

USER MANUAL
RAIN GAUGE

HOLYKELL.COM

HRS10 All Stainless Steel Rain Gauge User Manual

(RS485 Model)

Document Version: V1.3



1. Product Introduction

1.1 Product Overview

This instrument is a primary instrument for measuring precipitation. Its performance complies with the national standard GB/T 21978.2-2014 "Requirements for Precipitation Observation."

The core component of this instrument, the tipping bucket, adopts a three-dimensional streamlined design and is made entirely of stainless steel, allowing the bucket to tip water more smoothly. It also has self-cleaning (dust-shedding) properties and is easy to clean. The instrument outputs a pulse signal converted to RS485, allowing rainfall to be read directly without any secondary calculation, making it simple and convenient to use.

1.2 Structural Features

As shown in Figure 1, this instrument consists of a rain gauge housing, rain-collecting orifice, funnel, tipping-bucket support, tipping bucket, bearing screws, water outlet chamber, sealed connector, reed switch tube, bubble level, adjustment support plate, control box, leveling device, terminal blocks, leg supports, and rain gauge base. The base is fitted with the tipping-bucket shaft, a circular bubble level, the reed-switch-tube bracket, and the signal output terminals. Unlike other tipping-bucket rain gauges, this instrument's tipping-bucket shaft sleeve is an integrated positioning structure; the bucket is mounted in the bearing via the shaft. The internal structure is fully assembled at the factory, so no on-site assembly of internal components is required, which makes field installation more convenient.

The tipping bucket of this instrument uses a three-dimensional streamlined design with a drooping curved-surface flow-guiding tip, giving it an attractive, smooth appearance, better water-tipping performance, and easier cleaning and maintenance.

A permanent magnet is mounted on the tipping bucket, and a reed switch (reed tube) is mounted on its bracket. At the factory, the magnet and reed switch are adjusted to an appropriate coupling distance, ensuring a defined proportional relationship between the instrument's output signal and the number of bucket tips.

At the factory, the tipping-bucket tilt-adjustment screw has already been locked at the optimum tilt-angle set point, and the tilt screw has been sealed with a dab of red paint. When installing the instrument on site, the user only needs to adjust the overall instrument so that the bubble level is centered, as required in this manual, before putting it into use — there is no need to re-adjust the bucket tilt angle on site.

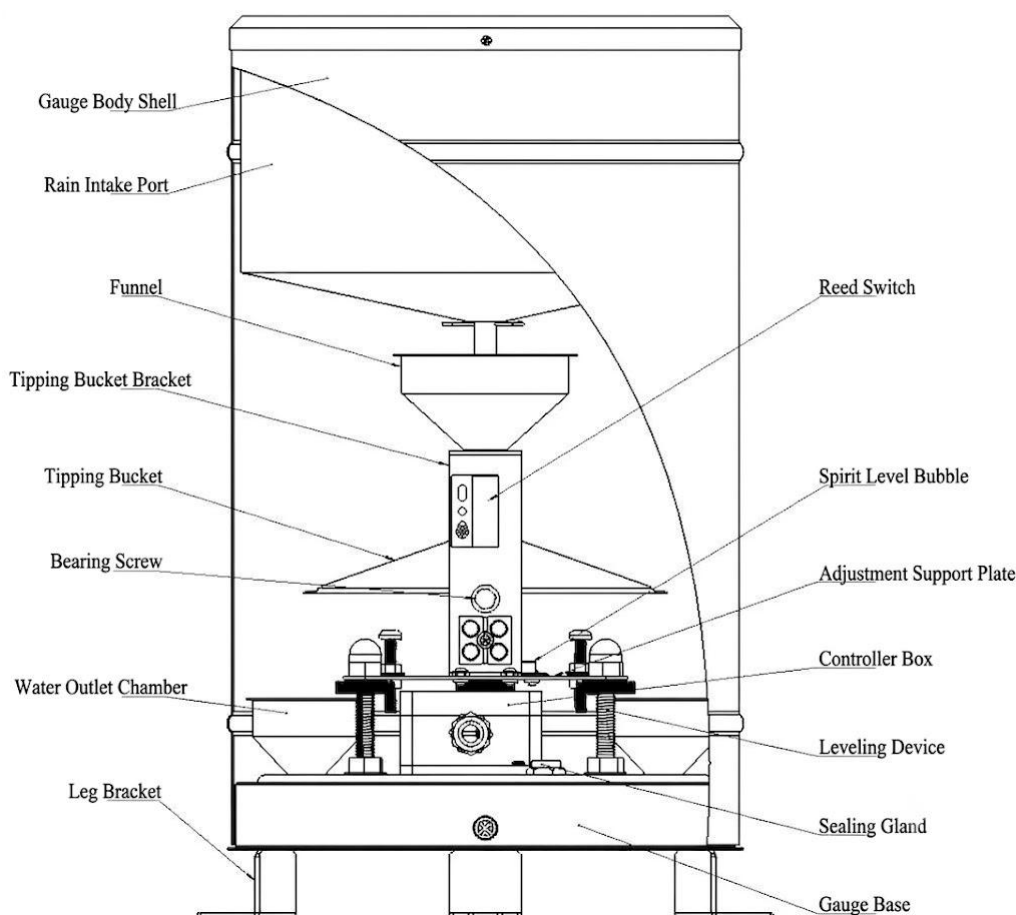


Figure 1

1.3 Main Technical Specifications

Parameter	Specification
Rain gauge cylinder diameter	Φ200 mm
Resolution	0.1 mm / 0.2 mm / 0.5 mm (optional)
Blade edge angle	40°~45°
Output method	RS485 communication (standard MODBUS-RTU protocol)
Power supply range	DC 4.5~30 V
Maximum power consumption	0.24 W
Operating temperature	0~55 °C
Operating humidity	<95% (40 °C)
Storage temperature	-40~125 °C
Storage humidity	<80% (non-condensing)
Typical accuracy	≤ ±4% (based on indoor artificial rainfall, referenced to the instrument's own drainage volume)
Rainfall intensity range	0 mm~4 mm/min; maximum allowable rainfall intensity: 8 mm/min

1.4 Product Model Selection

Note: The matching support plate must be purchased separately.

HRS10				Rain gauge
	N01-			RS485 signal output (standard ModBus-RTU protocol)
		5-		All stainless steel
			01	0.1 mm resolution
			02	0.2 mm resolution
			05	0.5 mm resolution
			01P	0.1 mm resolution, high precision
			02P	0.2 mm resolution, high precision
			05P	0.5 mm resolution, high precision

2. Equipment Installation Instructions

2.1 Pre-Installation Inspection

- (1) Remove the instrument from the packing box and carefully check it against the packing list in the manual to make sure all accessories are complete.
- (2) Carefully read the product manual and the certificate of conformity.
- (3) Check the instrument's exterior for damage, in particular checking whether the tipping bucket is intact. Take care when placing the bucket down to avoid damaging the pivot tips of the bucket shaft and the curved water-guiding tips at both ends of the bucket. Do not touch the inner surface of the bucket with your fingers, to avoid contaminating it, which could impair the instrument's accuracy.
- (4) Remove the three screws at the bottom of the device, take off the stainless-steel outer cylinder, remove the retaining rubber band, then refit the outer cylinder. Preparation is now complete.



2.2 Outdoor Installation and Commissioning

2.2.1 Building the Installation Base

For outdoor ground-level or rooftop installation, build a concrete mounting base according to the dimensions and requirements shown in Figure 2. The top surface of the concrete base must be level. The concrete base is generally either a square pedestal of 40 cm × 40 cm with a height of no less than 30 cm, or a circular pedestal 40 cm in diameter. The rain-collecting orifice of the instrument must be 70 cm above ground level, and there must be no obstruction higher than the rain-collecting orifice within 3–5 meters of the instrument's opening.

2.2.2 Mounting the Device and Leveling the Rain-Collecting Orifice

Following the dimensions in Figure 2, drill three $\Phi 12$ mounting holes, 8–12 cm deep, in the concrete base. Insert expansion bolts into the holes, then mount the instrument base onto the expansion bolts. Use a level to check whether the collecting-ring opening is level; ensure it is level, then tighten the nuts to secure the instrument.

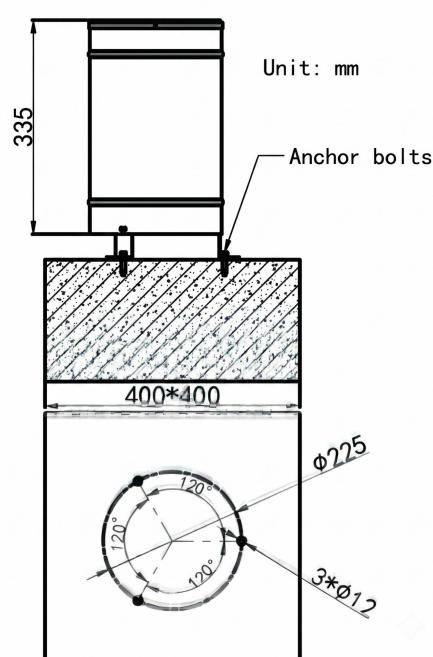


Figure 2

2.3 Wiring Instructions

Wire Color	Description	Wire Color	Description
Brown	Power +	Yellow	485A
Black	Power -	Blue	485B

3. Configuration Software Installation and Use

3.1 Software Selection

Open the resource package and select "Debugging Software" → "485 Parameter Configuration Software." Locate the 485 Device Parameter Configuration Tool.exe file and open it.

3.2 Parameter Settings

- ① Select the correct COM port (check it under "My Computer → Properties → Device Manager → Ports"). The figure below lists the driver names of several different RS485 converters, for example: Prolific USB-to-Serial Comm Port (COM1), USB Serial Port (COM2), USB-SERIAL CH340 (COM5).
- ② Connect and power up only a single device. Click the software's "Test Baud Rate" function; the software will detect 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 required, and query the device's current function status at the same time.
- ④ If the test is unsuccessful, please recheck the device wiring and the RS485 driver installation.

4. Communication Protocol

4.1 Basic Communication Parameters

Item	Value
Encoding	8-bit binary
Data bits	8 bits
Parity	None
Stop bits	1 bit
Error checking	CRC (Cyclic Redundancy Check)
Baud rate	1200 / 2400 / 4800 / 9600 / 19200 / 38400 / 57600 / 115200 bit/s configurable; factory default 4800 bit/s

4.2 Data Frame Format Definition

The ModBus-RTU communication protocol is used, with the following frame format:

Start structure: idle time ≥ 4 bytes

Address code = 1 byte

Function code = 1 byte

Data field = N bytes

Error check = 16-bit CRC code

End structure: idle time ≥ 4 bytes

Address code: the address of the transmitter, unique within the communication network (factory default 0x01).

Function code: indicates the function of the command issued by the master.

Data field: the specific communication data. Note that for 16-bit data, the high byte is transmitted first.

CRC code: a two-byte checksum.

Master query 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

Slave response frame structure:

Address code	Function code	Byte count	Data field 1	Data field 2	Data field N	Checksum
1 byte	1 byte	1 byte	2 bytes	2 bytes	2 bytes	2 bytes

4.3 Register Addresses

Register Address	Content	Operation (hex)	Range / Definition
0000H	Rainfall value	0x03 / 0x04 / 0x06	Rainfall value; reported value is 10× the actual value
07D0H	Device address	0x03 / 0x04 / 0x06 / 0x10	1~254 (factory default 1)
07D1H	Device baud rate	0x03 / 0x04 / 0x06 / 0x10	0 = 2400 1 = 4800 2 = 9600 3 = 19200 4 = 38400 5 = 57600 6 = 115200 7 = 1200

4.4 Communication Protocol Examples and Explanations

4.4.1 Query Current Rainfall Value

Query frame:

Address code	Function code	Start register	Data length	CRC low	CRC high
0x01	0x03	0x00 0x00	0x00 0x01	0x84	0x0A

Response frame:

Address code	Function code	Byte count	Rainfall value	CRC low	CRC high
0x01	0x03	0x02	0x00 0x0A	0x38	0x43

Current rainfall value (reported value is 10× actual): 000A (hex) = 10 (decimal) → rainfall value: 1.0 mm.

4.4.2 Clear Rainfall Data

Query frame:

Address code	Function code	Start register	Clear command	CRC low	CRC high
0x01	0x06	0x00 0x00	0x00 0x5A	0x09	0xF1

Response frame

Address code	Function code	Start register	Clear command	CRC low	CRC high
0x01	0x06	0x00 0x00	0x00 0x5A	0x09	0xF1

4.4.3 Modify Current Address

Query frame (example: current address 01, changing to 02):

Address code	Function code	Start address	New value	CRC low	CRC high
0x01	0x06	0x07 0xD0	0x00 0x02	0x08	0x86

Response frame

Address code	Function code	Start address	New value	CRC low	CRC high
0x01	0x06	0x07 0xD0	0x00 0x02	0x08	0x86

4.4.4 Modify Current Baud Rate

Query frame (example: current baud rate 4800, changing to 9600):

Address code	Function code	Start address	New value	CRC low	CRC high
0x01	0x06	0x07 0xD1	0x00 0x02	0x59	0x46

Response frame

Address code	Function code	Start address	New value	CRC low	CRC high
0x01	0x06	0x07 0xD1	0x00 0x02	0x59	0x46

4.4.5 Query Address

If the user forgets the device address, the following function code can be used to query it.

Query frame:

Address code	Function code	Start address	Data length	CRC low	CRC high
0xFF	0x03	0x07 0xD0	0x00 0x01	0x91	0x59

Response frame:

Address code	Function code	Byte count	Address	CRC low	CRC high
0xFF	0x03	0x02	0x00 0x01	0x50	0x50

The address code read back is the device's actual address: 01.

5. Maintenance

5.1 Routine Maintenance

As this instrument operates outdoors for extended periods under harsh conditions, the inner wall of the rain-collecting orifice should be wiped regularly with a soft cloth to keep it clean. If leaves or other debris are found inside the orifice, remove them promptly to keep the water path clear. When the instrument will not be used for an extended period, fit a protective cover over the collecting ring to protect the orifice.

The instrument should generally be cleaned once a month during long-term operation, and must be cleaned at least once every three months.

5.2 Cleaning the Tipping Bucket

The tipping bucket is a key component of the instrument and directly affects measurement accuracy. Over time, dust or grease may accumulate on the inner surface of the bucket, so it should be cleaned periodically. When cleaning, rinse the inside of the bucket repeatedly with clean water, or gently brush it with a degreased (grease-free) brush. Never scrub the inner surface of the bucket with your hands or any other objects.

6. Common Problems and Solutions

This section lists common fault symptoms, causes, and troubleshooting methods for the instrument.

Symptom at Central Station	Rain Sensor Fault	Solution
No data received during rainfall	Rain sensor has no signal output, or the transmission line is faulty	Check at the monitoring station
	Reed switch failure	Replace
	Magnet and reed switch too far apart	Adjust distance
	Soldered wire detached or signal line connected in reverse	Repair
	Tipping bucket stuck	Clear the obstruction
	Instrument blocked	Clean out
Rainfall data received differs significantly from the comparison rain gauge	Rain sensor's tipping-bucket base point out of adjustment (error generally does not exceed $\pm 10\%$)	Re-titrate and adjust the base point Adjust the distance Such are the objective conditions; the instrument is functioning correctly.
	Poor positioning of magnet and reed switch causing intermittent operation, so some signals are missed	
Central station continuously receives rainfall data even though it is not actually raining	Check whether the connector/socket has been exposed to water – this often occurs after heavy rain	Address water ingress and reseal

Note: The fault symptoms listed in the table above are not necessarily all caused by the rain gauge itself. After inspecting and ruling out faults in the instrument itself, also check the instrument's output cable, data acquisition device, and other equipment for faults, and eliminate them one by one.

7. Precautions

Warning: Risk of personal injury. This device must not be used as a safety device or emergency stop device, nor for any other purpose where a device failure could cause personal injury. Restriction of use: use only for its intended, authorized purpose. Consult the technical manual before installation, operation, or maintenance. Failure to follow the above guidance may result in death or serious injury.

8. Warranty Information

The warranty period is 12 months from the date of purchase (a valid purchase receipt is required as proof). During the warranty period, if a fault occurs in the device's own components, materials, or workmanship under normal use and maintenance, and this is verified upon inspection, the Company will provide free repair and replacement of parts.

After the warranty period expires, repair service is provided for the lifetime of the product.

The warranty does not apply under any of the following circumstances:

1. Damage to the device caused by incorrect installation, use, or operation.
2. The device has been disassembled, repaired, altered, or modified by personnel not employed by the Company, or any internal component has been replaced by the user.
3. Damage caused by careless use, or by water or other substances entering the device.
4. Faults or damage caused by accidents or natural disasters.
5. Faults or damage caused by operation outside the working parameter ranges listed in the product specifications.