Solar Radiation Sensor

JW-PYR20(Z25)

Beijing Jingelway Sci-Tech Co.,Ltd.
Add:3-201,Zhenguan International Park,No.7 Jinghai Road,Beijing,102600,China
Tel:86-13520127780 Website:www.jw-iot.com Email:info@jingelway.com

1. Product Introduction

JW-PRY20(Z25) radiation sensor is based on optical filter and precise detection circuit, which can continuously measure solar radiation. It is widely used in agriculture, flower gardening, grassland and pasture, plant culture, scientific experiment and other fields, such as solar energy resource assessment, photovoltaic power generation, solar energy system monitoring, solar energy balance research, heat exchange research, climate change research, etc.

2. Features

- Online real-time monitor the pyrgeometer
- Precision optical filter and detection circuit ensure stability and reliability
- Equipped with a horizontal regulating mechanism and a horizontal bubble for easy leveling
- Waterproof seal, high integration, small size, low power consumption, easy to carry, can be used outdoors.
- High precision, quick response, good interchangeability, reliable performance.
- Complete protection circuit and a variety of signal output interface.

3. Technical Parameters

Signal Output	Voltage output: 0~2V (Output Impedance≈0Ω)	Current Output: 4~20mA (Load resistance<500ohm)	RS485 Modbus protocol
Power Supply	3.9~30V/DC	12~30V/DC	3.9~30V/DC
Static Power	7mA@24V DC	30mA@24V DC (with 20mA output signal)	7mA@24V DC
Range and Accuracy	Range: 0~2000W/m^2, Accuracy: 5%, Resolution: 1W/m^2		
Spectral Range	400~1100nm		
Cosine Response	Reading percent:±3% (0~±70°angle of incidence); ±10% (±70~±85°angle of incidence)		
IP Grade	IP66		
Operating Environment	-40~85℃		
Default Cable Length	2m (or Customized)		
Dimension	75*55*58mm		

4. Wiring Diagrams

4.1 Analog Voltage Output

Red (V+): Power Supply +
Black (G): Power Supply -
Blue (O1): Analog Output

4.2 Analog Current Output

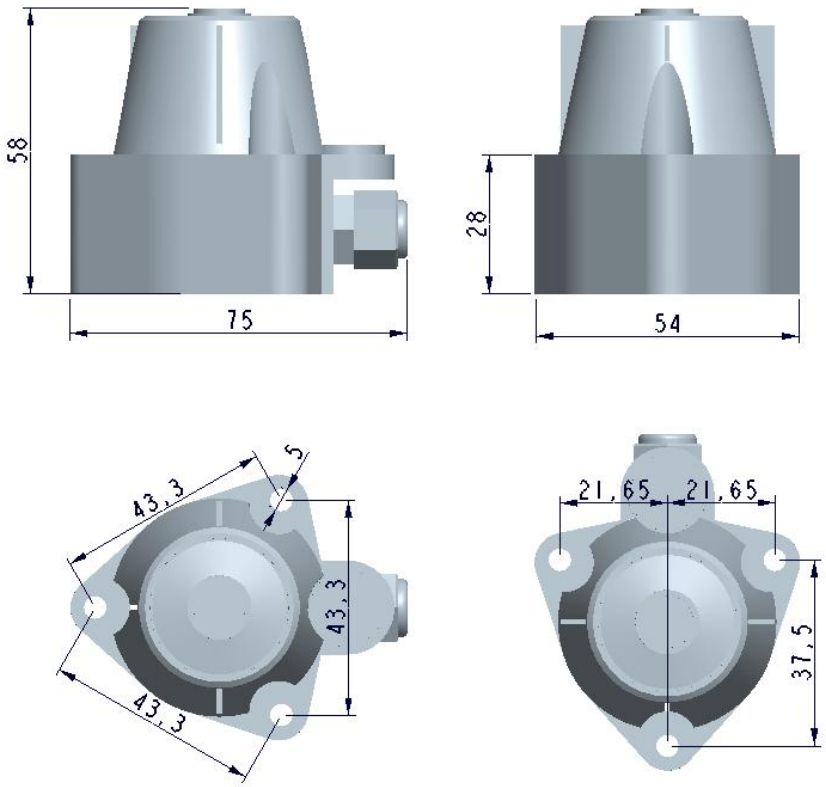
Red (V+): Power Supply +
Black (G): Power Supply -
Blue (O1): Analog Output

4.3 RS485 Modbus

Red (V+): Power Supply +
Black (G): Power Supply -
Yellow (T+): RS485+/A/T+
White (T-): RS485-/B/T-

All sensor parameters are stored by EEPROM,such as Modbus address, baud rate, check bit and comm. protocal. Sometimes the specific configuration of these parameters will be forgotten, resulting in the failure to communicate with the module. To prevent this problem, the module has a button, After pressing the button for three seconds, release the button, the indicator inside the module will go out. The parameters will restore the following factory Settings:
1.Modbus address is 1
2.Communication configuration: 9600,N,8,1
Protocol is Modbus-RTU.

5. Dimension



Unit: mm

6. Safty, Care and Installation

6.1 Safety and Care

Keep the white optical lens on the top of the sensor clean and wiping lens by soft rag. Always checking the horizontal bubble to keep the sensor horizontally placed.

6.2 Installation

Adjusting the screw and checking the horizontal bubble to make the sensor horizontally installed.

7. Output Signal Conversion

Output Interface	Parameters Range	Conversion Formula
Analog Voltage Output 0-2V	SR: 0-2000W/m2	SR=1000* VLOTAGE. When VOLTEGE=1.0V,then SR=1000*1.00=1000W/m2.
Analog Current Output 4-20mA	SR: 0-2000W/m2	SR = 2000 *(CURRENT-4)/16. When CURRENT=12mA,then SR =2000*(12-4)/16=1000 W/m2.
RS485 Modbus-RTU	SR: 0-2000W/m2	SR =(REGISTER VALUE). When REGISTER VALUE=1000,then SR = 1000 W/m2.

NOTE: The unit of VOLTAGE is (V), The unit of CURRENT is (mA).

NOTE: SR is solar radiation or pyranometer value.

8. Communication interface and Protocol

8.1 Modbus Protocol

Modbus Protocol is widely used to establish master-slave communication between intelligent devices or sensors. A MODBUS message sent from a master to a slave contains the address of the slave, the function code (e.g. 'read register' or 'write register'), the data, and a check sum (LRC or CRC).

The sensor is RS485 interface with Modbus protocol. The default serial communication settings is slave address 1, modbus rtu, 9600bps, 8 databits and 1 stop bit. All communication settings can be changed with modbus command, and take effective after re-power up the sensor.

Following modbus function code are supported by sensor.

Modbus Function Code 0x03 : used for reading holding register.

Modbus Function Code 0x04 : used for reading input register.

Modbus Function Code 0x06 : used for writing single holding register.

Modbus Function Code 0x10: used for writing multiple holding register.

8.2 Modbus Registers

Parameters	Register Addr. (HEX/DEC)	Data Type	Modbus Function Code(DEC)	Range and Comments	Default Value
SR Solar Radiation	0x0000 /0	UINT16 RO	3/4	0-2000 for 0-2000W/m2.	N/A
RESERVED	0x0001 /1	UINT16 RO	3/4	0	0
RESERVED	0x0002 /2	UINT16 RO	3/4	0	0
RESERVED	0x0003 /3	UINT16 RO	3/4	0	0
RESERVED	0x0004 /4	UINT16 RO	3/4	0	0
RESERVED	0x0004 /5	UINT16 RO	3/4	0	N/A
SLAVEADDRESS	0x0200 /512	UINT16 R/W	3/6/16	0-255	1
BAUDRATE	0x0201 /513	UINT16 R/W	3/6/16	0-6 0:1200bps 1:2400bps 2:4800bps 3:9600bps 4:19200bps 5:38400bps	3:9600bps
PROTOCOL	0x0202 /514	UINT16 R/W	3/6/16	0 0:Modbus RTU	0:Modbus RTU
PARITY	0x0203 /515	UINT16 R/W	3/6/16	0-2 0:None 1:Even 2:Odd	0:None Parity
DATABITS	0x0204 /516	UINT16 R/W	3/6/16	1 1:8 databits	1:8 databits
STOPBITS	0x0205 /517	UINT16 R/W	3/6/16	0-1 0:1 stopbit 1:2 stopbits	0:1 stopbit
RESPONSEDELAY	0x0206 /518	UINT16 R/W	3/6/16	0-255 for 0-2550 milliseconds	0
ACTIVEOUTPUTINTERVAL	0x0207 /519	UINT16 R/W	3/6/16	0-255 for 0-255 seconds.	0

NOTE: UINT16:16 bit unsigned integer, INT16:16bit signed integer

NOTE: R: Register is Read only, R/W: Register is Read/Write

NOTE: HEX is Hexadecimal (data with 0x/0X prefix), DEC is Decimal

8.3 Modbus Register Detail Description

SR --- Solar Radiation		
Data Range	0-2000 for 0-2000W/m2.	Default: N/A
Power Down Save	N/A	

Note: Pyranometer value

Example: When REGISTER=0x0702 (HEX format), then VALUE=(0x07*256+0x02)/100=1794W/m2.

SLAVEADDRESS --- Modbus Slave Address		
Data Range	0-255	Default: 1
Power Down Save	YES	

Note: Please re-power on the sensor to take effective after set.

BAUDRATE --- Serial Comm Baudrate		
Data Range	0-5 0: 1200bps 1: 2400bps 2: 4800bps 3: 9600bps 4: 19200bps 5: 38400bps	Default: 3
Power Down Save	YES	

Note: Please re-power on the sensor to take effective after set.

PROTOCOL --- Serial Comm Protocol		
Data Range	0 0:Modbus RTU	Default: 0
Power Down Save	YES	

Note: Please re-power on the sensor to take effective after set.

PARITY --- Serial Comm Parity		
Data Range	0-2 0:NONE 1:EVEN 2:ODD	Default: 0
Power Down Save	YES	

Note: Please re-power on the sensor to take effective after set.

DATABITS --- Serial Comm Databits		
Data Range	1 1:8 databits	Default: 1
Power Down Save	YES	

Note: Please re-power on the sensor to take effective after set.

STOPBITS --- Serial Comm Stopbits		
Data Range	0-1 0:1 stopbit 1:2 stopbits	Default: 0
Power Down Save	YES	

Note: Please re-power on the sensor to take effective after set.

RESPONSEDELAY --- Serial Comm Response Delay		
Data Range	0-255 for 0-2550 milliseconds, 0 for disabled	Default: 0
Power Down Save	YES	

Note: Please re-power on the sensor to take effective after set.

Note: Sensor will delay a period before response to master request command.

Example: When set to 5 and receive a request from master device, then sensor will delay 5*10ms=50ms, then response to master.

ACTIVEOUTPUTINTERVAL --- Serial Comm Active Output Interval time		
Data Range	0-255 for 0-255 seconds, 0 for disabled	Default: 0
Power Down Save	YES	

Note: Please re-power on the sensor to take effective after set.

Note: Sensor will output the data actively without any master request command.

Note: Only ONE sensor should be on RS485 network, or there will be data collision and corrupt the data on line.

Note: Refer to SETTING mode to exit the Active Output Mode.

Example: When set to 5 then sensor will output the data every 5 seconds without any master request command.

8.4 Modbus Function Code

For description below, data started with 0X/0x means that it's in HEX format.

8.4.1 Function Code 3 Protocol Example

Master Request:AA 03 RRRR NNNN CCCC

AA	1 byte	Slave Address,0-255
0x03	1 byte	Function Code 3
RRRR	2 byte	Starting Register Addr
NNNN	2 byte	Quantity of Register to read
CCCC	2 byte	CRC CHECKSUM

Slave Response:AA 03 MM VV0 VV1 VV2 VV3... CCCC

AA	1 byte	Slave Address,0-255
0x03	1 byte	Function Code 3
MM	1 byte	Register Data Byte Count
VV0,VV1	2 byte	Register Value (High8bits first)
VV2,VV3	2 byte	Register Value (High8bits first)
...	...	Register Value (High8bits first)
CCCC	2 byte	CRC CHECKSUM

Example: Read register 0x0200-0x0201,that is slave address and baudrate.

Master Request:01 03 0200 0002 C5B3

Slave Addr.	1 byte	0x01
Function Code	1 byte	0x03
Starting Register Addr.	2 byte	0x0200
Quantity of Register to read	2 byte	0x0002
Checksum	2 byte	0xC5B3

Slave Response:01 03 04 00 01 00 03 EB F2

Slave Addr.	1 byte	0x01
Function Code	1 byte	0x03
Register Data Byte Count	1 byte	0x04
Register Value: Address	2 byte	0x00(HIGH 8 Bits)
		0x01(LOW8 Bits)
Register Value: Baudrate	2 byte	0x00(HIGH 8 Bits)
		0x03(LOW8 Bits)
Checksum	2 byte	0xEBF2

8.4.2 Function Code 4 Protocol Example

Master Request:AA 04 RRRR NNNN CCCC

AA	1 byte	Slave Address,0-255
0x04	1 byte	Function Code 4
RRRR	2 byte	Starting Register Addr
NNNN	2 byte	Quantity of Register to read
CCCC	2 byte	CRC CHECKSUM

Slave Response:AA 04 MM VV0 VV1 VV2 VV3... CCCC

AA	1 byte	Slave Address,0-255
0x04	1 byte	Function Code 4
MM	1 byte	Register Data Byte Count
VV0,VV1	2 byte	Register Value (High8bits first)
VV2,VV3	2 byte	Register Value (High8bits first)
...	...	Register Value (High8bits first)
CCCC	2 byte	CRC CHECKSUM

Example: Read register 0x0000,that is solar radiation value.

Master Request: 01 04 0000 0001 31CA

Slave Addr.	1 byte	0x01
Function Code	1 byte	0x04
Starting Register Addr.	2 byte	0x0000
Quantity of Register to read	2 byte	0x0001
Checksum	2 byte	0x31CA

Slave Response: 01 04 02 0010 B8FC

Slave Addr.	1 byte	0x01
Function Code	1 byte	0x04
Register Data Byte Count	1 byte	0x02
Register Value: Pyranometer Value	2 byte	0x00(HIGH 8 Bits)
		0x10(LOW8 Bits)
Checksum	2 byte	0xB8FC

Solar Radiation=0x00*256+0x10=16W/m2.

8.4.3 Function Code 6 Protocol Example

Master Request:AA 06 RRRR VVVV CCCC

AA	1 byte	Slave Address,0-255
0x06	1 byte	Function Code 6
RRRR	2 byte	Register Addr (High8bits first)
VVVV	2 byte	Register Value (High8bits first)
CCCC	2 byte	CRC CHECKSUM

Slave Response:AA 06 RRRR VVVV CCCC

AA	1 byte	Slave Address,0-255
0x06	1 byte	Function Code 6
RRRR	2 byte	Register Addr (High8bits first)
VVVV	2 byte	Register Value (High8bits first)
CCCC	2 byte	CRC CHECKSUM

Example: Write Register 0x0200,that is change modbus slave address to 2.

Master Request: 01 06 0200 0002 09B3

Slave Addr.	1 byte	0x01
Function Code	1 byte	0x06
Register Addr.	2 byte	0x0200
Register Value	2 byte	0x0002
Checksum	2 byte	0x09B3

Slave Response: 01 06 0200 0002 09B3

Slave Addr.	1 byte	0x01
Function Code	1 byte	0x06
Register Addr.	2 byte	0x0200
Register Value	2 byte	0x0002
Checksum	2 byte	0x09B3

8.4.4 Function Code 16 Protocol Example

Master Request:AA 10 RRRR NNNN MM VVVV1 VVVV2 ...CCCC

AA	1 byte	Slave Address,0-255
0x10	1 byte	Function Code 0x10
RRRR	2 byte	Starting Register Addr
NNNN	2 byte	Quantity of Register to write
MM	1 byte	Register Data Byte Count
VVVV1	2 byte	Register Value(High8bits first)
VVVV2	2 byte	Register Value(High8bits first)
...	...	Register Value(High8bits first)
CCCC	2 byte	CRC CHECKSUM

Slave Response:AA 10 RRRR NNNN CCCC

AA	1 byte	Slave Address,0-255
0x10	1 byte	Function Code 0x10
RRRR	2 byte	Starting Register Addr
NNNN	2 byte	Quantity of Register to write
CCCC	2 byte	CRC CHECKSUM

Example: Write Register 0x0200-0x0201,that is set slave address to 1,and baudrate to 19200bp.

Master Request:01 10 0200 0002 04 0001 0004 BACC

0x01	1 byte	Slave Addr.
0x10(HEX)	1 byte	Function Code 0x10
0x0200	2 byte	Starting Register Addr
0x0002	2 byte	Quantity of Register to write
0x04	1 byte	Register Data Byte Count
0x0001	2 byte	Register Value: Slave Address 1
0x0004	2 byte	Register Value: Baudrate 19200bps
0xBACC	2 byte	CRC CHECKSUM

Slave Response:01 10 0200 0002 4070

0x01	1 byte	Slave Addr.
0x10(HEX)	1 byte	Function Code 0x10
0x0200	2 byte	Starting Register Addr(High8bits first)
0x0002	2 byte	Quantity of Register to write(High8bits first)
0x4070	2 byte	CRC CHECKSUM

Appendix

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