

PV DC FLOATING COMBINER BOX



Operating instructions

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Manufacturer

Weidmüller Interface GmbH & Co. KG
Klingenbergstraße 26
32758 Detmold, Germany
T +49 (0)5231 14-0
F +49 (0)5231 14-292083
www.weidmueller.com

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1 About this documentation

1.1 Target group and contents

This user manual is intended to personnel that is involved in mechanical and electrical installation of a Weidmüller PV DC FLOATING COMBINER BOX and moreover to service and maintenance personnel. This user manual gives the general overview about the complete range of PV DC FLOATING COMBINER BOX, the individual components, their function as well as their correct handling. An individual datasheet providing the specific information is attached to each combiner box.

1.2 Symbols and notes

The warnings in this documentation are structured differently depending on the severity of danger.

	DANGER
	<p>Imminent risk of life!</p> <p>Notices with the signal word "DANGER" warn you of situations which will result in serious injury or death if you do not follow the instructions given in this manual.</p>

	WARNING
	<p>Possible risk of fatality!</p> <p>Notices with the signal word "WARNING" warn you of situations which may result in serious injury or death if you do not follow the instructions given in this manual.</p>

	CAUTION
	<p>Risk of injury!</p> <p>Notices with the signal word "CAUTION" warn you of situations which may result in injury if you do not follow the instructions given in this manual.</p>

ATTENTION	
Material damage!	
Notes with the signal word "ATTENTION" warn you about hazards which may result in material damage.	

The situation-dependant 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 documentation

Additional formatting is used in the rest of the text which has the following meaning:

 Text items next to this arrow constitute information which is not related to safety, but which provides important information regarding correct and effective work.

- ▶ You can recognise handling instructions from the black triangle in front of the text.
- Lists are indicated with dashes.



Before start working with the product, read the documentation completely!

Keep the manual as well as the attached data sheet stored so that it can be inspected by operating personnel at any time.

The document is available to download from the Weidmüller website.

2 Safety

This section includes general safety instructions for handling the PV DC FLOATING BOX. Specific warning notices for specific tasks and situations are given at the appropriate places in the documentation. Failure to observe the safety and warning notices can result in damage to persons and material.

2.1 General safety notice

Proper transport, storage, installation, commissioning, operation and maintenance are required to ensure that the products operate safely and without any problems.

The permissible ambient conditions must be observed.

Ensure protection against unauthorised opening. Unauthorised persons must neither open nor operate the combiner box.

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

- "Working under voltage": Only electricians who have a qualification for working under voltage are allowed to carry out service activities under voltage. Observe the local regulations and make use of 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 regulations and make use of appropriate personal protective equipment.

Before connecting the cables to the input connectors, make sure that the fuses are not inserted and that the open circuit voltage of the corresponding string is equal to the other strings.

Do not extract or insert fuses under load. Before manipulating a fuse make sure there is no reverse current flowing into the corresponding string.

If the installation regulations are violated, all warranty and liability claims are void.

If a malfunction on a combiner box cannot be fixed after following the recommended measures, the product in question must be sent back to Weidmüller. Weidmüller does not assume any liability if the product has been tampered with.

2.2 Intended use

The PV DC FLOATING BOX series are intended for use in photovoltaic (PV) systems. The product joins different strings of a PV system and contains DC over-current and over-voltage protections for string level. String monitoring devices are provided optionally.

Weidmüller products may only be used for the applications described in the catalogue and in the relevant technical documentation. If products and components from other manufacturers are used, these must be recommended or approved by Weidmüller.

The observance of the documentation is part of the intended use.

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 sector to apply the five safety rules described in the standard EN 50110. Anyway, qualified electricians must analyse case by case on each installation the best way to proceed with safety.

The five safety rules are the following:

1. Disconnect completely
2. Secure against re-connection
3. Verify that the installation is dead
4. Carry our earthing and measures against short-circuiting
5. Provide protection against adjacent live parts

2.4 Legal notice

The PV DC FLOATING BOX is CE-compliant in accordance with Directive 2014/35/EU (Low Voltage Directive) and with Directive 2014/30/EU (EMC Directive).

3 Device description



Figure 3.1 Product range

3.1 Product overview

PV DC FLOATING BOX is a complete range of tailor-made Level 1 combiner boxes for utility-scale photovoltaic systems. The combiner boxes are installed to join and protect the DC strings that go from the PV panels to the solar inverter.

The PV DC FLOATING BOX product range offers solutions from 8 to 24 inputs and 1 or 2 outputs. These can be designed for systems with string voltage of 1000 or 1500 V DC.

The necessary string cables (+ and -) are to be connected at the inputs whereas one or two DC+ and DC- main cables will be at the output side. The output cables must be connected to a Level 2 combiner box, which will join DC+ and DC- from other Level 1 combiner boxes, or directly to the solar inverter.

Parameters influencing the selection of the optimal PV DC FLOATING COMBINER BOX

- Ambient temperature
- Degree of protection needed
- DC voltage range
- I_{sc} of the PV string
- DC earthing system
- Number of inputs
- Number of outputs
- Fuses in one or both poles (by default in both poles)
- Type of surge protection (by default Type II SPD)
- Type of input terminals (by default multivita cable glands)
- String monitoring (if yes: single or pair monitoring)

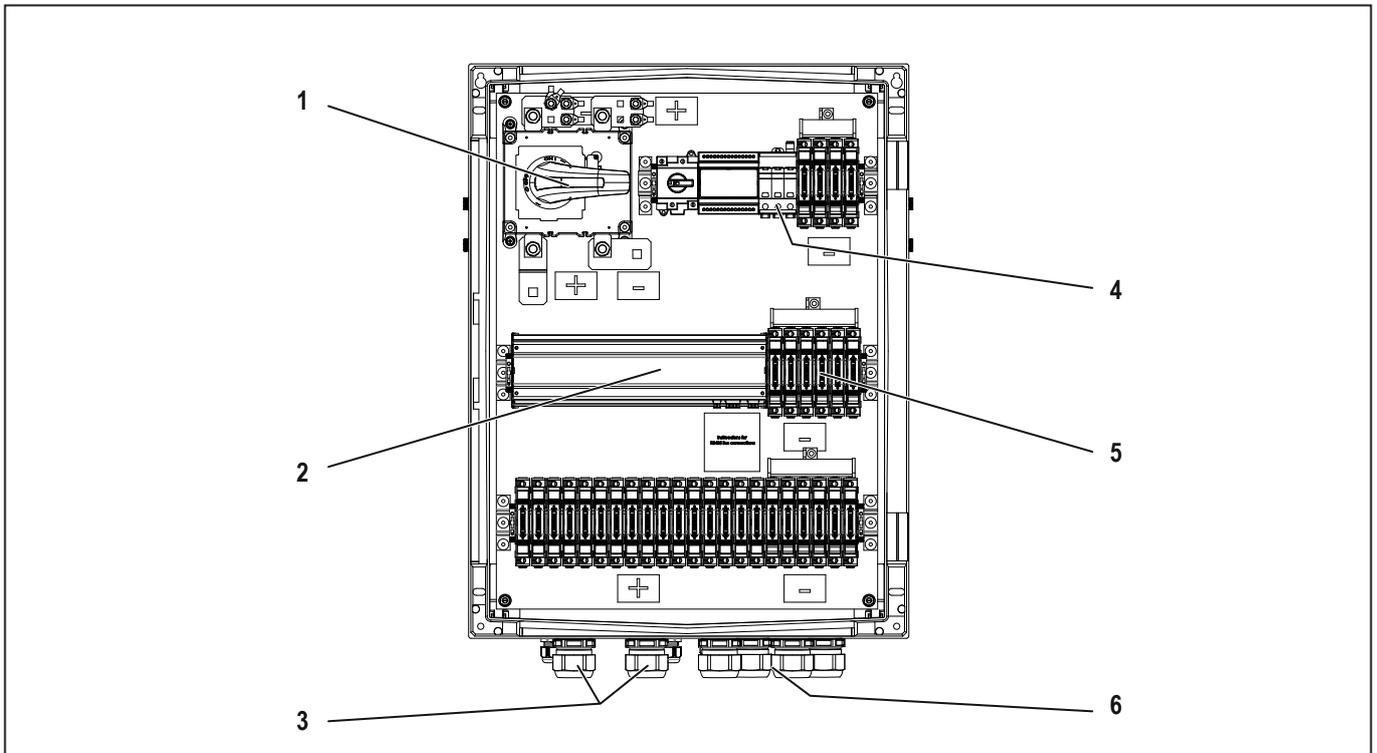


Figure 3.2 Main components of the PV DC FLOATING COMBINER BOX (example)

- 1 DC Switch
- 2 String monitoring device Transclenic 16i+ (optional)
- 3 Output DC +/-
- 4 Ground terminal
- 5 Fuse holders
- 6 Input DC +/- (cable glands, alternatively WM4 C connectors)

3.2 Enclosure

The enclosure of the PV DC FLOATING BOX is made of Glass Fibre Reinforced Polyester (GFRP). The enclosure provides IP65 and IK07 or higher in accordance with IEC 62208. Each enclosure is equipped with hinged door(s).

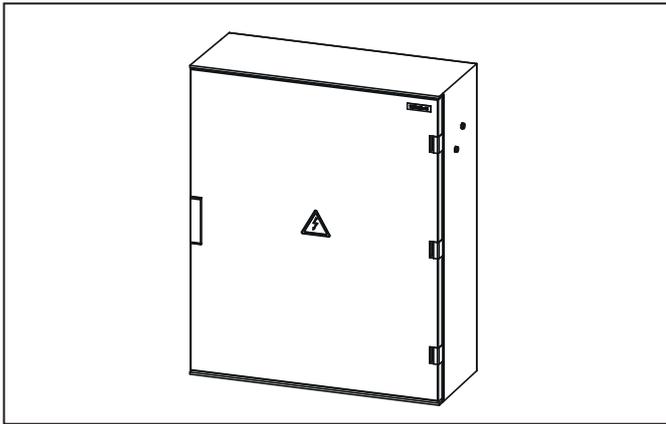


Figure 3.3 Enclosure

3.3 DC Switch

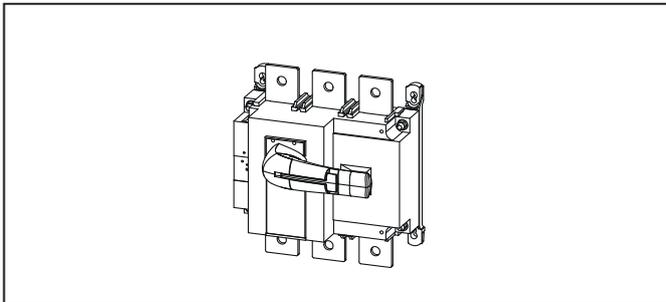


Figure 3.4 DC switch

The PV DC FLOATING BOX has a DC disconnection switch by default. The DC voltage of the switch depends on the voltage of the PV string. The switch disconnecter making and breaking capacity (according to the IEC 60947-3) has been selected to assure that it can switch the circuit at full load at the maximum operating temperature.

3.4 Surge protection device (SPD)

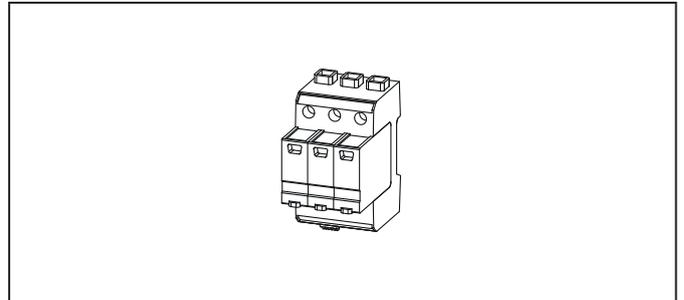


Figure 3.5 Surge protection device

The surge protection device has been selected corresponding to the customers requirements and in accordance with the standard for low-voltage surge protective devices IEC 61643-32.

Special units for 1 kV or 1.5 kV are used to provide the best performance in each specific system configuration.

3.5 Fuse holders

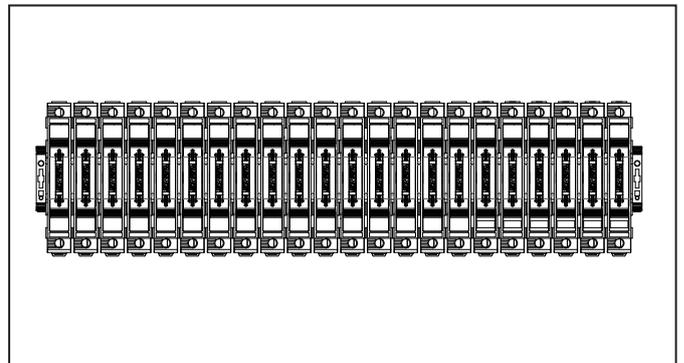


Figure 3.6 Fuse holders

The fuse holders provide the interconnection between the string input cables and other elements inside the combiner box. The fuse holders ensure that the fuses are placed in the optimum position to perform their protection function. Additionally, the type of fuse holders (IP 2X) enable the authorised personnel to operate the fuses in a safe manner. These products allow multiple setups which helps to build up specific tailor-made solutions of PV combiner boxes.

3.6 Fuses

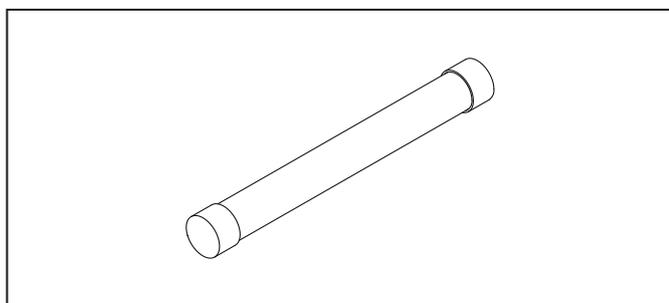


Figure 3.7 Fuse

The fuses protect the PV strings against over-current situations. The PV DC FLOATING BOX is provided with gPV fuses in accordance with IEC 60269-6:2010.

Each design of combiner box contains the most suitable fuse rating specially selected for each project, depending on I_{sc} of PV strings, on voltage rating and on ambient temperatures.

To assure the best performance of the complete solution, PV DC FLOATING BOX is delivered with fuses, optional without.

ATTENTION

Material damage!

Only use fuses with silver plated end-caps. If you have to replace a fuse inside a PV DC FLOATING BOX, use the same type of fuses delivered with the original combiner box. Pay special attention to the voltage and current rate as well as the size and material.

3.7 Terminals

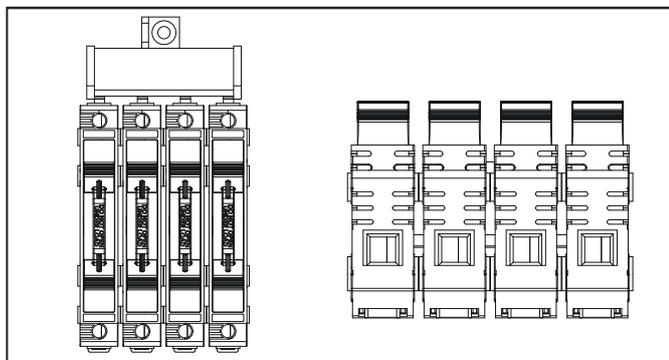


Figure 3.8 Terminals

The fuse holder terminals allow to connect the string cables safely.

3.8 Conductors

To realise the connections regard the following conductor specifications:

Stripping length (regard the tolerances below)	18 mm
Clamping range, min. / max.	0.5 mm ² ... 16 mm ²
Wire connection cross section AWG, min. / max.	AWG 20 ... AWG 4
Solid H05(07) V-U, min. / max.	0.5 mm ² ... 16 mm ²
Stranded H07V-R, min. / max.	6 mm ² ... 16 mm ²
Flexible H05(07) V-K, min. / max.	0.5 mm ² ... 16 mm ²
Wire end ferrule with plastic collar, DIN 46228-4, min. / max.	0.5 mm ² ... 16 mm ²
Wire end ferrule, DIN 46228-1, min. / max.	0.5 mm ² ... 16 mm ²
Plug gauge acc. to EN 60999 a x b; Ø	5.3 mm (B6)

Conductor cross section	Tolerance of stripping length
< 4 mm ²	± 1 mm
6 – 10 mm ²	± 1.5 mm
> 16 mm ²	± 2 mm



In order to assure a reliable connection we recommend to use appropriate crimping tools, as an example PZ 10 HEX (Order No.1445070000). Please check the Weidmüller product catalogue to select the appropriate tool.

3.9 Input terminals

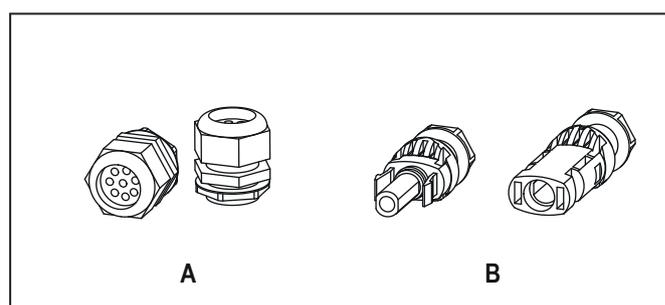


Figure 3.9 Cable glands (A) and WMC 4 connectors (B)

The PV DC FLOATING BOX is equipped either with cable glands or with special photovoltaic connectors WMC 4. The WMC 4 connectors reduce the installation time as well as the maintenance time. They fulfill the DIN EN 50521 and are TÜV certified.

The cost-efficient cable glands on the other hand allow the installer to adjust the necessary number of cables even in the field.

3.10 String monitoring device (optional)

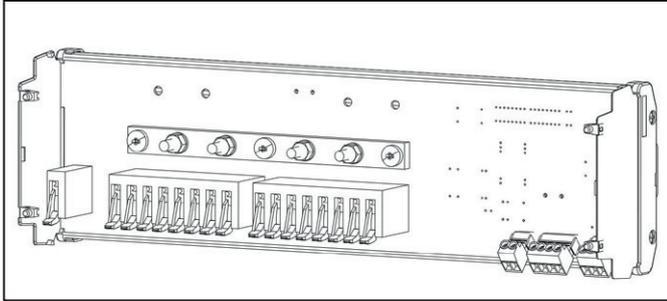


Figure 3.10 String monitoring device Transclenic 16i+

In case the PV DC FLOATING BOX is equipped with a string monitoring device, this device is a Transclenic 16i+ 1k5 HP with PUSH-IN terminals. This device simplifies the connection work inside the combiner box and reduces maintenance tasks due to the PUSH IN terminals. The Transclenic 16i+ can operate at full load (25 Amps) at maximum temperature range (+70 °C).

3.11 Power supply for string monitoring

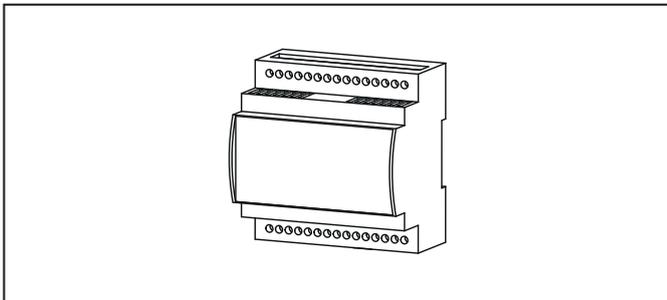


Figure 3.11 Power supply for string monitoring device

The string monitoring device is supplied by a Transclenic BKE DC/DC power supply device. Depending on the maximum voltage the device is a Transclenic BKE 1k0.4 (≤ 1000 V DC) or a Transclenic BKE 1k5.4 (≤ 1500 V DC).

3.12 PMMA Suncover

The PV DC FLOATING COMBINER BOX is equipped with a suncover meant to protect the enclosure from direct sunlight and rain. This part made of PMMA material ensures the proper operation of the combiner box in floating power plants applications. This cover comes pre-assembled with the enclosure and there is no need to do any extra operation on site.

ATTENTION

Material damage!

Be careful when opening the door of the enclosure when the cabinet is laying on its back side ! Do not drop the enclosure door when operating. Open it carefully and accompany it while handling it until it is fully opened. Opening the door without care may result into damage of the door hinges and PMMA cover.

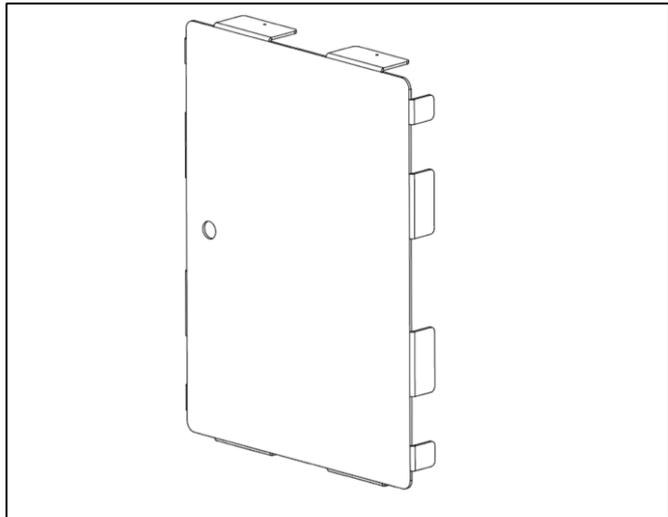


Figure 3.12 PMMA suncover

3.12 General technical data

Main application features	
Inputs	8 to 24
Outputs	1
Operating ambient temperature range	-20 °C ... +50 °C
Rated DC voltage	≤ 1.500 V DC
Input connectors	WM4 C connectors or cable glands
Input connector technology	Screw tied inputs (up to 16 mm ² cable)
DC earthing system	Floating, negative grounded or positive grounded system
Main electrical current protections	
Rated DC current per input	≤ 20A (single, double or triple string connection)
Maximum fuse rating	30 A for 10x38 / 32 A for 10x85
Protection against overcurrent	gPV fuse-links according IEC 60269-6
Fuses	10x85 mm for 1.5 kV
Switch-disconnector	Yes (optional)
Switch-disconnector making and breaking capacity (acc. to IEC 60947-3)	≤ 400 A (other options on demand)
Enclosure	
Enclosure material	GFRP (Glass Fiber Reinforced Polyester)
Enclosure fixing system	horizontally mounted (0-45° from horizontal plain)
Degree of protection (acc. to IEC 60529)	IP65
Form factor	Cabinet with hinged door or removable cover
Surge protection	
Surge protection device	Type I, Type II and Type I+II
Auxiliary contacts	optional
Surge protection on EIA-RS485 ports	optional
String monitoring (optional)	
String monitoring device	Transclenic 16i+ 1k5 H
Main monitored parameters	Voltage, current, temperature, DI status and auxiliary alarms
Communication	RS485 (3-wires)
Protocol	Modbus/RTU
Self-powered	Yes (DC/DC power supply)
Standards	
Standards	IEC 61439-2 ed 2.0 / EN 61439-2:2011



Please regard the data sheet attached to each combiner box.

4 Transport and storage

4.1 Transporting



- ▶ Always wear work shoes with foot protection when transporting and unpackage the combiner box.

- ▶ Regard the total weight and use appropriate transportation equipment.

4.2 Unpacking the delivery

- ▶ Before unpacking, check that the product contained is the one you have ordered (see the label laterally on the package).



If the product that you have received is not what you have requested or is incomplete, please do not open the shipping boxes. Please contact your Weidmüller representative office, your distributor or the relevant contact person immediately.

- ▶ Check the delivery for completeness. For the scope of delivery, see the enclosed data sheet and dispatch documents.



If you detect any issue or damage, do not install the unit. Please contact your Weidmüller representative office, your distributor or the relevant contact person immediately.

- ▶ Store away the transport packaging.
- ▶ Ensure that the operating instructions are accessible to the user at all times.

4.3 Storage

Make sure that in case of long-term storage the following conditions are met:

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

ATTENTION

Material damage!

The combiner box must be stored lying flat on the rear side. Otherwise the cable glands and connectors at the bottom of the enclosure can be damaged.

In the event that after the storage there is any ingress of dirt, pollutants or liquid into the equipment, or the formation of condensation, damage or any other failures the equipment must not be commissioned until the correct remedial procedure has been discussed with and approved by Weidmüller.

4.4 Establishing connections

ATTENTION

Material damage!

The tension of the cables can cause mechanical stress to the enclosure. For this reason, depending on the installation height, a strain relief underneath the combiner box may be needed. Regard the national regulations.

- Use only electrical solar cables rated for the voltages, currents and environmental conditions (temperature, UV, etc.) expected at the installation site.
- Ensure that you lay all cables with short-circuit protection and ground fault protection.
- As feeders use only single-core cables with double or reinforced insulation in accordance with IEC 60364-5-52.
- 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 combustible materials.
 - Cables must be accessible.
 - Cables must be protected against mechanical damage.
- Do not lay the wires over sharp edges.

5 Installation

5.1 Installation site

The PV DC FLOATING BOX is suitable for unprotected outdoor installation. Regard the following aspects when selecting the installation site:

- The location does not have to be protected from the weather and direct sunlight.
- The location must be easily accessible for installation work and later maintenance work.
- The installation site must not be in close proximity to easily flammable materials, gases or vapours.
- The combiner box must be positioned laying flat on its back side in an angle of 0° to 45° from horizontal plain.
- It must be ensured that unauthorised personnel cannot access the combiner box.
- The installation area must be stable enough to enable installation and maintenance work safely.
- The combiner box and especially the feeder conductors must be installed in such a way that damage cannot be caused by rodents.
- Regard the permissible ambient conditions:
 - 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.
- Ensure that neither the string input cables nor the PV output cables will be damaged by a lawnmower or similar agricultural implement.
- When installing, ensure rain cannot penetrate the combiner box.



Exposure to heavy and direct rain for extended periods and excessively high or low temperatures can result in a shorter lifetime or damage to the internal components of the combiner box.



FLOATING BOXES can be direct exposed under sunlight and rain, provided the designated protective cover is properly installed. Take air circulation around the box into account.

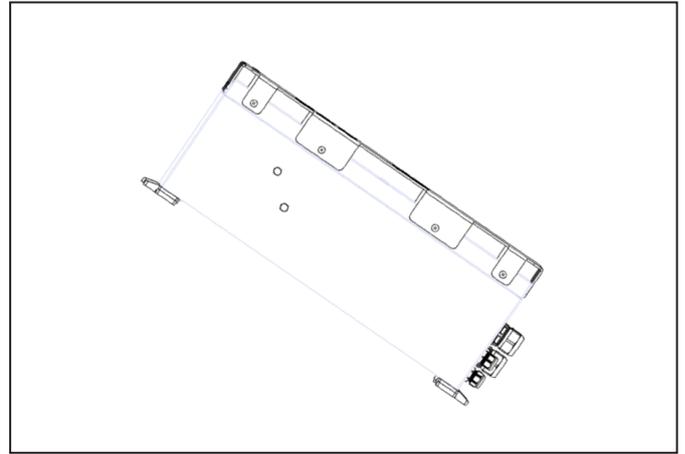


Figure 5.1 Installation under the PV modules

5.2 Positioning of the combiner box

The PV DC FLOATING BOX is designed to be installed horizontally with the cable glands or connectors leading down.

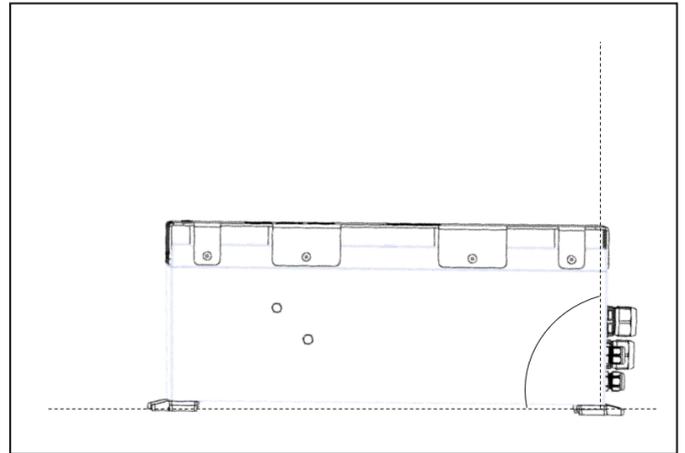


Figure 5.2 Installation laying on rear side of enclosure

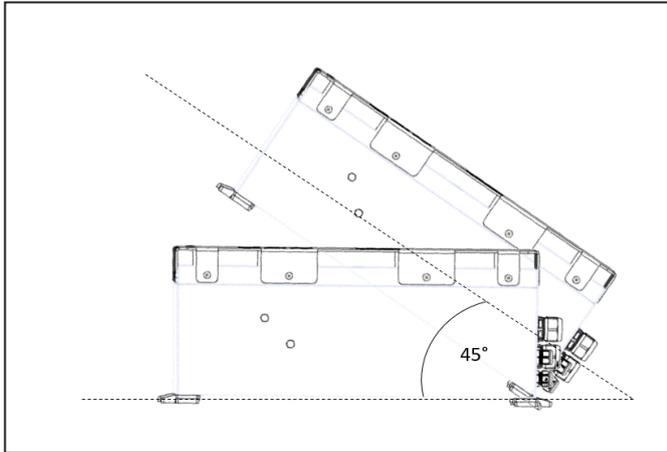


Figure 5.3 Tolerable inclination for the installation



The combiner box must not be installed horizontally laying flat on the rear neither in any other orientation.

The combiner box must not be installed indoors.

5.3 Fixation



The fixation of the combiner box directly affects the proper performance and the lifetime of the product.

Ensure that the requirements described in chapters 5.1 and 5.2 will also be observed.

Mounting material

Most of the Weidmüller combiner boxes are supplied with metal or plastic mounting lugs, depending on the model. Fixation screws are not delivered as standard with each model. Please check your delivery before starting the installation.

Requirements

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

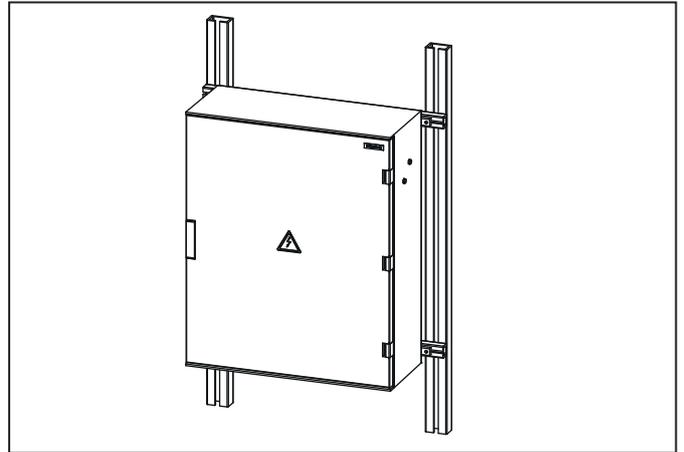


Figure 5.4 Fixing the enclosure to a structure

5.4 Installing the combiner box

CAUTION	
	<p>Risk of injury due to the size and the weight!</p> <p>► Always install the combiner box with two persons to avoid any injury or accident. Installers should be qualified for the specific works according IEC standards and/or local regulations and should bring the necessary safety equipment.</p>

ATTENTION	
The product can be destroyed!	
<ul style="list-style-type: none"> – Never drill the enclosure to add any extra hole or to modify any of the existing holes. Otherwise the IP protection will get lost as well as the product warranty. – If necessary lay down the combiner box only on the rear side after unpacking. Otherwise the cable glands and connectors at the bottom of the enclosure can be damaged. 	

- Remove the combiner box from the original packaging.
- Measure the exact distances between the drilling holes and mark the positions in the mechanical structure (or wall).
- Drill the holes in the mechanical structure (or wall).
- Mount the combiner box using the fixing lugs.

- Check the installation:
- Verify that the combiner box is correctly secured and fixed.
 - The surface of the enclosure should be totally flat. If the combiner box is bended over the edges, the tightness is not guaranteed.

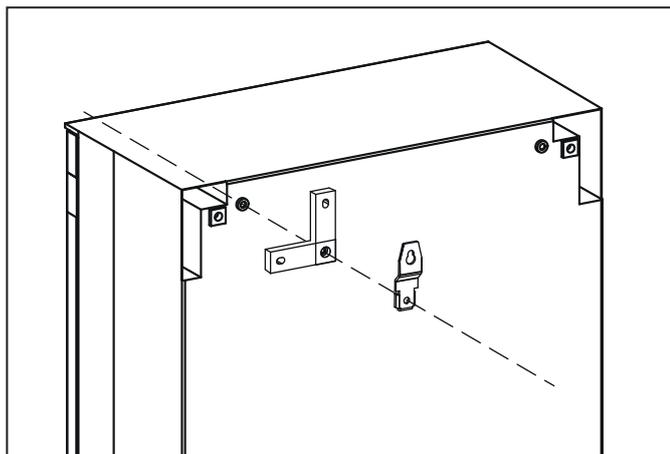


Figure 5.5 Fixing lugs enclosure type A

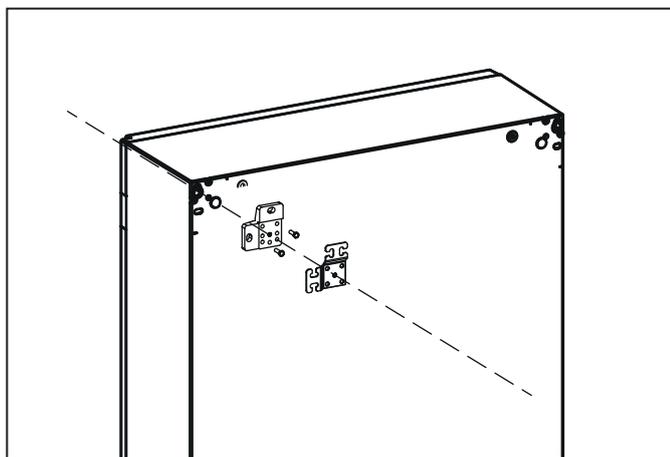
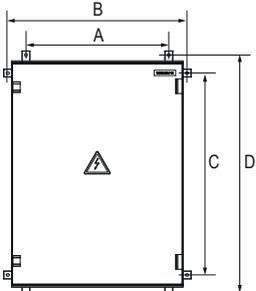
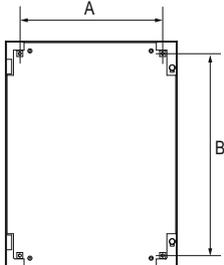
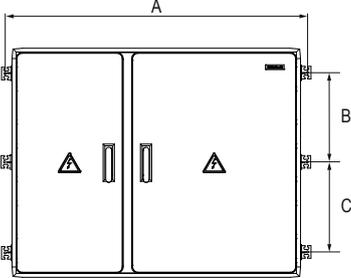
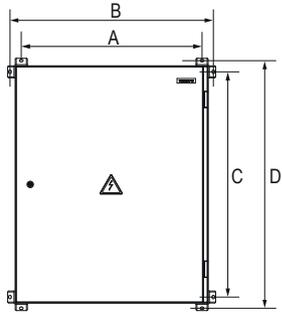
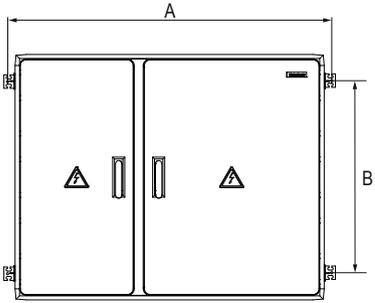


Figure 5.6 Fixing lugs enclosure type B

Each model has been designed according individual specifications and this has been approved by customer.

		Enclosures mounting lugs and fixing points if applies ¹⁾					
Size Dimensions H x W x D (mm)							
		mm		mm		mm	
54 530 x 430 x 200	A	325	A	325			
	B	465	B	455			
	C	455					
	D	590					
64 647 x 436 x 250	A	330	A	330			
	B	465	B	544			
	C	555					
	D	690					
75 747 x 535 x 300	A	430	A	430			
	B	565	B	655			
	C	655					
	D	790					
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					
573 538 x 750					A	786	
					B	125	
					C	-	
5103 538 x 1000					A	1036	
					B	125	
					C	-	
7103 788 x 1038					A	1052	
					B	375	
					C	-	
1010 788 x 1038					A	1050	
					B	312.5	
					C	312.5	
1012 1038 x 1200					A	1302	
					B	312.5	
					C	312.5	

1) This table is a reference. For specific measure of your product please refer to the documentation delivered with the product.

		Enclosures mounting lugs and fixing points ¹⁾			
Size Dimensions HxWxD (mm)					
		mm		mm	
75 735 x 535 x 270	A		483		
	B		580		
	C		682		
	D		780		
86 835 x 635 x 300	A		583		
	B		680		
	C		782		
	D		880		
108 1035 x 835 x 300	A		783		
	B		880		
	C		982		
	D		1080		
PS 440 1000 x 1000 x 320				A	783
				B	1060
PS 452 1000 x 1200 x 320				A	783
				B	1260

1) This table is a reference. For specific measure of your product please refer to the documentation delivered with the product.

5.5 Inserting the fuses

For each string voltage (1000 V DC and 1500 V DC) there are two types of fuse holders that can be used in the PV DC COMBINER BOX:

- for 1500 V

	WARNING
	<p>Do not operate under load.</p> <p>A serious damage on persons and equipment can occur by high voltage.</p> <ul style="list-style-type: none"> ▶ Ensure that there is no current flowing through the strings.

- ▶ Open the fuses carrier by pulling the fuse holder handle.
- ▶ Insert the fuse link laterally into the fuse holder carrier and push gently.
- ▶ Proceed in this way with all fuses that are to be inserted.

5.6 Connection of the inputs

The enclosure is equipped either with cable glands or with PV connectors (WM4 C or PV stick).

In order to realise proper connections we recommend to use wire end ferrules as well as appropriate stripping and crimping tools.

Input connections via cable glands



Each multivia cable gland has entries for 8 different cables. Pay attention to the string number as well as the polarity in order to avoid mistakes during connection.

Make sure that you have the electrical drawing provided with the combiner box to hand.

- ▶ Insert the DC string input cables through the multivia cable glands into the interior of the enclosure.
- ▶ Strip the conductor for 18 mm with an appropriate tool.
- ▶ Crimp the conductor with a tubular wire end ferrule with 18 mm length of the sleeve (the conductive part).
- ▶ Check the terminal in the electrical drawing and insert the conductor in the fuse holder connection insert.
- ▶ Use an appropriate screw-driver and tighten the screw with the torque indicated in the product drawing.
- ▶ Pull down the cables to assure that all of them are well connected.
- ▶ Make sure there is sufficient strain relief for the DC main lines and DC string input cables.
- ▶ Make sure that the cables are not mounted under mechanical load which could create an undesirable force.
- ▶ Proceed in this way with all input cables needed.

Input connections via PV connectors



Both connectors (box connector and field connector) must be from the same brand and same model to ensure the correct performance and reliability of the solution. Please assure that there is 100% compatibility between both connectors. Weidmüller supplies the range of combiner boxes with WM4 C terminals, so it is mandatory the usage of same connector.

If another connector should be used, this needs a specific authorisation by Weidmüller.

With PV connectors there is no need to get access inside the PV combiner box because all the cabling is already done. The installer has only to connect the DC string cables to the PV connectors at the bottom side of the enclosure by using a WM4 C connector or PV-Stick. To read more about these connectors, please check operating instructions on the Weidmüller website.

- ▶ Follow the instructions in the user manual coming with the PV connectors.

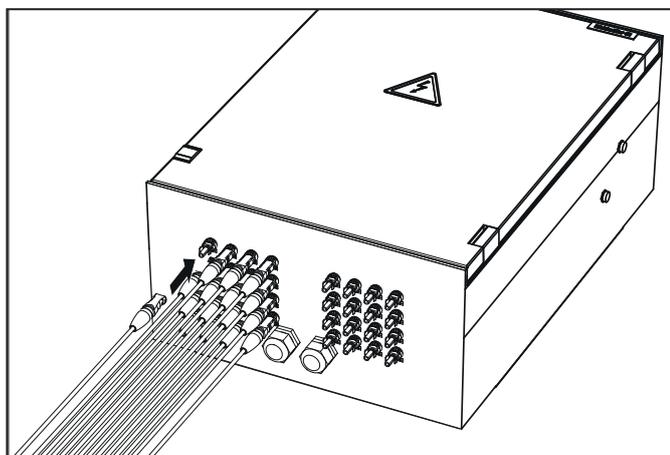


Figure 5.7 Connection of the PV connectors

- ▶ Pull down the cables to assure that all of them are well connected.

5.7 Connection of the outputs

The output connections depend on the design of each tailor-made PV DC FLOATING BOX. The output cables must be connected to the poles of the switch disconnecter or to the terminals prepared for this purpose. Regard the delivered datasheet for the cable glands and a description of the clamping area.

Please ensure that the cable that you are going to use fits with the specifications.

- The cross section of the conductor must be selected according to the rated current of the system and to the size of the cable gland of the combiner box.
- Use copper or aluminium cables only. When using aluminium cables regard the section "Preparing aluminium conductors" before starting the installation.
- Weidmüller is not responsible for the performance of the terminal lugs, terminal ring or terminal cage neither the output cable selected.

WARNING	
	<p>Do not operate under load.</p> <p>A serious damage on persons and equipment can occur by high voltage.</p> <ul style="list-style-type: none"> ▶ If string cables from the field are connected into the terminals, ensure that the power supply is disconnected. ▶ Ensure that the DC switch disconnecter is in OFF position. ▶ Ensure that there is no voltage in the output cables and that all safety measures have been considered.



- ▶ Before starting the installation check that the terminal lugs will fit through the cable glands.

- ▶ Insert the DC main cables through the cable glands into the enclosure.
- ▶ Regard the polarity when connecting the DC conductor to the appropriate terminal lug, ring terminal or cage terminals and follow the instructions of that component to crimp it in the right way.
- ▶ Connect the DC conductors to the stud terminals or direct to the switch-disconnector.
- ▶ Check the terminal in the electrical drawing provided with the combiner box.
- ▶ Check and apply the right tightening torques to the terminal lugs of the switch disconnecter (the correct tightening torques can be found in the specific documentation inside each PV DC FLOATING BOX).
- ▶ Tighten the cable glands.
- ▶ Make sure there is sufficient strain relief for the DC main lines/DC feeder cables.
- ▶ Close all unused cable glands with blanking plugs to prevent moisture penetrating the combiner box.

Preparing aluminium conductors

- Aluminium conductors are only suitable for installation sites that are free from humidity or aggressive atmospheres.
- It is recommended to use bimetallic connectors.
- Use neutral grease (e.g. acidfree and alkalifree vaseline) to protect the surface of the aluminium from oxidation.

As a well known characteristic aluminium forms a thin, non-conductive layer of oxide as soon as it is exposed to the air. This layer increases the contact resistance between the aluminium conductor and the current bar of the terminal which can lead to poor contact. As a precondition regard the following steps to prepare the aluminium conductors:

- ▶ Scrape the stripped end of the conductor carefully, e.g. with a knife, to remove the layer of oxide.



Do not use brushes, files or emery paper because particles of aluminium can be deposited on other conductors.

- ▶ Coat the end of the conductor immediately with a neutral grease, and connect it to the terminal immediately.
- ▶ Tighten the screws with the maximum permissible tightening torque.



Repeat the above procedure each time after the conductor has been disconnected and shall be reconnected.

- 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.

To ensure that the live conductors of the PV installation can withstand the surge current stress, the cumulated cross section of these conductors should not be less than 6 mm² for SPD Type II and 16 mm² for SPD Type I. Otherwise, if in the combiner box there is a specific grounding terminal for this purpose, check the specifications on the electrical diagram attached inside the product.

- ▶ Strip the conductor for 12.5 mm using an appropriate tool.
- ▶ Verify with the electrical diagram attached in the combiner box where to connect the cable (ground connector of the SPD or a specific terminal for this purpose).
- ▶ In case the grounding cable is connected to a specific terminal, connect the cable and tighten it with the screw (2 ... 4.5 Nm).
- ▶ Verify the correct connection of the grounding cable to the terminal.

5.8 Connection of the grounding cable

The PV DC FLOATING BOX is designed without any metallic mounting plate or similar. The enclosure is made of GFRP (Glass Fiber Reinforced Polyester). Therefore the unique ground connector is used for the surge protection. Note that this 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 DC side of PV installations must be as it follows:

- Earthing conductors of SPDs Type I shall have a minimum cross section of 16 mm² copper or equivalent or equal to the cross section of live connectors, if greater than 16 mm².
- Earthing conductors of SPDs Type II shall have a minimum cross section of 6 mm² copper or equivalent or equal to the cross section of live connectors, if greater than 6 mm².

6 Connection of the communications (optional)

This section is needed if the combiner box contains a string monitoring device Transclenic 16i+ 1k5 HP (from now on Transclenic). This device has a communication port RS485. The figure below shows how to connect multiple combiner boxes in a master-slave configuration using RS485 connection and its corresponding termination.

- The Transclenic is a slave and a server from the viewpoint of the Modbus standard.
- A SCADA or the program running in a PLC/datalogger is a client from the viewpoint of the Modbus standard.
- A RS485-to-Ethernet converter or the hardware of a PLC/datalogger is a master from the viewpoint of the RS485 standard.

ATTENTION

Material damage!

RS485 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.

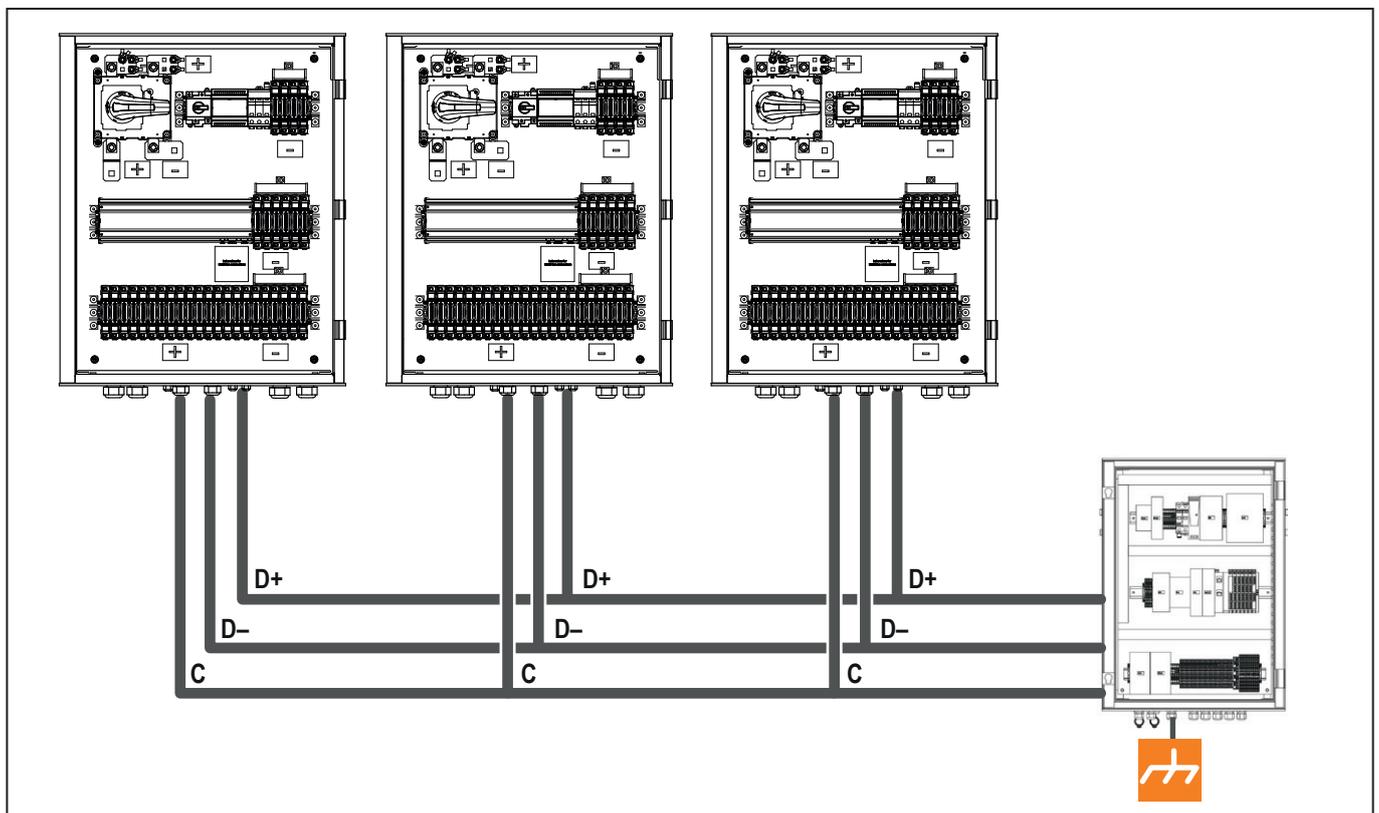


Figure 6.1 RS485 Communication bus (example)

This equipment complies with the latest RS485 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 RS485 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.

6.1 Wiring the communications

	DANGER
	<p>Imminent risk of life!</p> <p>High voltages up to 1.000 or 1.500 V DC are present in the live parts. Touching live parts can result in death or serious injury due to electric shock.</p> <p>► Before starting any work in the PV DC COMBINER BOX:</p> <ul style="list-style-type: none"> – disconnect the DC switch – ensure that there are no fuses inserted into the fuse-clips of the PCB boards

ATTENTION
<p>Material damage!</p> <p>A wrong installation can create a lack of communications, but also, it can damage the equipment.</p> <p>► Please pay attention when wiring RS485 cables.</p>

All the units shipped out from Weidmüller have their RS485 ports thoroughly tested right at the end of the production line. Weidmüller will not cover under warranty Transclenic units that have their RS485 transceiver IC damaged due to wrong wiring or due to surges.

Cable requirements

The RS485 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 mm² (AWG24) or larger

The following are two examples of proper RS485 cable:

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

6.2 Connecting the RS485 to the Transclenic

By default, the PV DC COMBINER BOX with monitoring comes with the internal communications pre-wired. This means that there is a communication cable between the device and 3 terminals at the bottom side of the enclosure. Depending on each design, these terminals are not present, so user must connect the communication cable directly on the RS485 communication terminal of the Transclenic. At any case, there will be 3 terminals available to connect.

The table below shows correspondence between alternate names for RS485 pins. The reason for choosing D+/D– over B/A or D1/D0 in this equipment is to avoid confusion with certain third party products on the market with erroneously swapped B/A and D1/D0 pins. The names D+/D– cannot lead to confusion.

Function	Non-inverting pin	Inverting pin	Reference pin
RS485 standard	B	A	C
Modbus standard	D1	D0	Common
Weidmüller	D+	D-	C

Even if the field communication wires are connected to 3 terminal blocks it is important to pay attention to the information about appropriate cable section and length.

Transclenic Connectors	Cable sections and lengths
Stranded wire cross section (with ferrule)	0.2 – 2.5 mm ²
Stranded wire cross section (without ferrule)	0.2 – 4 mm ²
Stranded wire stripping length	7 mm ±1 mm
Torque range (*)	Not needed
Required tool (*)	Not needed
External insulation required	simple

Please regard the following aspects when wiring the RS485:

- The RS485 bus topology must be a daisy chain (see picture below).
- Short stubs inside the combiner box should be at maximum 2 meters long.
- We recommend a bus length of 500 meters at maximum, even though the RS485 standard allows up to 1200 meters at low bit rates (i.e. 9600 bps and 19200 bps).
- Each end of the bus requires a 120Ω 10 % $\frac{1}{2} W$ termination resistor between D+ and D– (see the RS485 wiring diagram). One end of the bus will be the RS485 master which may or may not include an internal termination option. The other end will be inside the combiner box farthest away from the master in terms of RS485 cable distance.
- This equipment loads the RS485 bus with 1/8 UL (Unit Load).
- It is recommended not to mix Transclenic and other RS485 slaves within the same bus.
- The D+ and D– of each Transclenic should use one twisted pair of the cable, leaving the remaining wire (in cables with 1.5 pairs) or the remaining twisted pair (in cables with 2 pairs) for the C connection.
- Always make sure that D+, D– and C use the right color-coded wire of the cable. It is a must to connect the C pin of all the Transclenic and the RS– 485 master together (see picture below).



Damages to the RS485 transceiver IC of this equipment due to the following wiring errors will not be covered under warranty:

- Connecting the C pin of this equipment to protective earth anywhere except in one point (at the master end). This connection may be already done internally inside the RS485 master.
- Connecting the C pin of this equipment to the cable shield inside a combiner box.
- Using non-twisted pair or non-shielded cables.
- Connect RS485 cables in a different way than the specified in the wiring diagram of this user manual.

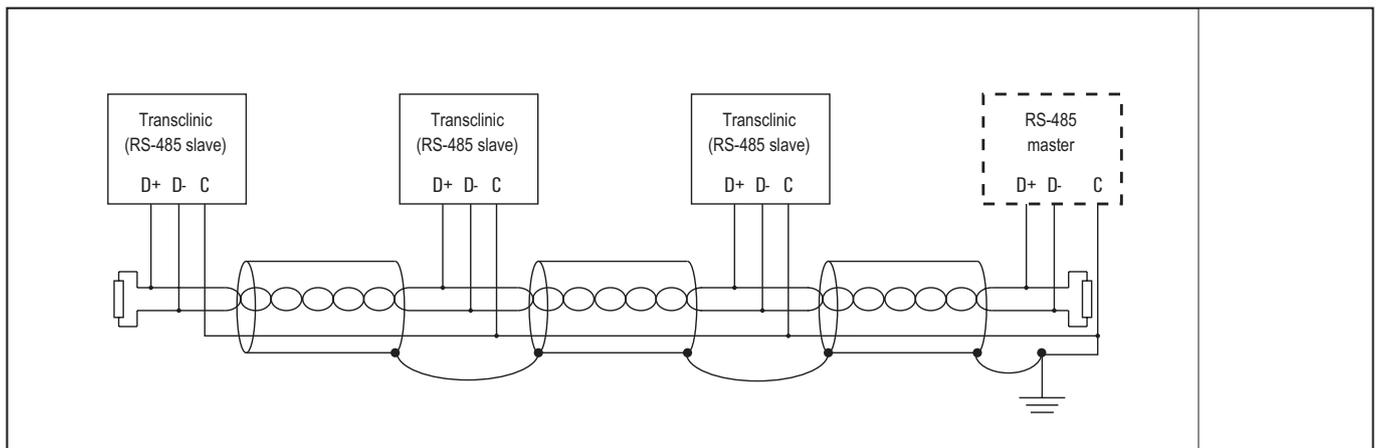


Figure 6.2 RS485 wiring diagram (daisy chain bus topology)

	WARNING
	<p>Risk of electrical shock and product damage.</p> <p>Too short RS485 cables can cause mechanical strain to the equipment.</p> <p>▶ Ensure that the RS485 cables are long enough.</p>



Regard the following instruction notes.

- ▶ Always wire the C pin first and only afterwards wire the D+ and D- pins.
- ▶ It is very important NOT to connect the shield to the C pin in any combiner box (see the RS485 wiring diagram).
- ▶ The daisy chained shield must run non-stop from end to end of the RS485 bus.
- ▶ Leave the shield floating (i.e. unconnected) at the far end of the RS485 bus (i.e. the combiner box farthest from the RS485 master in terms of cable length).
- ▶ Tie the shield directly to protective earth at the RS485 master end.
- ▶ Ensure that the C pin is not connected to protective earth anywhere else in the whole RS485 bus (keep in mind that some RS485 masters may already tie internally the C pin to protective earth or to their power supply ground!). This connection makes sure that the RS485 common-mode voltage stays close to earth potential instead of rising to dangerous voltages due to stray capacitances and conductances in the network.
- ▶ Tie the C pin to protective earth at the RS485 master end (see RS485 wiring diagram).

The RS485 shields should be joined as shown below.

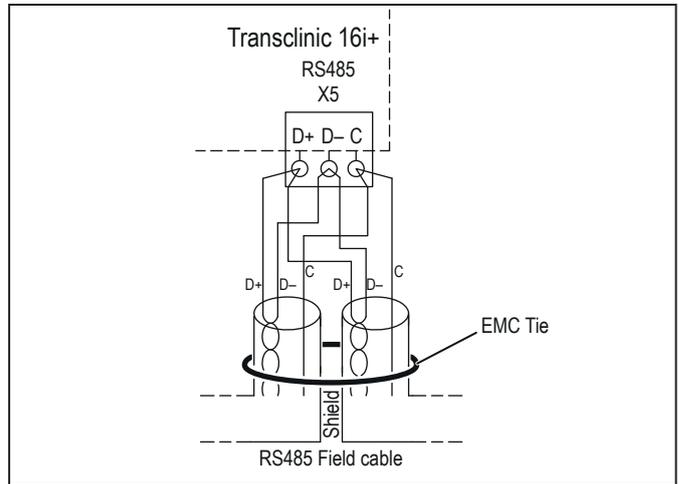


Figure 6.3 RS485 shields

- ▶ Make sure that the metal braid of the EMC tie has safe contact to the braided shield of the cables.
- ▶ Keep the stripped length as short as possible.
- ▶ Make sure that the wire-end ferrules are correctly tighten and crimped.

6.3 Configuration of the Modbus address and the RS485 serial settings

The Modbus device address and the RS485 serial settings are configured by setting the DIP switches SW1 and SW2.

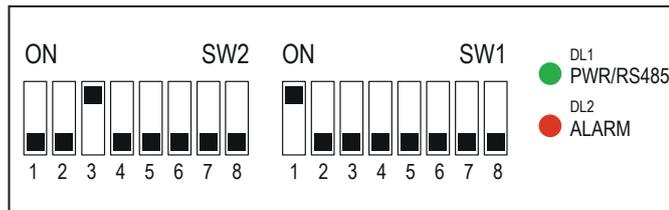


Figure 6.4 Default DIP switch settings on Transclenic 16i+



- All the devices belonging to one RS485 bus must have the same serial settings.
- The Modbus device address of each Transclenic can only be used once.
- After modifying any DIP switch setting, the changes need to be applied by powering off and then back on the equipment.
- Regardless of the SW 2.3 parity bit setting there is always ONE stop bit.

Description of SW1 (Modbus device address)

The factory default slave address is 1, as shown in the figure above (i.e. SW 1.1 in the ON position and SW 1.2 to SW 1.8 in the OFF position). The following table specifies the binary coding of the Modbus device address via DIP switches. As an example, the DIP switch coding for Modbus address 175 is shown (10101111 in binary).

	SW 1.1	SW 1.2	SW 1.3	SW 1.4	SW 1.5	SW 1.6	SW 1.7	SW 1.8
Weight	2 ⁰ (LSB)	2 ¹	2 ²	2 ³	2 ⁴	2 ⁵	2 ⁶	2 ⁷ (MSB)
Address Increment	1	2	4	8	16	32	64	128
Example Address: 175	ON	ON	ON	ON	OFF	ON	OFF	ON

Description of SW2 (RS485 serial settings)

	SW 2.1	SW 2.2	SW 2.3	SW 2.4 ... 2.8
	Data signaling rate	ID number	Parity bit	Reserved for future use
ON	9600 bps	must be left in default position	EVEN (default)	–
OFF	19200 bps (default)		NONE	must be left in OFF position

Changing the configuration

To validate the change ID number, baud-rate or parity the process must be as it follows:

- ▶ Switch off the device first.
- ▶ Configure the desired ID, baud rate or parity by using the DIP switches.
- ▶ Set the SW2.2 in ON position.
- ▶ Switch-on the device.
- ▶ Change the SW2.2 from ON to OFF.
- ▶ Switch-off the device and wait 5 seconds (any LED might be ON).
- ▶ Switch-on again the device.

6.4 Recommendations when using serial converters

Transclenic string monitoring devices have been designed to operate in PV utility scale and PV rooftop industrial-commercial systems. In this type of installation sites, the Modbus RTU client(s) sending requests to the Transclenic is/are normally:

- A set of PLCs (typically one PLC per inverter shelter) acting as local dataloggers. In this case a Scada software will send Modbus requests to the PLCs instead of to the Transclenic
- A Scada software located in the control room sends Modbus requests directly to the Transclenic. In this case the appropriate RS485 masters for the field buses should be used, such as Weidmüller Serial/Ethernet converters, installed in the inverter shelters.

ATTENTION

The RS485 transceiver ICs can be destroyed!

Some Serial/Ethernet converters internally tie the RS485 pin C to their power supply GND. Failure to observe this particularity could permanently destroy the RS485 transceiver ICs.

- ▶ Please ensure that there are no ground loops (i.e. different paths to protective earth) in the pin C of the RS485 bus.

Weidmüller provides also equipment for PV Communication boxes that can be used to guarantee the best performance and compatibility of all the electronic equipment in the PV site.

Please contact your Weidmüller sales representative for further information.

6.5 Recommendations when configuring the SCADA

If you will configure the Scada or PLC acting as Modbus client please follow these recommendations:

- The Modbus client timeout should be 1 second.
- The practical polling interval per slave should be 20 seconds.

This is a good tradeoff between unnecessary network traffic (and database size) and time resolution. Keep in mind that the sun, the clouds and the MPP of the inverter do not change significantly within 20 seconds!

- For the most efficient use of the PV site network bandwidth the Modbus registers of each Transclenic should be read in one single function code 0x04 "read input registers", request spanning from registers 1 to 35. This request will not create any 0x02 "illegal data address" exception due to the "gaps" in the register table.
- The averaging window length should be 2.5 seconds.
- The system should provide the following measurement and alarm information via Modbus:
 - Averaged PV system voltage
 - Averaged PV current for each input
 - Averaged PCB temperature
 - Status of the digital inputs
 - Alarm flag: PV system under-voltage (user-configurable threshold)
 - Alarm flag: Individual input undercurrent (user-configurable threshold)
 - Alarm flag: Blown fuse
 - Alarm flag: PCB over temperature (fixed threshold 70 °C)

7 Commissioning

Preconditions for the commissioning

- The installation work has been made according to the “Installation” chapter of this user manual.
- The floor around the PV DC FLOATING BOX is firm and easily accessible so that work can be done safe.
- ▶ Wear appropriate clothes and personal protective equipment.
- ▶ Use appropriate tools with the correct insulation.



A multimeter is necessary in order to verify the absence of voltage in the live parts of the combiner box.

- ▶ Check that the Multimeter is capable to read the maximum voltage of the string and the maximum current before starting.

	DANGER
	<p>Imminent risk of life!</p> <p>High voltages up to 1.000 or 1.500 V DC are present in the live parts. Touching live parts can result in death or serious injury due to electric shock.</p> <ul style="list-style-type: none"> ▶ Before starting any work in the PV DC FLOATING BOX: <ul style="list-style-type: none"> – disconnect the DC switch – ensure that there is no current flowing through the strings. ▶ Ensure that nobody reconnects the unit while work is not finished or any operator is still working. ▶ Ensure that no voltage is present in parts that are going to be checked or that could be accessible. ▶ Do not touch live components. ▶ If specific live parts cannot be insulated or disconnected, it is mandatory to use additional safety elements to avoid any risk to persons or equipment.

7.1 Main indications and checks

It is recommended to carry out a general inspection on the PV DC FLOATING BOX and the status of the installation. The installation must comply with either local and international regulations.

Visual inspection

Check the following issues:

- All cables are in good condition.
- All connections of cables to the terminals are correct.
- There are no hazards around the installation that could create any damage.
- The cables are connected to the correct polarity.
- The enclosure is firmly fixed to the structure, all mounting elements are tightened properly.
- The door of the enclosure is properly closed and the seal fits all around the door to provide the insulation. As a check press the door while locking the key-locks a few times.
- The cable glands are tightened correctly.
- If WM4 C connectors are used, they are fixed correctly.
- The grounding cable is connected through its own cable gland and the cable gland is tightened correctly.
- Check the correct status of the SPD. The viewing window should be in green colour.

Additional inspections issues for the PV DC FLOATING BOX with string monitoring:

- The RS485 wire is correctly connected to the specific terminals inside the combiner box or alternatively to the Transclinic RS485 connector through its own cable gland.
- The cable gland for communications cable is tightened correctly.

Measurements

	DANGER
	<p>Imminent risk of life!</p> <p>High voltages up to 1.000 or 1.500 V DC are present in the live parts. Touching live parts can result in death or serious injury due to electric shock.</p> <ul style="list-style-type: none"> ▶ Before starting any work in the PV DC FLOATING BOX: <ul style="list-style-type: none"> – disconnect the DC switch – ensure that there is no current flowing through the strings.

- ▶ Check the correct polarity of the positive and negative cables of the PV strings with a multimeter.

7.2 Start up

 	DANGER
	<p>Imminent risk to life!</p> <p>Work on live components may only be carried out by qualified electricians.</p> <ul style="list-style-type: none"> ▶ Observe the country-specific regulations for working on live components. ▶ When working on live components, always use suitable tools and aids that eliminate the risk of electric arcs and electric shocks.

	DANGER
	<p>Imminent risk of life!</p> <p>High voltages up to 1.000 or 1.500 V DC are present in the live parts.</p> <ul style="list-style-type: none"> ▶ Insert fuses into the fuse holders only if all previous tasks have been finished with satisfactory results. ▶ Use only fuses provided by Weidmüller within each individual PV DC FLOATING BOX.

-  ▶ In case the PV DC FLOATING BOX has been provided without fuses, please use the authorised fuses described in section “Fuses” or contact with your Weidmüller representative for more information.
- ▶ Insert the fuses provided with the PV DC FLOATING BOX into the fuse holders using the appropriate tool from Weidmüller (or equivalent appropriated for this activity).
 - ▶ Switch on the DC disconnection switch (from OFF to ON position)

Additionally for PV DC FLOATING BOX with string monitoring:

- ▶ Verify the Transclinic power LED lights green.
- ▶ Verify the Transclinic DC/DC power supply LED lights green.
- ▶ Close and secure the door with the key-tool lock.

8 Accessories and replacing parts



Some parts of the PV DC FLOATING BOX can be replaced in case of damage. Before proceed with any of these replacements, we highly recommend to contact with your Weidmüller representative to clarify any doubt.

8.1 Replacing fuses

	DANGER
	<p>Imminent risk of life!</p> <p>High voltages up to 1.000 or 1.500 V DC are present in the live parts.</p> <ul style="list-style-type: none"> ▶ Ensure that the product is switched off and that it is free of hazardous voltage (from generator side and from inverter side). ▶ Ensure that there is no current flowing through the string before removing fuses. Never remove fuses under load. ▶ Use only fuses provided by Weidmüller. ▶ Use only the same type of fuse like the ones inserted in the other fuse holder (same model and rate).

- ▶ Before replacing fuses, verify that there is no electrical issue active in the circuit which could cause the blowing of the new fuse.
- ▶ Verify by visual check, that the fuse holders are free from any damage
- ▶ Disconnect the DC switch.

Combiner box with PV connectors:

- ▶ Disconnect the PV string cable outside of the combiner box to assure that there is no voltage in the damaged fuse.
- ▶ Extract the damaged fuse and insert the new one.

8.2 Replacing a switch disconnecter

DC switches cannot be replaced easily by operators in the field. If this device is damaged, please contact your Weidmüller representative.

8.3 Replacing string monitoring devices

Transclinic 16i+ 1k5 HP string monitoring devices must not be replaced by operators in the field. If this device is damaged, please contact your Weidmüller representative.

8.4 Replacing surge protection arresters

	DANGER
	<p>Imminent risk to life!</p> <p>The contacts in the sockets of the surge protection arresters are live. The system must be switched off for this work.</p> <ul style="list-style-type: none"> ▶ Do not reach into the sockets when the arrester is removed.

Weidmüller SPDs have three individual arresters. If the SPD is damaged, the status indicator of the respective arrester will be red.

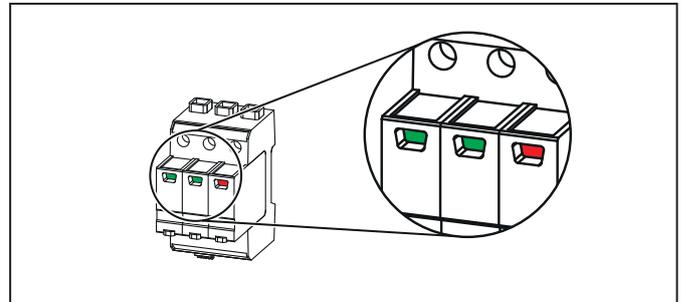


Figure 8.1 Status indicators of the SPD

- ▶ In order to replace an arrester, proceed as shown below.

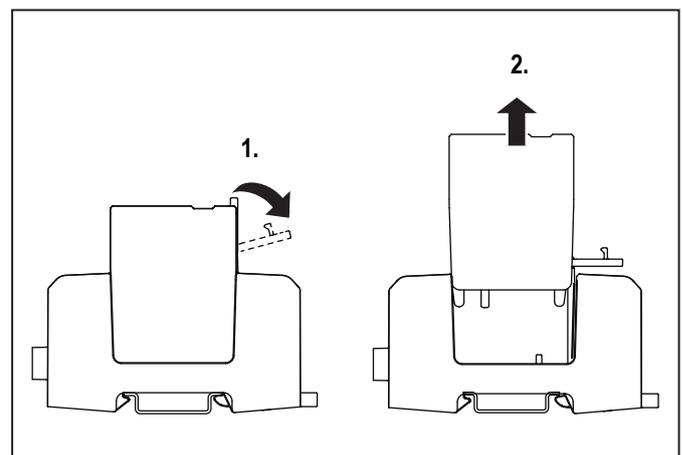


Figure 8.2 Removing a surge voltage arrester

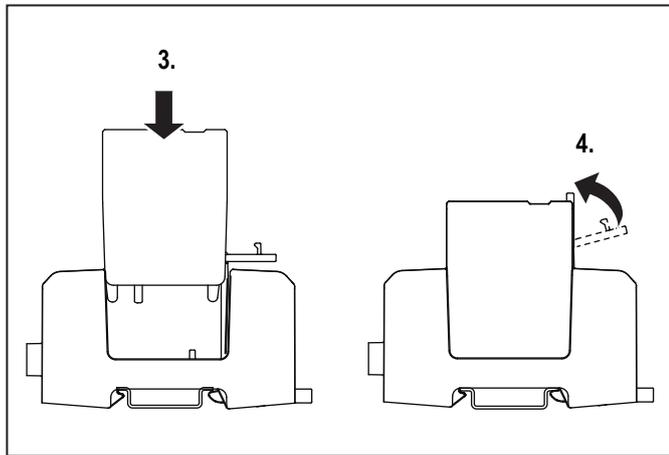


Figure 8.3 Inserting a surge voltage arrester

9 Cleaning

ATTENTION

The product can be destroyed!

The enclosure and cover may be damaged by detergents, scouring agents, solvents and high-pressure cleaners.

- ▶ Use a cloth moistened with clear water for cleaning.
- ▶ Clean the PV DC FLOATING 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 DC FLOATING BOX is a product with minimum maintenance.

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

	DANGER
	<p>Imminent risk of life!</p> <p>High voltages up to 1.000 or 1.500 V DC are present in the live parts.</p> <ul style="list-style-type: none"> ▶ Ensure that the product is switched off and that it is free of hazardous voltage (from generator side and from inverter side).

Check list for the annual inspection of the PV DC FLOATING 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.	<ul style="list-style-type: none"> ▶ 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 in the specific documentation inside each PV DC FLOATING BOX.	▶ Check the cable glands and retighten them if needed.	
Surge protection arresters (optional)		
The inspection windows of the surge arresters should be green.	▶ Replace each surge arrester the inspection window of which is red.	
The PV DC FLOATING BOX has a mark on all screws and nuts to indicate the torque position. If the mark is unchanged since the previous inspection, there is no loss of torque. Regard the tightening torques in the specific documentation inside each PV DC FLOATING BOX.	<ul style="list-style-type: none"> ▶ Check if any of the marks on screws and nuts have been changed. ▶ Retighten the screws if needed. 	
Fuses		
Blown fuses diminish the yield of the PV plant.	▶ Check the continuity of all fuses.	
DC switch		
The PV DC FLOATING BOX has a mark on all screws and nuts to indicate the torque position. If the mark is unchanged since the previous inspection, there is no loss of torque. Regard the tightening torques in the specific documentation inside each PV DC FLOATING BOX.	<ul style="list-style-type: none"> ▶ Check if any of the marks on screws and nuts have been changed. ▶ Retighten the screws if needed. 	

Check list for the annual inspection of the PV DC COMBINER BOX		
Remarks	Issue	Checked
Fuse holders		
Burn marks	▶ Check that there are no burn marks on the terminals.	
Measure voltage	▶ Check the voltage of the strings by using the testing points in the terminals.	
String monitoring device		
	▶ Check that the device is correctly fixed to the mounting plate with the screws.	
	▶ Check that the LED is working properly according its function.	
DC/DC power supply		
	▶ Check that the device is correctly tightened to the DIN rail.	
The PV DC FLOATING BOX has a mark on all screws and nuts to indicate the torque position. If the mark is unchanged since the previous inspection, there is no loss of torque. Regard the tightening torques in the specific documentation inside each PV DC FLOATING BOX.	▶ Check if any of the marks on screws and nuts have been changed. ▶ Retighten the screws if needed.	
General inspection		
	▶ Check that there are no burn marks on the terminals.	

10.2 Service

If you have any questions about the PV DC FLOATING BOX, please contact the Weidmüller representative in your country.
Information about the PV DC FLOATING BOX like videos, installation guides and FAQ's re provided on the Weidmüller website.

