

NBL-W-HPRS-A type Solar solar radiation meter



I、 Product Introduction

NBL-W-HPRS-A Solar radiation sensor(Pyranometer) is a short wave Solar radiation sensor(Pyranometer) used for solar radiation observation. It is a first level Solar radiation sensor(Pyranometer) that complies with the latest ISO9060 and WMO technical standards. It is used to measure the solar radiation received in W/m^2 from a 2π spherical solid angle (hemispherical direction) in the horizontal plane. The NBL-W-HPRS-A Solar radiation sensor(Pyranometer) adopts a completely passive working mode, using a thermopile sensor to generate an output voltage proportional to the incident radiation flux. Due to the use of two spherical glass covers, measurement errors, especially thermal offset, are reduced, resulting in high measurement accuracy of the sensor.

II、 Working principle

The NBL-W-HPRS-A Solar radiation sensor(Pyranometer) utilizes the black coating on the sensor to absorb solar radiation, which is converted into thermal energy and enters the interior of the sensor. A temperature difference is formed at both ends of the thermoelectric stack, generating a voltage output signal proportional to the incident solar radiation. The structural diagram of NBL-W-HPRS-A Solar radiation sensor(Pyranometer) is shown in Figure 1:

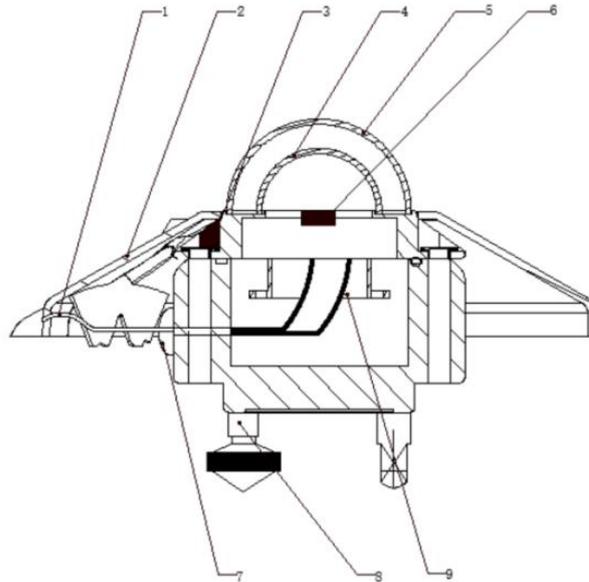


Figure 1

- (1)Cable (standard length 5 meters) (2)Protective cover (3)Leveling bubble
- (4)Quartz glass inner cover (5)Quartz glass cover
- (6)Thermoelectric stack sensor with black coating (7)Waterproof cable head
- (8)Horizontal adjustment foot (9)printed circuit board

III、 Application scenarios

Can be used for meteorological observation, architectural physics, climate and solar light collection experiments. The usual application is to measure outdoor solar radiation as part of a weather station.

IV、 Technical indicators

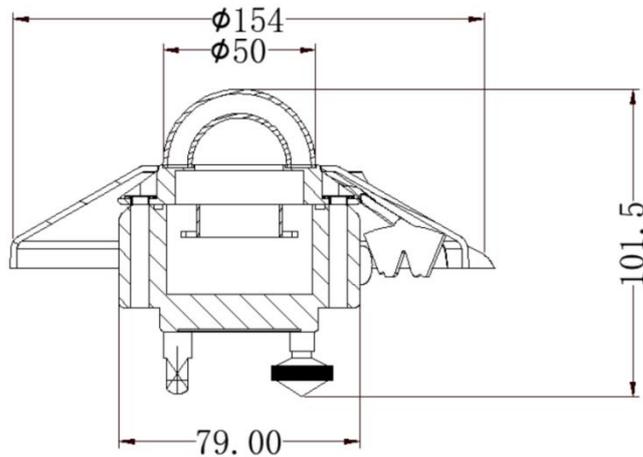
The main technical specifications of NBL-W-HPRS-A Solar radiation sensor(Pyranometer) are shown in Table 1:

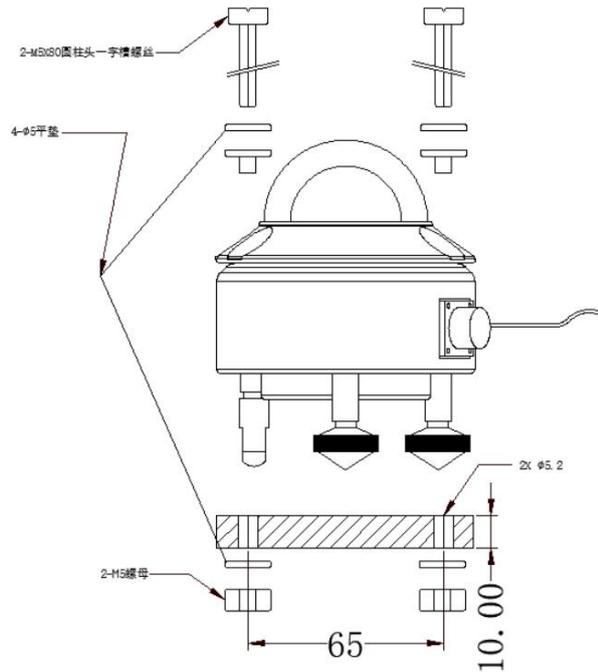
ISO/WMO Technical Indicators	NBL-W-HPRS-A
According to ISO 9060/WMO standard grading	A-level good quality
Response time (95% response)	<5s
Zero bias:	
Corresponding to 200W/m ² net thermal radiation (ventilation)	<7W/m ²
Stability (change/year, percentage of fullness)	±0.5%
Nonlinear	±0.2%(100~1000 W/m ²)
Directional response	±10 W/m ²

Temperature response	<1%(-10~40℃)
Tilt response	<0.5%
Sensitivity range	7-14μV/(W/m ²)
Operation temperature	-40~+80℃
Internal resistance	<50Ω
Standard cable length	3m
Measuring range	0~4000 W/m ²
Cable replacement	Users can remove and install cables
Spectral range	280~3000 nm (50% transmittance)
Reading requirements	A differential voltage channel or a single ended voltage channel
Horizontal calibration	Including leveling bubbles and adjustable feet
Uncertainty of daily exposure radiation	±1%
Weight (excluding cables)	0.8kg
Calibration traceability	ISO9847 Tracing WRR, the program follows ISO9847
Suggested calibration cycle	biennial
Output signal	Original output 0-20mV Optional output RS485/4-20mA

V、Product dimension diagram

unit: mm





VI、 packing list

The goods delivered to the customer should include the following items:

One Solar radiation sensor(Pyranometer) (including cable)

1 copy of calibration certificate of conformity

1 set of fixing screws

1 piece of mirror cloth

1 user manual

We recommend that users store their certificates of conformity in a secure location.

VII、 Sensor installation

The NBL-W-HPRS-A Solar radiation sensor(Pyranometer) is usually installed horizontally, but it can also be installed diagonally or upside down. Regardless of the installation method, the sensor measures the amount of radiation incident on a plane parallel to the sensing surface of the sensor.

The installation location of the Solar radiation sensor(Pyranometer) should have a wide field of view, especially in the sunrise and sunset directions throughout the year, there should be no obstructions greater than 5 degrees. It can be installed on the ground or rooftop platform, with dedicated columns or platforms. Fix a metal plate slightly larger than the base of the Solar radiation sensor(Pyranometer) on the upper part of the column, and provide good insulation to the contact surface with the instrument. The column platform is about 1.5m above the ground and is required to be firm. Even if it is subjected to severe impact and vibration (such as strong winds), it will not change the horizontal state of the instrument. To achieve higher precision measurements, we recommend that users use heated ventilation hoods.

The direction of the instrument terminal is facing north. Use screws to preliminarily position the

instrument on the mounting plate. Then, use the leveling bubble attached to the instrument to adjust the adjusting foot on the base so that the sensing surface of the Solar radiation sensor(Pyranometer) is in a horizontal state. Finally, fix the mounting screws. NBL-W-HPRS-A fixed installation precautions are shown in Table 2

Table 2 Precautions for Fixed Installation of Solar radiation sensor(Pyranometer)	
Mechanical fixation	Use the screws in the attachment to secure the Solar radiation sensor(Pyranometer) to the mounting base plate.
Installation position	Items should be avoided from being placed between the path of sunlight and the instrument to prevent shadows from appearing on the instrument.
Horizontal calibration	If it is fixed horizontally, using the leveling bubble on the instrument requires patient adjustment of the horizontal adjustment foot multiple times.
Installation direction	The terminal faces north.
Installation height	If installed upside down, WMO recommends installing at a height of no less than 1.5 meters above the ground.
Incline	Usually installed horizontally, but in some applications it can be installed diagonally or upside down, measuring the solar radiation flux incident on a surface parallel to the sensor surface in various situations.

VIII、Wiring Definition

Connect the sensor cable to the data acquisition system:

Table 3-1 Solar radiation wiring method (0-20mv)		
Signal	Colour	Measure
Sensor output+	Red	Voltage input+
Sensor output-	Blue	Voltage input - or ground
Shield	Shield	Ground

Table 3-2 Solar radiation sensor wiring method (RS485)		
Signal	Colour	Measure
Power input+	Red	Power Output+
Power input-	Black	GND
Signal output	Yellow	RS485-A
Signal output	Green	RS485-B

Table 3-3 Solar radiation sensor wiring method (4-20mA)		
Signal	Colour	Measure
Power input+	Red	Power Output+
Signal output	Yellow	4-20mA input
Power input-	Blue	Power output - or ground

IX、 Communication protocol

Limited to 485 output use only

I、 Communication parameters

Communication baud rate: 9600 configurable

Data bits: 8 bits

Stop position: 1

Parity check: No verification

Communication method: RS485

Communication address range: 1~255 configurable (default is 1)

Communication protocol: Modbus RTU protocol

II、 Function code introduction

Function code 03H (read multiple registers)

Read device data command

Command format: Device address+Function code+Register starting address+ Register length +CRC16 check

Example:

Device Address	Function code	Register starting address high byte	Register starting address low byte	Register length high byte	Register length low byte	CRC16 check low byte	CRC16 check high byte
0x01	0x03	0x00	0x00	0x00	0x01	0x84	0x0A

The meaning is as follows

- 1、 Device address: Multiple devices can be connected to a 485 bus, where the device address indicates which device needs to be communicated with.
- 2、 Function code: The function code for reading multiple registers is 03H
- 3、 Register starting address high 8 bits, low 8 bits: indicates the starting address of the register to be read, in the example, the starting address of the register is 0.
- 4、 Register length of 8 bits high and 8 bits low: indicates how many registers are read from the starting address. In the example, there is one register. Note that in the returned information, a register needs to return two bytes.
- 5、 CRC verification: using CRC-16/MODBUS, polynomial is: $(x^{16} + x^{15} + x^2 + 1)$, Low in the front, high in the back.

Device acknowledge

Device address	Function code	Data length in bytes	Register 0 data high byte	Register 0 data low byte	CRC16 check low byte	CRC16 check high byte
0x01	0x03	0x02	0x00	0x6F	0xF8	0x68

The meaning is as follows:

- 1、 The device address and function code are the same as above.
- 2、 Data length of bytes: represents the number of bytes returned for the data. In the example, a register data is returned, which is 2 bytes in total because a register requires 2 bytes.
- 3、 Register 0 data high byte, register 0 data low byte is the data in the 0th register.
- 4、 CRC16 verification is the same as above.

Function code 10H (write multiple registers)

- (1) Set the communication address of the device:

Name	Byte	Data
Device address	1	0xXX: Device address
Function code	1	0x10: Function code

Register starting address high byte	1	0x05: Register starting address high byte
Register starting address low byte	1	0x01: Register starting address low byte
Register length high byte	1	0x00: Register length high byte
Register length low byte	1	0x01: Register length low byte
Data length in bytes	1	0x02: Data length in bytes
High byte data written into the register	1	0xXX: Device communication address
Low byte data written into the register	1	0x00: Reserve
CRC16 check	2	CRC16 check

(2) Device acknowledge

Name	Byte	Data
Device address	1	0xXX: Device address
Function code	1	0x10: Function code
Register starting address high byte	1	0x05: Register starting address high byte
Register starting address low byte	1	0x01: Register starting address low byte
Register length high byte	1	0x00: Register length high byte
Register length low byte	1	0x01: Register length low byte
CRC16 check	2	CRC16 check

Set the communication baud rate of the device:

Name	Byte	Data
Device address	1	0xXX: Device address
Function code	1	0x10: Function code
Register starting address high byte	1	0x05: Register starting address high byte
Register starting address low	1	0x03: Register starting address

byte		low byte
Register length high byte	1	0x00: Register length high byte
Register length low byte	1	0x01: Register length low byte
Data length in bytes	1	0x02: Data length in bytes
High byte data written into the register	1	0xXX: Communication baud rate 0x01: 4800 0x02: 9600 0x03: 19200 0x04: 38400 0x05: 57600 0x06: 115200
Low byte data written into the register	1	0x00: Reserve
CRC16 check	2	CRC16 check

Device response

Name	Byte	Data
Device address	1	0xXX: Device address
Function code	1	0x10: Function code
Register starting address high byte	1	0x05: Register starting address high byte
Register starting address low byte	1	0x03: Register starting address low byte
Register length high byte	1	0x00: Register length high byte
Register length low byte	1	0x01: Register length low byte
CRC16 check	2	CRC16 check

X、Maintenance and fault diagnosis

(1) When the glass cover is contaminated, clean it with a soft cloth dipped in water or alcohol; Check the inside of the ball glass cover for condensed water droplets. If so, it needs to be returned to the factory for repair;

(2) Horizontal status check: When the horizontal status of the sensor changes, it is necessary to loosen the fixing screw and readjust the horizontal adjustment foot until the sensor is level, and then tighten the fixing screw;

- (3) Check if the cable is damaged to prevent an open circuit;
- (4) Strictly checking data, functional errors usually manifest as abnormal measurement values, and strict inspection of measurement data is the best daily maintenance;
- (5) Re calibrate, it is recommended to calibrate every two years.

2、Fault diagnosis

When the sensor is not working properly, perform fault diagnosis according to Table 4.

Table 4 Sensor Fault Diagnosis	
The sensor has no output signal	<ol style="list-style-type: none"> 1. Measure the impedance of the wires at both ends of the sensor, which should be less than 200 ohms. If this value is close to zero, it indicates a short circuit in the circuit (check wires), and if this value is infinitely large, it indicates an open circuit in the circuit (check wires). This inspection can also be performed when the sensor is covered; 2. Use a lit incandescent lamp to check the response of the sensor. Fixing a 100 watt bulb at a distance of 10 centimeters from the sensor can produce a certain degree of response: 3. Check data acquisition by applying a millivolt level signal source to the sensor within the range of 1 millivolt.
The sensor signal is abnormally high or low	<ol style="list-style-type: none"> 1. Check if the correct sensitivity coefficient is inputted into the algorithm, as each sensor has its own specific sensitivity coefficient: 2. Check if the algorithm $\varphi=U/E$ is correct and verify the wiring status of the data collector; 3. Check if the cable is broken; 4. Check the reading range of the data collector. The heat flow rate can be a negative value (which is already outside the reading range) or the amplitude can exceed the reading range; 5. Check the data collector by applying a millivolt level signal source to the sensor within the millivolt reading range.
The sensor signal shows unexpected fluctuations	<ol style="list-style-type: none"> 1. Check if there are strong electromagnetic radiation signal sources (radar, radio, etc.) nearby; 2. Check the shielding situation; 3. Check the connection status of the sensor cable;



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