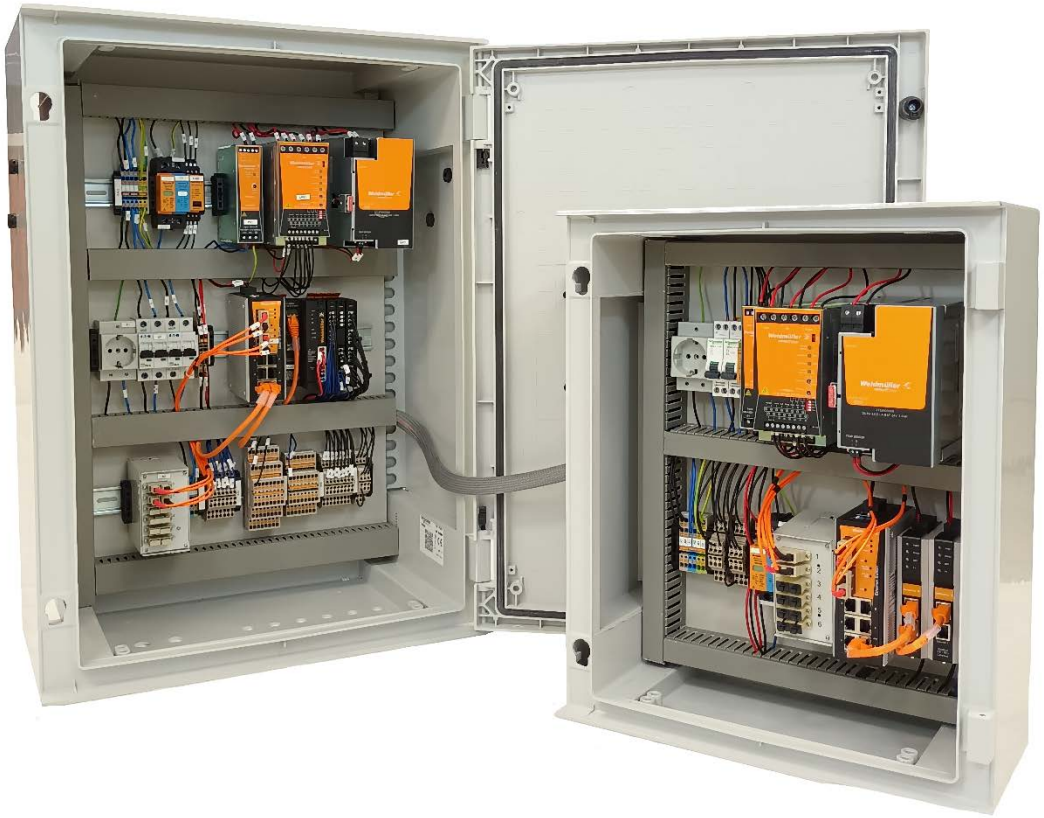


PV Weather Box

Operating instructions

(Version 0.0)

CONTENT

1. ABOUT THIS DOCUMENTATION

1.1 Target group and content

This user manual is dedicated to all personnel involved in mechanical installation and electrical connection of Weidmüller photovoltaic PV Weather box, as well as for operation and maintenance engineers who may interact with such devices during construction or commissioning of utility scale solar plants.

This user manual gives a general overview of the complete range of PV Weather boxes, its individual components, their function as well as their correct handling. An individual datasheet providing specific information comes with each PV Weather box. This information specifies the features of each PV Weather Box for a specific project.

1.2 Symbols and notes

Warnings in this documentation are structured differently depending on the severity of danger as the following criteria describes.

	**DANGER** **Imminent risk to life!** Notes with the signal word “Danger” warn users of situations which will result in serious injury or death if the instructions given in this manual are not followed.

	**WARNING** **Possible danger to life!** Notes with the signal word “Warning” warn users of situations which will result in serious injury if instructions given in this manual are not followed.

	**CAUTION** **Risk of injury!** Notes with the signal word “Caution” warn users of situations which will result in minor injuries if instructions given in this manual are not followed.

ATTENTION
Material damage! Notes with the signal word “Attention” warn users of hazards which may result in material damage.

	Text followed by this arrow shows notes which are not relevant to safety but provide important information about proper and effective work procedures.

The situation dependent to safety notices may contain the following warning symbols:

Symbol	Meaning
	Warning against hazardous electrical voltage
	Warning against explosive atmospheres
	Warning against electrostatically charged components
	Instruction: observe the provided documentation

- ▶ All instructions can be identified by a black triangle before the text.
- \- Lists are marked with a dash.

Before start working with the product, read the documentation completely! Keep the manual as well as the attached datasheet stored so that it can be inspected by operating personnel at any time. The document is available to download from Weidmüller website (www.weidmueller.com).

NOTE: All pictures, drawings and illustrations in this document are merely for information purposes. The final product delivered to customer may differ from the product shown in the operating instructions.

2. SAFETY

This section includes general safety instructions for handling the PV Weather box. Specific warning notices for different tasks and situations are given in the appropriate sections within this document. Failure to observe the safety and warning notices may result in to personal and material damage.

2.1 General safety notice

Proper transportation, storage, installation, commissioning, operation, and maintenance are required to ensure the safety operation of the product.

The permissible ambient conditions must be observed.

Before any work is carried out on the products (installation, maintenance, retrofitting), the product must be switched off and need to be free of hazardous voltage (from inverter and grid side). Manipulation must be carried out with the designated safety equipment and authorized personnel.

Photovoltaic systems may generate hazardous voltages. Two different ways of service activities are allowed on these products:

- "Working under voltage": Only electricians who have a qualification to work under voltage are allowed to carry out service activities under such circumstances. Observe the local rules and regulations and make sure to use the appropriate personal protective equipment.

- "Working without voltage": Electricians and trained persons are allowed to carry out work without voltage, when input and output connections are safely disconnected and secured against re-connection. Observe the local rules and regulations and make use of appropriate personal protective equipment.

Before starting any work, ensure that the system and the devices are disconnected from grid side.

Ensure protection against unauthorised opening. Unauthorised persons must neither open nor operate the weather box at any time.

If the installation regulations are violated, all warranty and liability claims shall be voided.

In case of any doubt or concern please follow the local installation regulations and/or mid voltage operation rules and regulations.

If a malfunction on a PV Weather box cannot be solved with the information provided in this document the product must be sent back to Weidmüller.

Weidmüller does not assume any liability if the product has been tampered or manipulated inappropriately.

2.2 Intended use

The PV weather box series are intended to be used in photovoltaic (PV) systems to monitor the weather information about a PV plant with different sensors.

Weidmüller products may only be used for the applications described in the catalogue and in the relevant technical documentation.

2.3 Personnel

All activities described in this document may only be carried out by specialists and instructed persons with the following qualifications:

- Knowledge of the functionality and principle of PV systems
- Training in handling dangers and risks during installation and handling electrical devices and systems
- Knowledge of applicable standards and guidelines
- Knowledge and observance of these operating instructions and the safety instructions contained therein

It is a common practise in the industry to apply the five safety rules described in the standard EN 50110. Additionally, qualified electricians must analyse case by case on each installation the best way to proceed in a safely manner.

The five safety rules in the EN50110 are the following:

1. Switch off the system's power supply
2. Block the possibility to repower the system accidentally
3. Verify that the installation has no power
4. Manipulate always with safety measures
5. Provide protection against adjacent live parts

2.4 Legal notice

PV Weather boxes are CE-compliant in accordance with Directive 2014/35/EU (Low Voltage Directive) and with Directive 2014/30/EU (EMC Directive).

3. DEVICE DESCRIPTION

3.1 Product overview

PV Weather boxes are a complete range of tailor-made solutions for utility-scale photovoltaic systems designed to monitoring the weather parameters in the photovoltaic plant. The PV Weather product range offers solutions with touch screen (to visualize the data) or without touch screen depending on customer necessities.

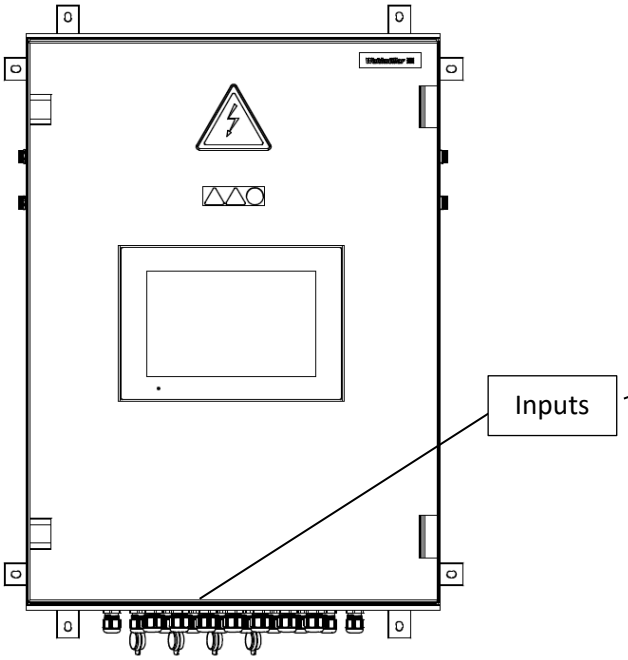


Figure 3.1 Product overview with touchscreen (front view)

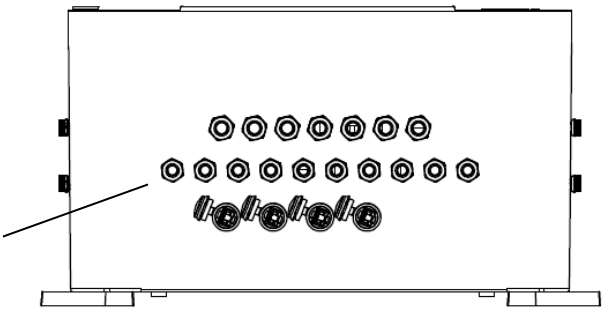


Figure 3.2 Product overview (bottom view)

Parameters influencing the selection of the optimal PV Weather box includes:

- Ambient temperature
- Degree of protection needed
- Number of inputs
- Data to monitor
- Need to visualize data
- Over-current protection
- Need of surge protection (Type I + II SPD)

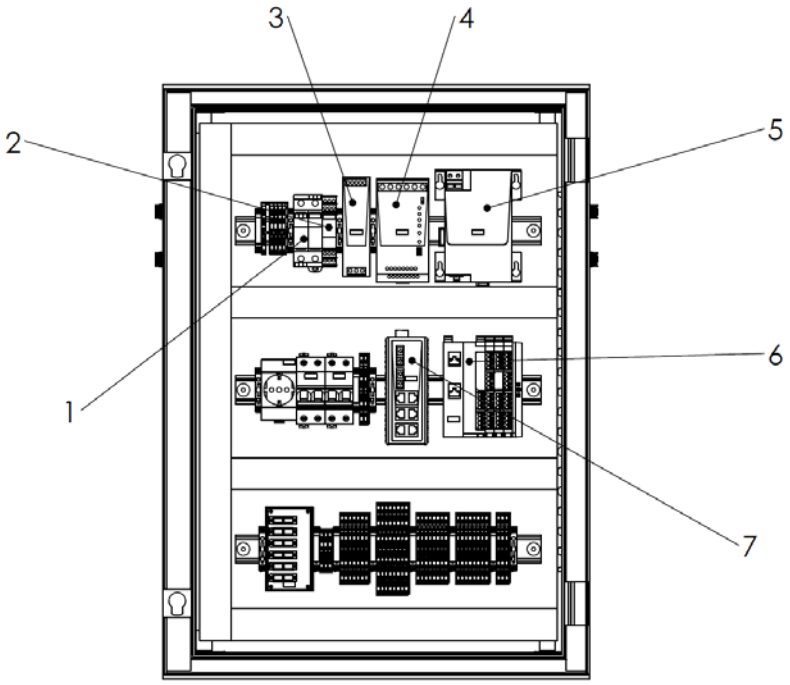


Figure 3.3 Main components of a PV Weather box (example)

1 AC surge protection device
2 RS-485 surge protection device
3 Power supply unit
4 Uninterruptible power suppy
5 Battery
6 U-Control
7 IE managed switch

3.2 Enclosure

The enclosures of all PV Weather box are made of Glass Fibre Reinforced Polyester (GFRP). They are IP65 and IK07 or higher in accordance with IEC 62208. Each enclosure is equipped with hinged door(s). Different enclosure sizes and configuration (landscape or portrait) may be used depending on each project configuration and power dissipation needs.

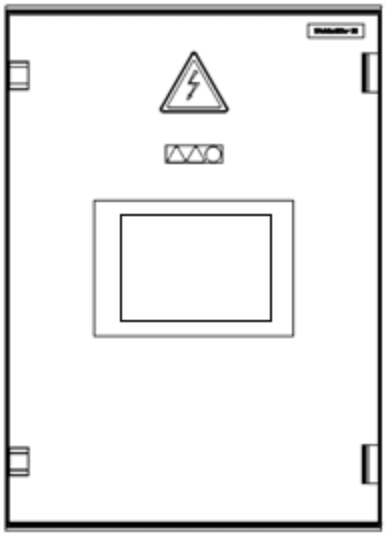


Figure 3.4 Enclosure

3.3 Conductors

To do the electrical connections inside the PV Weather box refer to the following conductor specifications:

Input conductor cross-section	Tolerance ofstripping length
< 4 mm^2	± 1 mm
6 – 10 mm^2	± 1.5 mm
> 16 mm^2	± 2 mm

To ensure a reliable connection, it is recommended the usage of proper crimping tools, as an example PZ 10 HEX (Order No.1445070000). Please check the product catalogue to select the appropriate tool for each cable and wire-end ferrule.

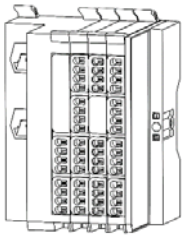
3.4 Input terminals

Figure 3.5 Cable glands

The PV Weather box is equipped with cable glands. They comply with DIN EN 50521 and are TÜV certified. The cost-efficient cable glands allow the installer to adjust the necessary number of cables entering and exiting the weather box to ensure the required water tightness.

3.5 General components

Component	Usage	Link to catalogue	Image
VPU	Protects the sensors against overcurrent's and overvoltage's	https://www.weidmuller.es/es/search.jsp?query=1352040000&tab=products	
VSPC	Protects the components against overcurrent's	https://www.weidmuller.es/es/search.jsp?query=8924670000&tab=products	
Pro ECO	Power Supply of 24 VDC and 3 ADC	https://www.weidmuller.es/es/search.jsp?query=1469470000&tab=products	
UPS	Controls the connection and disconnection of the battery	https://www.weidmuller.es/es/search.jsp?query=1370050010&tab=products	

Battery	Supplies the components when the weather box is disconnected of the grid	https://www.weidmuller.es/es/search.jsp?query=2789900000&tab=products	
U-Control	Controls the input data	https://www.weidmuller.es/es/search.jsp?query=1334990000&tab=products	
U-Control RS485 card	To connect RS485 inputs	https://www.weidmuller.es/es/search.jsp?query=1315750000&tab=products	
U-Control digital card	To connect digital inputs	https://www.weidmuller.es/es/search.jsp?query=1315200000&tab=products	
U-Control analog card	To connect analog inputs	https://www.weidmuller.es/es/search.jsp?query=1315620000&tab=products	
IE managed switch	Connects U-Control with the other devices	https://www.weidmuller.es/es/search.jsp?query=1344770000&tab=products	
Touchscreen	Visualizes the data	https://www.weidmuller.es/es/search.jsp?query=2555840000&tab=products	

4. TRANSPORTATION AND STORAGE

4.1 Transportation

► Always wear security footwear when handling or manipulating any PV Weather box.
► Mind item weight and use appropriate transportation equipment.

4.2 Unpacking the delivery

► Before unpacking the PV Weather box, make sure the product contained is the one ordered (see the label attached at the side on the package).

If the product received is not the requested one or is incomplete, please do not open the carton boxes and contact the local Weidmüller representative office, distributor, or the relevant contact person immediately.

► Check the delivery for completeness. For the scope of delivery, see the enclosed datasheet and dispatch documents.

In case of damage on the PV Weather box or missing parts are detected, do not install the unit, and contact the local Weidmüller representative office, distributor or the relevant contact person immediately.

► Ensure that the operating instructions are always accessible to the user

4.3 Storage

Make sure that the following conditions are met when material is stored:

- Ambient temperature: -25 °C to +40 °C
- Relative humidity: 0 % to 50 %

ATTENTION

Material damage!

The PV Weather box must be stored lying flat on its rear side. Otherwise, cable glands and connectors at the bottom of the enclosure may be damaged.

In case that dirt, dew, pollutants, or liquid enters into the equipment, or the equipment is suspected to be damaged it must not be commissioned until the correct remedial procedure has been discussed and approved by Weidmüller.

4.4 Establishing connections

ATTENTION

Material damage!

The weight of electrical cables may cause mechanical stress to the enclosure. For this reason, depending on the installation height, a strain relief underneath the PV Weather box may be installed.

- Use only electrical cables rated for the voltages, currents and environmental conditions (temperature, UV, etc.) expected at the installation site.
- Ensure that all cables are laid with short-circuit and ground fault protections.
- To ensure short-circuit-proof and ground-fault-proof installation in accordance with IEC 60364-5-52, the following requirements must be fulfilled:
- Cables must not be installed in the proximity of flammable materials or atmospheres
- Cables must be accessible and easy to manipulate.
- Cables must be protected against mechanical damage.
- Do not lay the wires over sharp edges.

5. INSTALLATION

5.1 Installation site

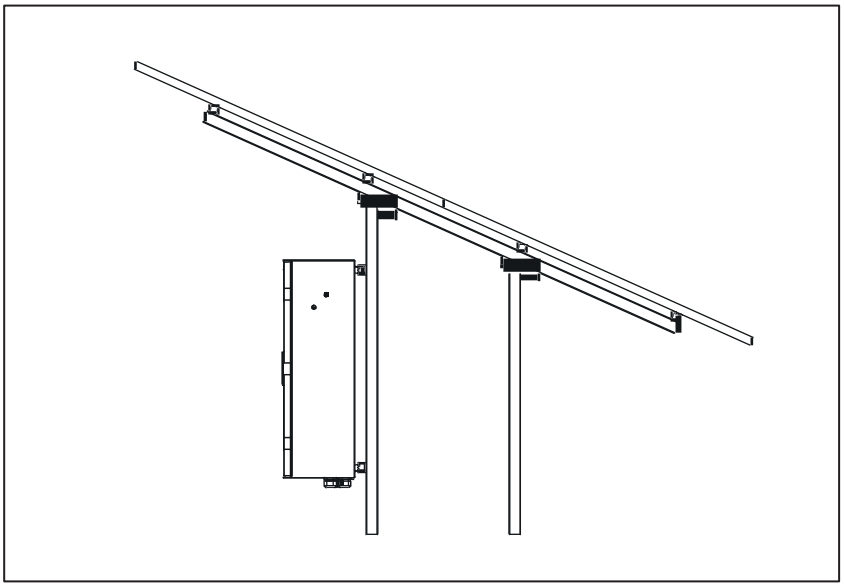


Figure 5.1 Installation under the PV modules

PV Weather boxes are suitable for protected outdoor installation. Ensure the following aspects when selecting the installation site:

- The location must be protected of the direct sunlight.
- The location must be accessible for installation and maintenance works.
- The installation site must not be located in flammable environments.
- The PV Weather box must be positioned as described in the following section or in other position ensuring the needed requirements.
- It must be ensured that unauthorised personnel cannot access the PV Weather box.
- The PV Weather box and especially the feeder conductors must be installed in such a way to avoid damage or wearing caused by rodents.
- Regard the operation conditions of the equipment:
- The temperature range is indicated on the label inside the box.
- The relative humidity may temporarily be as high as 100 % at a maximum temperature of +25 °C.
- Ensure that no object is blocking the pressure compensation elements at both sides of the combiner box.
- When installing the equipment, ensure rain cannot penetrate the PV Weather box.

Exposure to direct sunlight and direct rain for extended periods and excessively high or low temperatures may result in a shorter lifetime or damage of the internal components of the PV Weather box.

To protect the PV Weather box against direct sunlight and rain, it shall be installed under the photovoltaic modules or a protective canopy. Make sure there is enough air circulation around the equipment.

5.2 Positioning of the PV Weather box

PV Weather boxes are designed to be installed vertically with the cable glands or connectors pointing downwards. Merely a positive inclination from 15º to 90º is allowed.

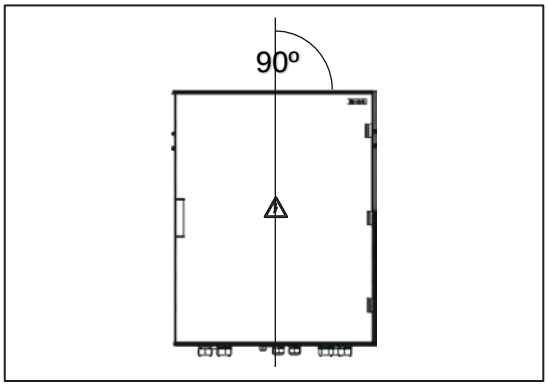


Figure 5.2 Installation in upright vertical position

The PV Weather box must not be installed horizontally lying flat on the rear side neither in any other orientation.

5.3 Fixation

Ensure that the requirements described in chapters 5.1 and 5.2 are fulfilled before proceeding to the fixation of the PV weather box.

- **Mounting material**

Most of Weidmüller's PV Weather boxes are supplied with metal or plastic mounting lugs, depending on the model. Fixation screws are not delivered with the PV Weather boxes. Please make sure all needed material is available before starting the installation.

- **Requirements**

The PV Weather box shall be fixed to a suitable and stable metallic structure or wall that will support its weight during the entire lifetime. Always use all fixations that are supplied with the PV Weather box. In case the installation is done on a pedestal, the PV Weather box should be fixed on the top of it with the specific supplied accessories.

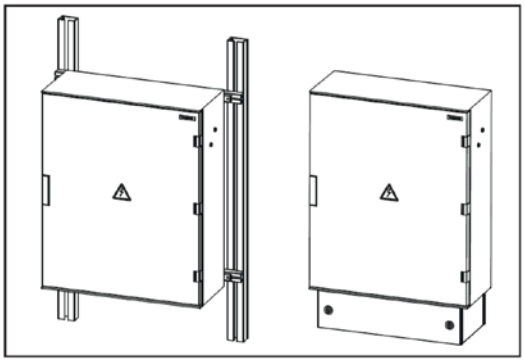


Figure 5.3 Fixing the enclosure to a structure or on a pedestal

5.4 Installation of the PV Weather box

	**CAUTION** **Risk of injury due to size and weight!** Always install the PV Weather box with two people to avoid any injury or accident. Installers should be qualified for the specific works according IEC standards and/or local regulations and should wear the necessary safety equipment.

ATTENTION

The product can be destroyed!

- Never drill the enclosure to add any extra hole or to modify any of the existing holes. Otherwise, the product IP warranty will be voided.
- Lay down the PV Weather box only on its rear side after unpacking. Otherwise, the cable glands and connectors at the bottom of the enclosure may be damaged.

► Remove the PV Weather box from the original packaging.
► Measure the exact distances between the drilling holes and mark the positions in the mechanical structure (or wall) where the PV Weather box is planned to be installed.
► Drill the holes in the mechanical structure (or wall).
► Mount the PV Weather box using the provided fixing lugs.

Installation check:

- Verify that the PV Weather box is correctly secured and fixed.
- Make sure the PV Weather box is not bended over the edges, otherwise the water tightness is not guaranteed.

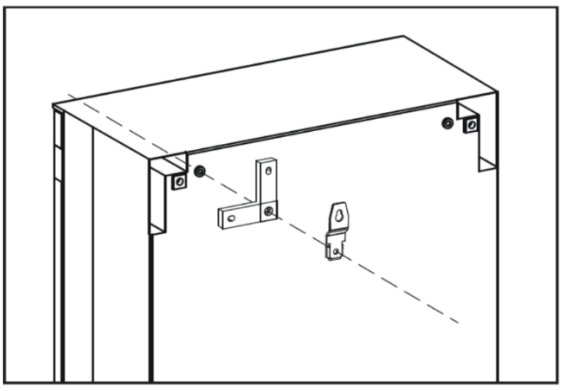


Figure 5.4 Fixing lugs enclosure type A

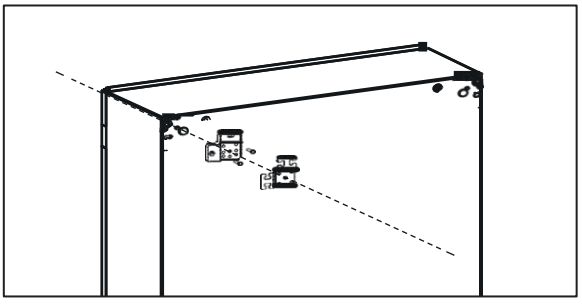
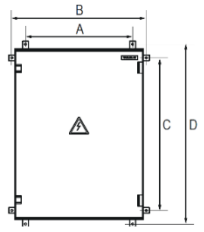
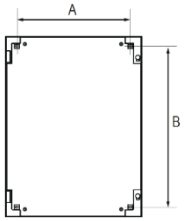
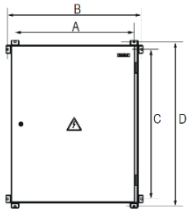


Figure 5.5 Fixing lugs enclosure type B

Enclosures type A mounting lugs and fixing points				
Size Dimension H x W x D (mm)				
86 847 x 636 x 300	A	530	A	560
	B	665	B	755
	C	755		
	D	890		
108 1056 x 853 x 362	A	750	A	750
	B	885	B	955
	C	955		
	D	1090		
1) This table is a reference. For specific measure of your product please refer to the documentation delivered with the product.				

Enclosures type B mounting lugs and fixing points		
Size Dimension H x W x D (mm)		
86 847 x 636 x 300	A	583
	B	680
	C	782
	D	880
108 1056 x 853 x 362	A	783
	B	880
	C	982
	D	1080
1) This table is a reference. For specific measure of your product please refer to the documentation delivered with the product.		

Each PV Weather box model is designed according to individual specifications and approved by the Customer. Please make sure that during mounting process all specifications and requirements are met according to the present manual.

5.6 Input connections

In order to properly connect all inputs and of the PV Weather box, it is recommended to use wire end ferrules as well as appropriate stripping and crimping tools. The enclosure is equipped with cable glands. No tools are necessary fix the cables in their position and cover the gap existing between the cables and the holes drilled in the enclosure.

- **Input connections via cable glands**

There are various cable entries with their associated cable gland. Pay attention to the number of inputs as well as their phases to avoid mistakes during connection. Make sure that electrical drawings provided with the PV Weather box are available and consulted during assembly and connection. Make sure that the final input connections match the electrical drawing provided.

► Insert AC input cables (for feeding the PV Weather box) through the designated holes at the bottom of the enclosure towards the interior of the PV Weather box.
► Make sure the wires pass through their designated cable gland with their thread in correct position.
► Strip the conductor for the input cross section according to the end ferrule used by utilizing the appropriate tool.
► Crimp the conductor with a tubular wire end ferrule with 15 mm length of the sleeve (the conductive part).
► Pull softly down the cables to ensure that all of them are properly connected.
► Make sure there is sufficient strain relief for the AC input cables.
► Make sure that the cables are not mounted under stress conditions.
► Tighten the cable glands.

5.8 Grounding cable connections

The PV Weather boxes are designed with non-metallic mounting plate. The enclosures are made of GFRP (Glass Fibre Reinforced Polyester). Therefore, the unique ground connector is used for the surge protection. Note that earthing cable must be connected to provide the correct operation of the surge protection device (SPD). Protective conductors and other earthing conductors for functional and protective purposes cannot generally be considered as equipotential bonding dedicated for surge and lightning protection.

According to the standard CLC-TS 50539-12, the cross section of connecting conductors to SPDs on the AC side of PV installations must be as follows:

- Earthing conductors of SPDs Type I+II shall have a minimum cross section of 16 mm^2 copper or equivalent or equal to the cross section of live connectors, if greater than 25 mm^2.
- The cross section of the connecting conductors from the SPD to live conductors shall not be smaller than the cross section of the live conductors of the associated circuit.

6. WEATHER SENSORS

Weidmüller could provide following type of sensors on demand in order to get the needed weather data.

Sensor	Function
MULTIPARAMETRIC WEATHER WS601-UMB LUFFT	Global sensor (Ambient temperature, humidity, wind, rain…)
PYRANOMETER SMP10A KIPP&ZONEN	Solar radiation
MODULE TEMPERATURE 3S-MT-PT1000-MB SEVEN	Panel temperature
SOLAR IRRADIANCE 3S-IS SEVEN	Solar irradiance

Other weather sensors can be connected to any PV Weather box as far as they met the technical requirements specified in the PV Weather box datasheet.

6.1 Weather sensors communications

The sensors must be connected using Modbus-RTU interface to properly communicate with the U-Control (other type of communications will not work). Communications with external compatible weather sensors is limited to 8 devices.

ATTENTION
Material damage! RS-485 wiring requires technical skills and tools different to those available to regular electricians. Please ensure that this step of the equipment installation is performed by staff with the right skills and tools.

This equipment complies with the latest RS-485 and Modbus standards, which are the official sources of information. The installation staff must refer to the following documents, which always have priority:

- TIA/EIA–485–A: Electrical characteristics of generators and receivers for use in balanced multipoint systems
- TIA TSB–89–A: Application guidelines for TIA/EIA– 485–A
- Modbus application protocol specification v1.1b
- Modbus over serial line specification and implementation guide v1.02

The RS-485 port of this equipment is floating with regards to the rest of the circuit. This is accomplished by means of dedicated DC/DC converters and optocouplers which provide a double insulation barrier between the communications ports and the PV-side terminals. From the user perspective, this means reliable communications, no ground loops and full safety even under severe surges.

6.2 Wiring the communications

	DANGER
	**Imminent risk of life!** High voltages up to 230 or 400 V AC are present in the live parts. Touching live parts can result in death or serious injury due to electric shock. ► Before starting any work in the PV Weather box: • disconnect the PV Weather box from mains supply while ensuring that MCB is open and no voltage is present so all devices are turned off

ATTENTION
Material damage! A wrong installation can create a lack of communications, but also, it can damage the equipment. Please pay attention when wiring RS-485 cables.

All the units shipped out from Weidmüller have their RS-485 ports thoroughly tested right at the end of the production line. Weidmüller will not cover under warranty units that have their RS-485 transceiver IC damaged due to wrong wiring or due to surges.

6.3 Cable requirements

The RS-485 cable used to wire this equipment must fulfill the following specifications:

- Shielded twisted pair with 1.5 or 2 pairs (preferably 1.5 pairs)
- Braid shield, not foil shield
- 120 Ω characteristic impedance
- Cross section of individual wires 0.2 mm^2 (AWG24) or larger

The following are two examples of proper RS-485 cable:

- Belden: 3106 A
- Lapp Cable Unitronic Bus LD 2×2×0.22 (part number 2170204)

Please regard the following aspects when wiring the RS-485:

- The RS-485 bus topology must be a daisy chain
- Short stubs inside the PV Weather box should be at maximum 2 meters long
- We recommend a bus length of 500 meters at maximum, even though the RS-485 standard allows up to 1200 meters at low bit rates (i.e. 9600 bps and 19200 bps)
- Each end of the bus requires a 120 Ω 10 % ½ W termination resistor between D+ and D–. One end of the bus will be the RS-485 Master which may or may not include an internal termination option. The other end will be inside the PV Weather box farthest away from the Master in terms of RS-485 cable distance
- This equipment loads the RS-485 bus with 1/8 UL (Unit Load)
- Always make sure that D+, D– and C use the right color-coded wire of the cable

7. COMMISSIONING

Preconditions for the commissioning are as follows:

- The installation has been made according to the “Installation” chapter of this user manual.
- The ground around the PV Weather box is firm and easily accessible allowing a safe operation and work.

► Wear appropriate safety clothes and personal protective equipment.
► Use appropriate tools with the correct isolation.

A digital multimeter is necessary to verify the absence of voltage in the live parts of the PV Weather box.

► Check that the digital multimeter is capable to read the maximum voltage of the input AC mains and the maximum current flowing through it before starting any operation.

	**DANGER** **Imminent risk to life!** High voltages up 400 V AC are present in the live parts. Touching live parts can result in death or serious injury due to electric shock. ► Before starting any work in the PV Weather box: • disconnect the main supply while ensuring that the MCB switch is in OFF position and no current is flowing/feeding the PV Weather box. ► Ensure that nobody reconnects the unit until work is finished or while any operator is working. ► Ensure that no voltage is present in parts to be manipulated or could be accessible. ► Do not touch live components. ► If specific live parts cannot be isolated or disconnected, it is mandatory to use additional safety elements to avoid any risk to people or equipment.

7.1 Main indications and inspections

It is recommended to carry out a general inspection on the PV Weather box and the status of the installation before commencing operation. The installation must comply with either local or international regulations.

- **Visual inspection**

Check the following issues:

- All cables are in good condition.
- There are no hazards around the installation that could eventually create any damage.
- The cables are connected to the correct phase and according to electrical drawing provided.
- The enclosure is firmly fixed to the structure and all mounting elements are tightened properly.
- The door of the enclosure is properly closed, and the seal fits all door perimeter to provide the required isolation. As a check, press the door while locking the key-locks a few times.
- The cable glands are tightened correctly.
- The grounding cable is connected through its own cable gland and the cable gland is tightened correctly.
- Check the correct status of the surge protection device (the indicator window should be in green colour).

- **Additional inspections issues for PV Weather boxes with controller:**

  - The RS-485 wire is correctly connected to the specific terminals inside the PV Weather box or alternatively to the U-Control connector through its own cable gland.
  - The cable gland for communications cable is tightened correctly.

7.2 Start-up

	**DANGER** **Imminent risk to life!** High voltages up to 400V AC are present in the live parts. ► Reconnect the MCB switch only if all previous tasks have been finished with satisfactory results.

► Switch on the main MCB switch (from OFF to ON position).
► Close and secure the door with the key-tool lock.

8. ACCESSORITES AND SPARE PARTS

Some parts of the PV Weather box can be replaced in case of damage. Before proceeding with any of these replacements, we highly recommend contacting with the indicated Weidmüller representative to clarify any doubt.

8.1 Replacement of SPD

	**DANGER** **Imminent risk to life!** The contacts in the sockets of the surge protection arresters are live. ► Do not reach into the sockets when arresters are removed.

Weidmüller SPDs have two individual arresters. If the SPD is damaged, the status indicator window of the respective arrester shall be in red colour.

9. CLEANING

ATTENTION
The product can be destroyed! The enclosure and cover may be damaged by detergents, scouring agents, solvents, and high-pressure cleaners.

► Clean the PV Weather box at regular intervals so that the warning symbols are always clearly visible.
► Only clean the exterior of the enclosure when it is closed.
► Take care not to damage the sticker with warning symbols.

10. MAINTENANCE AND SERVICE

10.1 Maintenance

The PV Weather box is a product with minimum maintenance.

► Carry out a visual inspection once per year checking the issues listed below.

	**DANGER** **Imminent risk to life!** High voltages up to 400V AC are present in the live parts. ► Ensure when operating the product that main MCB switch is switched off and it is free of hazardous voltage.

Checklist for annual inspection of the PV Weather Box		
Remarks	Issue	Checked
Enclosure and seals		
Temperature fluctuations on outdoor sites strain the seals.	►Check that the cover seals are in proper condition.	
Porous or squeezed seals decrease the tightness and therefore the IP class of the enclosure.	►Check that there is no or dust inside the enclosure.	
Humidity inside the enclosure can cause corrosion.	►Check the seals and screw connections as well as the drainage inserts. ►Check that there are no signs of corrosion, water, or humidity inside the enclosure.	
Regard the tightening torques.	►Check the cable glands and retighten them if needed.	
Surge protection device (optional)		
The inspection windows of the surge arresters should be green colour.	►Replace each surge arrester the inspection window of which is red colour.	
General Inspection		
General components overview.	►Check that there are no burn marks on the terminals.	

10.2 Service

If you have any questions about the PV Weather box, please contact the Weidmüller representative in your country.

Information about the PV Weather box like videos, installation guides and FAQ's re provided on the Weidmüller website (www.weidmueller.com).