SUNGROW
Clean power for all

User Manual

PV Intelligent Combiner Box

PVS-16MH/PVS-18MH/PVS-20MH/PVS-24MH

PVS-16_18_20_24MH-UEN-Ver64-202305

Contents

1 About This Manual

1.1 Validity

This manual is valid for the following PV intelligent combiner boxes:

- PVS-16MH
- PVS-18MH
- PVS-20MH
- PVS-24MH

Unless otherwise specified, any of the above products is hereinafter referred to as "PVS".

1.2 Target Group

This manual is for technical personnel who are responsible for the transport, installation, and operations of this product. Readers shall meet at least the following requirements:

- Know electronic, electrical wiring and mechanical expertise, and be familiar with electrical and mechanical schematics.
- Be familiar with the composition and working principles of grid-connected PV power generation system and the front- and rear-level equipment of the PVS.
- Have received professional training related to the installation and commissioning of electrical equipment.
- Be familiar with the relevant standards and specifications of the country/region where the project is located.
- Be familiar with the content of this manual.

Only personnel meeting the above requirements may perform installation, operation and maintenance, overhaul, and other operations on the PVS. Unauthorized personnel must not perform any operations on the PVS to avoid accidents.

1.3 How to Use This Manual

Read this manual carefully before transporting and installing the product. Please keep this manual and other materials of components together, and ensure that relevant personnel can easily access and use them.

In order to continuously improve customer satisfaction, products, and product manuals of SUNGROW are always in the process of improvement and upgrade. If your manual is not in accord with the product, it may due to the product version upgrade, and the actual product shall prevail. For any questions, please contact Sungrow Customer Service.

1.4 Symbol Explanations

This manual contains important instructions, which are highlighted with relevant symbols, to ensure personal and property safety during usage, or to help optimize the product performance in an efficient way.

Symbols that may be used in this manual are listed below. Please read them carefully to make better use of this manual.

DANGER

indicates a hazardous situation which, if not avoided, will result in death or serious injury.

WARNING

indicates a hazardous situation which, if not avoided, can result in death or serious injury.

CAUTION

indicates a slightly hazardous situation which, if not avoided, may result in minor or moderate injury.

NOTICE

indicates potential risks that, if not avoided, can lead to device malfunctions or financial losses.

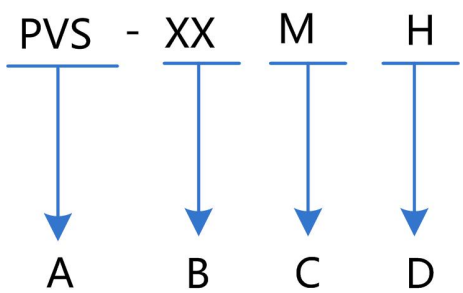
Indicates additional information in this manual. This information emphasizes or supplements the content and may provide tips to better use the product, helping you solve problems or save time.

Always note hazard warnings on the device enclosure.

Marks	Explanation
	High voltage inside! Risk of electric shock by touching it!
	Temperature beyond the acceptable range for the human body. Do not touch it arbitrarily to avoid personal injury.
	Protective ground terminal which needs to be firmly grounded to ensure the safety of operators.

1.5 Model Description

Description of the PVS model is as follows:



Each letter means:

- A: Code of the PVS
- B: Max. number of PV strings in parallel
- C: With monitoring function
- D: High voltage, up to 1,500Vdc

1.6 Other Precautions

This manual takes the PVS-24MH with a wireless communication module as an example. The installation instructions also apply to following models.

- PVS-16MH
- PVS-18MH
- PVS-20MH

The above models are the same as PVS-24MH in electrical structure, installation method, and usage. But the number of PV inputs connected to each model varies.
If there is any question, please contact Sungrow.

2 Safety Instructions

Please read this chapter carefully when installing and using the PVS. SUNGROW reserves the right not to assume responsibility and quality assurance for any personal injury or device damage due to failure to observe these safety precautions.

⚠ DANGER

There is a high voltage in the PV string. Accidental contact may cause fatal electric shock or severe burns. When wiring the PVS, observe the following safety precautions:

- **Before wiring, please disconnect the end of PV strings.**
- **Before wiring, do not use an ordinary multimeter to measure the DC voltage. A multimeter with a withstand voltage of at least 1500V is recommended. Otherwise, serious damage may follow.**
- **Please follow all safety instructions of the PV module manufacturer.**

⚠ DANGER

Damaged equipment or system failure may cause electric shock or fire!

- **Before operation, visually check the equipment for damage or other dangerous conditions.**
- **Check whether other external devices or circuit connections are in a safe state.**

Make sure the device is in a safe state before operating.

⚠ DANGER

Touching the internal terminals of the equipment may result in electric shock or fire!

- **Do not touch the terminals or conductors connected to the inverter or string.**
- **Pay attention to all instructions or safety documents regarding the connection of PVS.**

⚠ DANGER

High voltage inside! Risk of electric shock!

- **Note and observe the warnings on the product.**
- **Respect all safety precautions listed in this manual and other pertinent documents.**

DANGER

The grounding cable must be well connected to ground, otherwise:

- **It may cause fatal electric shock to the operator in case of failure!**
- **The equipment may be damaged when struck by lightning!**

WARNING

Incorrect cable connection can cause damage to PV modules, the PVS, and inverters. When wiring, observe the following precautions:

- **Wire according to the wiring drawing.**
- **Measure the open circuit voltage of strings before wiring to ensure that the DC input voltage range meets the requirements of the PVS.**
- **Distinguish the positive and negative polarity of strings before wiring, and ensure that there is no ground fault.**

WARNING

- **Only professional electricians or qualified personnel can operate and wire the product.**
- **Operations and wiring must be done in accordance with relevant national and local standards.**
- **Warning signs must be legible and should be replaced immediately if damaged.**

WARNING

Make sure that the fastening screws on terminals of the PVS are fastened in place. If the copper core of the cable cannot be fully contacted with the wiring terminal and pressed tightly, the terminal will be heated and burned after a prolonged period. Use stranded copper core flame-retardant cables with the wire diameter not less than the recommended value in the appendix.
Fasten the screw cap of the waterproof terminal in place, otherwise, it may cause water leakage and damage to the PVS.

WARNING

Disconnect loads before checking and replacing fuses! Install or take out fuses when there is no load connected to avoid arc damage to the equipment and personal injury.

NOTICE

Be sure to lock the door after operation.

Do not open the door cover of the PVS frequently to avoid affecting its waterproof performance.

⚠ CAUTION

Touching the PCB or other static sensitive components may cause damage to components.

- **Do not touch other parts inside the cabinet except the terminals during installation.**
- **Observe the regulations to protect against electrostatic and wear an anti-static wrist strap.**

3 Product Description

3.1 Product Introduction

3.1.1 Overview

For large-scale grid-connected PV power generation systems, it is generally necessary to add a DC combiner device between PV modules and inverters to minimize cable connections, facilitate maintenance, and improve reliability.

The PVS independently developed and produced by SUNGROW is an outdoor combiner box. It is designed for meeting these requirements and provides a Turnkey solution for PV systems together with SUNGROW's PV inverters.

3.1.2 Main Features

- Meets outdoor installation requirements;
- Can be connected with multiple PV inputs, each is equipped with a fuse (can be replaced with a fuse of other degrees);
- Equipped with special PV high-voltage SPD, lightening protection for positive and negative polarities;
- Contains a current detector, which monitors the current of each string. The monitoring information can be viewed on the LED screen and uploaded through RS485 or DC PLC communication;
- Monitors the bus voltage, and the monitoring information can be viewed on the LED screen and uploaded through RS485 or DC PLC communication.

3.1.3 Application Scenarios

The PVS in line with outdoor standards developed and produced by SUNGROW is mainly used in large and medium-sized PV plants. It adopts a modular design to achieve fast installation and to ensure a long-term, reliable, and safe grid-connected operation of the PV plant.

A PV power generation system with the PVS is shown in below.

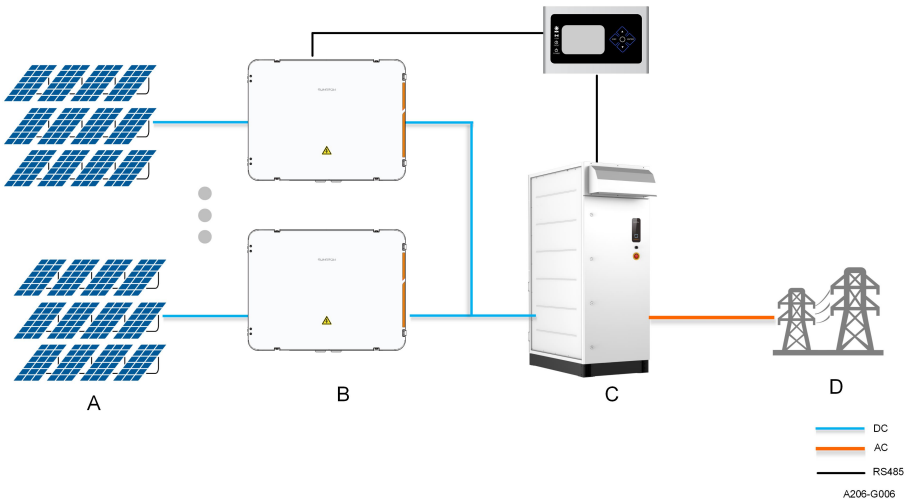


figure 3-1 Composition of grid-connected PV generation system

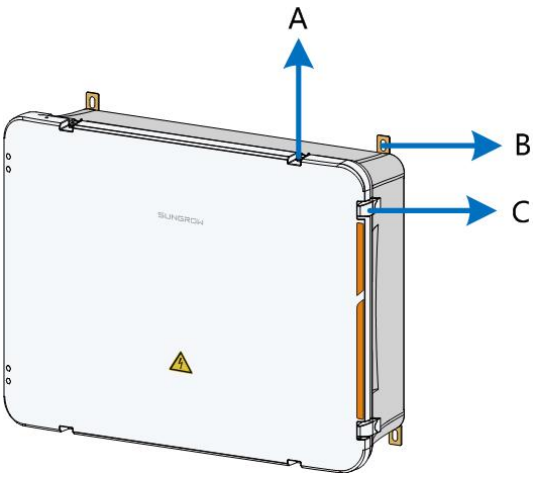
table 3-1 Device description

No.	Device
A	PV array
B	PVS
C	Inverter
D	Public power grid
E	Logger / Smart monitoring unit

3.2 External Structure

3.2.1 Appearance

Taking PVS-24MH as an example, the appearance of the PVS is shown in the figure below.



No.	Name	Description
A	Clasp	-
B	Mounting hanger	Used to fix the PVS
C	Door lock	-

3.2.2 External Dimensions

Taking PVS-24MH as an example, the dimensions of the PVS is shown in the figure below.

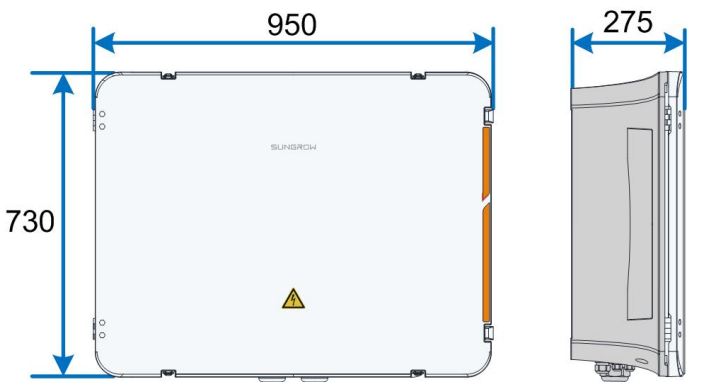


figure 3-2 Dimensions

3.3 Internal Structure

Taking PVS-24MH as an example, the internal structure of the PVS is shown in the figures below.

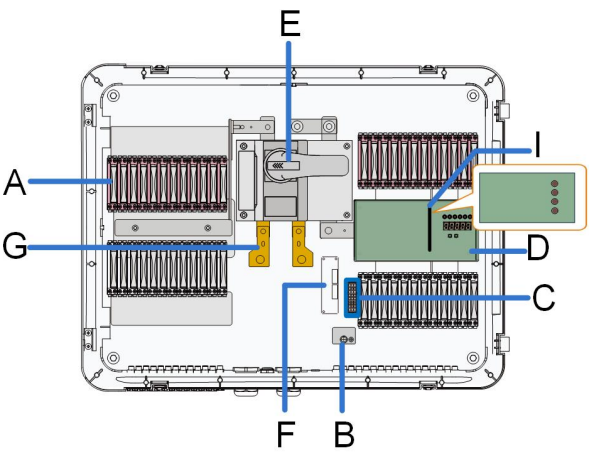


figure 3-3 Negative fuse version

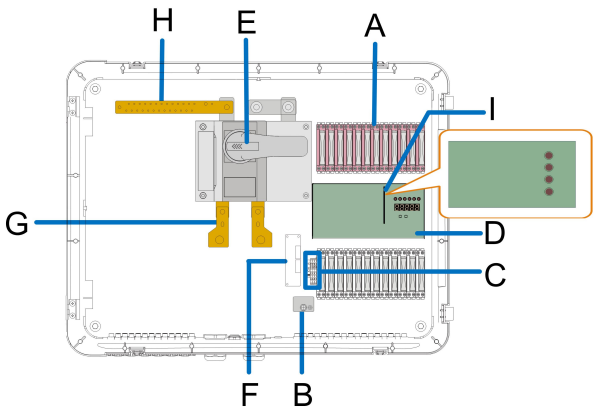


figure 3-4 Negative fuseless version

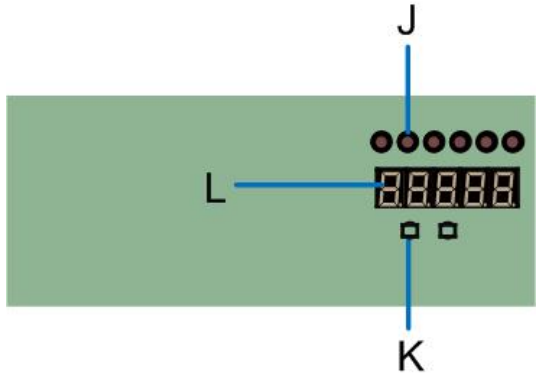
* Figures are for reference only. The product received may differ.

No.	Description
A	DC fuse holder and fuse
B	Grounding point, for equipotential connection
C	RS485 communication terminal
D	Monitoring panel
E	Load switch/ Circuit breaker
F	SPD
G	DC output wiring terminal
H	Copper bar and wiring hole
I*	DC PLC communication module

* is optional

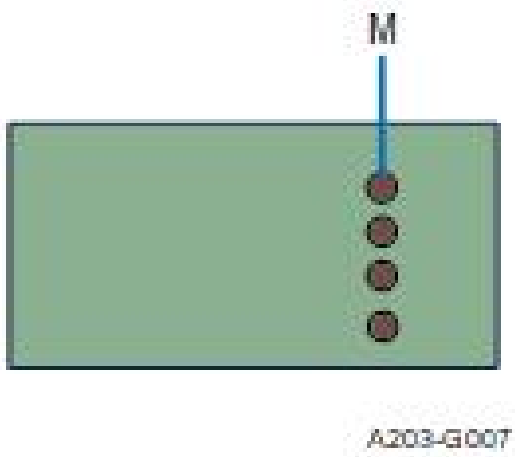
Monitoring Panel

The monitoring panel monitors the current of each string and uploads the current data to the host computer through RS485 or DC PLC communication. Users can judge whether modules are faulty by comparing the actual current value with the set value.



No.	Description
J	Indicators. From left to right: • RX: Indicator of receiving communication data signal; • TX: Indicator of sending communication data signal; • RUN: Operating status indicator of monitoring unit; • SPD: SPD failure indicator; • CB: Switch status indicator; • POWER: Power status indicator of monitoring unit.
K	Key buttons K1 and K2 (for switching parameters between current, communication, etc.)
L	LED screen (for displaying the current, communication baud rate, communication address, cabinet temperature, etc. of each string)

DC PLC communication module



No.	Description
M	Indicators. From top to bottom: • LED1: Power indicator; • LED4-PLC: Indicator of receiving communication data signal; • LED5-PLC:Indicator of sending communication data signal; • LED6-PLC: Running indicator;

SPD (Surge Protection Device)

The PVS is equipped with built-in SPD to prevent transient over-voltage caused by lightning. The SPD failure signal can be sent to the PC through the RS485 or DC PLC.

Grounding

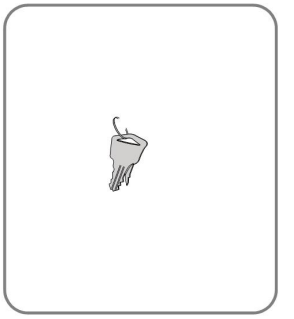
There is a grounding copper bar inside the PVS for equipotential connection.

4 Delivery and Storage

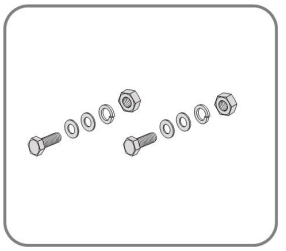
4.1 Scope of Delivery

A

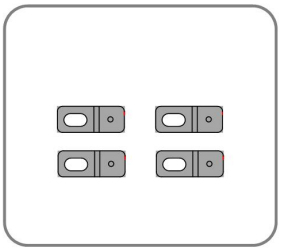
B



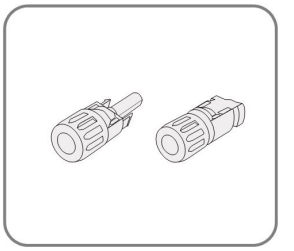
C



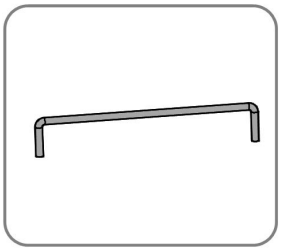
D



E



F



G

No.	Name	Description	Quantity
A	PVS	-	1
B	Related documents	Including certificate, warranty card, factory inspection report, user manual, etc.	1
C	Key	To open the cabinet door of the PVS	1
D	Bolt assembly	M8 x 16	4

No.	Name	Description	Quantity
E	Mounting hangers	To fix the PVS to the installation plane	4
F*	MC4 connector	To connect the PV input	16 pairs [a] / 18 pairs [b] / 20 pairs [c] / 24 pairs [d]
G	Limit rod	To support the cabinet door when it is open	1

Note1: * means optional.

Note 2: Parameters noted with a) apply to PVS-16MH; Parameters noted with b) apply to PVS-18MH; Parameters noted with c) apply to PVS-20MH; Parameters noted with d) apply to PVS-24MH.

4.2 Checking for Transport Damages

The PVS has been strictly inspected and firmly packed before delivery. Despite robust packaging, the PVS may be damaged during transport.

For this reason, please conduct a thorough inspection after receiving the PVS. Verify at least the following items:

- Check the scope of delivery for completeness according to the packing list.
- Confirm that the model of the PVS and internal equipment received is consistent with your order.
- Check the internal and external components to see if any damage has occurred during transportation.

Contact the forwarding company or SUNGROW in case of any damage or incompleteness.

⚠ WARNING

Only intact and undamaged PVS can be installed and started for commissioning.

Ensure the following items before installation:

- **The PVS is in good condition, without any damage.**
- **All internal and external equipment is in good condition, without any damage.**

4.3 Storage

If the PVS is not put into use immediately, store it under specific environmental conditions:

- Store the PVS with outer package in a ventilated, dry, and tidy indoor environment with desiccant retained.

- The storage carrier should be solid enough to bear the weight of the PVS and its outer package.
- The number of stacking layers of PVSs cannot exceed the "stacking layer limit" marked on the outer box.
- The packing box cannot be tilted or turned upside down.
- Ensure that the storage environment is well ventilated and free of moisture and water.
- The storage environment should be at the temperature of -40 ℃ ~ +70 ℃ and the relative humidity of 0 ~ 95%, and free of condensation.
- Pay attention to possible hazards in the surrounding environment, such as sudden temperature changes or collisions, to prevent any damage to the PVS.
- If the PVS has been stored for more than half a year, comprehensive inspection and testing by professionals are required before it can be put into operation
- Conduct regular inspection, generally not less than once a week. Check that the packaging is not damaged in any way and prevent any damage that may be caused by pests and animals. Replace the packaging immediately if it is damaged.

NOTICE

Storage without packaging is strictly prohibited!

Storage outdoors or in direct sunlight is strictly prohibited!

Tilting the PVS or placing it upside down is strictly prohibited!

NOTICE

After long-term storage, a thorough inspection should be carried out to determine whether the PVS is intact before installation. If necessary, request professionals for testing before installation.

5 Transport and Installation

5.1 Transport

Outer Package Dimensions

Six PVSs are transported as a group. Two PVSs on each layer and three layers in total, as shown in Figure 5-1.

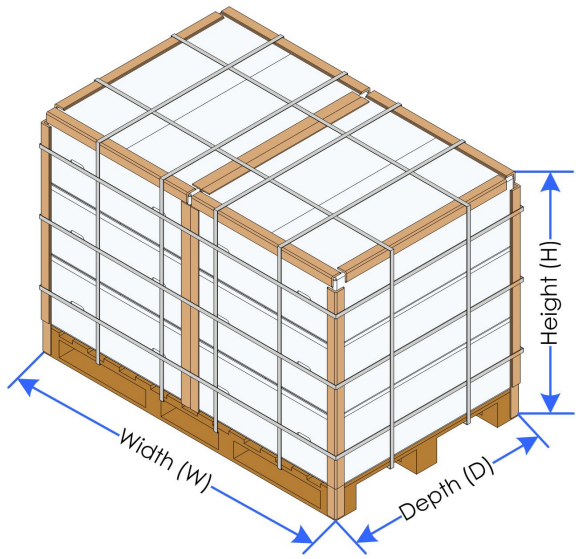


figure 5-1 Outer package dimensions

Width (W)	Height (H)	Depth (D)
1740 mm	1240 mm	1100 mm

At most two groups can be stacked up and transported as a whole, that is, two PVSs on each layer and six layers in total.

5.2 Installation Environment Selection

The PVS can be installed outdoors or indoors. The following requirements should be met:

- Dimensions and weight of the PVS shall be fully considered when choosing the installation position ("10.1 Technical Data"). Try to install the PVS near PV modules for better work performance and less cable usage.
- The ambient temperature of the installation site should be between -40℃~+60℃, and the relative humidity should be between 0~95%. It should be installed in a dry, well-ventilated, and dust-proof place.

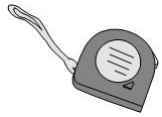
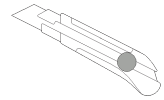
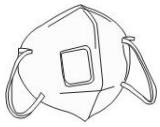
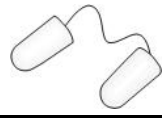
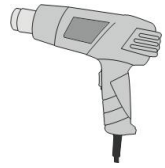
- For large-scale utility plant projects, the PVS should be vertically installed in a dark place on mounting brackets of PV modules. Reserve sufficient space around the PVS for better heat dissipation and easier daily maintenance.

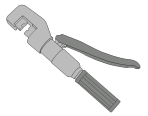
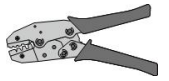
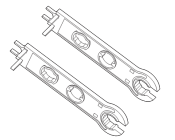
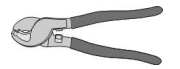
NOTICE

Moisture during the installation process will cause damage to the PVS. Do not install the PVS in rainy days or when the air humidity is high.
After installation, the waterproof terminal must be tightened to prevent water vapor from entering. After wiring, the unused terminals must be blocked.

5.3 Preparation Before Installation

Tools

General Tools			
Marker pen 	Tape 	Level ruler 	Tool knife 
Multimeter Range: ≥1500Vdc 	Anti-static wrist strap 	Protective gloves 	—
Dust mask 	Sound insulation earplugs 	Goggles 	Insulated shoes 
Vacuum cleaner 	Heat-shrink tube 	Heat gun 	—
Installation Tools			

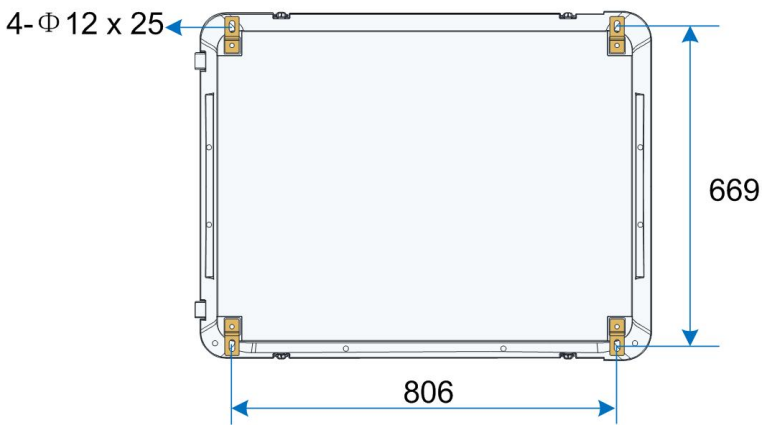
General Tools			
φ11 impact drill 	M10 electric screwdriver 	M10 screwdriver 	Wire stripper 
Hydraulic clamp 	Crimping tool 	MC4 terminal wrench 	Wire cutter 

5.4 Installing PVS

The PVS is fixed to the installation plane by hangers. Therefore, ensure that hangers are installed to the back of the PVS before fixing the PVS to the installation plane.

5.4.1 Installing Hangers

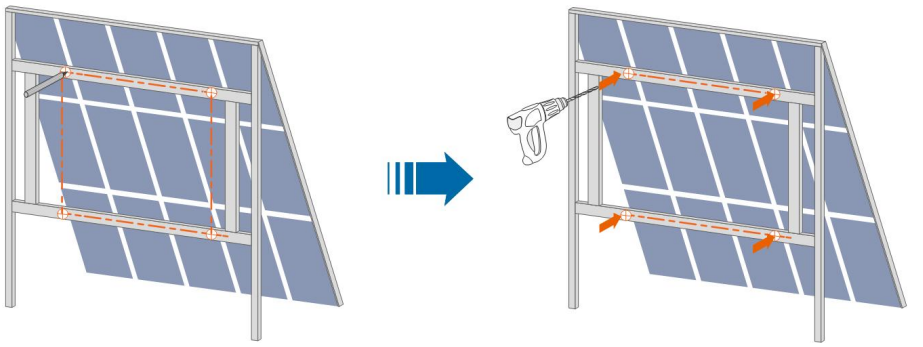
Anchor the hangers to the back of the PVS with supplied M8 x 16 bolt assembly, as shown in the figure below.



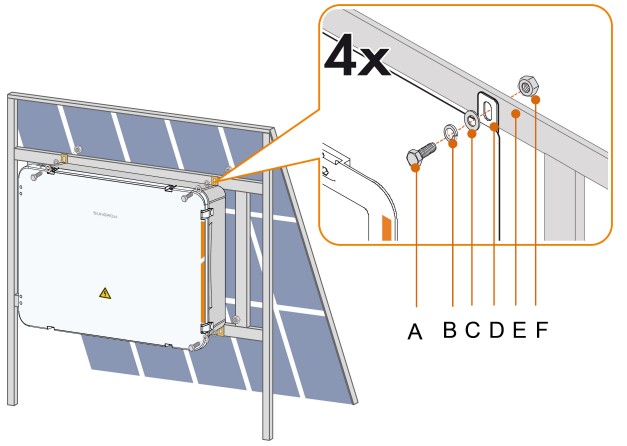
5.4.2 Vertically Mounted Combiner Box

Easy to maintain later, select the appropriate height on site to install the combiner box on the bracket or on the back of the PV module.

step 1 Mark positions on the back of the PV module according to the distance between the hangers, and drill holes according to the marks.



step 2 Anchor the PVS to the bracket in the sequence shown in the figure below, where the recommended torque is: 51±0.7 N.m.



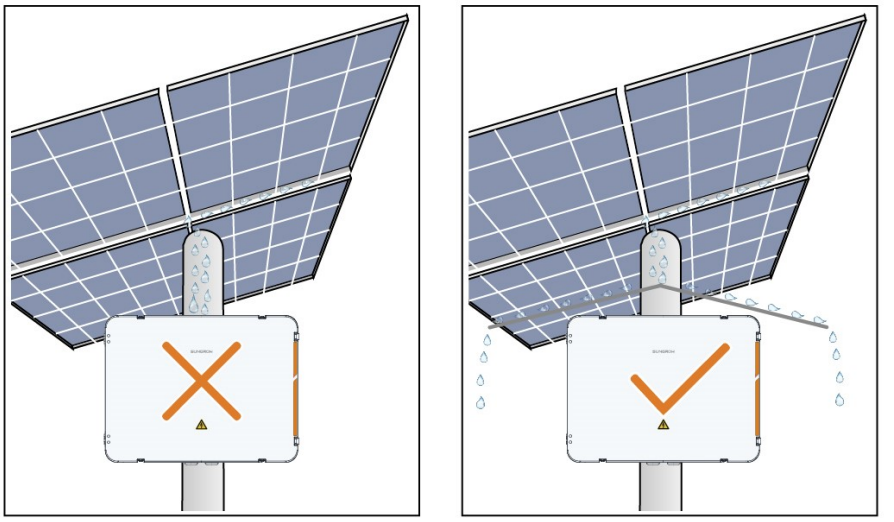
- - End

No.	Name	Description
A	M10 bolt	Beyond the scope of delivery
B	Spring washer	Beyond the scope of delivery
C	Flat washer	Beyond the scope of delivery
D	PVS hangers	—
E	PV module bracket	Beyond the scope of delivery
F	Nut	Beyond the scope of delivery

NOTICE

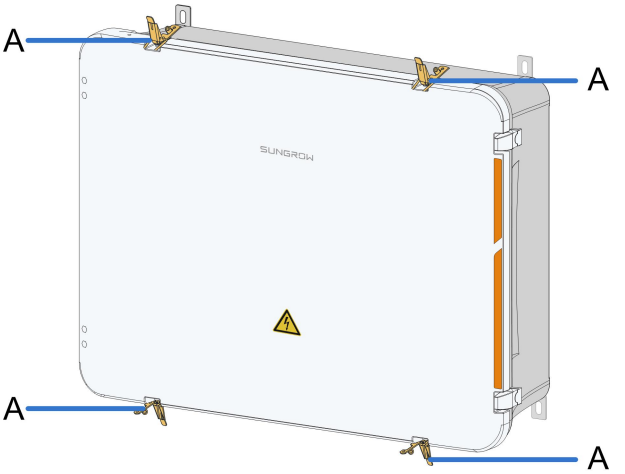
The PVS should not be installed at a place that is susceptible to rain water. It is recommended to install it on the back of the PV module.

If the combiner box is installed at the rainwater confluence, a protective cover should be installed on the top of the combiner box to avoid rainwater scouring and damage to the combiner box.



Follow-up processing

The combiner box can be opened or closed through the clasp, the position of the clasp is shown in Figure A below. When installing other components, such as cable guards, make sure that other components do not affect the normal operation of the clasp.



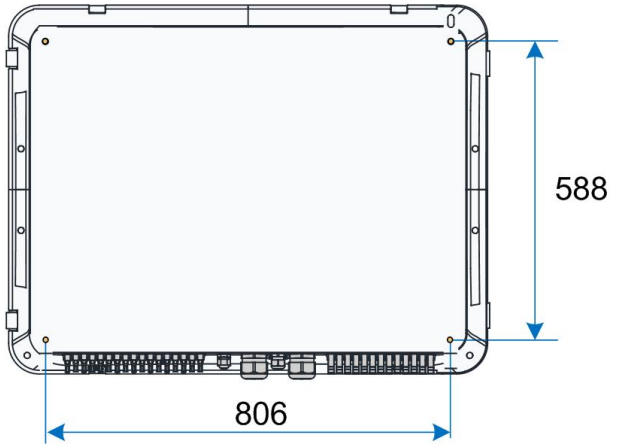
NOTICE

Claps is not closed tightly, the equipment in the combiner box may be damaged, or even the combiner box may fail.

5.4.3 Horizontally Mounted Combiner Box

Horizontal installation is recommended when the PVS is applied to floating power plants.

When horizontal installation is adopted, it is necessary to fix the positioning holes on the back of the PVS with those on the installation plane (such as bracket).



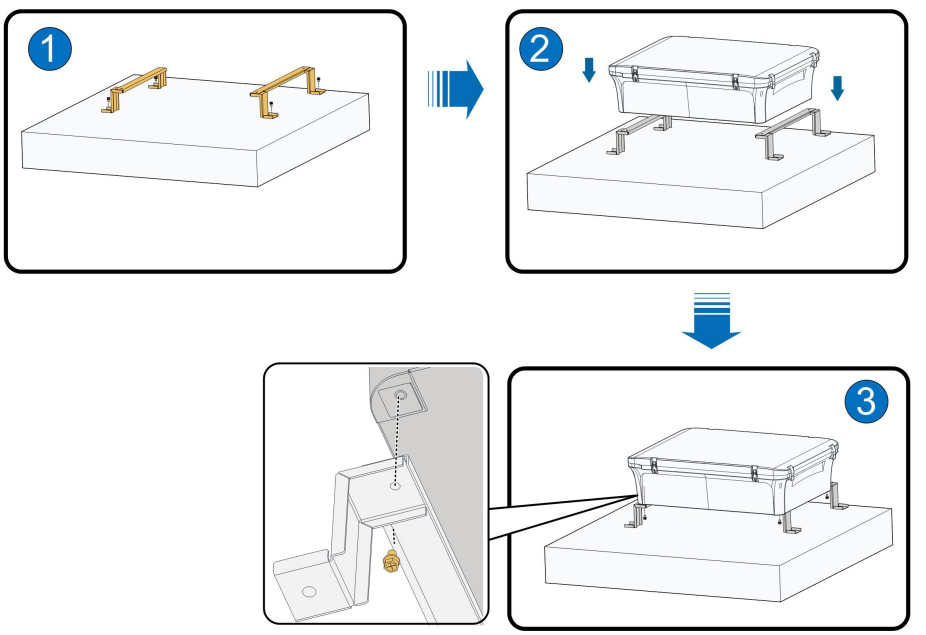
The distances between positioning holes on the back of the PVS are as shown above.

step 1 Drill holes in the mounting brackets in advance according to the above distances.

step 2 Move the PVS onto the brackets and align the positioning holes at the bottom of the PVS with the holes on the brackets.

step 3 Use M8x16 bolt assemblies to secure the PVS to brackets with a tightening torque of 16N.m. (The specific bolt length can be adjusted according to the actual situation on site.)

- - End



6 Electrical Connection

6.1 Preparation before Electrical Connections

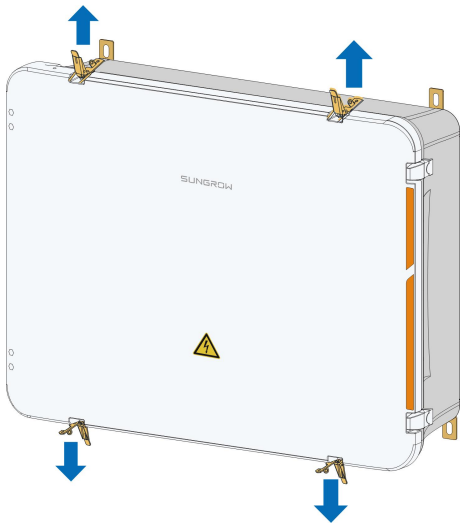
Electrical connections between devices inside the inverter have been performed before delivery. On site, the connections between the inverter and external devices need to be performed, including DC connection, AC connection and communication connection.

6.1.1 Opening Cabinet Door

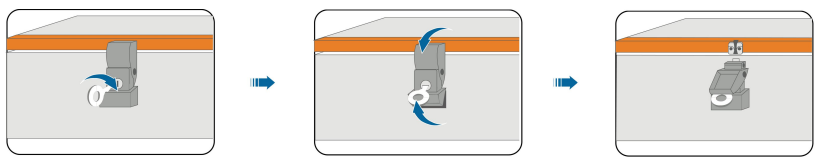
NOTICE

To prevent moisture from entering the cabinet, do not open the cabinet door in rainy or snowy days. If it is unavoidable, please take protective measures
To avoid deformation of the limit rod, do not open the cabinet door in windy days.

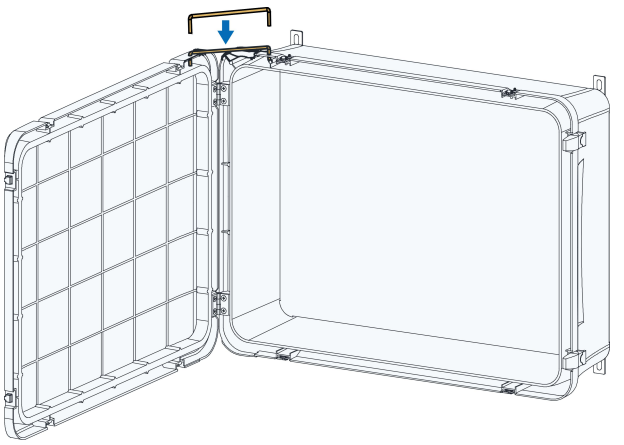
step 1 Release the two clasps on upper and lower sides of the cabinet door.



step 2 Open the door with the door key included in the delivery.



step 3 Take out the limit rod in the scope of delivery, insert and fix it from the upper side of the cabinet.



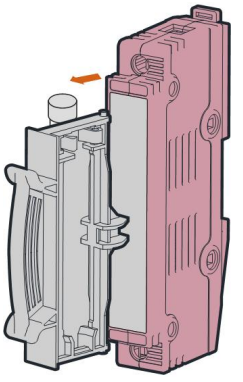
- - End

6.1.2 Power-off Preparation

step 1 Check whether the load switch / circuit breaker of the PVS is in the "OFF" position.

step 2 Disconnect the fuse. The fuse has been installed in the fuse holder before delivery. Before electrical connection, pull out the fuse holder to disconnect the fuse.

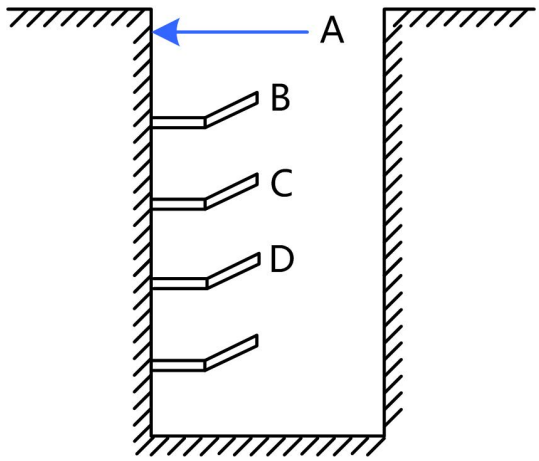
- - End



6.1.3 Cable Layout

Lay cables between the PVS and external devices in cable trenches for easy installation and maintenance. Cable trenches should be designed and constructed in accordance to related regulations, and the quantity and dimensions of devices.

Lay the output cables of different polarities, as well as different communication cables in different layers of the support arm in cable trenches to avoid short circuit caused by cracked insulation layer of cables, as shown in the following picture. User can adjust the number of supporting arms as needed.



No.	Name
A	Cable trench
B	Supporting arm of positive output cable
C	Supporting arm of negative output cable
D	Supporting arm of communication cable

Note: Figures here are for reference only, and users can make adjustment as needed.

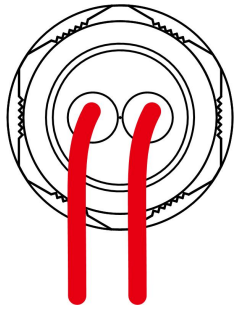
6.1.4 Waterproof Terminal and Cable Specification

Waterproof Terminal and Cable Specification

Marks	Description	Model	Cable Outer Diameter (mm)
INPUT DC+	Positive input terminal	M24*	4.5 ~ 6.8
		MC4**	4.7 ~ 6.4
INPUT DC-	Negative input terminal	M24*	4.5 ~ 6.8
		MC4**	4.7 ~ 6.4
MONITOR INPUT	Communication input terminal	PG-11	5 ~ 10
MONITOR OUTPUT	Communication output terminal		
⏚	Grounding terminal	PG-16	10 ~ 14
OUTPUT DC+	Positive output terminal	PG-42	32-42
OUTPUT DC-	Negative output terminal		

Note 1: Parameters marked with * apply to the version with waterproof terminals; Parameters marked with ** apply to the version with MC4 terminals.

Note 2: The two positive (negative) input cables can be connected to the same waterproof terminal according to actual needs, as shown in the following figure.



Note 3: The above terminals and models are all based on the standard version of the PVS. Please refer to the ordering agreement for details.

Note 4: If no waterproof terminals are used, use fireproof mud to seal the gap.

6.2 Input Connections

⚠ DANGER

There is a high voltage in the PV string. Accidental contact may cause fatal electric shock or severe burns. When wiring the PVS, observe the following safety precautions:

- **Before wiring, please disconnect the end of the PV string.**
- **Before wiring, do not use an ordinary multimeter to measure the DC voltage. A multimeter with a withstand voltage of at least 1500V is recommended. Otherwise, serious damage may follow.**
- **Please follow all safety instructions of the PV module manufacturer.**

⚠ WARNING

Incorrect cable connection can cause damage to PV modules, the PVS, and inverters. When wiring, observe the following precautions:

- **Wire according to the wiring drawing.**
- **Measure the voltage of positive and negative polarities of each string by a multimeter with a withstand voltage of at least 1500V and ensure there is no reverse connection before wiring;**
- **Distinguish the positive and negative polarity of strings before wiring, and ensure that there is no ground fault.**
- **Star-shape wiring is not supported on site.**

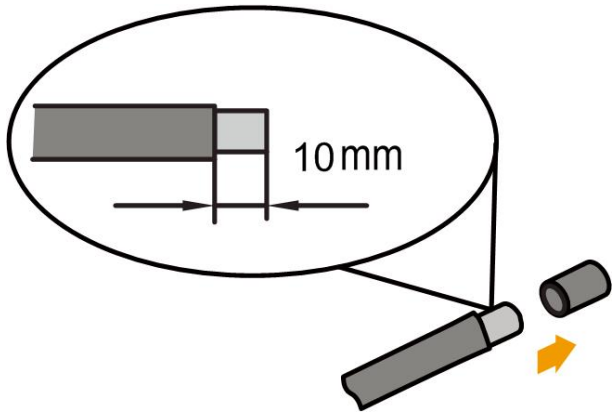
6.2.1 Brief Introduction

There are two types of input terminals:

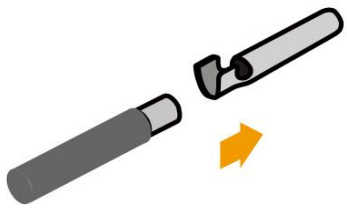
PVS Input Terminal	Internal Design	Wiring Reference
PG Gland terminal	With a negative fuse	"6.2.3 PG Gland Terminal"
	Without a negative fuse	
MC4 connector	With a negative fuse	"6.2.2 MC4 Connector"

6.2.2 MC4 Connector

step 1 Strip off the insulation layer of 10mm from the positive and negative DC cables.

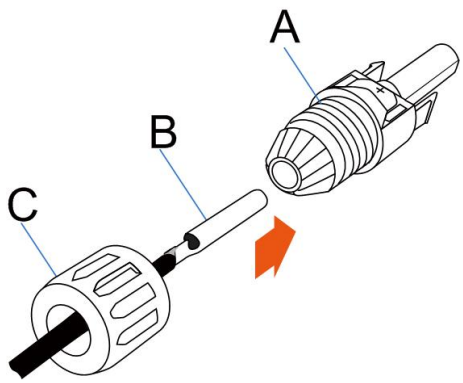


step 2 Assemble the cable ends with crimp contacts by the crimping tool.



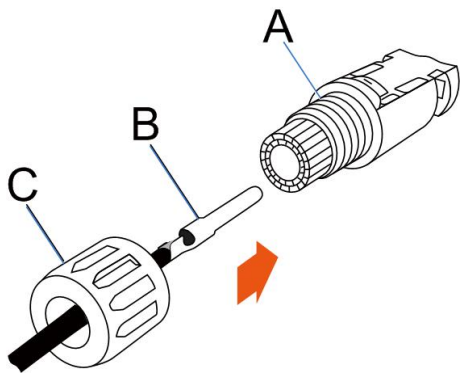
step 3 Connect the cables as shown below. Pull the cable gently to make sure it is secured.

—Connect the positive input cable as shown below.



A	B	C
Positive input terminal	Positive Input cable	Sealing cover

—Connect the negative input cable as shown below.



A	B	C
Negative input terminal	Negative Input cable	Sealing cover

WARNING

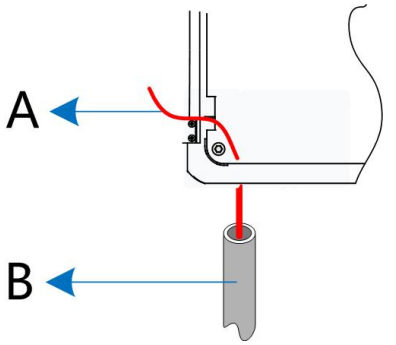
After wiring, it is strictly prohibited to seal the gap between cables and the MC4 connector with fireproof mud.

- - End

6.2.3 PG Gland Terminal

step 1 Loosen nuts of "INPUT DC+" and “INPUT DC-” waterproof terminals at the bottom of the PVS.

step 2 Lead the “PV1+” cable through "INPUT DC+” waterproof terminal, and connect it to the “PV1+” wiring terminal inside the PVS. Leave a proper margin in cable length so that the cable can be bent and fixed inside the PVS.



No.	Description
A	Cable ("PV1+", "PV2+"… "PV1-", "PV2-", etc.)
B	Conduit

step 3 Positive wiring

Strip off the cable insulation layer using the wire stripper to reveal the copper core. Press-fit the cable and a cord-end terminal.

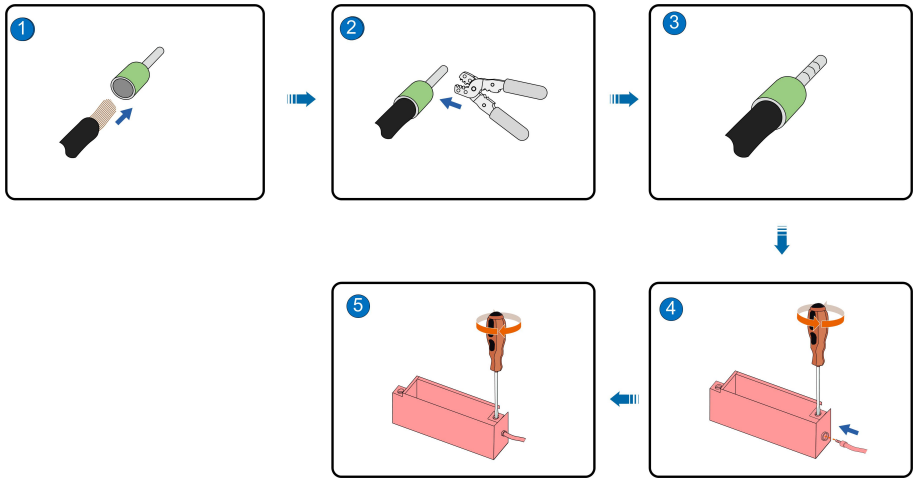


figure 6-1 Positive input wiring

step 4 Negative wiring

—For the negative fuse version, the wiring method is the same as that of the positive wiring. Connect the cable to the “PV1-” wiring terminal inside the PVS referring to"figure 6-1 Positive input wiring"

— For the negative fuseless version, strip the wire and press-fit the cable and the OT terminal, and then fix it to the wiring hole on the copper bar.

1— Heat shrinkable tubing.
2—DT termial

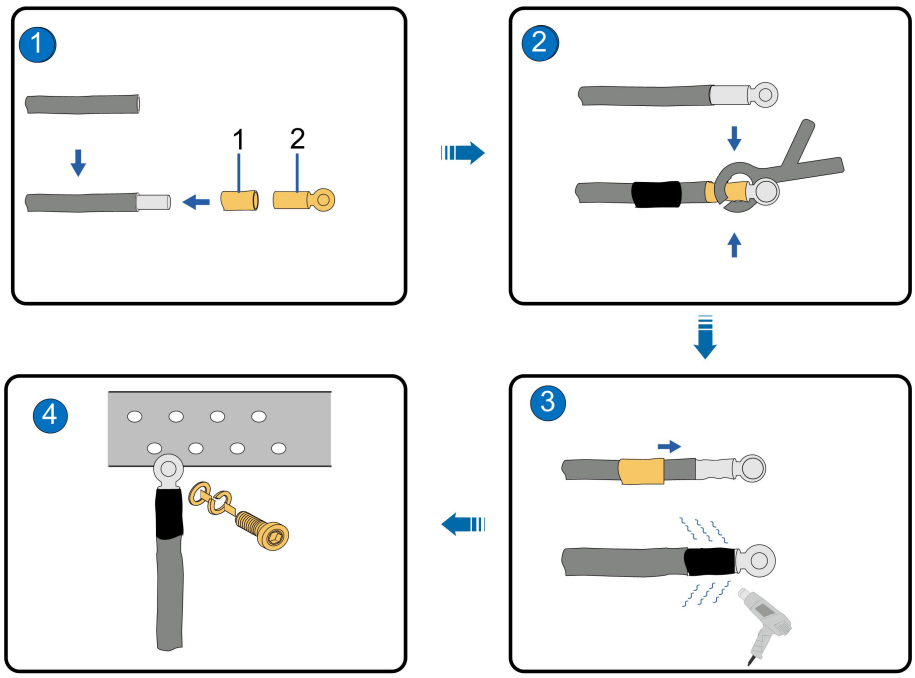


figure 6-2 Negative input wiring

- - End

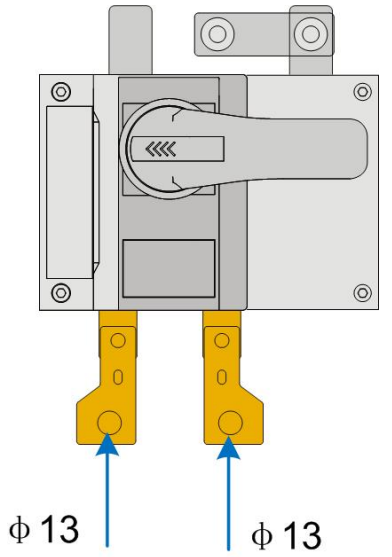
6.3 Output Connections

Preparation Before Wiring

Unscrew the waterproof terminals at the DC output port of the PVS.

Open the protective cover of the output terminals.

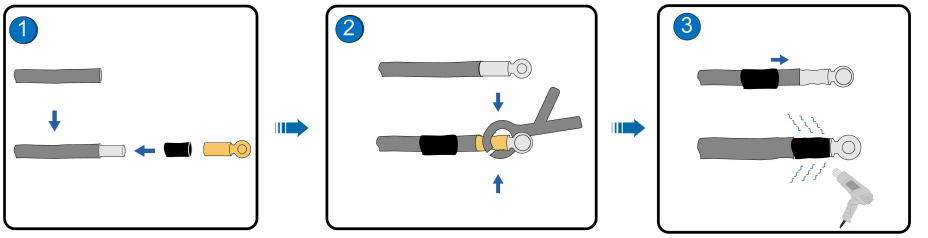
Overview of Wiring Area



Note: The figure is for reference only and the actual product shall prevail.

step 1 Lead the “DC+” cable through the "OUTPUT DC (+)" waterproof terminal. Enough cable bending space should be ensured.

step 2 Strip the protective layer and insulation layer of the cable to expose the copper core of L ≈ 25mm, crimp the cable to the appropriate DT terminal, and tighten them with a heat shrinkable tubing.



step 3 Fix the crimped DT terminal to the output terminal.

When copper wire is used, fix the DT terminal to the output terminal in an order shown in the figure below, and the tightening torque is 60~70N.m.

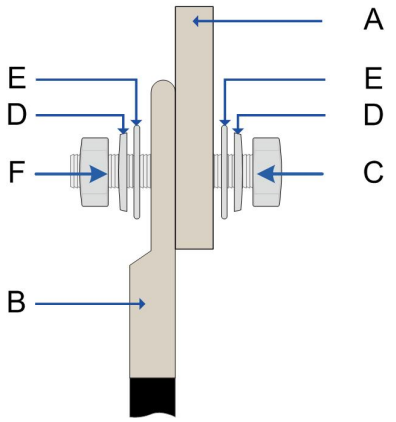


figure 6-3 Schematic of copper wire connection

A	B	C	D	E	F
Copper bar	Copper terminal	M12 bolt	Spring washer	Flat washer	Nut

When aluminum wire is used, fix the DT terminal to the output terminal in an order

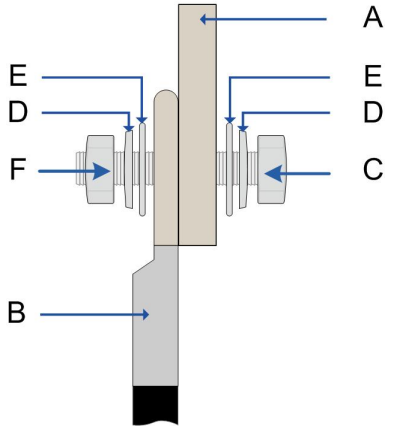


figure 6-4 Schematic of aluminum wire connection

A	B	C	D	E	F
Copper bar	Copper-aluminum transition terminal	M12 bolt	Spring washer	Flat washer	Nut

step 4 Tighten the nut of the waterproof terminal clockwise.

WARNING

Make sure that fastening screws on terminals are fastened in place. If the copper core has not been fully and tightly contacted with the wiring terminal, long-time work may burn the terminal.

Use stranded copper core flame-retardant cables with the wire diameter not less than the recommended value in the appendix.

Fasten screw caps of waterproof terminals in place, otherwise, it may cause water leakage and damage to the PVS.

- - End

6.4 Ground Connection

Brief Introduction

WARNING

The grounding cable must be well connected to ground, otherwise:

- **It may cause fatal electric shock to the operator in case of failure!**
- **The equipment may be damaged when struck by lightning!**

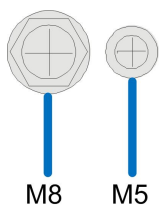
NOTICE

Relevant standards and regulations must be observed.

- **Grounding cables must be connected firmly with both the device and ground terminals.**
- **The ground resistance shall be measured after the ground connection is finished, and its resistance value shall be no more than 1Ω.**

Grounding Hole

There are grounding holes reserved for M5 and M8 riveting screws in the PVS, as shown in the figure below.



On site, select the appropriate grounding holes according to actual conditions.

table 6-1 Wiring requirements

Riveting Screw Specifications	M5	M8
Recommended cable specifications	16mm²	95mm²
Stripping length L	15 mm	25 mm
Tightening torque	4.4±0.4N.m	20.5±2.5N.m

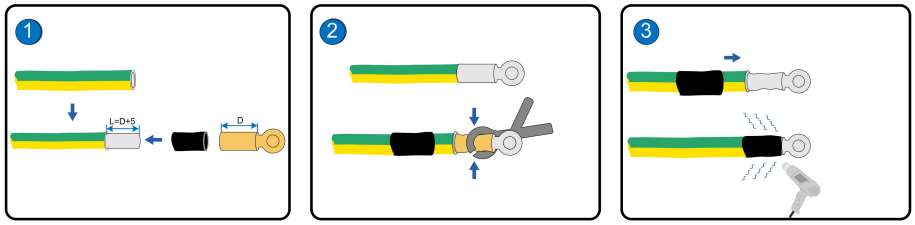
Connection Method

step 1 Loosen the nut of grounding waterproof terminal.

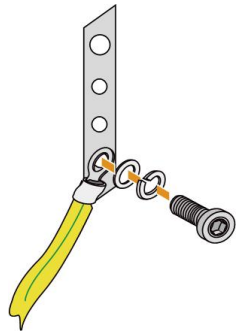
step 2 Lead the yellow green cable through waterproof terminal, leaving a proper margin in cable length.

step 3 Use wire strippers to strip the protective layer and insulation layer of the cable to expose the copper core of the wire. For the specific stripping length, refer to"table 6-1 Wiring requirements"

step 4 Crimp the OT terminal.



step 5 Fix it to the ground copper bar in the sequence of screw, spring washer, flat washer, OT terminal, and grounding hole. Refer to"table 6-1 Wiring requirements" for the tightening torque.



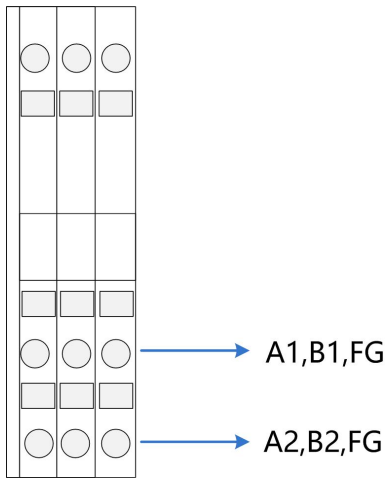
step 6 Tighten the nut of the waterproof terminal clockwise.

- - End

6.5 Communication Connection

6.5.1 Cable Connection

The communication terminals inside the PVS are shown below.



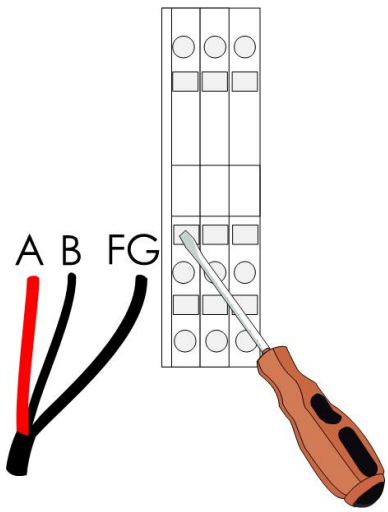
Upper terminals are for input cable connection and lower terminals are for output cable connection. User may adjust the connection according to real need.

step 1 Loosen the waterproof terminals of "MONITOR INPUT" and "MONITOR OUTPUT".

step 2 Lead the communication cable through the waterproof terminal into the PVS.

step 3 Use wire strippers to strip the protective layer and insulation layer of the cable to expose the copper core of 8mm.

step 4 Insert the screwdriver into holes of input wiring terminals to lever leaf springs until they are bounced completely.



step 5 Insert wires into bottom of wiring holes A1, B1, and FG. Among them:

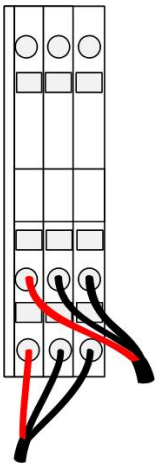
—Insert RS485-A into A1;

—Insert RS485-B into B1;

—Insert the shielded layer of the communication cable into FG.

step 6 Pull out the screwdriver so that wires are firmly pressed by leaf springs.

step 7 Follow the same steps to insert the output cable into A2, B2 and FG at the lower part respectively.



- - End

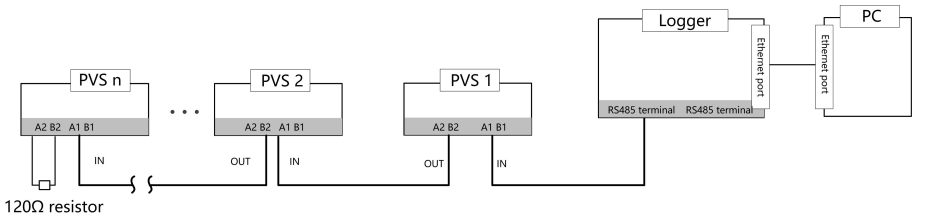
NOTICE

Communication cable must be shielded twisted pair cable, unstable communication or communication failure may follow if otherwise.
Communication cable should be far away from the high voltage cable. Placing the communication cables and power cables in parallel or strapping them together is strictly forbidden. Communication interference or device damage may follow if otherwise. If it cannot be avoided, lead the communication cable through galvanized conduit.

6.5.2 Communication Solution

RS485 Communication

The PVS adopts series RS485 communication, as shown in the following figure.



- A1 and B1 of PVS 1 are connected to A1 and B1 of the logger;

- A2 and B2 of PVS 1 are connected to A1 and B1 of PVS 2;
- A2 and B2 of PVS 2 are connected to A1 and B1 of PVS 3;

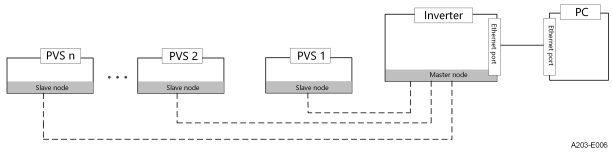
And so forth, A2 and B2 of the PVS n-1 are connected to A1 and B1 of PVS n.

NOTICE

The 120Ω resistor shown in the figure above is not a required item.
If on-site communication is poor, it is recommended to connect a resistor to the last device on the RS485 bus to improve the communication quality. For example, connect a resistor between the RS485-A and RS485-B of PVS n in the above picture.
If the communication quality is not improved, check whether the cable routing meets requirements. For details, please refer to"6.1.3 Cable Layout"

DC PLC communication (optional)

The PVS adopts series DC PLC communication, as shown in the following figure.



- The client node of the first PVS communicates with the host node of the inverter;
- The client node of the second PVS communicates with the host node of the inverter.

And so on, all PVS client nodes communicate with the host nodes of the inverter.

NOTICE

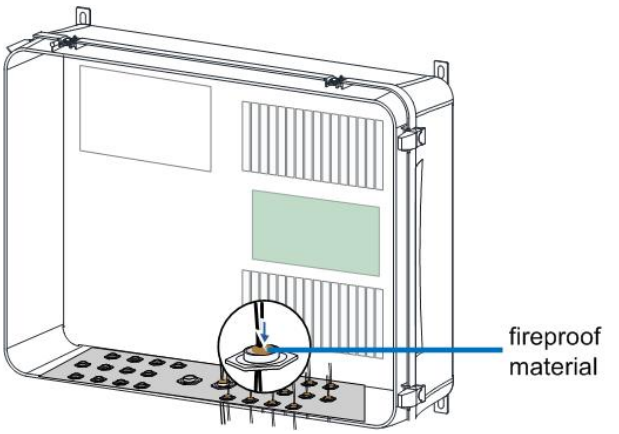
The monitoring panel only works when the PV string voltage reaches the rated working voltage of the switching power supply of the PVS.

NOTICE

After installation or maintenance, ensure the door is locked and the key cover is fully closed to avoid water penetration.
Sufficient bending space for each cable should be reserved, and cables must not be tightened and stressed.

Subsequent processing

After all wiring is completed, for the unsealed PG waterproof terminal, use fireproof material to seal the PG waterproof terminal gap from the inside of the combiner box.



NOTICE

Blocking the waterproof vent valve may cause condensation in the combiner box and even damage the equipment inside the combiner box.

6.6 Communication Settings

Communication parameters of the PVS can be set and viewed on the monitoring panel.

LED Screen

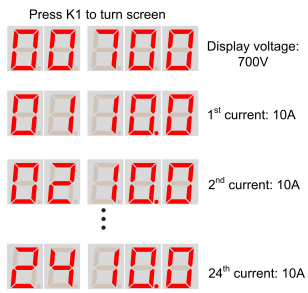
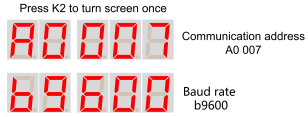
The LED screen on the monitoring panel is used to display relevant electrical parameters and communication parameters.

Buttons

Buttons are located on the monitoring panel. The left button is K2 and the right button is K1.

- Press K1 to view the current and voltage information.
- Press K2 to view the communication address, baud rate and cabinet temperature of the PVS.

table 6-2 Function description of buttons (PVS-24MH as an example)

Function	Graphics	Description
Voltage and current display		Short press K1 to see the voltage and current information on the LED screen. The first two digits Indicate the branch number of the input, and the last three digits indicate the current value of the branch. For example, "0110.0" means that the current of the 1st input is 10A. Note: If the first two digits are "00", the last three digits indicate the voltage value. For example, "00700" means that the current voltage is 700V.
Communication display		Short press K2 to see the current communication address and communication baud rate on the LED screen.
Ambient temperature display		Short press K2 again when the communication baud rate is displayed on the screen to view the current ambient temperature of the monitoring panel.

6.6.1 Setting Communication Address

step 1 Press and hold K1 for 2s until "A = 001" is displayed on the LED screen.

step 2 Press K1 to increase the value and K2 to decrease the value. The communication address ranges from 1 to 231.

step 3 Press K1 and K2 at the same time to save the settings.

- - End

6.6.2 Setting String Access Status

Types of standard PVS researched by SUNGROW are as follows:

- PVS-16MH
- PVS-18MH
- PVS-20MH
- PVS-24MH

If the number of strings connected is the same as the number in the PVS model, skip this step.

This section takes PVS-24MH as an example to briefly explain the communication settings when the number of actual inputs (e. g., 23) of the PVS is inconsistent with the number indicated on the model (24).

step 1 Press and hold K2 for 2s until the last three digits on the LED screen is "P=0" or "P=1", at which the access status can be set.

step 2 Press K1 to select the number of actual inputs, such as 23.

step 3 Press K2 to switch the last digit to "0", which means "Not connected".

—"0" corresponds to "Not connected";
—and "1" corresponds to "Connected".

step 4 If only 23 inputs are connected to the PVS, set the 24th input as "Not connected", as shown below.

step 5 Press and hold both K1 and K2 for 2s to save the foregoing settings.

- - End

6.7 Start/Stop

The PVS runs automatically after being powered on, and stops automatically after being powered off.

The PVS can be manually shut down through the internal load switch.

7 Commissioning

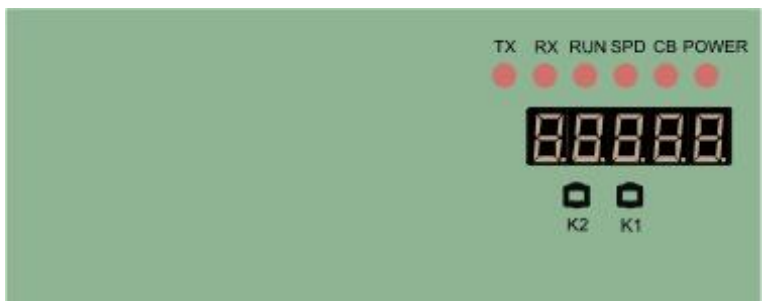
Follow the steps below to check whether the PVS operates normally after installation:

step 1 Connect the wiring terminals of each PV input.

step 2 Measure the input voltage between positive and negative polarities of each input to make sure they are basically same and there is no reverse connection.

step 3 Fasten the fuse holder.

step 4 Close the load switch. If the "POWER" indicator is on, the "RUN" indicator flashes, and there is numerical value on the monitoring panel when K1 is pressed, the PVS operates normally.



step 5 Secure the clasps.

step 6 Lock the door.

step 7 Pull out the key.

step 8 Complete commissioning.

- - End

8 Routine Maintenance

8.1 Brief Introduction

Due to the influence of ambient temperature, humidity, dust and vibration, the internal components of the PVS will age and wear, which may lead to potential failures of the PVS. Therefore, it is necessary to implement daily and regular maintenance on the PVS to ensure its normal operation and service life.

⚠ WARNING

Only qualified electricians can perform the maintenance work described in this chapter.

NOTICE

Do not leave screws, washers, or other metal parts in the PVS during maintenance. Otherwise, damage may be caused to the device!

Shut down the PVS before maintaining hardware to ensure the parts that may be touched are voltage free.

8.2 Maintenance Work

Inspection content	Inspection method	Maintenance cycle
Electrical connection	Check the fuse holder, PG gland terminal and other joints for looseness and dislodgement. Check the cables for damage.	3 months/time
Sealing strip inspection	Regularly check the sealing strip for bubbles, cracks, broken skin and lack of glue, pits, etc.	1-2 months/time in the first period, usually 1 year/time

The recommended routine maintenance periods in the table are only for reference. The actual maintenance period shall be determined reasonably in consideration of the specific installation environment of the product.

Power plant scale, location, site environment, and other factors also affect the maintenance period of the product. It is necessary to shorten the maintenance period and increase the maintenance frequency in the event of a heavy sandstorm or dust in the operating environment.

8.3 Fuse Replacement

WARNING

Once the fuse is blown, it cannot be restored and should be replaced by a qualified operator in time.

Replace the fuse with a new one of the same model and the same grade.

Follow the procedure below to replace the fault fuse.

step 1 Disconnect load switch/circuit breaker.

step 2 Use a clamp meter to measure the current of each channel to ensure that the current is 0.

step 3 Open the fuse box and remove the fuse.

step 4 Install a fuse of the same size.

step 5 Close the fuse box.

step 6 Connect the load switch/circuit breaker.

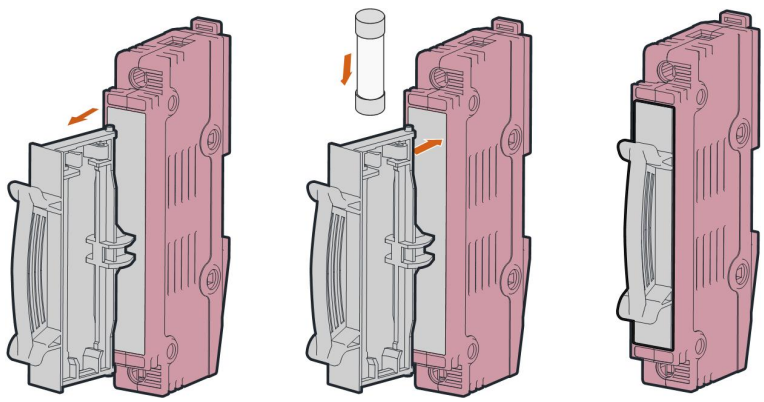


figure 8-1 Fuse replacement steps

- - End

WARNING

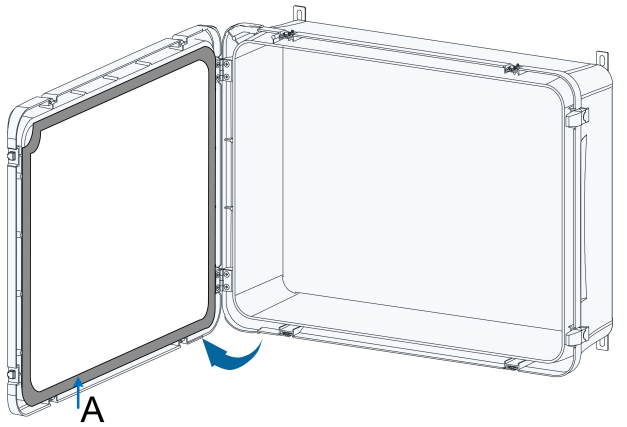
Push the fuse holder back into place and fasten it after the fuse is replaced.

⚠ WARNING

Disconnect the load switch before checking and replacing the fuse. Please notice that high voltage still exists in all terminals of the load switch. Make sure the current of each input is zero by a clamp meter and only then can the fuse be replaced.

8.4 Sealing Strip Replacement

The internal sealing strip wraps around the door, shown as “A” in the figure below. It is recommended to check the sealing strip regularly. If there is any damage caused due to non-human factors, please contact SUNGROW immediately to replace the door and the sealing strip.



9 Troubleshooting

9.1 Before Troubleshooting

Please notice the following items before troubleshooting:

- Disconnect the load switch before operation.
- Do not touch bare metal parts such as copper bar under the protective plate.
- Pull out the fuse holder to disconnect the input for maintenance of the combiner busbar.

⚠ WARNING

High voltage may still exist in terminals of the load switch when it is disconnected! The fuse holder may still be live when the fuse is removed. Please do not touch it.

9.2 Common Faults and Corrective Methods

Indicator Faults

Fault Detail	Possible Cause	Corrective Method
"RX" and "TX" are off	RS485 communication failure	Check the communication connection referring to"6.5 Communication Connection"
"RX" flashes, "TX" is off	Address error	Reset the address referring to"6.6 Communication Settings"
“POWER” is off	No 5V output from switching power board	Check and ensure that the voltage at +5V plug of the monitoring unit is 5V; Otherwise, the switching power board is faulty and please contact SUNGROW for maintenance.
"RUN" is steady on or steady off	CPU board failure	Contact SUNGROW to replace the monitoring unit
"SPD" is on	SPD failure	Replace the SPD

Fault Detail	Possible Cause	Corrective Method
“LED1” is not steady on*	Power supply abnormal	Check the wiring, or replace the PVS monitoring panel/ burning software
"LED6–PLC" is steady on or steady off*	No program, or chip damaged	Replace the PVS monitoring panel/burning software
“LED4-PLC” and “LED5-PLC” are not blinking alternately and periodically at a high frequency*	Hardware abnormal, communication abnormal	Check whether parameters of the host node and the client node are consistent, change the frequency band of the host node and the client node, or lower the gain of the client node Please contact SUNGROW if the problem is not resolved.

Note: *It applies only to products with DC PLC communication modules.

Other Faults

Fault Detail	Possible Cause	Corrective Method
Current of a branch is apparently smaller or larger than current of other branches	Abnormal current	Check the size of PV strings of this branch for consistency; Check whether any string of this branch is blocked
Open circuit fault of a branch	No PV string connected to this branch	Refer to"6.6.2 Setting String Access Status"
	Cable falling off or fuse blown	Check PV cables for disconnection or replace the fuse
Occasional communication failure	Disturbance to communication circuit	Use shielded twisted pair cable of which the shielded layer should be grounded and connect a 120Ω resistor between communication terminals A2 and B2 of the last PVS referring to"6.5 Communication Connection"

10 Appendix

10.1 Technical Data

PVS-16MH /PVS-18MH

Electric Parameters	PVS-16MH	PVS-18MH
Max. PV string voltage	1500V	
Max. PV string parallel inputs	16	18
Rated fuse current of each string (Optional)	20A/25A/30A/32A/35A	
Rated current of load switch	400A	
SPD	1500 Vdc Type II (Optional: Type I+II)	
Input terminal type	PG Gland / MC4 terminal	
Output cable specification	120 - 400 mm²	
Degree of protection	IP65 / IP67 (Optional)	
Ambient temperature	-35℃ ~ +60℃	
Ambient humidity	0~95%	
Dimensions (width * height * depth)	950×730×275 mm	
Weight	40 kg	
Load switch handle	Built-in	
Material	SMC	
Standard Accessories		
Positive fuse	Yes	
PV specific SPD	Yes	
Optional Accessories		
String current and voltage monitoring	Optional	
RS485 communication port	Optional	
SPD failure monitoring	Optional	
Load switch status monitoring	Optional	
IP2X protection for operating areas	Optional	
DC PLC communication	Optional	

PVS-20MH / PVS-24MH

Electric Parameters	PVS-20MH	PVS-24MH
Max. PV string voltage	1500V	
Maximum number of input channels	20	24
Rated fuse current of each string (Optional)	20A/25A/30A/32A	20A/25A
Rated current of load switch	400A	
Lightning arrester	1500 Vdc Type II (Optional: Type I+II)	
Input terminal type	PG Gland / MC4 terminal	
Output cable specification	120 - 400 mm²	
Degree of protection	IP65 / IP67 (Optional)	
Ambient temperature	-35℃ ~ +60℃	
Ambient humidity	0~95%	
Dimensions (width * height * depth)	950×730×275 mm	
Weight	42 kg	44 kg
Load switch handle	Built-in	
Material	SMC	
Standard Accessories		
Positive fuse	Yes	
PV specific SPD	Yes	
Optional Accessories		
String current and voltage monitoring	Optional	
RS485 communication port	Optional	
SPD failure monitoring	Optional	
Load switch state monitoring	Optional	
IP2X protection for operating areas	Optional	
DC PLC communication	Optional	

10.2 Cable Requirements

Model	PVS-16MH / 18MH / 20MH /24MH
Input cable	Specifications: MC4 terminal or 4~6mm^2(outer diameter 4-mm~6mm) stranded flame-retardant copper wire Stripped length: 10mm Screw: M4 Tightening torque: 2.8N.m
Output cable	Specifications: 120~400mm^2(copper wire) flame-retardant cable Stripped length: 35mm
Communication cable	Specifications: 2 x 0.75 mm^2 —2 × 1.5mm^2(outer diameter 5mm ~ 10mm) shielded twisted pair cable Stripped length: 7mm
Grounding cable	Specifications: stranded flame-retardant copper wire with outer diameter of 10mm ~ 14mm Stripping length: 15mm or 25mm Screw: M5 or M8 Tightening torque: 4.4±0.4N.m or 20.5±2.5N.m

10.3 Quality Assurance

When product faults occur during the warranty period, SUNGROW will provide free service or replace the product with a new one.

Evidence

During the warranty period, the customer shall provide the product purchase invoice and date. In addition, the trademark on the product shall be undamaged and legible. Otherwise, SUNGROW has the right to refuse to honor the quality guarantee.

Conditions

- After replacement, unqualified products shall be processed by SUNGROW.
- The customer shall give SUNGROW a reasonable period to repair the faulty device.

Exclusion of Liability

In the following circumstances, SUNGROW has the right to refuse to honor the quality guarantee:

- The free warranty period for the whole machine/components has expired.
- The device is damaged during transport.
- The device is incorrectly installed, refitted, or used.

- The device operates in harsh conditions beyond those described in this manual.
- The fault or damage is caused by installation, repairs, modification, or disassembly performed by a service provider or personnel not from SUNGROW.
- The fault or damage is caused by the use of non-standard or non-SUNGROW components or software.
- The installation and use range are beyond stipulations of relevant international standards.
- The damage is caused by unexpected natural factors.

For faulty products in any of above cases, if the customer requests maintenance, paid maintenance service may be provided based on the judgment of SUNGROW.

10.4 Contact Information

In case of questions about this product, please contact us.
We need the following information to provide you the best assistance:

- Model of the device
- Serial number of the device
- Fault code/name
- Brief description of the problem

For detailed contact information, please visit: **https://en.sungrowpower.com/contactUS**

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