Weighing Bucket Rain Gauge Sensor

User Manual

ATO-SN-3008-CYL

1.1 Product Overview

The weighing-type rain gauge sensor employs weighing principle technology, utilizing high-precision sensors to measure precipitation intensity. It monitors all precipitation types—solid, liquid, and solid-liquid mixtures. The product outputs data including precipitation intensity and cumulative precipitation. The product's real-time precipitation intensity measurement range spans 6 to 1800 mm/h, ensuring high measurement accuracy under various rainfall conditions including light rain and heavy downpours. Equipped with a heating device, it prevents the collection chamber from freezing or narrowing due to low temperatures, enabling reliable operation in frigid northern regions and humid southern areas experiencing freezing weather events.

The product features a low-power operating mode, enabling the data acquisition system to be powered by solar energy. It offers simple and convenient installation, low maintenance requirements, and straightforward calibration. With multiple output formats including RS485 and pulse signals, it adapts to various data acquisition devices. The product serves applications in hydrology, meteorology, oceanography, emergency response, transportation, agriculture and forestry, power generation, national defense, and scientific research.

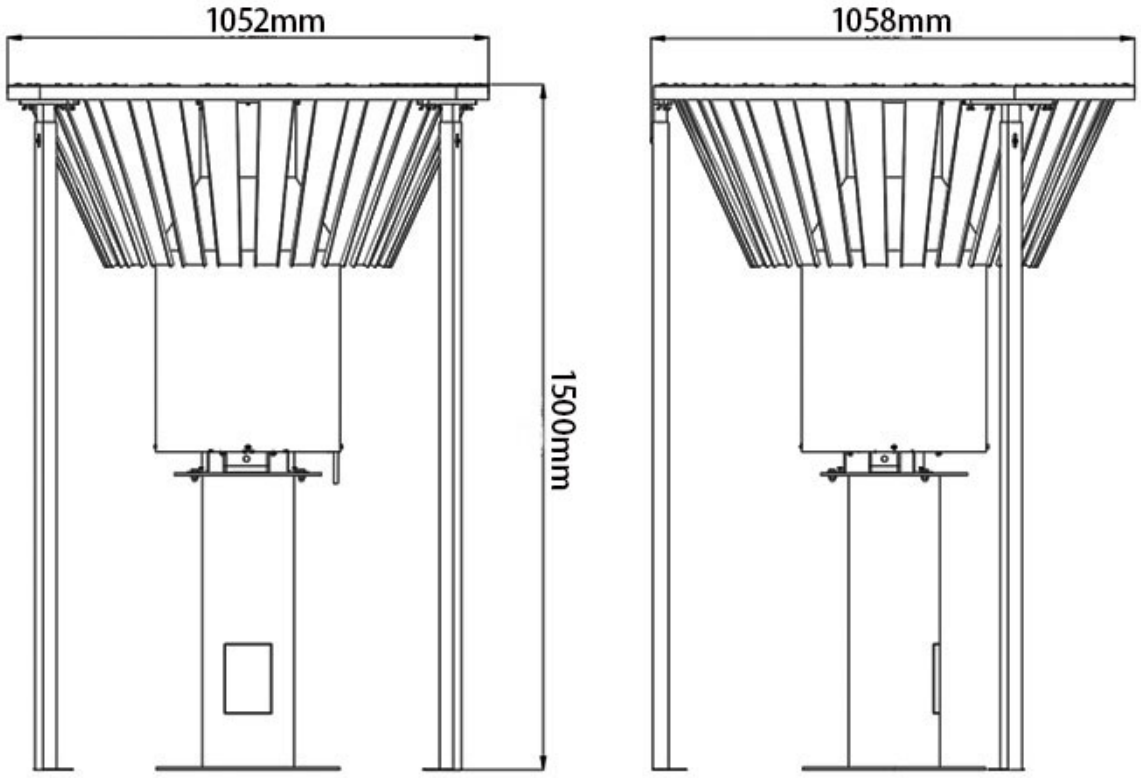
1.2 Features

- The precipitation intensity measurement range spans from 6 to 1800 mm/h.
- The device features a heating function, enabling measurement of snowfall and preventing freezing issues during winter.
- The device features automatic drainage. When water volume reaches 80% of capacity, the device will automatically drain.
- High measurement accuracy, capable of precise measurement regardless of whether rainfall intensity is low or high, outperforming traditional tipping-bucket gauges.
- The shell design features a convex shape, serving to block wind, reduce evaporation, and increase precipitation capture.
- The equipment can be optionally equipped with heating. Heating is automatically controlled: the device begins heating when the temperature falls below 1°C and stops heating when it rises above 9°C.

1.3 Key Parameters

Power Supply	12V DC
Power Consumption	0.15W（DC12V）
Range	0~1000mm
Resolution	0.1mm
Rainwater Collector Inlet Diameter	$^{+}200\ \phi^{0.6}$ mm
Error	ower mm w en ≤Sw mm; oru w en >Sw mm
Transmitter Component Temp and Humidity Resistance	-35℃~+65℃，0%RH~95% RH (non-pondensingl

1.4 Product Dimensions



2.1 Pre-Installation Equipment Inspection

Equipment List:

- Weighing-type rain gauge sensor*1
- Mounting base*1
- Windproof ring*1

2.2 Interface Specification

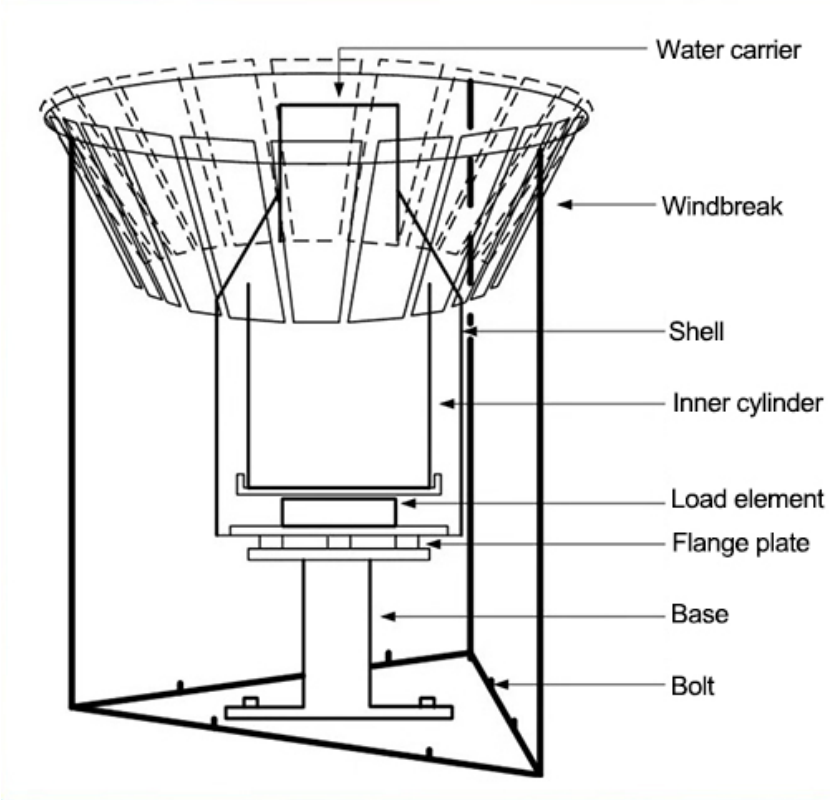
485 Type:

Line Color	Note	Line Color	Note
Brown line	V+	Yellow line	485A
Black line	V-	Blue line	485B

Pulsed Type:

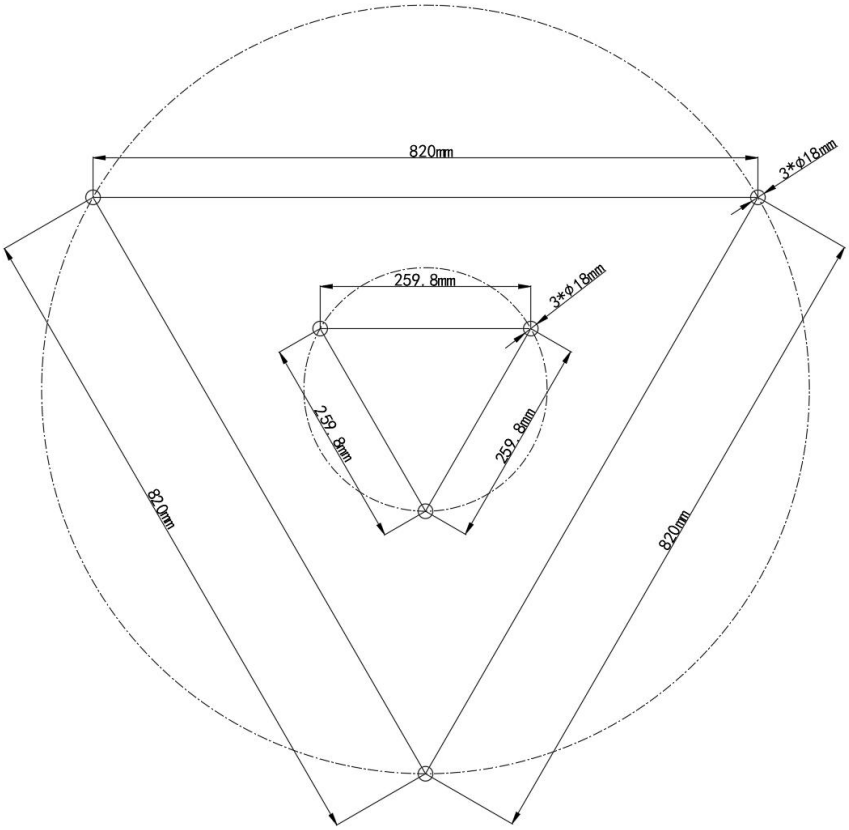
Line Color	Note	Line Color	Note
Brown line	V+	Yellow line	Pulse out NO terminal
Black line	V-	Blue line	Pulse out COM terminal

2.3 Schematic Diagram



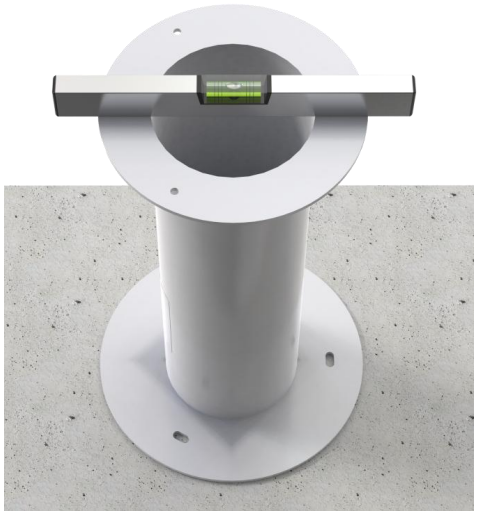
2.4 Foundation Construction

The concrete foundation measures 150 cm*150 cm*50 cm (LWH), with its top surface flush with the ground level. Drill six φ18 installation holes (12–15 cm deep) into the cement foundation according to the dimensions shown below (two concentric circles). Insert expansion bolts into the installation holes.



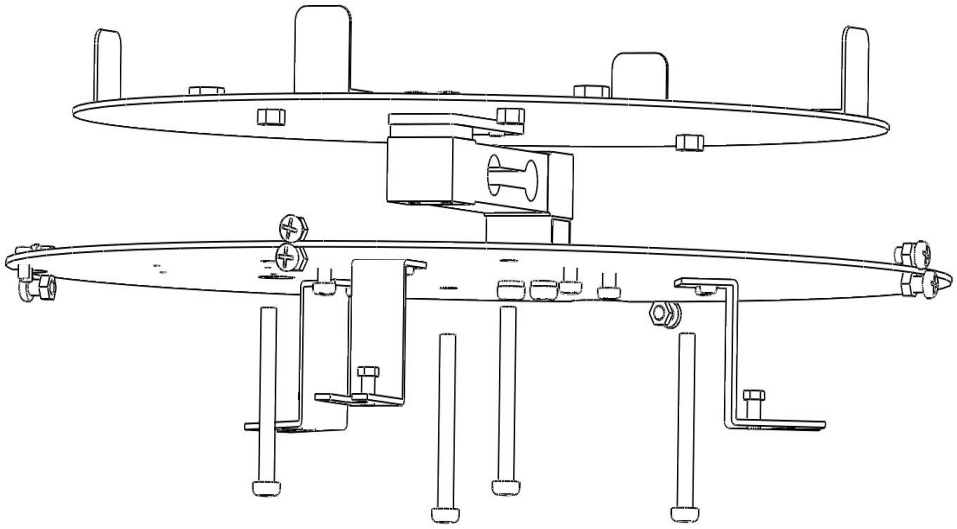
2.5 Base Installation

Route the DC power supply cable (user-supplied) and output signal cable from the distribution box through the conduit in the concrete foundation. Secure the base to the concrete foundation using bolts (pre-installed in the foundation) and nuts. To facilitate subsequent base leveling and ensure overall sensor installation quality, maintain the base as level as possible during installation.

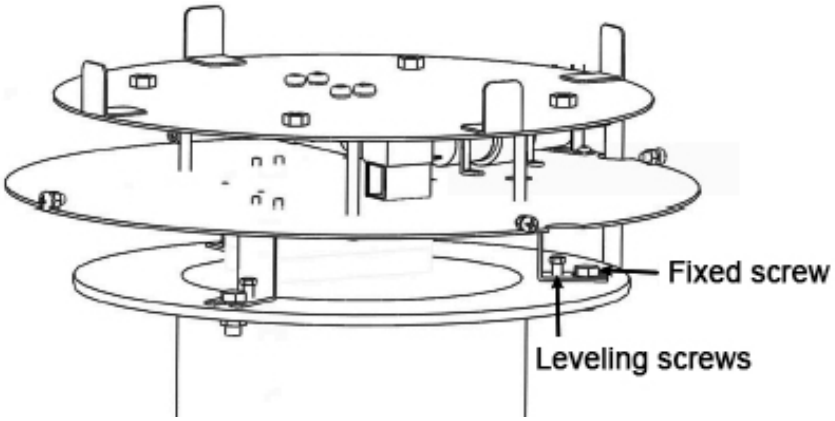


2.6 Installation of the Rain Gauge Main Unit

Unscrew the three screws on the outer casing, remove the casing and sampling bucket, and store them securely in the transport box. The device features a transport lock consisting of four hex socket countersunk screws (M6*60). This design minimizes the risk of damage to the electronic balancing system during transportation. The transport lock must be removed prior to installation.



Screw the three leveling bolts (M5*10) into the base plate. Place the entire base plate onto the foundation. Secure the base plate to the foundation using three sets of fixing bolts (M8*20) and nuts (M8) (do not fully tighten the bolts). Adjust the three leveling bolts until the base plate is level with the foundation surface. Then, use a wrench to fully tighten the three sets of fixing bolts. Connect the heating device plug to the main control unit.



2.7 Pre-add Liquid

To enhance measurement accuracy, add approximately 1 liter of water to the sampling bucket before use, then securely place the sampling bucket on the tray. If evaporation is severe, an environmentally friendly evaporation suppressant oil may be used, with the dosage sufficient to completely cover the surface of the collection container.

Fill to the liquid surface level in the container, avoiding overfilling. When temperatures drop below 0°C, use antifreeze solution. This solution must be an environmentally friendly mixture formulated to prevent freezing of the collected liquid in temperatures below -35°C. Add antifreeze before winter sets in. No additional water is required after adding antifreeze. When operating below 0°C without antifreeze, ensure precipitation does not exceed 80% of the bucket's capacity. Failure to do so may cause irreversible damage to the measurement system.

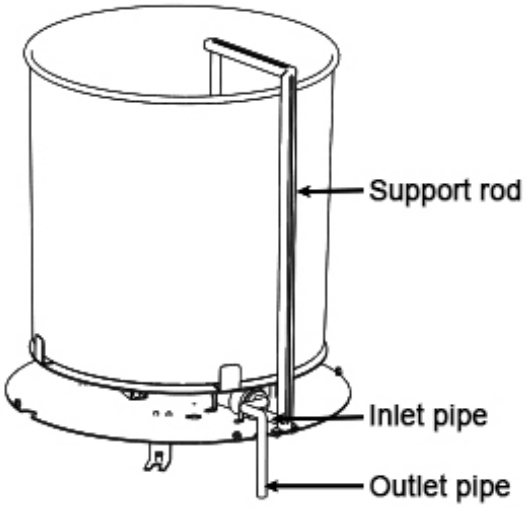
Antifreeze Addition Ratio Chart

(Inner cylinder capacity: 1000mm precipitation volume)

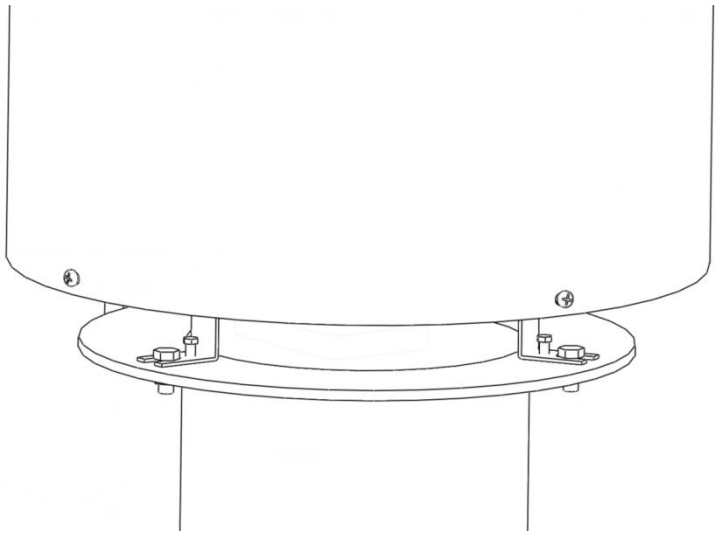
Annual Average Min Temp	$C_2H_6O_2$ Addition Volume (L)	CH_3OH Addition Volume (L)
0°C (or above)	0	0
-5°C	1.75	2.25
-10°C	2.75	4.25
-15°C	4	5.5
-20°C	4.5	6.75
-25°C	5.25	7.75
-30°C	6	8.75
-35°C (or below)	6.5	9.5

Note: Methanol is a flammable, toxic hazardous material with an irritating odor. Ethylene glycol is also a chemical substance. Strict adherence to safety precautions is required for their proper use and storage.

After adding the liquid, secure the automatic drain support rod to the base using two screws (M4*6). Insert the water inlet pipe into the pump inlet on the base.



After installation is complete, reinstall the outer casing onto the base.

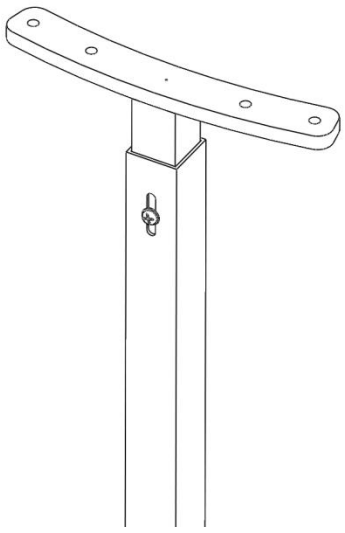


2.8 Install the Windbreak Ring

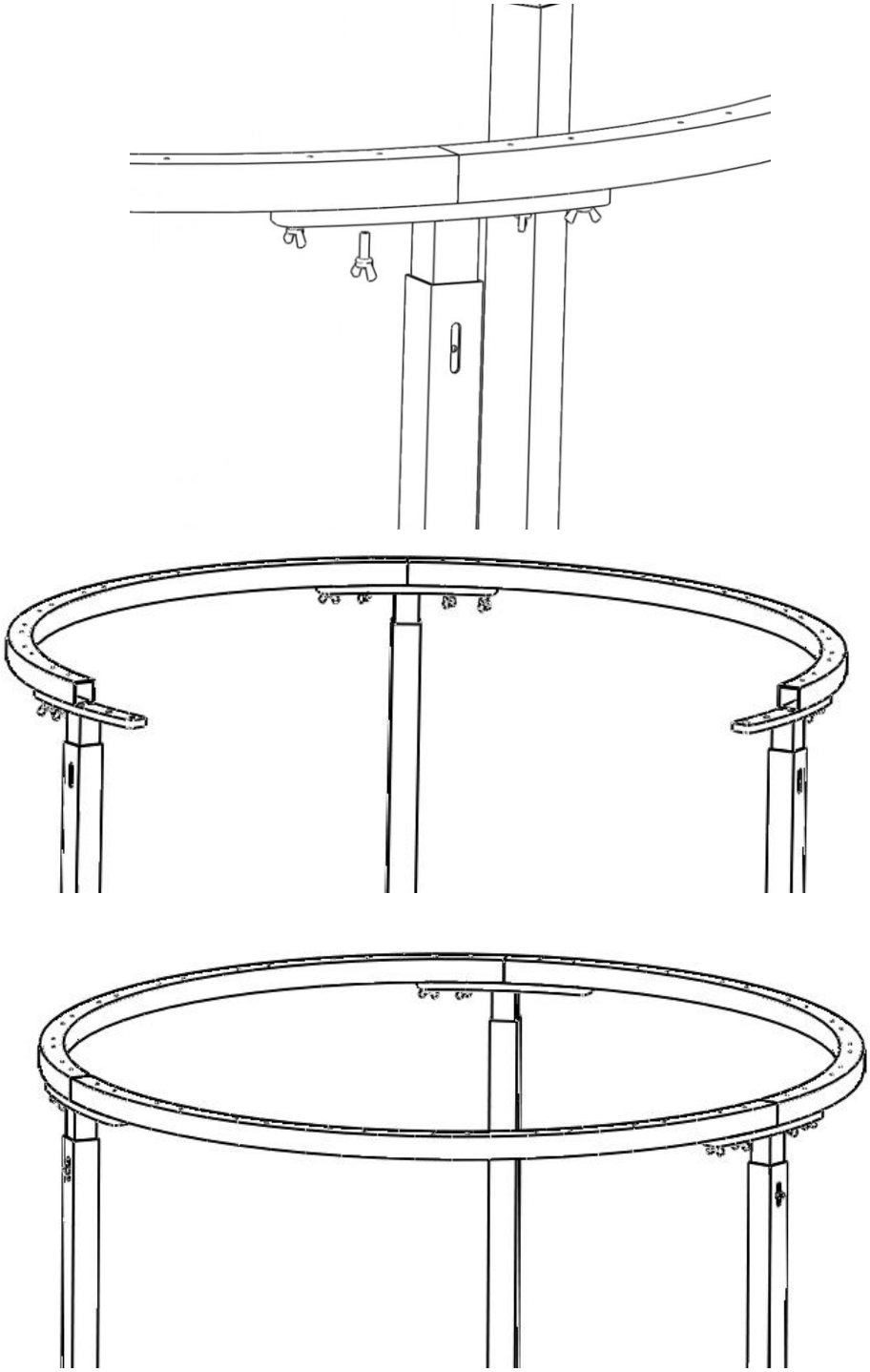
Ensure the precipitation sensor is positioned at the center of the windshield. The height of the windshield should be slightly higher than the upper edge of the sensor's water collection port. Installing the windshield is an independent process from sensor installation. You may assemble the windshield in an open area first, then move it to the foundation for securing; alternatively, assembly can be performed directly on the foundation.

2.8.1 Install the Windshield Mounting Ring

Secure the three T-shaped support brackets to the upper ends of the vertical rods using spring-loaded screws (M5*10). The inner arcs of the T-shaped brackets should align with the grooves on the support plate.



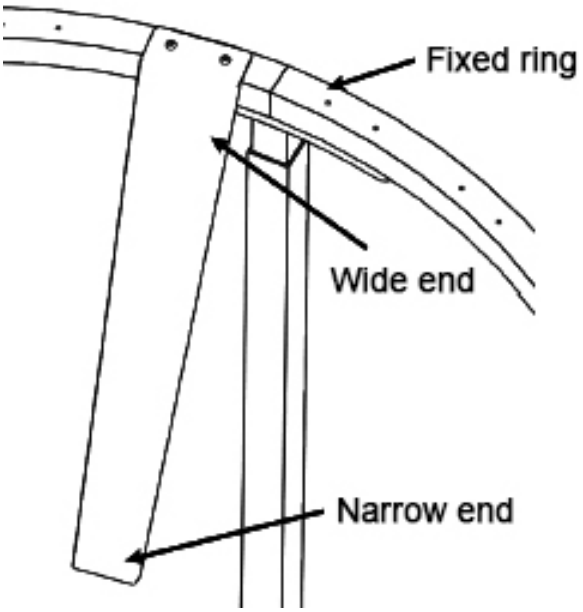
Attach the three windshield retaining rings to the three windshield support brackets using M5 wing screws (M5*16).



2.8.2 Install the Wind Deflector Blades

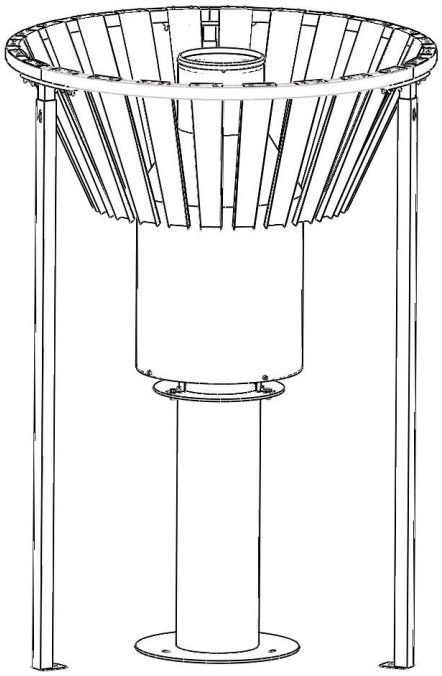
Install the windshield blades onto the windshield mounting ring using screws (M4*12). During installation, slightly adjust the height and angle of the windshield blades as needed to ensure they are evenly spaced and aesthetically pleasing.

Note: Generally, adjust the blade position so that its upper edge aligns with the upper edge of the retaining ring.



2.8.3 Completed Installation

After securing all windshield blades, the windshield assembly is complete. Finally, install it onto the pre-installed mounting screws on the base. Adjust the windshield height using the oval holes on the vertical support rod until the top surface of the windshield mounting ring is 2 cm above the upper edge of the sensor port.



Equipment Field Commissioning

After connecting the sensor power supply on-site, to ensure the precipitation sensor is correctly installed and connected, perform a test after parameter configuration before formal detection. Follow these steps:

(1) Connect the sensor's communication cable to the laptop;

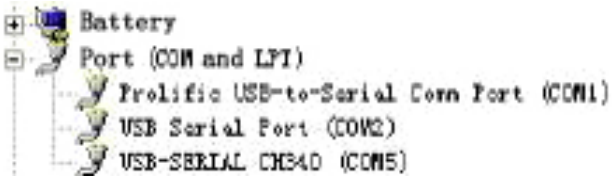
(2) Run the configuration software on the computer and configure communication parameters;

(3) After powering on the device for 5 minutes, perform a water test;

(4) Using the 10mm rain gauge's dedicated measuring cup, slowly pour 10mm of water into the rain gauge bucket (taking approximately 2 minutes); (5) Read the precipitation amount using the configuration software; the result should be within 10mm ± 0.2mm.

4.1 Connect the Sensor to the Computer

ATO provides a dedicated “Sensor Monitoring Software” that allows convenient reading of sensor parameters via computer, while also enabling flexible modification of sensor device IDs and addresses. Note that when using the software's automatic detection feature, ensure only one sensor is present on the 485 bus. After correctly connecting the sensor to the computer via a USB-to-485 adapter and providing power, the correct COM port will be visible in the computer (check the COM port under “My Computer > Properties > Device Manager > Ports”).



Open the data package, select “Debugging Software” → “485 Parameter Configuration Software,” locate the 485 configuration software, and open it. If no COM port is found in Device Manager, it indicates that you have not installed the USB-to-485 driver (included in the documentation package) or that the driver was not installed correctly. Please contact technical support for assistance.

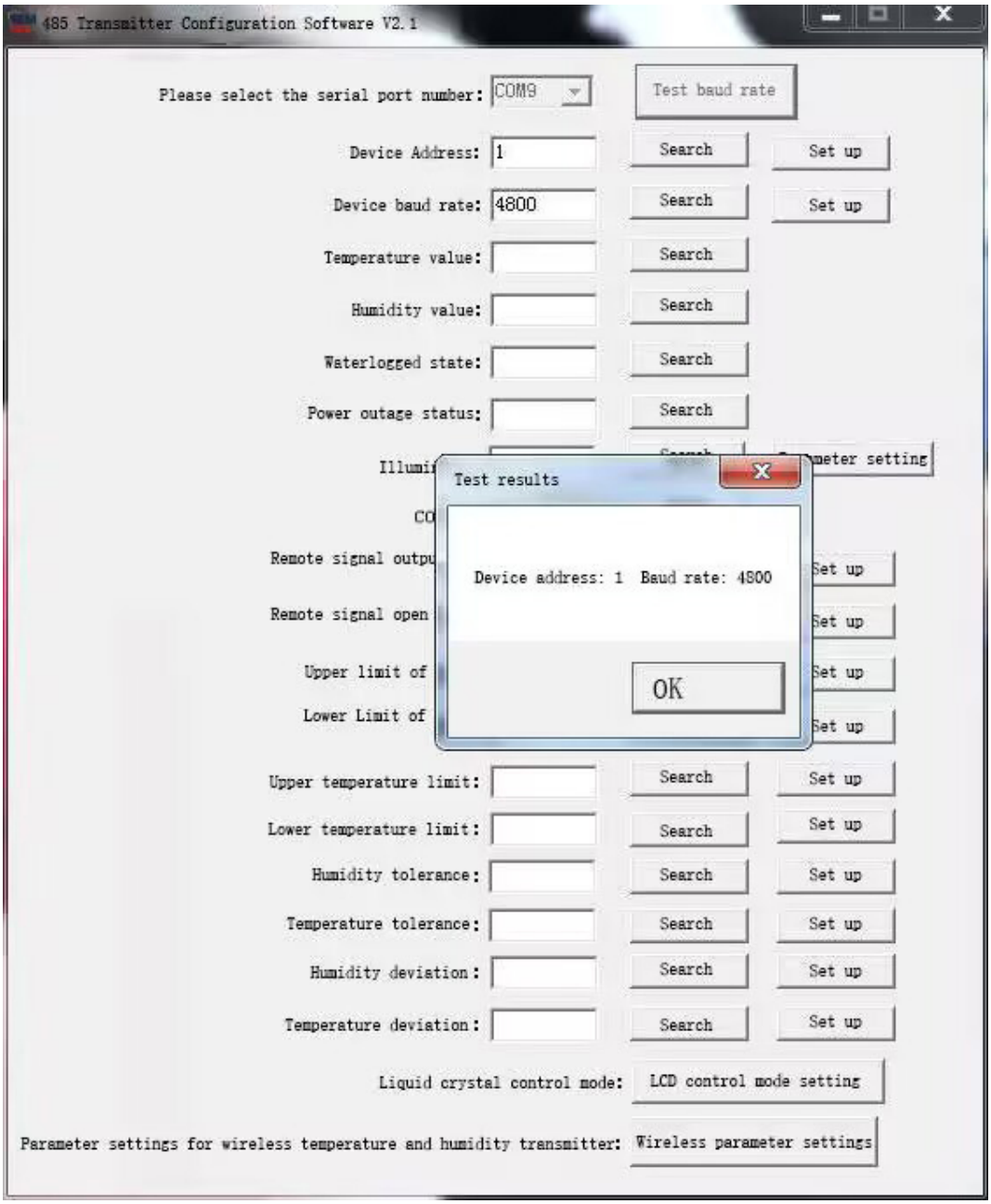
4.2 Usage of Sensor Monitoring Software

① The configuration interface is shown in the figure. First, obtain the serial port number using the method described in Section 4.1 and select the correct serial port.

② Click the software's test baud rate button to determine the current device's baud rate and address. The default baud rate is 4800 bit/s, and the default address is 0x01.

③ Modify the address and baud rate as needed, while also checking the device's current functional status.

④ If the test fails, please recheck the device wiring and the installation of the 485 driver.



5.1 Basic Communication Parameters

Code	8-bit binary
Data bit	8-bit
Parity bit	None
Stop position	1-bit
Error check	CRC
Baud rate	1200 bit/s, 2400 bit/s, 4800 bit/s, 9600 bit/s, 19200 bit/s, 38400 bit/s, 57600 bit/s, 115200 bit/s are configurable. The factory default is 4800 bit/s.

5.2 Data Frame Format Definition

Using the ModBus-RTU communication protocol, the format is as follows:

Initial structure ≥4 bytes of time

Address code = 1 byte

Function code = 1 byte

Data area = N bytes

Error check = 16-bit CRC code

End structure ≥4 bytes of time

Address code: Represents the sensor's address, which is unique within the communication network (factory default 0x01).

Function Code: Indicates the command type sent by the host. This sensor only uses function code 0x03 (read register data).

Data Area: Contains the specific communication data. Note: For 16-bit data, the high byte comes first!

CRC Code: A two-byte check code.

Host Inquiry Frame Structure:

Address code	Function code	Register start address	Register length	Checksum low byte	Checksum high byte
1 byte	1 byte	2 bytes	2 bytes	1 byte	1 byte

From-machine response frame structure:

Address code	Function code	Number of valid bytes	Data area 1	Data area 2	Data area N	Checksum
1 byte	1 byte	1 byte	2 bytes	2 bytes	2 bytes	2 bytes

5.3 Register Address

Register address	Content	Operation (Hexadecimal)	Scope, Content, and Definitions

0000 H	Today's rainfall	03/04	Rainfall from midnight to present: mm, multiplied by 10
0001 H	Minute precipitation	03/04	Set the rainfall unit within the sampling interval to mm, multiplied by 10.
0002 H	Yesterday's rainfall	03/04	Rainfall over the past 24 hours: mm， multiplied by 10
0003 H 0004 H	Total precipitation	03/04	Total precipation Unit: mm, multiplied by 10
0005 H	Rainfall intensity	03/04	Unit: mm/min, multiplied by 10
0009 H	Version No.	03/04	Version No.
0020 H	Sampling interval	03/04	Range: 1 to 60 min, default 1 min
0034 H	Month and Year	03/04/06/10	High-order digit: Year (last two digits 00–99) Low-order digit: Month (1–12)
0035 H	Day and time	03/04/06/10	High position: Day (01–31) Low position: Hour (00–24)
0036 H	Seconds	03/04/06/10	Hour: (00–59) Minute: (00–59)
0037 H	Rainfall reset	06/10	Write 3 to reset rainfall
07D0 H	Device address	03/04/06/10	1–254 (default 1)
07D1H	Device baud rate	03/04/06/10	0:2400; 1:4800; 2:9600 3:19200; 4:38400; 5:57600; 6:115200; 7:1200

5.4 Communication Protocol Examples and Explanations

5.4.1 Check Today's Rainfall

Amount Query Frame:

Address code	Function code	Start register	Date length	Checksum low byte	Checksum high byte
0x01	0x03	0x00 0x00	0x00 0x01	0x84	0x0A

Response Frame:

Address code	Function code	Return the number of valid byte	Rainfall value	Checksum low byte	Checksum high byte
0x01	0x03	0x02	0x00 0x1A	0x39	0x8F

Current rainfall value: (Uploaded value multiplied by 10)

001A (hexadecimal) = 26 (decimal) → Rainfall value: 2.6 mm

5.4.2 Check/Set Time

Query time, inquiry frame:

Original address	Function code	Register address high	Register address low	High register length	Low register length	Low CRC16	High CRC16
0x01	0x03	0x00	0x34	0x00	0x03	0x44	0x05

If the sensor receives correctly, return the following data in the response frame:

Address	0x01	
Function code	0x03	
Date length	0x06	
Year	0x20	BCD code Represents: March 30, 2020, 10:25:10 AM
Month	0x03	
Day	0x30	
Hour	0x10	
Minute	0x25	
Second	0x10	
Low CRC16	0x77	
High CRC16	0x8C	

If the clock is out of sync, you can calibrate it: master → slave.

Address	0x01	
Function code	0x10	
Start address high	0x00	
Start address low	0x34	
High register length	0x00	
Low register length	0x03	
Date length	0x06	
Year	0x20	BCD code Represents: April 3, 2020, 17:06:28
Month	0x04	
Day	0x03	
Hour	0x17	
Minute	0x06	
Second	0x28	

Low CRC16	0xE2	
High CRC16	0xF4	

If the sensor receives correctly, return the following data from slave → master:

Address	Function code	Start address high	Start address length	High register length	Low register length	Low CRC16	High CRC16
0x01	0x10	0x00	0x34	0x00	0x03	0xC1	0xC6

Note: Calibration will clear all rainfall data.

5.4.3 Rainfall Data Reset Settings

Rainfall data reset settings: Master → Slave

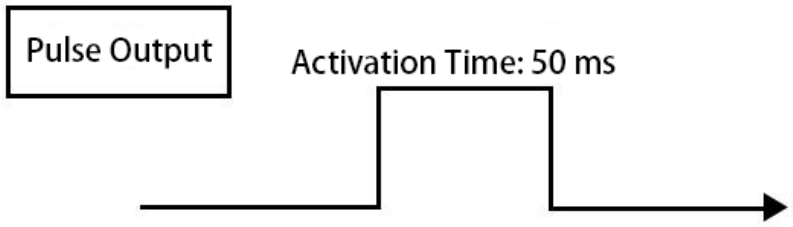
Original address	Function code	Register address high	Register address low	High data content	Low data content	Low CRC16	High CRC16
0x01	0x06	0x00	0x37	0x00	0x03	0x78	0x05

If the sensor receives data correctly, the data is returned via the original path.

Note: Before installation and use, the rainfall counter must be reset to zero.

6. Pulse Output Instruction

For every 0.1mm of accumulated rainfall, one valid pulse is output (non-real-time, with a 1-minute delay). Output waveform:



7. Maintenance and Care

(1) The instrument is exposed to outdoor conditions for extended periods under harsh environmental conditions. Therefore, the inner surface of the rainwater inlet should be regularly wiped with a soft cloth to maintain cleanliness. If leaves or other foreign objects are found inside the inlet, they should be promptly removed to ensure unobstructed water flow.

(2) When the instrument is not in use for an extended period, cover the ring opening with a cap to protect the rain inlet.

(3) Instruments operating continuously should be cleaned once a month, and must be cleaned at least once every three months.

(4) When the antifreeze and evaporation inhibitor oil in the inner cylinder are insufficient, add an appropriate amount;

(5) Conduct annual spring lightning safety inspections on the weighing-type precipitation sensor.

8. Important Notes

1) Warning: Risk of Personal Injury

This equipment must not be used as a safety device, emergency stop device, or in any situation where equipment failure could result in personal injury.

2) Restrictions on Use

This equipment must only be used for its intended purpose and within authorized parameters.

Before installation, operation, or maintenance, carefully read and understand all relevant instructions in the technical manual.

Failure to comply with these warnings and instructions may result in death or serious personal injury.

This document lists common malfunctions that may occur with the instrument, their causes, and troubleshooting methods.

Central Station Presentation Format	Rainfall Sensor Malfunction	Solution
No signal during rainfall	Indicates no signal output from the rain gauge sensor or transmission line failure; weighing module malfunction; instrument blockage;	Lower station inspection Replacement Cleaning
The rainfall measurements recorded during precipitation events differ significantly from those of the reference rain gauge.	Automatic drainage failure caused equipment to stop draining, resulting in rainwater overflow and weighing module malfunction.	Replace, drain accumulated water, and contact technical support for recalibration.

Note: The fault symptoms listed in the table above may not all be caused by the rain gauge sensor itself. After inspecting and troubleshooting the instrument itself, you should also check whether the instrument's output cable, data acquisition device, and other equipment are faulty, and resolve each issue one by one.