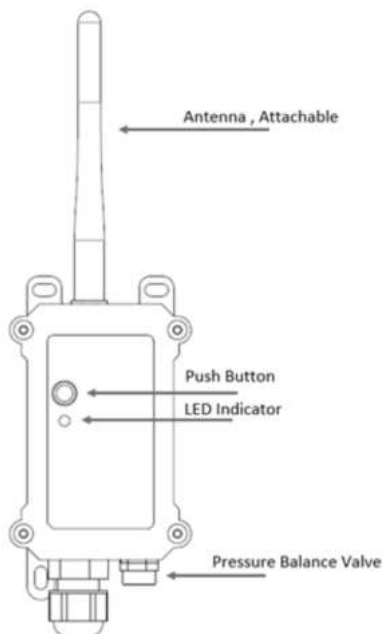
- Smart Buildings & Home Automation
- Logistics and Supply Chain Management
- Smart Metering
- Smart Agriculture
- Smart Cities
- Smart Factory

### 1.5 Sleep mode and working mode

**Deep Sleep Mode:** Sensor doesn't have any LoRaWAN activate. This mode is used for storage and shipping to save battery life.

**Working Mode:** In this mode, Sensor will work as LoRaWAN Sensor to Join LoRaWAN network and send out sensor data to server. Between each sampling/tx/rx periodically, sensor will be in IDLE mode), in IDLE mode, sensor has the same power consumption as Deep Sleep mode.

### 1.6 Button & LEDs



Behavior on ACT	Function	Action
-----------------	----------	--------

Pressing ACT between 1s < time < 3s	Send an uplink	If sensor is already Joined to LoRaWAN network, sensor will send an uplink packet, blue led will blink once. Meanwhile, BLE module will be active and user can connect via BLE to configure device.
Pressing ACT for more than 3s	Active Device	Green led will fast blink 5 times, device will enter OTA mode for 3 seconds. And then start to JOIN LoRaWAN network. Green led will solidly turn on for 5 seconds after joined in network. Once sensor is active, BLE module will be active and user can connect via BLE to configure device, no matter if device join or not join LoRaWAN network.
Fast press ACT 5 times.	Deactivate Device	Red led will solid on for 5 seconds. Means device is in Deep Sleep Mode.

## 1.7 BLE connection

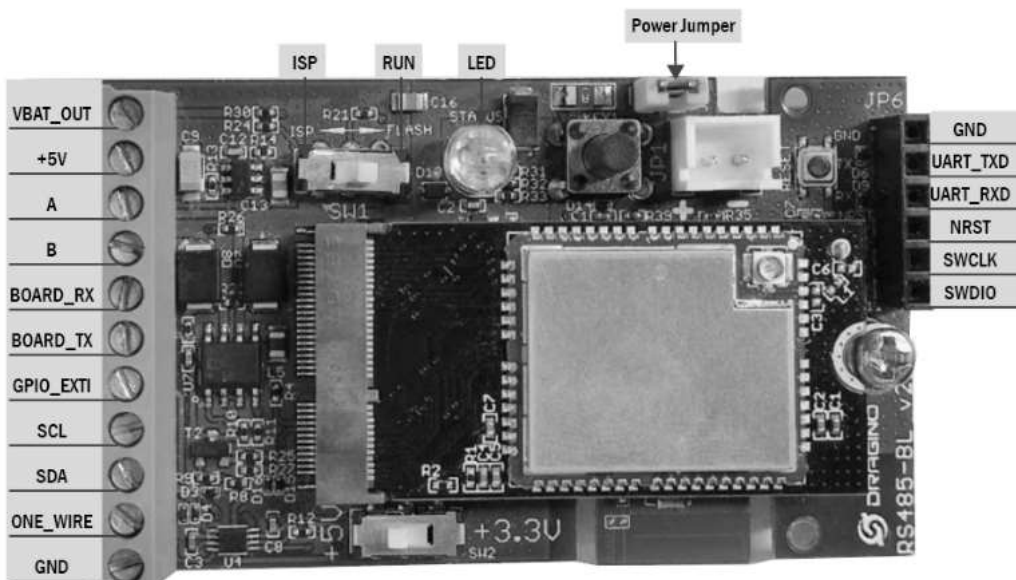
RS485-LB/LS supports BLE remote configure.

BLE can be used to configure the parameter of sensor or see the console output from sensor. BLE will be only activate on below case:

- Press button to send an uplink
- Press button to active device.
- Device Power on or reset.

If there is no activity connection on BLE in 60 seconds, sensor will shut down BLE module to enter low power mode.

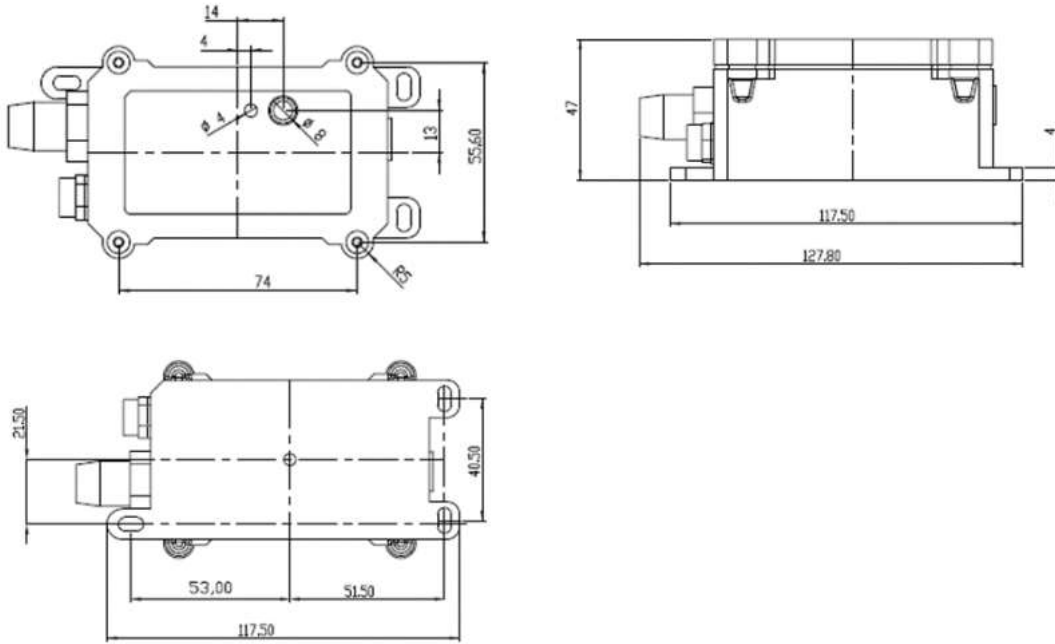
## 1.8 Pin Definitions



### 1.8.1 SW2 Jumper (Define UART level to external Sensor)

SW2 defines the voltage level of BOARD\_RX and BOARD\_TX pins. It should match the external sensor voltage level

## 1.9 Mechanical

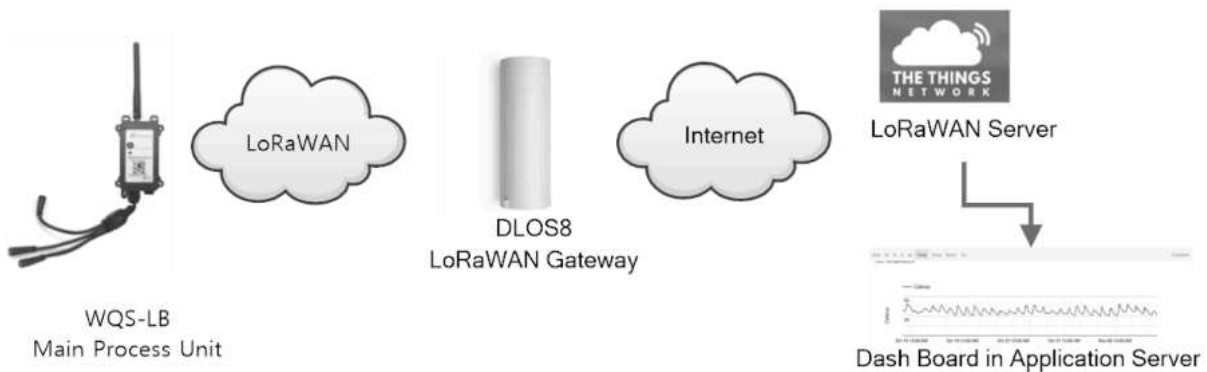


## 2. How to use

### 2.1 Example to use for LoRaWAN network

This section shows an example for how to join the TTN V3 LoRaWAN IoT server. Usages with other LoRaWAN IoT servers are of similar procedure.

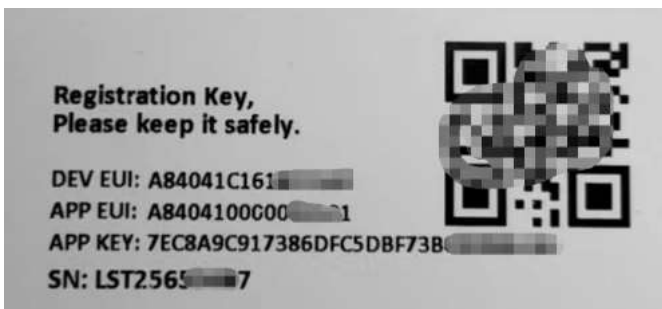
#### WQS-LB Weather Station Installation Diagram



Assume the DLOS8 is already set to connect to TTN V3 network (<https://eu1.cloud.thethings.network/>) . We need to add the WQS-LB device in TTN V3:

**Step 1:** Create a device in TTN V3 with the OTAA keys from WQS-LB.

Each WQS-LB is shipped with a sticker with the default device EUI as below:



User can enter these keys in the LoRaWAN Server portal. Below is TTN V3 screen shot:

**Add APP EUI in the application.**

## Add application

Owner\*

davidhuang

Application ID\*

my-new-application

Application name

My new application

Description

Description for my new application

Optional application description; can also be used to save notes about the application

Create application



4 End devices 2 Collaborators 2 API keys

Created 95 days ago

### General information

Application ID: 123

Created at: Feb 2, 2021 11:12:30

Last updated at: Apr 30, 2021 11:00:33

### Live data

See all activity →

↑ 18:09:42 1231234234.. Forward data message to Application Server

↑ 18:09:42 1231234234.. Store upstream data message

↑ 18:09:42 1231234234.. Forward uplink data message

↑ 18:09:42 1231234234.. Receive uplink data message

↑ 18:09:42 1231234234.. Successfully processed data message

↑ 18:09:42 1231234234.. Drop data message

End devices (4)

Search by ID

Import end devices

Add end device

ID

Name

DevEUI

JoinEUI

Created

Choose Manually to add WQS-LB

# Register end device

From The LoRaWAN Device Repository Manually

## Preparation

### Activation mode\*

- Over the air activation (OTAA)
- Activation by personalization (ABP)
- Multicast
- Do not configure activation

### LoRaWAN version ⓘ\*

### Network Server address

### Application Server address

### External Join Server ⓘ

## Add APP KEY and DEV EUI

### 2. Enter registration data

#### Frequency plan ⓘ\*

The frequency plan used by the end device

#### AppEUI ⓘ\*

The AppEUI uniquely identifies the owner of the end device. If no AppEUI is provided by the device manufacturer (usually for dev

#### DevEUI ⓘ\*

The DevEUI is the unique identifier for this end device

#### AppKey ⓘ\*

The root key to derive session keys to secure communication between the end device and the application

#### End device ID\*

#### After registration

**Step 2:** Power on WQS-LB, it will start to join TTN server. After join success, it will start to upload sensor data to TTN V3 and user can see in the panel.



## 2.2 Uplink Payload

Uplink payloads include two types: Valid Sensor Value and other status / control command.

- Valid Sensor Value: Use FPORT=2
- Other control command: Use FPORT other than 2.

### 2.2.1 Uplink FPORT=5, Device Status

Uplink the device configures with FPORT=5. Once WQS-LB Joined the network, it will uplink this message to the server. After first uplink, WQS-LB will uplink Device Status every 12 hours

User can also use downlink command(0x2301) to ask WQS-LB to resend this uplink

Size(bytes)	1	2	1	1	2
Value	Sensor Model	Firmware Version	Frequency Band	Sub-band	BAT



Example Payload (FPort=5): 3C 01 00 01 00 0D C8

#### Sensor Model:

For WQS-LB, this value is 0x3C.

#### Firmware Version:

0x0100, Means: v1.0.0 version.

#### Frequency Band:

0x01: EU868

0x02: US915

0x03: IN865

0x04: AU915

0x05: KZ865

0x06: RU864

0x07: AS923

0x08: AS923-1

0x09: AS923-2

0x0a: AS923-3

0x0b: CN470



0x0c: EU433

0x0d: KR920

0x0e: MA869

### Sub-Band:

value 0x00 ~ 0x08(only for CN470, AU915,US915. Others are0x00)

### BAT:

shows the battery voltage for WQS-LB MCU.

Ex1: 0x0DC8/1000 = 3.528 V

## 2.2.2 Uplink FPORT=2, Real time sensor value

WQS-LB will send this uplink after Device Config uplink once join LoRaWAN network successfully. And it will periodically send this uplink. Default interval is 20 minutes and can be changed.

Uplink uses FPORT=2 and every 20 minutes send one uplink by default.

The upload length is dynamic, depends on what type of weather sensors are connected. The uplink payload is combined with sensor segments. As below:

Size(bytes)	2	2	1	2	2	2	2	2	2
Value	BAT	temperature DS18B20	flag and Sensor Identifier	turbidity	dissolved oxygen	ORP	ECK10	ECK1	PH



**Payload Example(FPort=2):**0CDE 0CCC 29 01E7 00A8 03AA

One WQS-LB can connect three sensors, and obviously I connected a PH ORP turbidity sensor.

### BAT:

shows the battery voltage for WQS-LB MCU.

Ex1: 0x0CDE/1000 = 3.294 V

### Temperature:

This is the data of the external DS18B20 temperature sensor.

If the DS18B12 sensor is not connected, it will display:0CCC/10 =327.60°C

### flag and Sensor Identifier:

The flag and Sensor Identifier uses a hexadecimal byte, which becomes 8 digits when converted to binary.

Example:0x29=0010 1001

00 indicates the interrupt identifier.

The remaining six digits represent the identifier of the turbidity, dissolved oxygen, ORP, ECK10, ECK1, and pH sensor in order.

101001 means that I have connected three sensors: turbidity, ORP, and pH.

### Sensor data:

turbidity:0x01E7/10=48.7

ORP:0x00A8=168

pH:0x03AA/100=9.38

## 2.2.3 Decoder in TTN V3

In LoRaWAN platform, user only see HEX payload by default, user needs to use payload formatters to decode the payload to see human-readable value.

Download decoder for suitable platform from: <https://github.com/dragino/dragino-end-node-decoder> (<https://github.com/dragino/dragino-end-node-decoder>)

and put as below:

Overview Live data Messaging Location **Payload formatters** Claiming General settings

Uplink Downlink

These payload formatters are executed on uplink messages from this end device and take precedence over application level payload formatters.

Formatter type

Use application payload formatter  None  Javascript  GRPC service  CayenneLPP  Repository

Formatter parameter \*

```

1 function decodeUplink(input) {
2   return {
3     data: {
4       bytes: input.bytes
5     },
6     warnings: [],
7     errors: []
8   };
9 }

```

Save changes

## 2.3 Show data on Application Server

Application platform provides a human friendly interface to show the sensor data, once we have sensor data in TTN V3, we can use Datacake to connect to TTN V3 and see the data in Datacake. Below are the steps:

**Step 1:** Be sure that your device is programmed and properly connected to the LoRaWAN network.

**Step 2:** Configure your Application to forward data to Datacake you will need to add integration. Go to TTN V3 Console --> Applications --> Integrations --> Add Integrations.

The screenshot shows a grid of integration options in the TTN V3 Console. The 'TagoIO' integration is highlighted with a red arrow. Other visible integrations include Homey, IoT in a Box, MClimate, Qubitro, tellsens.io, thethings.io, ThingSpeak, TTN Mapper, Ubidots, UIB, Widelix, and IoT Wonderland.

**Add TagoIO:**

## Add custom webhook

### Template information

**TagoIO**  
Integrate with TagoIO  
[About TagoIO](#) | [Documentation](#)

### Template settings

Webhook ID\*

Authorization\*

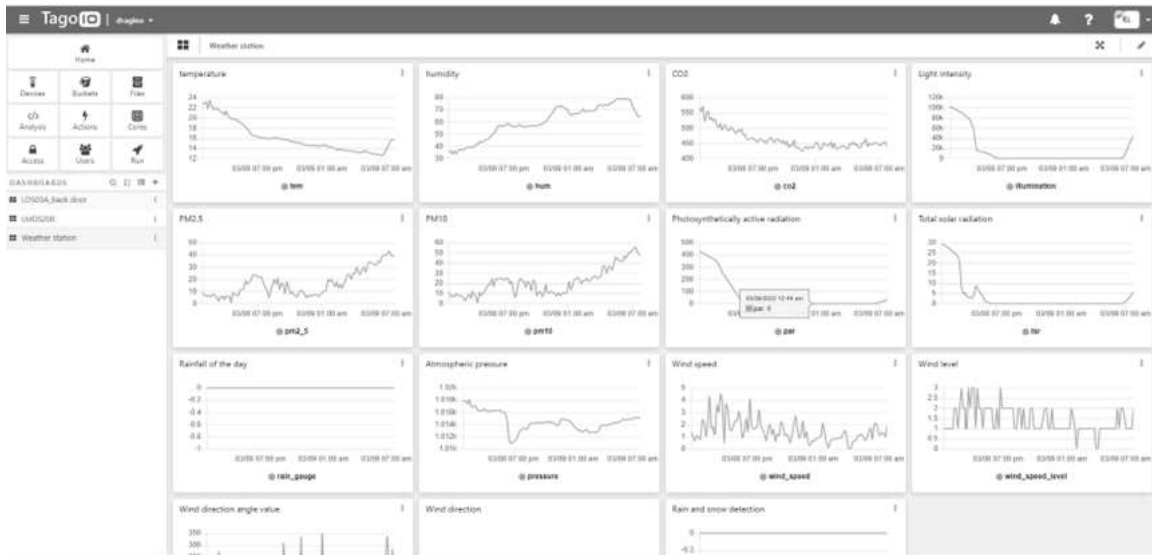
TagoIO Authorization

Create tagoio webhook

### Authorization:

Name	Last Input	Last Output	Connector	Network	Active	Bucket linked	Created at
气象站	2 minutes ago	None	Custom The Things Industries	LoRaWAN TTYTN v3	Yes	气象站	2 months ago
气象站	22 minutes ago	None	Custom The Things Industries	LoRaWAN TTYTN v3	Yes	气象站	2 months ago
气象站	2 minutes ago	None	Custom The Things Industries	LoRaWAN TTYTN v3	Yes	气象站	2 months ago

In TagoIO console (<https://admin.tago.io/> (<https://datacake.co/>)), add WQS-LB:



## 3. Configure WQS-LB via AT Command or LoRaWAN Downlink

You can configure WQS-LB via AT Command or LoRaWAN Downlink.

- AT Command Connection: See FAQ.
- LoRaWAN Downlink instruction for different platforms: Use Note for Server (/xwiki/bin/view/Main/)(IoT LoRaWAN Server)

There are two kinds of commands to configure WQS-LB, they are:

- **General Commands.**

These commands are to configure:

- General system settings like: uplink interval.
- LoRaWAN protocol & radio related command.

They are same for all Dragino Device which support DLWS-005 LoRaWAN Stack(Note\*\*). These commands can be found on the wiki: End Device Downlink Command (/xwiki/bin/view/Main/End%20Device%20AT%20Commands%20and%20Downlink%20Command/)

**Note\*\*:** Please check early user manual if you don't have v1.8.0 firmware.

- **Commands special design for WQS-LB**

These commands only valid for WQS-LB, as below:

### 3.1 Set Transmit Interval Time

Feature: Change LoRaWAN End Node Transmit Interval.

**AT Command: AT+TDC**

Command Example	Function	Response
AT+TDC=?	Show current transmit Interval	30000 OK the interval is 30000ms = 30s
AT+TDC=60000	Set Transmit Interval	OK Set transmit interval to 60000ms = 60 seconds

**Downlink Command: 0x01**

Format: Command Code (0x01) followed by 3 bytes time value.

If the downlink payload=0100003C, it means set the END Node's Transmit Interval to 0x00003C=60(S), while type code is 01.

- Example 1: Downlink Payload: 0100001E // Set Transmit Interval (TDC) = 30 seconds
- Example 2: Downlink Payload: 0100003C // Set Transmit Interval (TDC) = 60 seconds

### 3.2 Set Interrupt Mode

**AT Command:AT+INTMOD**

Command Example	Function	Response
AT+INTMOD=?	Show current interrupt mode	0 OK the mode is 0 =Disable Interrupt
AT+INTMOD=2	Set Transmit Interval 0. (Disable Interrupt), 1. (Trigger by rising and falling edge) 2. (Trigger by falling edge) 3. (Trigger by rising edge)	OK

### 3.3 Set Power Output Duration

**AT Command:**

Command Example	Function	Response
AT+5VT=?	Show 5V open time.	0 (default) OK
AT+5VT=1000	Close after a delay of 1000 milliseconds.	OK

**Downlink Command:**

Format: Command Code (0x07) followed by 2 bytes.

The first and second bytes are the time to turn on.

- Example 1: Downlink Payload: 070000 ---> AT+5VT=0
- Example 2: Downlink Payload: 0701F4 ---> AT+5VT=500

## 3.4 Sensor Calibration Commands

Command Example	Function	Response
AT+CALPH=xx	Parameter 4 6 9 downlink: 0xFB XX	4:10 06 00 22 07 24 28 aa 6:10 06 00 21 07 4e 58 85 9:10 06 00 20 08 bc 8d 30
AT+CALORP=xx	Parameter 86 256 downlink:0xFC XX XX	86:13 06 00 24 07 dc c9 1a 256:13 06 00 25 07 37 d8 95
AT+CALEC=xx	Parameter 1 10 downlink:0xFD XX	1:12 01 00 26 00 02 5E A3 10:11 06 00 26 00 02 EB 50
AT+CALNTU=xx	Parameters 0 2 4 6 8 10 downlink: 0xFE XX	0:15 06 00 5E 00 01 2A CC 2:15 06 00 5E 00 02 6A CD 4:15 06 00 5E 00 03 AB 0D 6:15 06 00 5E 00 04 EA CF 8:15 06 00 5E 00 05 2B 0F 10:15 06 00 5E 00 06 6B 0E

## 4. Water Qualit Sensors

### 4.1 PH Sensor

PH01 is a device for measuring the pH value (hydrogen ion concentration index, acidity and alkalinity) of a solution.

It adopts an integrated design, is lighter and simpler in structure, and is more convenient to use. The waterproof grade is IP68.

The reference electrode adopts a double salt bridge design, which has stronger anti-pollution ability.

This product is suitable for industrial sewage, domestic sewage, agriculture, aquaculture and other scenes in non-corrosive weak acid and weak alkali environments.

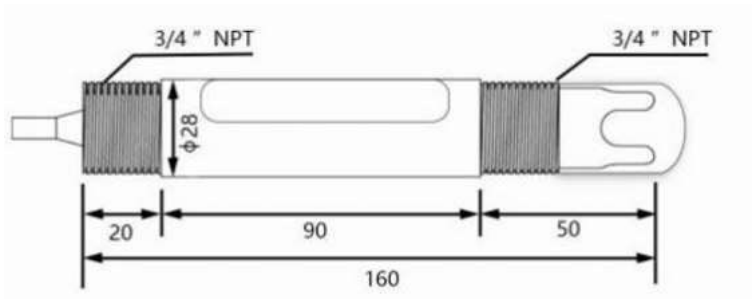
#### 4.1.1 Feature

- pH measurement range 0~14pH, resolution 0.01pH.
- One-piece design, light and simple structure, easy to use.
- The reference adopts a double salt bridge design, which has stronger anti-pollution ability and waterproof grade IP68.
- The equipment adopts a wide voltage power supply DC 7~30V.

#### 4.1.2 Specification

- Power supply: DC7~30V
- Power consumption: ≤0.5W
- Communication interface: RS485; standard MODBUS-RTU protocol; communication baud rate: default 9600
- pH measurement range: 0~14.00pH; resolution: 0.01pH
- pH measurement error: ±0.15pH
- Repeatability error: ±0.02pH
- Equipment working conditions: Ambient temperature: 0-60°C
- Waterproof grade: IP68
- Pressure resistance: 0.6MPa

#### 4.1.3 Dimension



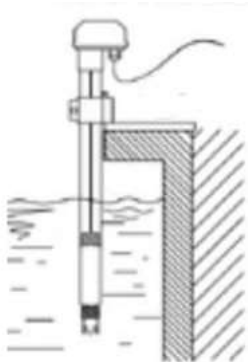
#### 4.1.4 Installation Notice

Do not power on while connect the cables. Double check the wiring before power on.

Installation Photo as reference:

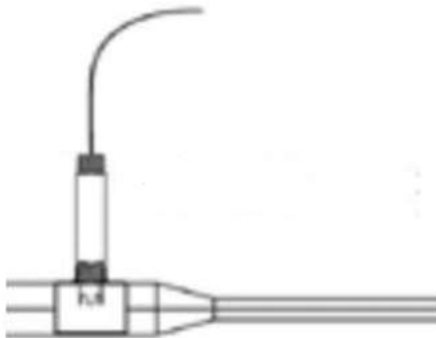
##### Submerged installation:

The lead wire of the equipment passes through the waterproof pipe, and the 3/4 thread on the top of the equipment is connected to the 3/4 thread of the waterproof pipe with raw tape. Ensure that the top of the equipment and the equipment wire are not flooded.



##### Pipeline installation:

Connect the equipment to the pipeline through the 3/4 thread.



##### Sampling:

Take representative water samples according to sampling requirements. If it is inconvenient to take samples, you can also put the electrode into the solution to be tested and read the output data. After a period of time, take out the electrode and clean it.

##### Measure the pH of the water sample:

First rinse the electrode with distilled water, then rinse it with the water sample, then immerse the electrode in the sample, carefully shake the test cup or stir it to accelerate the electrode balance, let it stand, and record the pH value when the reading is stable.

#### 4.1.5 Maintenance

- The equipment itself generally does not require daily maintenance. When an obvious fault occurs, please do not open it and repair it yourself. Contact us as soon as possible!
- There is an appropriate amount of soaking solution in the protective bottle at the front end of the electrode. The electrode head is soaked in it to keep the glass bulb and the liquid junction activated. When measuring, loosen the bottle cap, pull out the electrode, and rinse it with pure water before use.
- Preparation of electrode soaking solution: Take a packet of PH4.00 buffer, dissolve it in 250 ml of pure water, and soak it in 3M potassium chloride solution. The preparation is as follows: Take 25 grams of analytical pure potassium chloride and dissolve it in 100 ml of pure water.
- The glass bulb at the front end of the electrode cannot come into contact with hard objects. Any damage and scratches will make the electrode ineffective.

- Before measurement, the bubbles in the electrode glass bulb should be shaken off, otherwise it will affect the measurement. When measuring, the electrode should be stirred in the measured solution and then placed still to accelerate the response.
- The electrode should be cleaned with deionized water before and after measurement to ensure accuracy.
- After long-term use, the pH electrode will become passivated, which is characterized by a decrease in sensitivity gradient, slow response, and inaccurate readings. At this time, the bulb at the bottom of the electrode can be soaked in 0.1M dilute hydrochloric acid for 24 hours (0.1M dilute hydrochloric acid preparation: 9 ml of hydrochloric acid is diluted to 1000 ml with distilled water), and then soaked in 3.3M potassium chloride solution for 24 hours. If the pH electrode is seriously passivated and soaking in 0.1M hydrochloric acid has no effect, the pH electrode bulb can be soaked in 4% HF (hydrofluoric acid) for 3-5 seconds, washed with pure water, and then soaked in 3.3M potassium chloride solution for 24 hours to restore its performance.
- Glass bulb contamination or liquid junction blockage can also cause electrode passivation. At this time, it should be cleaned with an appropriate solution according to the nature of the contaminant.
- The equipment should be calibrated before each use. For long-term use, it is recommended to calibrate once every 3 months. The calibration frequency should be adjusted appropriately according to different application conditions (degree of dirt in the application, deposition of chemical substances, etc.). After aging, the electrodes should be replaced in time.

## 4.1.6 Calibration

This device uses three-point calibration, and three known PH standard solutions need to be prepared.

**The steps are as follows:**

(1) Wash the electrode in distilled water, and put it in 9.18 standard buffer solution. After the data stabilizes, enter the following calibration command, that is, 9.18 calibration is completed. **"AT+CALPH=9" [downlink:0xFB 09](#)**

(2) Wash the electrode in distilled water, and put it in 6.86 standard buffer solution. After the data stabilizes, enter the following calibration command, that is, 6.86 calibration is completed; **"AT+CALPH=6" [downlink:0xFB 06](#)**

(3) Wash the electrode in distilled water, and put it in 4.01 standard buffer solution. After the data stabilizes, enter the following calibration command, that is, 4.00 calibration is completed. **"AT+CALPH=4" [downlink:0xFB 04](#)**

## 4.2 EC Sensor

EC K1/K10 is a device for measuring the conductivity of solutions. EC K1/K10 adopts an integrated design, which is lighter and simpler in structure and more convenient to use.

The waterproof grade is IP68. It can be widely used in continuous monitoring of the conductivity of aqueous solutions such as cross-section water quality, aquaculture, sewage treatment, environmental protection, pharmaceuticals, food and tap water.

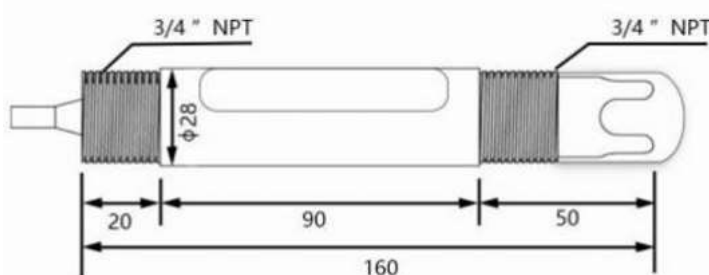
### 4.2.1 Feature

- Conductivity measurement range is 0-2000us/cm; 10~20000us/cm.
- Integrated design, light and simple structure, easy to use.
- Waterproof grade IP68.
- With salinity and TDS conversion function.
- RS485 communication interface: MDDBUS RTU communication protocol can be easily connected to the computer for monitoring and communication.
- ModBus communication address can be set and baud rate can be modified.
- The device adopts wide voltage power supply, DC 7~30V is available.

### 4.2.2 Specification

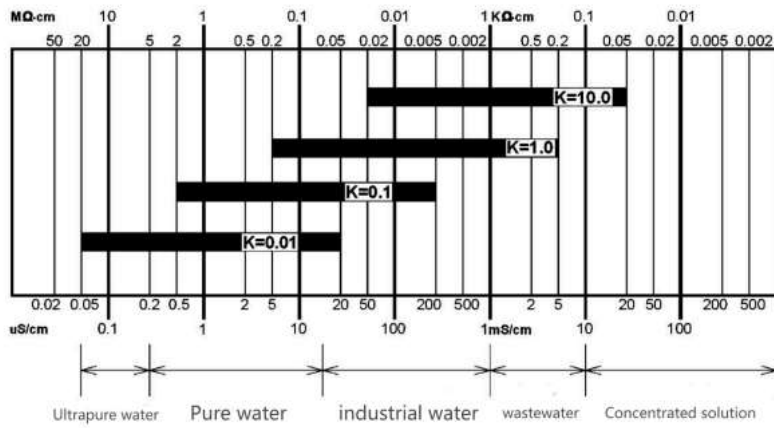
- Power supply: DC7~30V
- Power consumption: ≤0.5W
- Communication interface: RS485; standard MODBUS-RTU protocol; communication baud rate: default 9600
- Conductivity measurement range: K=1: 0~2000μs/cm; resolution: 1μs/cm K=10: 10~20000μs/cm; resolution: 10μs/cm
- Conductivity measurement error: ±1%FS
- Equipment working conditions: Ambient temperature: 0-60°C
- Waterproof grade: IP68
- Pressure resistance: 0.6MPa

### 4.2.3 Dimension



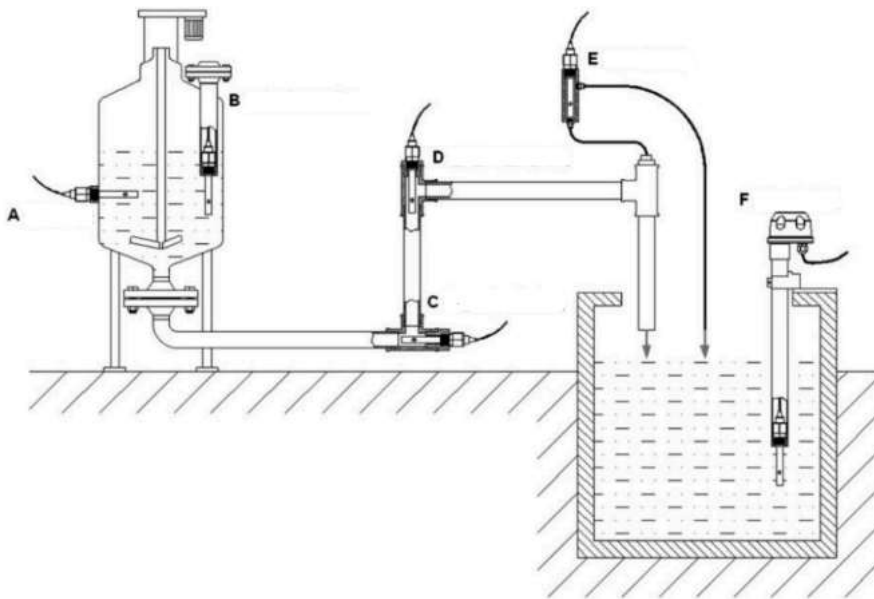
## 4.2.4 Installation Notice

Selection of matching electrode constant



### Electrode installation form

- A: Side wall installation
- B: Top flange installation
- C: Pipeline bend installation
- D: Pipeline bend installation
- E: Flow-through installation
- F: Submerged installation

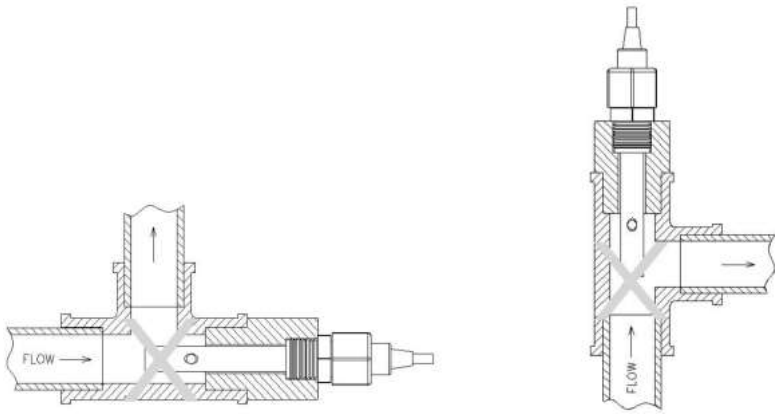


### Several common installation methods of electrodes

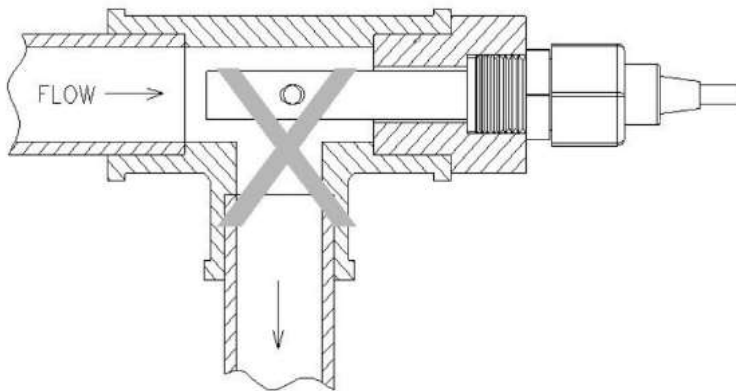
When installing the sensor on site, you should strictly follow the correct installation method shown in the following picture. Incorrect installation method will cause data deviation.

- A. Several common incorrect installation methods



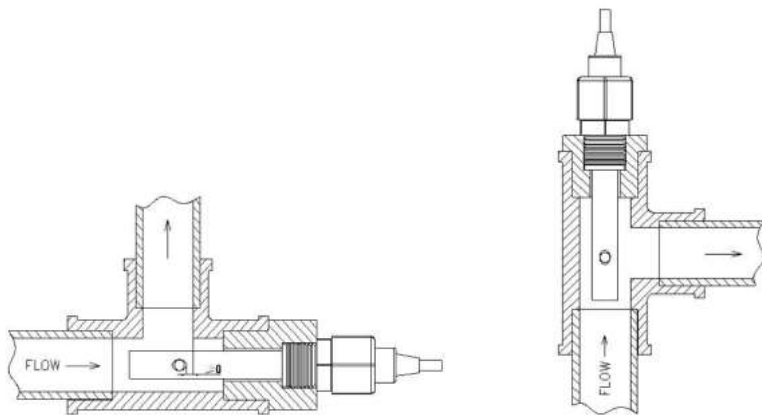


Error cause: The electrode joint is too long, the extension part is too short, the sensor is easy to form a dead cavity, resulting in measurement error.



Error cause: Measurement error or instability may occur due to water flow not being able to fill the pipe or air accumulation at high altitudes.

B. Correct installation method



## 4.2.5 Maintenance

- The equipment itself generally does not require daily maintenance. When an obvious fault occurs, please do not open it and repair it yourself, and contact us as soon as possible.
- If the electrode is not used for a long time, it can generally be stored in a dry place, but it must be placed (stored) in distilled water for several hours before use to activate the electrode. Electrodes that are frequently used can be placed (stored) in distilled water.
- Cleaning of conductivity electrodes: Organic stains on the electrode can be cleaned with warm water containing detergent, or with alcohol. Calcium and magnesium precipitates are best cleaned with 10% citric acid. The electrode plate or pole can only be cleaned by chemical methods or by shaking in water. Wiping the electrode plate will damage the coating (platinum black) on the electrode surface.
- The equipment should be calibrated before each use. It is recommended to calibrate it every 3 months for long-term use. The calibration frequency should be adjusted appropriately according to different application conditions (degree of dirt in the application, deposition of chemical substances, etc.).

## 4.2.6 Calibration

This device uses one-point calibration, and you need to prepare a known E standard solution. When the mileage  $K=1$ , 1~2000 uses 1413uS/cm standard solution, and when the mileage  $K=10$ , 10~20000 uses 12.88mS/cm standard solution.

**The steps are as follows:**

(1) Put the electrode in distilled water to clean it. When the mileage is 1~2000, use 1413HS/cm standard solution. After the data is stable, enter the following calibration command

"AT+CALEC=1" downlink:0xFD 01

(2) Put the electrode in distilled water to clean it. When the range is 10~20000, use 12.88mS/cm standard solution. After the data is stable, enter the following calibration command

"AT+CALEC=10" downlink:0xFD 10

## 4.3 ORP Sensor

ORP01 is a device for measuring the redox potential of a solution. It uses high-purity platinum to make an ORP composite electrode, which has strong acid and alkali resistance and antioxidant capacity, and has high measurement accuracy, fast response, and good stability.

The electrode can automatically compensate according to temperature. It is suitable for online monitoring of the redox potential of cyanide-containing and chromium-containing wastewater.

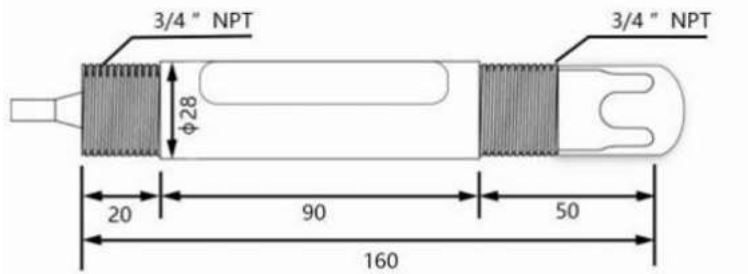
### 4.3.1 Feature

- ORP measurement range -1999~1999mV, resolution 1mV.
- Applicable electrode temperature 0~80°C.
- The electrode is made of high-purity platinum, which has strong acid and alkali resistance and antioxidant capacity, high measurement accuracy, fast response and good stability.
- RS485 communication interface: ModBus-RTU communication protocol can be easily connected to the computer for monitoring and communication.
- ModBus communication address can be set and baud rate can be modified.
- The equipment adopts wide voltage power supply, DC 7~30V

### 4.3.2 Specification

- Measuring range: -1999~1999mV
- Resolution: 1mV
- Output signal: RS485
- Measurement error:  $\pm 3$ mV
- Stability:  $\leq 2$ mv/24 hours
- Equipment working conditions: Ambient temperature: 0-60°C Relative humidity: <85%RH
- Waterproof grade: IP68
- Pressure resistance: 0.6MP

### 4.3.3 Dimension



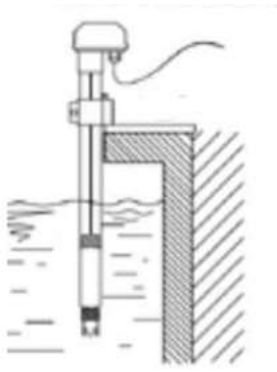
### 4.3.4 Installation Notice

Do not power on while connect the cables. Double check the wiring before power on.

Installation Photo as reference:

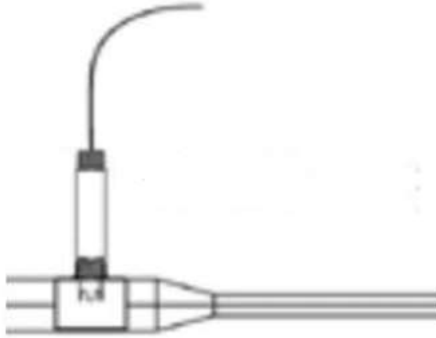
#### **Submerged installation:**

The lead wire of the equipment passes through the waterproof pipe, and the 3/4 thread on the top of the equipment is connected to the 3/4 thread of the waterproof pipe with raw tape. Ensure that the top of the equipment and the equipment wire are not flooded.



#### Pipeline installation:

Connect the equipment to the pipeline through the 3/4 thread.



### 4.3.5 Maintenance

- (1) The equipment itself generally does not require daily maintenance. When an obvious fault occurs, please do not open it and repair it yourself, and contact us as soon as possible.
- (2) In general, ORP electrodes do not need to be calibrated and can be used directly. When there is doubt about the quality and test results of the ORP electrode, the electrode potential can be checked with an ORP standard solution to determine whether the ORP electrode meets the measurement requirements, and the electrode can be recalibrated or replaced with a new ORP electrode. The frequency of calibration or inspection of the measuring electrode depends on different application conditions (the degree of dirt in the application, the deposition of chemical substances, etc.).
- (3) There is an appropriate soaking solution in the protective bottle at the front end of the electrode, and the electrode head is soaked in it to ensure the activation of the platinum sheet and the liquid junction. When measuring, loosen the bottle cap, pull out the electrode, and rinse it with pure water before use.
- (4) Preparation of electrode soaking solution: Take 25 grams of analytical pure potassium chloride and dissolve it in 100 ml of pure water to prepare a 3.3M potassium chloride solution.
- (5) Before measuring, the bubbles in the electrode glass bulb should be shaken off, otherwise it will affect the measurement. When measuring, the electrode should be stirred in the measured solution and then placed still to accelerate the response.
- (6) The electrode should be cleaned with deionized water before and after the measurement to ensure the measurement accuracy.
- (7) After long-term use, the ORP electrode will be passivated, which is manifested as a decrease in sensitivity gradient, slow response, and inaccurate readings. At this time, the platinum sheet at the bottom of the electrode can be soaked in 0.1M dilute hydrochloric acid for 24 hours (0.1M dilute hydrochloric acid preparation: 9 ml of hydrochloric acid is diluted to 1000 ml with distilled water), and then soaked in 3.3M potassium chloride solution for 24 hours to restore its performance.
- (8) Electrode contamination or liquid junction blockage can also cause electrode passivation. At this time, it should be cleaned with an appropriate solution according to the nature of the contaminant. If the platinum of the electrode is severely contaminated and an oxide film is formed, toothpaste can be applied to the platinum surface and then gently scrubbed to restore the platinum's luster.
- (9) The equipment should be calibrated before each use. It is recommended to calibrate once every 3 months for long-term use. The calibration frequency should be adjusted appropriately according to different application conditions (degree of dirt in the application, deposition of chemical substances, etc.). After aging, the electrodes should be replaced in time.

### 4.3.6 Calibration

OPR01 uses two-point calibration. You need to prepare two known ORP standard solutions.

#### The steps are as follows:

- (1) Put the electrode in distilled water to clean it, put it in 86mV standard buffer, wait for the data to stabilize, enter the following calibration command, and the 86mV point calibration is completed.

"AT+CALORP=86" [downlink:0xFD 00 56](#)

- (2) Put the electrode in distilled water to clean it, put it in 256mV standard buffer, wait for the data to stabilize, enter the following calibration command, and the 256mV point calibration is completed.

"AT+CALORP=256" [downlink:0xFD 01 00](#)

## 4.4 Dissolved Oxygen Sensor

The fluorescence dissolved oxygen sensor is a newly developed online digital sensor, using imported components and advanced production technology and surface mounting technology.

It has an IP68 waterproof rating, and the cable is seawater-proof. It can be directly put into the water without a protective tube, ensuring the long-term stability, reliability and accuracy of the sensor.

The fluorescence dissolved oxygen sensor is based on the principle of quenching active fluorescence by specific substances in physics.

The blue light from a light-emitting diode (LED) shines on the fluorescent material on the inner surface of the fluorescent cap.

The fluorescent material on the inner surface is excited and emits red light.

By detecting the phase difference between the red light and the blue light and comparing it with the internal calibration value, the concentration of oxygen molecules is calculated, and the final value is automatically compensated for temperature and air pressure.

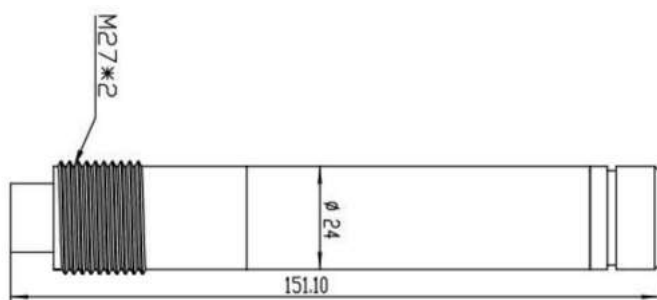
#### 4.4.1 Feature

- Small size, low power consumption, easy to carry.
- Truly achieve low cost, low price, high performance.
- High integration, long life, high reliability.
- Up to four isolations, can resist complex interference conditions on site, waterproof level IP68.
- The electrode uses high-quality low-noise cable, which can make the signal output length reach more than 20 meters.

#### 4.4.2 Specification

- Measuring range: 0-20mg/L, 0-50°C
- Accuracy: 3%,  $\pm 0.5^{\circ}\text{C}$
- Resolution: 0.01 mg/L, 0.01°C
- Maximum operating pressure: 6 bar
- Output signal: A: 4-20mA (current loop)
- B: RS485 (standard Modbus-RTU protocol, device default address: 01)
- Power supply voltage: 5-24V DC
- Working environment: temperature 0-60°C; humidity <95%RH
- Power consumption:  $\leq 0.5\text{W}$

#### 4.4.3 Dimension



#### 4.4.4 Instructions for use and maintenance

- Sampling: Take representative water samples according to the sampling requirements.
- Determine dissolved oxygen in water samples: First rinse the electrode three times with distilled water, then rinse it three times with the water sample, then immerse the electrode in the sample, carefully shake the test cup or stir it to accelerate the electrode balance, let it stand, and record the dissolved oxygen when the reading is stable.
- If it is inconvenient to take samples, you can also put the electrode in the measured solution, wait for the measured data to stabilize, read the output data, and take out the electrode after a period of time. Clean it.
- After the sample measurement is completed, rinse the electrode three times with distilled water and put the electrode back in the protective solution upright.

Note: When measuring multiple samples, the electrode should be cleaned before measuring the next sample to avoid affecting the experimental data.

If the water conditions are complex and you want accurate data, you need to wipe the sensor probe frequently.

#### 4.4.5 Precautions

- To ensure that the electrode measures correctly on the pipeline, avoid bubbles between the measuring cells that may cause data inaccuracy.
- Please check whether the packaging is intact and whether the product model is consistent with the selected model.
- Do not connect the wires with power on. After the wiring is completed and checked, power can be turned on.
- Do not arbitrarily change the components or wires that have been welded at the factory when using the product.
- The sensor is a precision device. When using it, please do not disassemble it by yourself or contact the sensor surface with sharp objects or corrosive liquids to avoid damaging the product.

### 4.5 Turbidity Sensor

The turbidity sensor is a newly developed online digital turbidity sensor, using imported components and advanced production technology and surface mounting technology.

It has an IP68 waterproof rating, and the cable is seawater-proof. It can be directly put into the water without a protective tube, ensuring the long-term stability, reliability and accuracy of the sensor. This sensor probe uses a scattered light turbidity measurement method.

Since the turbidity in the water sample causes light to scatter, the intensity of the scattered light in the direction perpendicular to the incident light is measured and compared with the internal calibration value to calculate the turbidity in the water sample.

The ambient light interference is eliminated by infrared light and filters. After linearization processing, the output signal is stable and accurate.

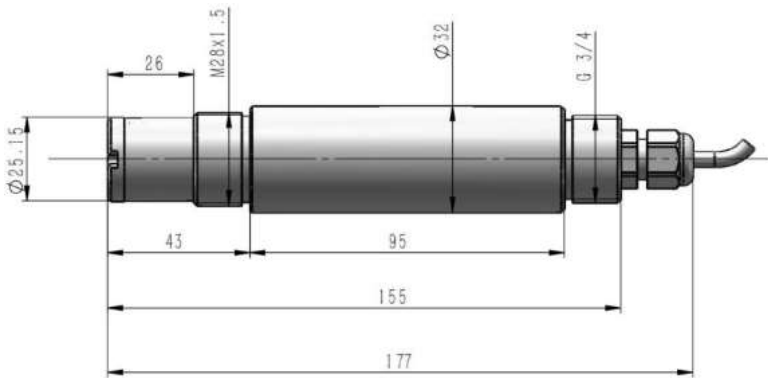
### 4.5.1 Feature

- RS485 Temperature, Humidity, Illuminance, Pressure sensor
- Axial capacitor filtering is used internally, and 100MΩ resistor increases impedance and enhances stability.
- Small size, low power consumption, and easy to carry.
- Truly achieve low cost, low price, and high performance.
- High integration, long life, and high reliability.
- Up to four isolations can resist complex interference conditions on site, and the waterproof level is IP68.
- The electrode uses high-quality low-noise cable, which can make the signal output length reach more than 20 meters

### 4.5.2 Specification

- Measuring range: 0.1 ~ 1000.0NTU
- Accuracy: ±5%
- Resolution: 0.1NTU
- Stability: ≤3mV/24 hours
- Output signal: A: 4 ~ 20 mA (current loop) B: RS485 (standard Modbus-RTU protocol, device default address: 15)
- Power supply voltage: 5 ~ 24V DC (when the output signal is RS485)
- 12 ~ 24V DC (when the output signal is 4 ~ 20mA)
- Working environment: temperature 0 ~ 60°C; humidity ≤95%RH
- Power consumption: ≤0.5W

### 4.5.3 Dimension



### 4.5.4 Instructions for use and maintenance

- It can be directly put into water without adding a protective tube, ensuring the long-term stability, reliability and accuracy of the sensor.
- If the water conditions are complex and you want accurate data, you need to wipe the sensor probe frequently.

### 4.5.5 Calibration

For turbidity calibration, you only need to prepare a solution. You can choose 0NTU, 200NTU, 400NTU, 600NTU, 800NTU, 1000NTU, and then enter the corresponding calibration command.

- |   |                            |
|---|----------------------------|
| "AT+CALNTU=0" <a href="#">downlink:0xFE 00</a>  | 0NTU turbidity solution    |
| "AT+CALNTU=2" <a href="#">downlink:0xFE 02</a>  | 200NTU turbidity solution  |
| "AT+CALNTU=4" <a href="#">downlink:0xFE 04</a>  | 400NTU turbidity solution  |
| "AT+CALNTU=6" <a href="#">downlink:0xFE 06</a>  | 600NTU turbidity solution  |
| "AT+CALNTU=8" <a href="#">downlink:0xFE 08</a>  | 800NTU turbidity solution  |
| "AT+CALNTU=10" <a href="#">downlink:0xFE 0A</a> | 1000NTU turbidity solution |

### 4.5.6 Precautions

- To ensure that the electrode measures correctly on the pipeline, avoid bubbles between the measuring cells that may cause data inaccuracy.
- Please check whether the packaging is intact and whether the product model is consistent with the selected model.
- Do not connect the wires with power on. After the wiring is completed and checked, power can be turned on.
- Do not arbitrarily change the components or wires that have been welded at the factory when using the product.

- The sensor is a precision device. When using it, please do not disassemble it by yourself or contact the sensor surface with sharp objects or corrosive liquids to avoid damaging the product.
- Do not power on while connect the cables. Double check the wiring before power on

## 5. OTA Firmware update

User can change firmware WQS-LB to:

- Change Frequency band/ region.
- Update with new features.
- Fix bugs.

Firmware and changelog can be downloaded from : Firmware download link (<https://www.dropbox.com/scl/fo/14cr8sv0yv5f4vhsx2gil/AJsl0MKHqmuo1-g7D2tFXwg?rlkey=ls08i07mt1fowivs9eb5xoc0o&st=ww2gbjs9&dl=0>)

Methods to Update Firmware:

- (Recommended way) OTA firmware update via wireless: <http://wiki.dragino.com/xwiki/bin/view/Main/Firmware%20OTA%20Update%20for%20Sensors/> (<http://wiki.dragino.com/xwiki/bin/view/Main/Firmware%20OTA%20Update%20for%20Sensors/>)
- Update through UART TTL interface: **Instruction** (<http://wiki.dragino.com/xwiki/bin/view/Main/UART%20Access%20for%20LoRa%20ST%20v4%20base%20model/#H1.LoRaSTv4baseHardware>)

## 6. FAQ

## 7. Order Info

### 7.1 Main Process Unit

Part Number: **WQS-LB-XX**

**XX**: The default frequency band

- **AS923**: LoRaWAN AS923 band
- **AU915**: LoRaWAN AU915 band
- **EU433**: LoRaWAN EU433 band
- **EU868**: LoRaWAN EU868 band
- **KR920**: LoRaWAN KR920 band
- **US915**: LoRaWAN US915 band
- **IN865**: LoRaWAN IN865 band
- **CN470**: LoRaWAN CN470 band

### 7.2 Sensors

Sensor Model	Part Number
PH Sensor	DR-PH01
EC K1 Sensor	DR-ECK1.0
EC K10 Sensor	DR-ECK10.0
ORP Sensor	DR-ORP1
Dissolved Oxygen Sensor	DR-DO1
Turbidity Sensor	DR-TS1

## 8. Support

- Support is provided Monday to Friday, from 09:00 to 18:00 GMT+8. Due to different timezones we cannot offer live support. However, your questions will be answered as soon as possible in the before-mentioned schedule.
- Provide as much information as possible regarding your enquiry (product models, accurately describe your problem and steps to replicate it etc) and send a mail to [support@dragino.com](mailto:support@dragino.com) (file:///D:/市场资料/说明书/LoRa/LT系列/support@dragino.com)

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