SENSOR SOLUTIONS

3S-CWS

Compact
Weather Station

USER MANUAL

USER MANUAL TABLE OF CONTENTS

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1. Introduction

Compact Weather Station is a product from the SEVEN meteorological sensors range of professional and intelligent measuring sensors with digital interface for environmental and industrial applications.

Figure 1 – Compact Weather Station

It is an all-in-one compact weather station with measures of irradiance, temperature, wind speed, wind direction, relative humidity, air pressure and rainfall. All measured meteorological data is transferred to dataloggers and receiver units via a 2-wire RS485 bus with Modbus RTU protocol.

The flexible design of the Compact Weather Station makes it possible to select external sensors according to the required parameters in meteorological applications.

SEVEN products use reliable and high-quality instruments to provide accurate meteorological information in environmental and industrial applications.

Note: *SEVEN reserves the right to make changes in this entire document without prior notice.*

2. Compact Weather Station Installation

It is suggested that the system be operated at ground level to make sure that all components are working properly prior to installation. A general diagram of the progress of the installation steps is given below.

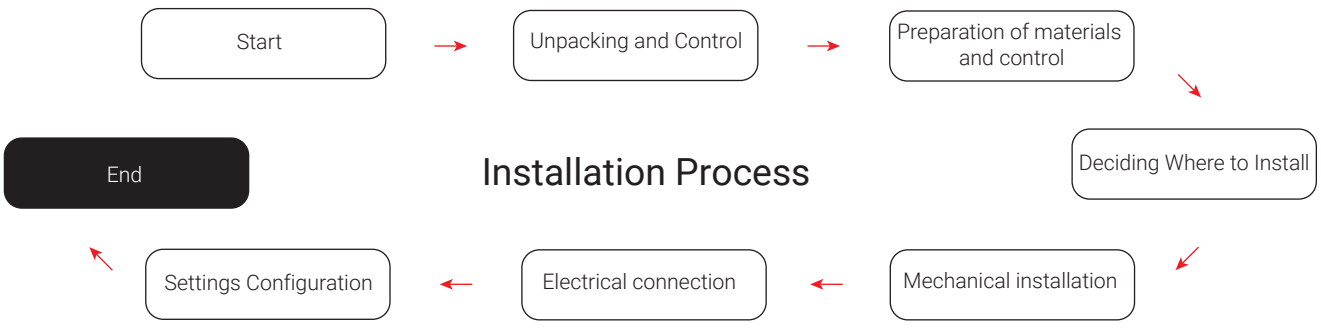

Figure 2 – Installation Proces

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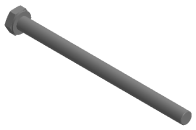
2.1. Unpacking and Control

Upon receipt of the product, it must be carefully checked whether the package content is complete. SEVEN Sensor Solutions must be contacted if any of the components are missing, damaged or defective.

 A Qty :1	 B Qty :1	 C Qty :2	 D Qty :2	 E Qty :2	 F Qty :1
Mounting Pole	20x40x1000 Profile	20x40x300 Profile	Irradiance Sensor Support Apparatus	Irradiance Sensor Connection Apparatus	Wind Speed Sensor Connection Sheet
 G Qty :1	 H Qty :2	 a Qty :6	 b Qty :4	 c Qty :2	 d Qty :2
Wind Direction Sensor Connection Sheet	Ambient Tmp. Sensor Connection Apparatus	M6x30 Hexagon Head Bolt	M6x50 Hexagon Head Bolt	M6x55 Hexagon Head Bolt	M6x70 Hexagon Head Bolt
 e Qty :2	 f Qty :16	 g Qty :6	 h Qty :1	 ı Qty :3	
M6x90 Hexagon Head Bolt	M6 Fibre Nut	20x40 Profile Plug	40x40 Profile Plug	Support Apparatus	

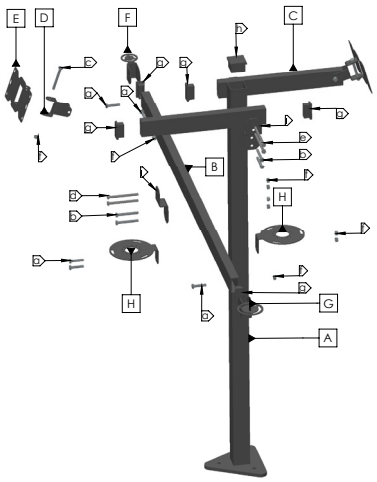


Figure 3 – Mounting Structure Packing List

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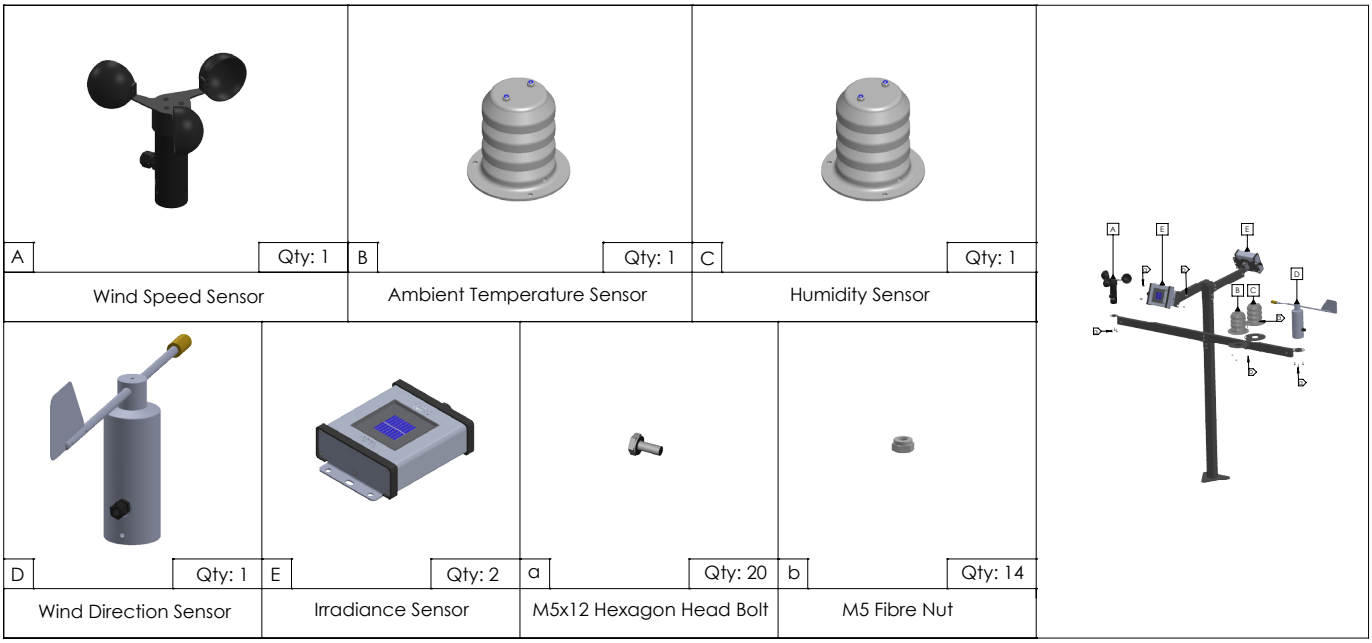

Figure 4 – Installation Process

Note: *Quantity and content of the received material may be different based on customer confirmed order.*

2.2. Site Requirements and Considerations

Each site is different and has its own unique challenges. For this reason, the installation of the product may differ in each site. First of all, it should be decided where the product will be installed. Ambient temperature, plane of array irradiance, wind speed and direction can be affected by obstructions, shading source and local topography.

The Compact Weather Station should be placed no closer than 10 times the height of any obstruction or shading source. It should also be placed away from any dark or reflective and heat-absorbing surfaces.

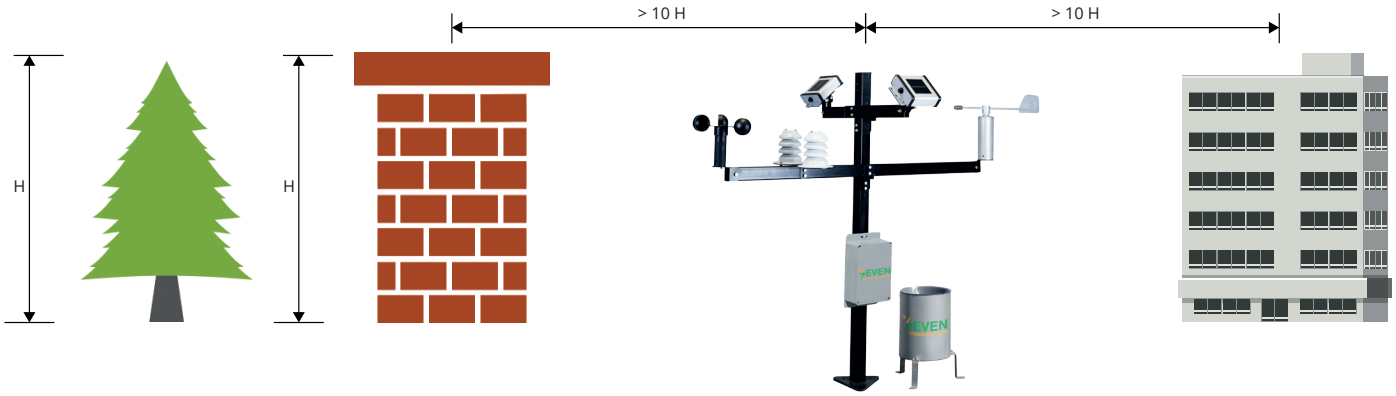

Figure 5 – Installation Site Selection

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When the Compact Weather Station is to be mounted on a rooftop, it should preferably be mounted on the prevailing wind side of the building. It should also be avoided to place the weather station near any heat source such as chimneys or ventilation.

The Irradiance Sensor needs to be in the same direction and the same inclination as the solar panels. They should be positioned in the same or higher plane than the solar panels. The azimuth angle can be adjusted with a compass by rotating the mounting structure on its axis and the tilt angle can be adjusted by rotating the connection apparatus on the mounting structure.

Figure 6 – Adjustable connection apparatus of Irradiance Sensor

Note: *To facilitate the maintenance and cleaning of the Irradiance Sensor, the Compact Weather Station must be installed in an easily accessible location, especially for rooftop projects.*

When placing the Wind Direction Sensor on the mounting structure, attention should be paid to the north direction mark and it should be aligned to the north with the help of a compass.

The Installation location should be selected so that pollution of the rain gauge funnel by falling leaves etc. can be avoided as far as possible.

The Module Temperature Sensor must be installed at the exact midpoint of the solar panel. A sensor location should be chosen in the center of the cell closest to the exact midpoint of the module, avoiding the boundaries between cells. Module Temperature Sensor Installation Manual can be checked for more details.

2.3. Preparation of Materials to be Used in Installation

The materials needed during installation are provided by SEVEN. The user should only prepare the following hand tools and personal protective equipment.

Figure 7 – Materials to be Used in Installation

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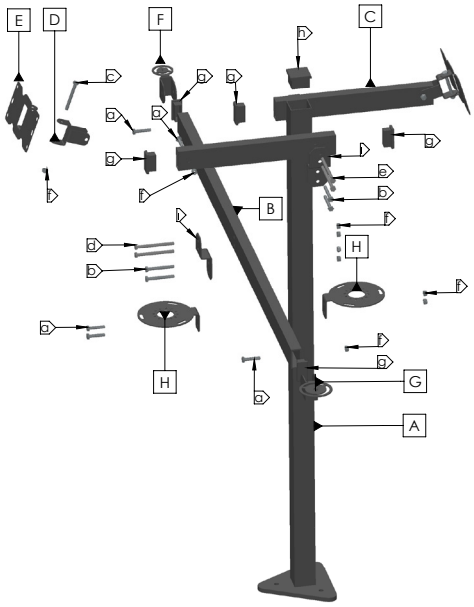
2.4. Installation

3S-CWS Compact Weather Station installation can be handled in 2 steps. Firstly, the Compact Weather Station mounting structure must be installed. Then the sensors must be fixed to the mounting structure. The installation can be easily completed by a qualified electrician by following SEVEN instructions.

2.4.1. Mounting Structure

The installation of the mounting structure in which the sensors are to be mounted is very simple and fast.



No	Part Name	Qty
A	Profile (40 x 40 x 1000 mm)	**1**
B	Profile (20 x 40 x 1000 mm)	**1**
C	Profile (20x40x300 mm)	**2**
D	Irradiance Sensor Bracket	**2**
F	Wind Speed Sensor Bracket	**2**
G	Wind Direction Sensor Bracket	**1**
H	Ambient Temperature Sensor Bracket	**2**
I	Support Bracket	**3**
a	M6 x 30 Hexagon Head Bolt	**6**
b	M6x50 Hexagon Head Bolt	**4**
c	M6x55 Hexagon Head Bolt	**2**
d	M6x70 Hexagon Head Bolt	**2**
e	M6x90 Hexagon Head Bolt	**2**
f	M6 Fibre Nut	**16**
g	20x40 Profile Plug	**6**
h	40x40 Profile Plug	**1**

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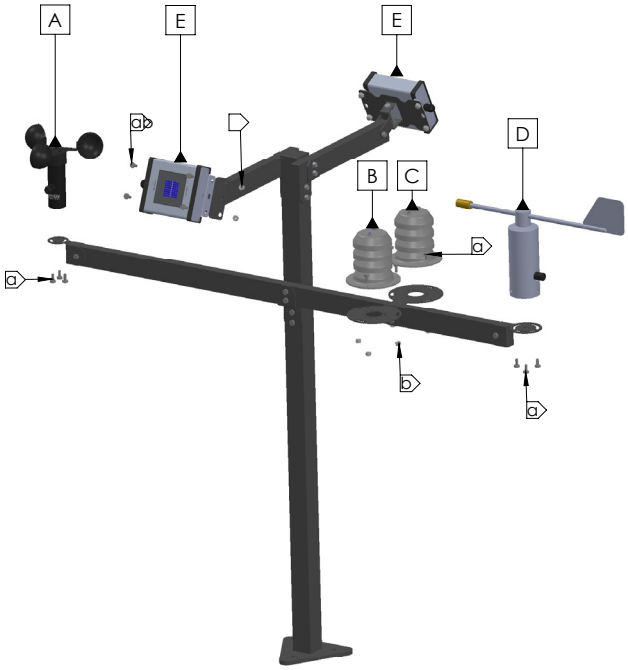
2.4.2. External Sensors

The external sensors must be fixed to the mounting structure as shown below, after the installation of the mounting structure is completed.



No	Part Name	Material	Qty
A	Wind Speed Sensor	Anodized Aluminum Housing – ABS Cup	**1**
B	Ambient Temperature Sensor	ABS	**1**
C	Humidity & Pressure	ABS	**1**
D	Wind Direction Sensor	Polyamide / Aluminum Housing – Aluminum Vane	**1**
E	Irradiance Sensor	Aluminum	**2**
a	M5x12 Hexagon Head Bolt	Stainless Steel	**20**
b	M5 Fibre Nut	Stainless Steel	**14**

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2.5. Inspection and Maintenance

Compact Weather Station is not requiring any maintenance or changing of spare parts. However, the cleaning of the solar cell surface should be done periodically according to the standard which is followed for the site monitoring. The surface of the solar cell glass can be gently cleaned with a soft cloth and soapy water.

Fastener tightness and cable conditions, looking for damage, deterioration, or disconnection of sensors and electrical enclosures, soiling or displacement of optical sensors, evidence of moisture or vermin in enclosures, loose wiring connections, detachment of temperature sensors, embrittlement of attachments and other potential problems, should be checked periodically.

Note: *We recommend to use thread-locking fluid for fasteners.*

According to IEC 61724-1:2021, the monitoring system should be inspected at least annually and preferably at more frequent intervals.

3. Test and Calibration

SEVEN delivers all irradiance sensors with calibration certificates.

Each Irradiance Sensor is calibrated under Class AAA Sun Simulator according to IEC 60904-2 and IEC 60904-4 standards by using a reference cell calibrated by Institute for Solar Energy Research (ISFH) in Germany.

Each Irradiance Sensor is tested under natural sunlight by using a reference cell calibrated by the Fraunhofer Institute for Solar Energy Systems ISE in Germany.

3.1. Recalibration

Recalibration of Irradiance Sensors according to IEC 61724-1 standard shall be conducted in a manner that minimizes downtime and sensor outages in order to prevent interruption of monitoring.

Effective methods may include:

- Exchanging installed sensors with new or recalibrated sensors
- Performing on-site recalibration of sensors where possible
- Providing redundant sensors and alternating laboratory recalibration schedules.

According to IEC 61724-1 standard, “for Class A systems, irradiance sensors shall be recalibrated once every 2 years, or more frequently per manufacturer recommendations. For Class B systems, recalibrate Irradiance Sensors according to manufacturer recommendations.”

The recommended recalibration period is at least once every 3 years from the installation of the irradiance sensors in the site.

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4. Connections

External sensors are designed with the Plug & Play principle. The sensor connection box has waterproof and UV resistant connectors. Each external sensor has a different pin configuration, so wrong connection is not possible. The minimum bending radius at cables is 5 mm.

Connector Assignment for External Sensors	
Wind Speed Sensor	2 pin Connector
Wind Direction Sensor	3 pin Connector
Module Temperature Sensor	4 pin Connector
Rain Gauge	5 pin Connector
Global Irradiance Sensor	6 pin Connector
Plane of Array Irradiance Sensor	6 pin Connector
Humidity & Pressure & Ambient Temperature Sensor	7 pin Connector

The voltage supply for the Compact Weather Station is 12 - 30 V DC. Operation with a voltage supply of 24 V is recommended.

The Compact Weather Station has an electrically isolated, half-duplex, 2 wire RS485 interface for configuration, communication and the firmware update.

The communication and power cable of Compact Weather Station should be always laid separated from AC/DC cables.

Note: *The installation and electrical connections of SEVEN sensors should be carried out by a qualified electrician.*

Wire Assignment for Power & Communication	
RS485 A / Data (+)	Green
RS485 B / Data (-)	Yellow
Positive Supply Voltage	Brown
Supply Voltage Ground	White

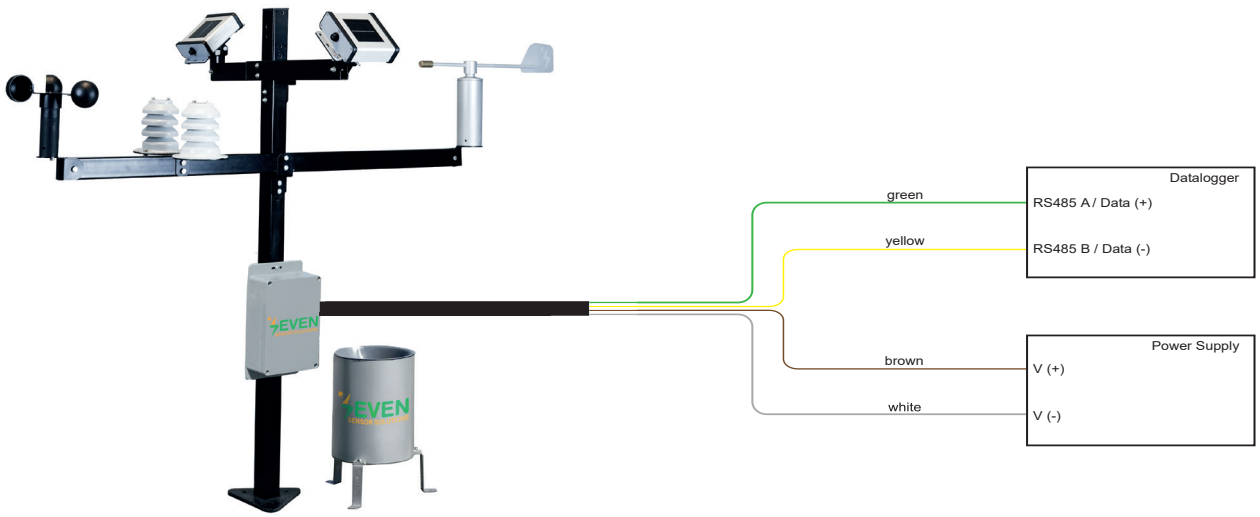

Figure 8 – Wire Assignment for Power & Communication

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5. Configuration and Communication

Once the Compact Weather Station has been installed and connected correctly, the sensor begins autonomously to take measurements.

Attention must be paid to the following points:

• A measurement request should be made to the Compact Weather Station with the 3S-CWS Configuration Tool and it should be checked whether it correctly operation in the site.

• The Wind Direction Sensor must be aligned to the North in order to ensure correct wind measurement data.

• If several Modbus Devices are operated on a network, a unique device ID must be assigned to each device.

Follow SEVEN instructions to configure the Compact Weather Station on dataloggers.

5.1. 3S-CWS Configuration Tool

3S-CWS Configuration Tool is a software tool for testing communication and adjusting Modbus parameters on the Compact Weather Station. The 3S-CWS Configuration Tool can also be used to update the firmware of the Compact Weather Station.

A Windows® PC with a serial bus interface set as a serial COM port, 3S-CWS Configuration Tool software, and USB to RS485 Converter are required for configuration and testing purposes.

Follow the instructions in 3S-CWS Configuration Tool User Manual:
https://www.sevensensor.com/files/d/en/3S-CWS_Configuration_Tool_v2.0.pdf

5.2. Modbus RTU Specifications

5.2.1. Supported Bus Protocol

The Compact Weather Station is equipped with an RS-485 communication port that supports Modbus RTU commands. The Compact Weather Station can be configured to operate in different communication parameters. The table that follows describes each supported bus protocol.

Baud Rate	4800, 9600, 19200, 38400
Parity	None, Even, Odd
Stop Bit	1, 2 (only at None parity)
Factory Default	9600 Baud, 8N1, address: 1

5.2.2. Supported Function Codes

The Compact Weather Station supports a specific subset of Modbus RTU commands. The table that follows lists each supported function code.

0x03	Read Holding Registers
0x04	Read Input Registers
0x46	Read & Change Parameters
0x08	Diagnostics

Note: *All checksums of the Modbus protocol are omitted in this document. These checksums must always be calculated and sent during communication.*

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5.2.2.1. Read Holding Registers (0x03)

Master Request:

Address	1 Byte	1 to 247
Function Code	1 Byte	0x03
Start Register	2 Byte (Big Endian)	see register table below
End Register	2 Byte (Big Endian)	see register table below

Slave Response:

Address	1 Byte	1 to 247
Function Code	1 Byte	0x03
Number of Bytes	1 Byte	0 to 255 (2xN) N = Number of Registers
Data	2 Byte x N (Big Endian)	see register table below

Holding Register Map

The Compact Weather Station holding register map is based on the **"SunSpec Alliance"** communication standards.

Start	End	Value	Type	Units	Scale Factor	Constant
40000	**40001**	**SunSpec ID**	uint32	N/A	N/A	**"SunS"**
40002	**40002**	**SunSpec Device ID**	uint16	N/A	N/A	**0x0001**
40003	**40003**	**SunSpec Length**	uint16	Registers	N/A	**65**
40004	**40019**	**Manufacturer**	String (32)	N/A	N/A	**"SevenSensor"**
40020	**40035**	**Model**	String (32)	N/A	N/A	**"3S-CWS"**
40036	**40043**	**Hardware Version**	String (16)	N/A	N/A	**"1.1"**
40044	**40051**	**Software Version**	String (16)	N/A	N/A	**"2.0"**
40052	**40067**	**Serial Number**	String (32)	N/A	N/A	**"23.12.345.65.0013"**
40068	**40068**	**Device ID**	uint16	N/A	N/A	**1**
Sunspec Device Model Measurement Registers						
40069	**40069**	**Block ID**	int16	N/A	N/A	**307**
40070	**40070**	**Length**	int16	Registers	N/A	**11**
40071	**40071**	**Air Temperature**	int16	°C	0.1	**Measured**
40072	**40072**	**Relative Humidity**	int16	%	0	**Measured**
40073	**40073**	**Barometric Pressure**	int16	hPa	0	**Measured**
40074	**40074**	**Wind Speed**	int16	m/s	0.1	**Measured**
40075	**40075**	**Wind Direction**	int16	°	0	**Measured**
40076	**40076**	**Rain Gauge (Hour)**	int16	mm/hour	0	**Measured**
Irradiance Model Registers						
40082	**40082**	**Block ID**	int16	N/A	0	**302**
40083	**40083**	**Length**	int16	Registers	0	**5**
40084	**40084**	**Global Horizontal Irradiance**	uint16	W/m²	0.1	**Measured**
40085	**40085**	**Plane of Array**	uint16	W/m²	0.1	**Measured**

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Back of Module Temperature Registers						
40089	**40089**	**Block ID**	int16	N/A	N/A	**303**
40090	**40090**	**Length**	int16	Registers	N/A	**3**
40091	**40091**	**Modul Temp 1**	int16	°C	0.1	**Measured**
40092	**40092**	**Modul Temp 2**	int16	°C	0.1	**N/A**
40093	**40093**	**Total Effective Modul Temperature**	int16	°C	0.1	**N/A**
40099	**40099**	**Air Temperature**	int16	°C	0.1	**Measured**
Device Model Measurement Registers						
40100	**40100**	**Block ID**	int16	N/A	N/A	**308**
40101	**40101**	**Length**	int16	Registers	N/A	**5**
40102	**40102**	**Total Eff. Irradiance**	int16	W/m²	0.1	**Measured**
40103	**40103**	**Modul Temp1**	int16	°C	0.1	**Measured**
40104	**40104**	**Modul Temp2**	int16	°C	0.1	**Measured**
40105	**40105**	**Wind Speed**	int16	m/s	0.1	**Measured**
40106	**40106**	**Air Temperature**	int16	°C	0.1	**Measured**
End of Block Registers						
40107	**40107**	**End of SunSpec Block**	uint16	N/A	N/A	**0xFFFF**
40108	**40108**	**Length**	uint16	Registers	0	**0**
40109	**40109**	**Device ID**	uint16	N/A	N/A	**1**

5.2.2.2. Read Input Registers (0x04)

Master Request:

Address	1 Byte	1 to 247
Function Code	1 Byte	0x04
Start Register	2 Byte (Big Endian)	see register table below
End Register	2 Byte (Big Endian)	see register table below

Slave Response:

Address	1 Byte	1 to 247
Function Code	1 Byte	0x04
Number of Bytes	1 Byte	0 to 255 (2xN) N = Number of Registers
Data	2 Byte x N (Big Endian)	see register table below

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The following Modbus data can be read individually or in blocks.

ID-Dec	ID-Hex	Value	Range	Resolution
30000	0x00	Irradiance 1	0…1600 W/m²	0.1 W/m²
30001	0x01	Irradiance 2	0…1600 W/m²	0.1 W/m²
30006	0x06	Temperature Compensated Irradiance 1	0…1600 W/m²	0.1 W/m²
30007	0x07	Temperature Compensated Irradiance 2	0…1600 W/m²	0.1 W/m²
30015	0xF	Internal Cell Temperature 1	-40…+85 °C	0.1°C
30016	0x10	Internal Cell Temperature 2	-40…+85 °C	0.1°C
30022	0x16	Module Temperature 1	-40…+85 °C	0.1°C
30029	0x1D	Ambient Temperature	-40…+85 °C	0.1°C
30032	0x20	External Ambient Temperature (SHT45)	-40…+85 °C	0.1°C
30033	0x21	Relative Humidity	0…100%	0.1%
30035	0x15	Pressure	260…1260 hPa	0.1
30036	0x16	Rain Gauge (Hour)	0-900 mm/hR	0.1 mm/h
30037	0x1C	Rain Gauge (Min)	0-15 mm/min	0.1 mm/min
30038	0x1D	Rain Gauge (Sec)	0-0,25 mm/sec	0.1 mm/sec
30052	0x14	Wind Direction	0…359°	1
30053	0x11	Wind Speed	0…40 m/s	0.1 m/s

Additionally, the following internal data can be read individually or in blocks.

ID-Dec	ID-Hex	Value		Range
30301	0x12D	Hardware Version		Manufacturer Parameters Read Only
30302	0x12E	Software Version		
30304	0x130	Calibration Value 1		
30305	0x131	Calibration Value 2		
30310	0x136	Temperature Coefficient Value 1		
30311	0x137	Temperature Coefficient Value 2		
30323	0x143	ADC Offset Value		
30324	0x144	ADC Offset Value 2		
30329	0x149	T90 value		
30330	0x14A	Wind Speed Sensor Offset Value		
30331	0x14B	Wind Speed Sensor Slope High Value		
30332	0x14C	Wind Speed Sensor Slope Low Value		
30333	0x14D	Wind Speed Sensor Interval Value		
30342	0x156	Serial Number	Production Year	
30343	0x157		Production Code	
30344	0x158		Cell Serial Number	
30345	0x159		Board Serial Number	
30346	0x15A		Box Serial Number	
30347	0x15B		Sensor Serial Number	
30348	0x15C	Production Date	Production Day	
30349	0x15D		Production Month	
30350	0x15E		Production Year	
30351	0x15F	Calibration Date	Calibration Day 1	
30352	0x160		Calibration Month 1	
30353	0x161		Calibration Year 1	
30354	0x162		Calibration Day 2	
30355	0x163		Calibration Month 2	
30356	0x164		Calibration Year 2	
30370	0x172	Wind Direction Enable		
30371	0x173	Rain Gauge Enable		

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5.2.2.3. Read & Change Parameters (0x46)

Sub Function (0x04): Write Device Address

Master Request:

Address	1 Byte	1 to 247
Function Code	1 Byte	0x46
Start Register	1 Byte	0x04
End Register	1 Byte	1 to 247

Slave Response:

Address	1 Byte	1 to 247
Function Code	1 Byte	0x46
Start Register	1 Byte	0x06
End Register	1 Byte	1 to 247

Sub Function (0x06): Write Communication Parameters

Master Request:

Address	1 Byte	1 to 247
Function Code	1 Byte	0x46
Sub Function Code	1 Byte	0x06
New Baud Rate	1 Byte	0 to 3, see table below
New Parity / Stop Bit	1 Byte	0 to 3, see table below

Slave Response:

Address	1 Byte	1 to 247
Function Code	1 Byte	0x46
Sub Function Code	1 Byte	0x06
New Baud Rate	1 Byte	0 to 3, see table below
New Parity / Stop Bit	1 Byte	0 to 3, see table below

Note: *When the* ***"Write Communication Parameters"*** *command is used, the* ***"Write Device Address"*** *command must also be used before the restart communication command.*

Communication Parameter Settings

Parameter changes will take effect after restart of the sensor by power on reset or restart communication command.

Baud Rate	Value	Parity / Stop Bit	Value
4800	0	**None/1**	0
9600	1	**None/2**	1
19200	2	**Odd**	2
38400	3	**Even**	3

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Sub Function (0x07): Read Hardware & Software Versions

Master Request:

Address	1 Byte	1 to 247
Function Code	1 Byte	0x46
Start Register	1 Byte	0x07

Slave Response:

Address	1 Byte	1 to 247
Function Code	1 Byte	0x46
Sub Function Code	1 Byte	0x07
Hardware Version	2 Byte (Little Endian)	0 to 65535
Software Version	2 Byte (Little Endian)	0 to 65535

Sub Function (0x08): Read Serial Number - Production Date - Calibration Date

Master Request:

Address	1 Byte	1 to 247
Function Code	1 Byte	0x46
Sub Function Code	1 Byte	0x08

Slave Response:

Address	1 Byte	1 to 247
Function Code	1 Byte	0x46
Sub Function Code	1 Byte	0x08
Production Year	1 Byte	0 to 99
Production Code	1 Byte	0 to 99
Cell Serial Number	2 Byte (Little Endian)	0 to 999
Board Serial Number	1 Byte	0 to 99
Box Serial Number	1 Byte	0 to 99
Sensor Serial Number	2 Byte (Big Endian)	0 to 9999
Production Day	1 Byte	1 to 31
Production Month	1 Byte	1 to 12
Production Year	1 Byte	0 to 99
Calibration Day 1	1 Byte	1 to 31
Calibration Month 1	1 Byte	1 to 12
Calibration Year 1	1 Byte	0 to 99
Calibration Day 2	1 Byte	1 to 31
Calibration Month 2	1 Byte	1 to 12
Calibration Year 2	1 Byte	0 to 99

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5.2.2.4. Diagnotics (0x08)

Master Request:

Address	1 Byte	1 to 247
Function Code	1 Byte	0x08
Restart Code	4 Byte	0x00000000

Slave Response:

Address	1 Byte	1 to 247
Function Code	1 Byte	0x08
Restart Code	4 Byte	0x00000000

6. Additional Documents and Software

The following documents and software can be downloaded from www.sevensensor.com or requested from SEVEN Sensor Solutions.

User Manual	This document
Datasheet	Compact Weather Station brochure
3S-CWS Configuration Tool	Windows® software for testing, firmware updates and configuration of the device
Firmware	Current device firmware

7. Contact Details

Please feel free to contact us if you face any difficulties during installation or configuration.

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