3S-IS

Class

Secondary Standart C 61724-1

WORKING PRINCIPLES

Solar irradiance is the power per unit area received from sun and measured by Photovoltaic Prynometer , in other words irradiance sensor, as electromagnetic radiation in Watt per square meter (W/m²). This sensor is made by a monocrystalline silicon solar cell , which is activated by light and produces electric current that is converted to millivolts (mV) due to the connected shunt resistor, at its back side. The cell works almost in short circuit because of low resistance of the shunt resistor a temperature sensor is located at the back side of the cell to measure the cell temperature which causes small deviation on the current.
Temperature increases inverse proportion of the cell current production. The monocrystalline cell and temperature sensor are connected to an electronic card, which is designed to calculate temperature compensated solar irradiance value in W/m² unit.
Thanks to design of this card, 7 different sensors can be connected and provide RS485 port to transfer data in Modbus RTU protocol. SEVEN provides Sunspec options for needed devices, also.

CONSTRUCTION FEATURES

Monocrystalline Cell:

The cell is laminated with 2 EVA sheets, one Tedlar sheet and 3mm tempered glass under 180 °C homogeneous temperature and under vacuum effect. The size of the monocrystalline cell is 52 x 52mm and size of the tempered glass is 92 x 92mm.

Sensor Box:
The solar cell, all input connectors, output connector and ventilation port located on an UV protected aluminum box, is called Sensor Box.
The sensor box has two access for opening and the mounting holes on its sides are for easy site installation. It is a water proof sensor with IP68 protection.

Connectors:
Each chrome plated connector has a different pin number which prevents any connection confusion during site installation. The connection cables are delivered as 3m or 5m lengthes. Seven irradiance sensor is designed as plug & run device and end user friendly operation.

Ventilation Port:
This port is made of a plastic material and allows air circulation and moisture releasing in the box which is required for long run life time of the electronic card.

CALIBRATION

SEVEN delivers all irradiance sensors with calibration certificates.

The calibration is done under natural sunlight and against a calibrated reference cell calibrated at Fraunhofer-Institut für Solare Energiesysteme ISE,Germany.

Recommended periodic calibration is at least 3 years from installation of the irradiance sensor. As per IEC 61724-1 irradiance sensors should be recalibrated as follows ; Class A , once per year, Class B once every two years and Class C as per manufacturer requirement.

CONFIGURATION TOOL

SEVEN firmware is downloadable directly from SEVEN website (**https://www.sevensensor.com/files/configuration-tool.zip**) Download the program and run it. The User-friendly GUI assist, the end user if needed.

DATALOGGER COMMUNICATION

SEVEN sensor boxes communicate by Modbus RTU protocol through RS485. SEVEN sensor is compatible with many well-known datalogger brands. However, the purchaser should get the confirmation from SEVEN whether his datalogger is compatible with SEVEN sensor or not.

SEVEN test, all sensor before dispatching them from Factory.

WARRANTY

SEVEN provides 5-year warranty certificate for each irradiance sensor. The certificate will be delivered with products. This certificate does not cover loss or damages due to incorrect usage of the sensor.
The irradiance sensor box is not allowed to be opened which will cause the termination of the warranty conditions.

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ALL SENSORS ARE CALIBRATED IN NATURAL SUNLIGHT AGAINST A REFERENCE CELL OF THE SAME TYPE. THE REFERENCE CELL IS PERIODICALLY CALIBRATED AGAINST A REFERENCE CELL CALIBRATED BY ***FRAUNHOFER ISE, FREIBURG***.

TECHNICAL DATA

General Information	
Reference Cell	*Monocrystalline Silicon (52 mm x 52 mm)*
Current Shunt	*High precision shunt resistor directly soldered to the terminals of the cell*
Operating Temperature	*-40 °C to +85 °C*
Electrical Connection	*3 m LIYYC11Y Cable , UV and weather resistant*
Power Supply	*12 to 30 VDC (30 mA typically at 20 VDC)*
Interface	*RS485 up to 19200 Baud*
Protocol	*The sensor is connected via a 2-wire RS485 bus with open vendor-independent Modbus RTU Protocol*
Galvanic Isolation	*1000 V between power supply and RS485 bus*
Sensor Box	*Advanced weatherproof junction box made of UV resistant material*
Dimensions , Weight	*140 mm x 108 mm x 42 mm (Width x Length x Height),approx 300 g*
Protection	*IP 68*
Standard and Classification	
Irradiance	*0...1600W/m2, Secondary Standard. Uncertanity ≤ 3% as per IEC61724-1 Class A standard.*
Drift	*Very small drift of <0.3%/ year*
Response Time	*1 sec. less than 3 sec. As per IEC61724-1 Class A standard*
Field of View	*171° , Larger than 160° as per IEC61724-1 Class A standard*
Resolution	*... ≤ 1W/m² as per IEC61724-1 Class A standard*
Tilt-Azimuthal Angle	*0°- 0° , ≤ 1° as per IEC61724-1 Class A standard*
Electrical Connection	
Input#1	*3S-AT-18B20, Ambient temperature sensor, 2 pin connector*
Input#2	*3S-MT-18B20, Module temperature sensor, 3 pin connector*
Input#3	*Wind direction or Relative humidity sensor, 4 pin connector*
Input#4	*3S-WS-PLS, Wind speed sensor, 5 pin connector*
Output#5	*Power and Communication, 6 pin connector*
Others	
Calibration	*Individual calibration of each sensors in the natural sunlight at AM 1,5 spectrum by using a compatible calibrated reference cell by Fraunhofer.ISE.*
Warranty	*5 years Limited warranty against manufacturer defects. Opening of the sensor box by the user or installation staff is not accepted. Opening of the sensor box is one of the reason of terminating the warranty conditions.*
Modbus Specification	
Baud Rate	*1200 , 2400 , 9600 , 19200 , 38400*
Parity	*No, even, odd*
Stop Bit	*1, 2 (only at no parity)*
Factory Default	*9600 Baud, 8N1, address: 1*

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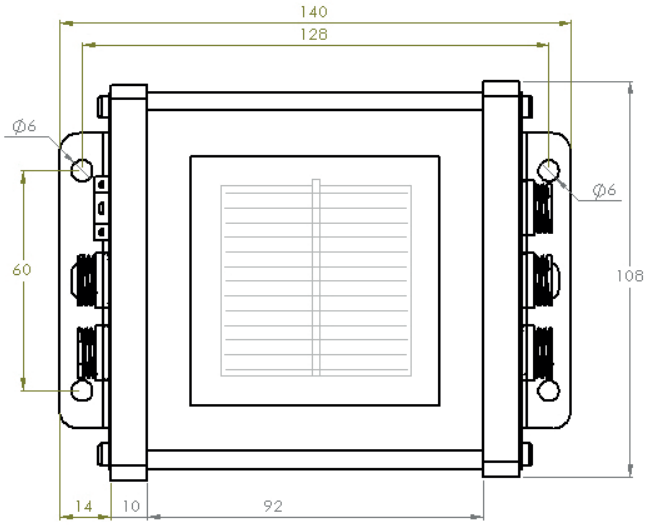
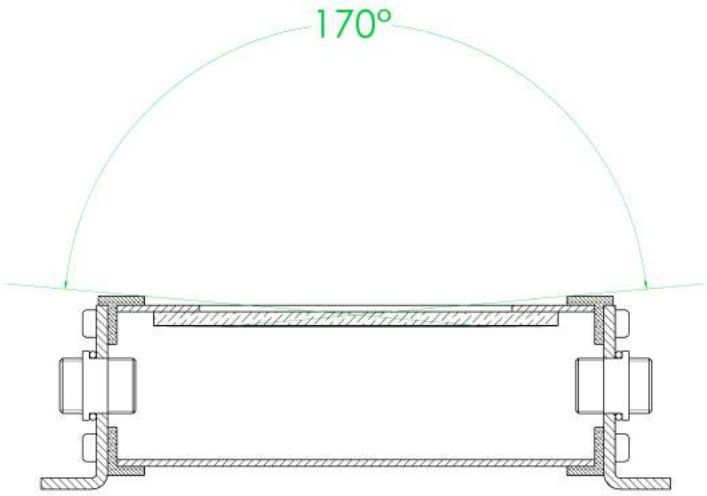
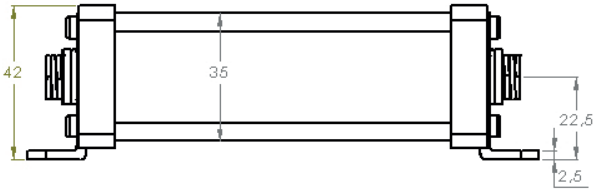
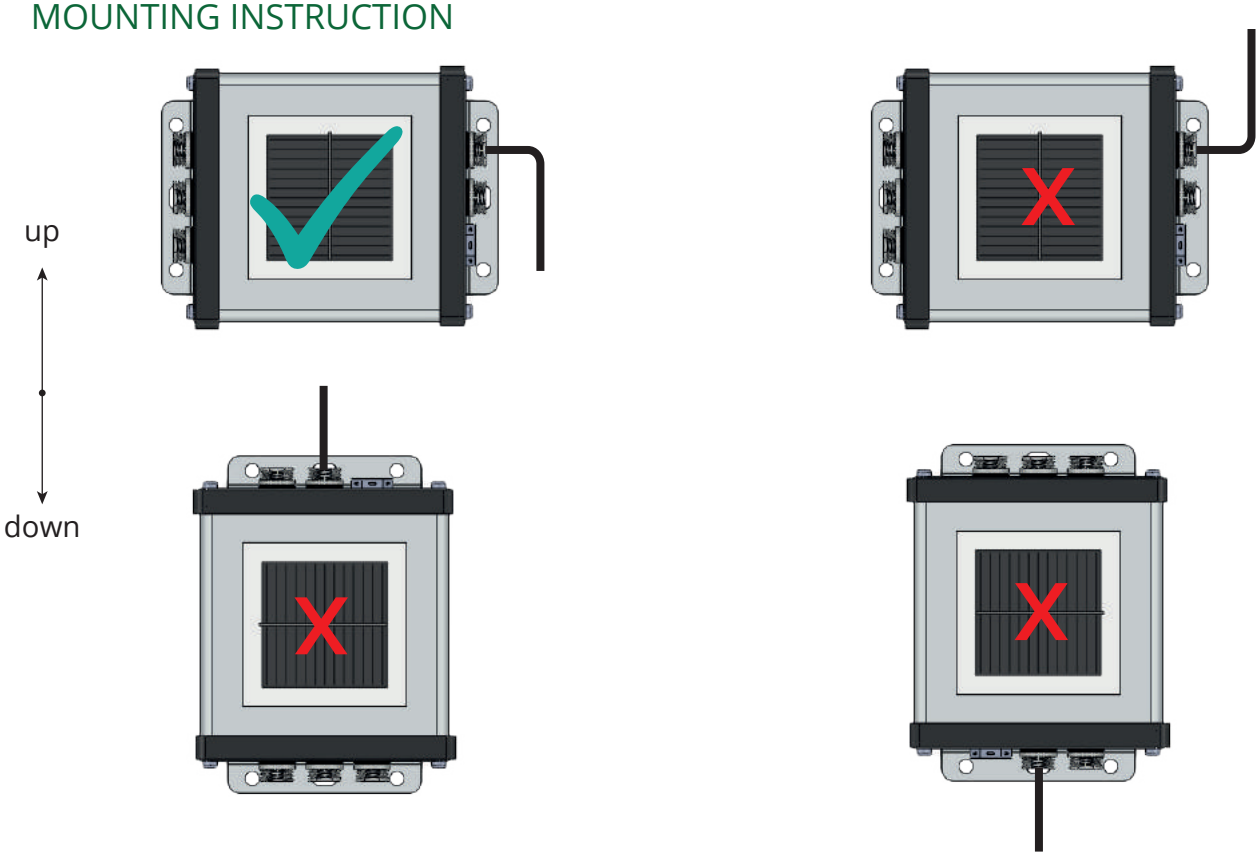
DIMENSION OF SENSOR BOX







MOUNTING INSTRUCTION



								
Sensor Box Model	Irradiance Sensor *(PV Pyranometer)*	Internal Temperature Sensor	Module Temperature Sensor	Ambient Temperature Sensor	Wind Speed Sensor	Wind Direction Sensor	Relative Humidity Sensor	Output Type
3S-IS-mV	✓	X	X	X	X	X	X	mV
3S-IS-T-I	✓	✓	X	X	X	X	X	4-20 mA
3S-IS-T	✓	✓	X	X	X	X	X	RS485
3S-IS-MT	✓	✓	✓	X	X	X	X	RS485
3S-C1	✓	✓	✓	✓	✓	X	X	RS485
3S-C1-WD	✓	✓	✓	✓	✓	✓	X	RS485
3S-C1-RH	✓	✓	✓	✓	✓	X	✓	RS485
3S-C2	X	X	✓	✓	✓	✓	✓	RS485

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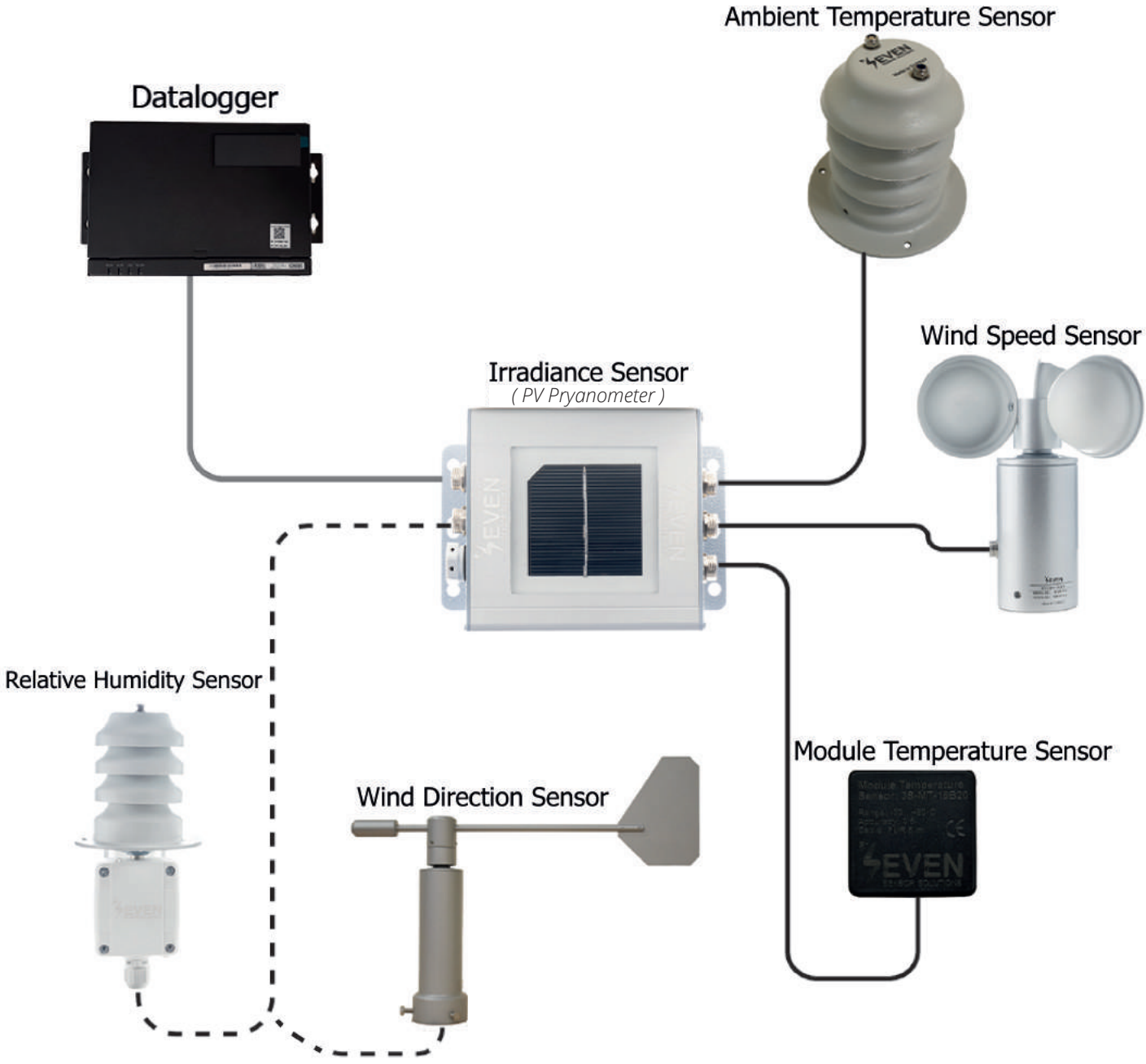
SELECTION OF SENSORS



RELATED PRODUCTS

3S-WS-PLS	Wind speed sensor, reed contact, pulse; pin connection 5
3S-AT-18B20	Ambient temperature sensor, DS18B20, pin connection 2
3S-MT-18B20	Module temperature sensor, DS18B20, pin connection 3
3S-WD-I	Wind direction sensor, analog output, pin connection 4
3S-RH-I	Relative Humidity sensor, analog output, pin connection 4

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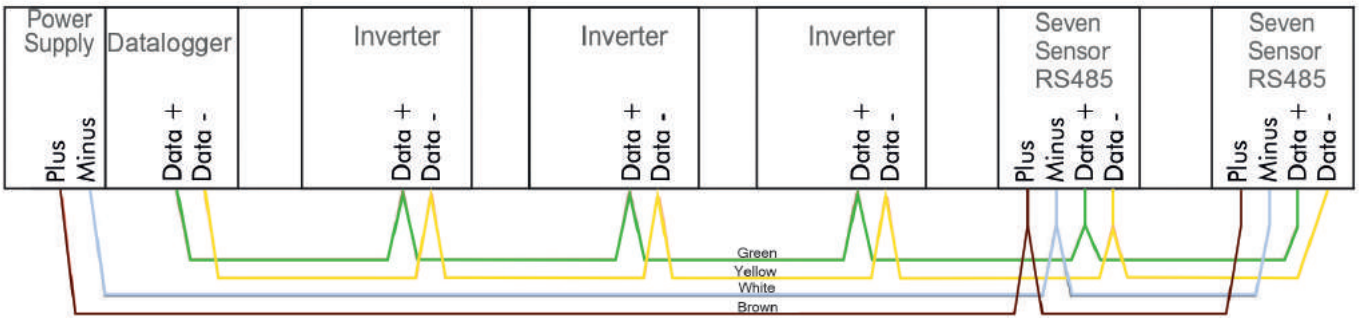
IRRADIANCE SENSOR DATALOGGER CONNECTION

BUS TOPOLOGY



INSTALLATION

SEVEN sensors are designed with **Plug & Run** principle. The sensor box provides waterproof pin connectors. Each sensor has different pin configuration, so wrong connection is not possible. Follow SEVEN instructions for cable connection to dataloggers.
SEVEN provides mounting features or mounting brackets for all the products. End user will be responsible for just fastening the screws for brackets.
The sensor box should be installed with the same alignment and inclinations as the photovoltaic panel. The mounting area should be free from shading and possibility of snow jeopardise.
The sensor cables should be always laid separated from AC/DC cables. The minimum bending radius at cables is 5mm.
The installation and assembly of SEVEN sensors should be carried out by a qualified electrician.

OPERATION & Maintenance

Irradiance sensor is not requiring any maintenance or changing of spare parts. However, cleaning the surface of the solar cell should be done periodically as per site conditions. The cell glass surface can be cleaned by a soft mod with soapy water. Cleaning the solar cell, checking cables, fastener tightness and cable conditions , looking for damage or displacement of external sensors , evidence of moisture or vermin in enclosures , base wiring connections at sensors , detachment of temperature sensors , embrittlement of attachments and other potential problems, should be done periodicly. As per IEC61724-1 , for Class A and Class B the monitoring system should be inspected at least annually and preferably at more frequent intervals , while Class C inspection should be as per site-specific requirements.

Modbus RTU Specifications

Supported Bus Protocol
BaudRate:1200,2400,9600, 19200,38400
Parity: No, even, odd
Stop Bit: 1, 2 (only at no parity)
Factory Default: 9600 Baud, 8N1, address: 1
Transmission mode: MODBUS RTU
Supported function codes: 0x04: Read Input Register
The following Modbus data can be read individually or in blocks:

Register Map:

ID-Dec.	ID-Hex	Value
3	0x03	Wind speed in 1/100 m/s 0...6000
5	0x05	Temperature compensated Irradiance value 0...16000 in 0.1Watt/m²
15	0x0F	Cell temperature as 'sign value' -550 ... +1250 [range -55 ... +125°C] in 0.1°C
16	0x10	Ext. temp. 1 as 'sign value' -550 ... +1250 [range -55 ... +125°C] in 0.1°C
17	0x11	Ext. temp. 2 as 'sign value' -550 ... +1250 [range -55 ... +125°C] in 0.1°C
18	0x12	External relative humidity 0...100 [%]
19	0x13	Wind direction 0...359 in 1°

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SunSpec and Modbus

Serial/ General
Baud Rate: 9600
Parity: None
Stop Bits: 1

RS-485
Interface Mode: 2-Wire Half Duplex

Modbus
Device ID: 60

Register Map:

Start	End	#	Name	Type	Units	Scale Factor	Contents	Description
0001	0002	2	C_SunSpec_ID	uint32	N/A	N/A	"SunS"	Well-known value. Uniquely identifies this as a SunSpec Modbus Map
0003	0003	1	C_SunSpec_DID	uint16	N/A	N/A	0x0001	Well-known value. Uniquely identifies this as a SunSpec Common Model block
0004	0004	1	C_SunSpec_Length	uint16	registers	N/A	65	Length of common model block
0005	0020	16	C-Manufacturer	String(32)	N/A	N/A	"SEVEN"	Well-known value
0021	0036	16	C-Model	String(32)	N/A	N/A	"3S-IS"	Manuf specific value
0037	0044	8	C-Options	String(16)	N/A	N/A	"0"	Manuf specific value
0045	0052	8	C-Version	String(16)	N/A	N/A	"1"	Manuf specific value
0053	0068	16	C_Serial Number	String(32)	N/A	N/A	"Serial"	Manuf specific value
0069	0069	1	C_DeviceAddress	unint16	N/A	N/A	60	Modbus Id
0070	0070	1	C_SunSpec_DID	int16	N/A	N/A	307	Start of next Device
0071	0071	1	C_SunSpec_Length	int16	N/A	N/A	11	Device Model Block Size
0072	0072	1	E_BaseMet_Air Temperature	int16	°C	-1	Measured	Ambient Air Temperature
0073	0073	1	E_BaseMet_Relative	int16	%	0	Measured	Relative Humidity
0075	0075	1	E_BaseMet_Wind _Speed	int16	m/s	0	Measured	Wind Speed
0076	0076	1	E_BaseMet_Wind	int16	Degrees	0	Measured	Wind Direction
0083	0083	1	C_SunSpec_DID	int16	N/A	0	302	Well-known value. Uniquely identifies this as a SunSpec Irradiance Model
0084	0084	1	C_Sunspec_Length	int16	N/A	0	5	Variable length model block =(5*n), where n=number of sensors blocks
0086	0086	1	E_Irradiance _Plane-of-Array_1	uint16	W/m²	0	Measured	Plane-of-Array Irradiance
0090	0090	1	C_SunSpec_DID	int16	N/A	0	303	Well-known value. Uniquely identifies this as a SunSpec Back of Module Temperature Model
0091	0091	1	C_Sunspec_Length	int16	N/A	0	2	Variable length model block =(5*n), where n=number of sensors blocks
0092	0092	1	E_BOM_Temp_1	int16	°C	-1	Measured	Back of module temperature
0094	0094	1	EndOfSunspecBlock	uint16	N/A	N/A	0xFFFF	End of SunSpec Block
0095	0095	1	C_Sunspec_Length	uint16	N/A	0	0	Terminate length, zero
0200	0200	1	Modbus Id - Write Register	int16	N/A	N/A	60	Modbus device address, write register
0205	0205	1	Baud Rate	uint16	N/A	N/A	9600	Baud Rate, write register