PVS-8M-HV/ PVS-16M-HV
PV Array Combiner Box
User Manual
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1 About This Manual

1.1 Foreword

Thank you for purchasing the PV Array Combiner Box from Sungrow Power Supply Co., Ltd. We hope that the device will meet with your satisfaction when you use it with your PV system. Your commands and feedbacks on the performance and function of the device are very important for our further improvement.

1.2 Contents

- Safety instructions
  Safety instructions for the installation, operation, commissioning and maintenance of PVS.
- Product description
  Location of PVS in the PV system, structure, function and classification.
- Installation guide
  The installation methods and electrical connections of PVS.
- Routine maintenance
  How to replace the fuses of PVS.
- Others
  Technical data of PVS, exclusion of liability and the way to contact us.

1.3 Target Readers

This manual is for users who operate the PVS or conduct the maintenance work. The operators must be trained and qualified personnel.

1.4 How to Use this Manual

Read this manual and other related documents before installation of the PVS.
Documents must be stored in a convenient place for future reference.

The contents of the manual will be periodically updated or revised due to the product development. It is probably that there are changes of manual in the subsequent converter edition.

1.5 Others

This document will take the PVS-16M-HV for example. For the installation and use of other types of combiner boxes, please also refer to this manual.

- PVS-6M-HV
- PVS-8M-HV
- PVS-12M-HV
- PVS-16M-HV

The electrical structure, installation and use method of these are the same with that of PVS-16M-HV. The only difference between them is the numbers of DC input string. Please call us (+86 551 6532 7834) if you have any questions.

1.6 Symbol Explanation

This manual contains important safety and operational instructions that must be accurately understood and followed during the installation and maintenance of the equipment.

To ensure optimum use of this manual, note the following explanations of symbols used.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DANGER</strong></td>
<td>Indicates a hazard with a high level of risk which, if not avoided, will result in death or serious injury.</td>
</tr>
</tbody>
</table>

| **WARNING** | Indicates a hazard with a medium level of risk which, if not avoided, will result in death or serious injury. |
The following symbols on the device enclosure must be paid attention to.

<table>
<thead>
<tr>
<th>Symbols</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>⚡️</td>
<td>Risk of electric shock! If not avoided, lethal hazard can be caused.</td>
</tr>
<tr>
<td>🔥</td>
<td>Hot surface! Do not touch!</td>
</tr>
<tr>
<td>🔫</td>
<td>The symbol represents protective conductor terminal. The terminal should be connected firmly to avoid potential injury or property damage.</td>
</tr>
</tbody>
</table>

1.7 Picture Explanation

Pictures used in this manual all take the PVS with standard configuration for example.

The real PVS you received may differ from the example pictures in the numbers of the installation hangers and etc. Please refer to the actual product you receive.
2 Safety Instructions

This chapter describes some important safety instructions about SunBox PVS.

Please read the manual carefully before installation. If any device damage occurs when ignoring the safety instructions, our company has the right to exclude all warranty claims.

⚠️ DANGER
Lethal Voltage!
- Death resulting from burning and electric shock upon touching the live components of the PVS.
- Disconnect the end connection of the PV string before cable connection;
- Do not use ordinary ammeter to measure the DC voltage before cable connection. An ammeter with withstanding voltage of 1500V is recommended. Serious consequences may follow if otherwise.
- Observe all safety instructions required by the PV cell manufacturer.

⚠️ DANGER
Device damage or system fault may cause fire and electric shock!
- Optical check the device for any possible damages or dangerous states before operation.
- Check if other external devices or circuit connection are in safe state. Work on the device only when it is safe to do so.

⚠️ DANGER
Death or burning hazard by touching the internal terminals of the device!
- Do not touch the terminals or conductors in contact to the inverter or PV string.
- Observe all the instructions and safety regulations related to PVS connection.
High voltage is present inside the device!
- Follow all the warning signs in the device.
- Respect all the safety instructions in this manual and other documents.

The ground cable must be grounded properly, otherwise,
- lethal electric shock happens to the operator or installer once a fault occurs.
- device may be damaged after lightening stroke.

Incorrect cable connection may cause damages to the PV cells, the PVS and inverter. Respect the following instructions during cable connection:
- Connect by strictly following the circuit diagram;
- Measure and make sure the string open-circuit voltage meets the requirements of the PVS before inserting the fuse;
- Identify the positive pole and negative pole before connection.

Only qualified personnel or professional electrician can perform the operation and wiring described in this manual.
- All operations and wirings must in full accordance with the national and local standards and requirements.
- All warning marks and labels must be clear and intact. Replace them if any damages are found.
**WARNING**

Make sure the terminals are firmly connected during wiring. If the cable copper core and the terminals are not connected firmly, terminals will be over-heating and burnt. Anti-flaming cables with multi-strand are advisable and the cable cross-sectional area should be no less than the recommended value.

The nuts of the water-proof terminals must be firmly screwed to prevent water leakage and PVS damages.

**WARNING**

Pull the fuse out of the fuse holder for personal and device safety.

- Do not touch the fuse with bare hands.
- Do not bring any metallic materials during fuse replacement.

Replace only one fuse at one time. Once the one fuse is replaced, check to make sure the new one is installed firmly and then replace the next one.

**WARNING**

When checking or replacing the fuse, the under load operation is forbidden. The installing and removing of the fuses can be done only when there is no load to prevent possible arc flash which may damage the device and cause injury.

**NOTICE**

Lock the cabinet door and seal the water-proof cover of the lock core after operation.

No not open the cabinet door frequently.

**NOTICE**

Touching or improper operation on the PCB or other sensitive components may damage the device.

Do not touch any parts inside the cabinet other than the connection terminals.

Respect all ESD related safety regulations and wear antistatic wrist strap.
3 Product Description

3.1 System introduction

For a large-scale grid-connected PV system, it is widespread to install a DC combining device between PV modules and inverters to minimize cable connections, facilitate maintenance and enhance reliability.

Our SunBox PVS combiner box series (PVS) are designed for meeting these requirements, which provides a turnkey solution for PV plant systems.

Considering different types of PVS, a certain number of PV strings can be connected to the input side of PVS. After combining work done, at the output side, there will be one DC+ and one DC- main line. By using of surge protection device (SPD) and circuit breakers, the output can be connected to inverters directly.

The PV generation system including a PVS is shown in following figure.

![Fig. 3-1 Composition of PV generation system](image)

**Tab. 3-1 Device in above figure**

<table>
<thead>
<tr>
<th>No.</th>
<th>Device</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>PV arrays</td>
</tr>
<tr>
<td>B</td>
<td>PVS-16M-HV PV array combiner box</td>
</tr>
<tr>
<td>C</td>
<td>Inverter</td>
</tr>
<tr>
<td>D</td>
<td>Data acquisition device</td>
</tr>
<tr>
<td>E</td>
<td>Environment monitoring device</td>
</tr>
<tr>
<td>F</td>
<td>Grid</td>
</tr>
</tbody>
</table>
For PVS-8M-HV, up to 8 PV strings can be connected to the input side. And for PVS-16M-HV, up to 16 PV strings can be connected to the input side.

PVS has the following features:

- Meet outdoor installation requirement
- Connect to multiple PV inputs with fuse for each input (can be replaced to other degree)
- PV-specific high voltage SPD equipped, lightening protection function for positive and negative pole
- Current sensor inside to monitor the current of each string; the monitored information can be displayed by the LED or sent by RS485
- Monitor busbar voltage and the monitored information can be displayed by the LED and sent by RS485

3.2 Demonstration of the type

Type of the PVS is illustrated below:

```
PVS - XX - M - HV
   A      B      C      D
```

- A: Device name
- B: Max. input number of PV strings
- C: Possess the function of monitoring
- D: High voltage at 1500Vdc.
3.3 Identifying the PVS

The appearance of the PVS is shown in the figure below (take PVS-16M-HV for example).

![Fig. 3-2 Appearance of PVS-16M-HV](image)

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Lockhole</td>
<td>-</td>
</tr>
<tr>
<td>B</td>
<td>Fixing hanger</td>
<td>Allow fixing of the PVS</td>
</tr>
<tr>
<td>C</td>
<td>Handle</td>
<td>Used to move the PVS</td>
</tr>
</tbody>
</table>

3.4 Fuse rating

In power system, fuses are used for over-current protection. Choosing right-rating fuses is very important to ensure safety operation.

The minimum current rating of a fuse can be calculated with short circuit current (Isc) of PV arrays. Except for some special needs, the recommended rating would be 1.5×Isc.

Users can calculate fuse rating easily. If maximum current of PV arrays=9A, and DC voltage range of PV arrays=500 - 1500V, then the fuse rating will be 1500V/(15A).

3.5 DC switch rating

The DC voltage of the switch is decided by the nameplate. For example, from the nameplate it can be seen that the maximum DC voltage of the PV array is 1500V, i.e. DC switch's withstanding-voltage is at least 1500V. DC switch this product is equipped meets the required withstanding-voltage degree.
4 Installation Guide

4.1 Checking before installation

The delivery content of the PVS is shown below:

- PV array combiner box
- User Manual
- Warranty card
- Certificate card
- Test report

Check the completeness of the delivery according to the package list inside the crate.

4.2 Installation Tools

- Electric drill
- Hex wrench
- Bolt (M10×30, 4 PCS)
- M8 Allen wrench for tightening of output terminal
- Screwdriver with withstanding voltage of 1500Vdc:
  - Recommended model: 65-416-1
  - Specification: 2#x125
4.3 Mechanical installation

4.3.1 Dimensions

The dimensions of the PVS are shown in the figure below (take PVS-16M-HV for example).

![Dimensions Diagram]

- Pictures in this manual are indicative only! The real product you receive may differ.

4.3.2 Installation site requirements

With IP65 protection degree, the PVS can be installed outdoors. Please meet the following requirements:

- Dimensions and weight of PVS should be considered sufficiently.
- Ambient temperature -40°C~+60°C; Relative humidity 0~95%
- Installation site should be as close as possible to PV arrays for minimum cables and wires usage.
- Installation site should be safe venting.
- Never install the device in direct sunlight to guarantee optimal performance.
- For big PV plants, it is suggested that the device is installed on the back side of PV arrays.
- For better heat dissipation and convenient maintenance, enough space must be maintained around the PVS.
• For large-scale PV plant, install the PVS on the back of the PV cell installation bracket

NOTICE
Humidity during installation may damage the PVS. Do not install the PVS during rainy or humidity days.

Screw the water-proof terminals tightly to prevent moisture penetration no matter the installation is vertically or horizontally. Seal the unused terminals after cable connection.

NOTICE
PVS is equipped with plastic buckle on the cabinet before delivery. The plastic buckle is functioned as a buffer to prevent the sealing strip from scratches and damages.

Before installing the PVS, please proceed as follows to remove the plastic buckle (Take nylon terminal for example).

If this plastic buckle is missing during transport, the normal function of the PVS is not affected.
4.3.3 Installation Method

Connect the PVS to the installation surface by the hangers on the four corners of the PVS. The dimensions of the hangers are shown in the figure below.

PVS has two installation methods: vertical installation and horizontal installation.

Solution 1: Horizontal installation

Horizontal installation is applied to distributed PV plant and on rooftop.

**Step 1** Measure the distances of the hangers of the PVS and mark positions on the installation surface.

**Step 2** Fix the PVS to the surface according to the sequence of bolt, flat washer, spring washer, PVS hangers, support, and nut. Torque: 18N.m.

Solution 2: Vertical installation

Vertical installation is applied to PV ground plant. PVS is installed in the shadow place of the PV cells. Wall mounted or column mounted method can be adopted. Install PVS upside down is strictly forbidden.

- Wall-mounted: fix PVS to the PV array's installation frame through the mounting holes of the PVS by 4 M10×30 bolts
- Column-mounted: use hold hoop and steel angle as fixture to fix to the support column. fix PVS to the steel angle through the mounting holes of the PVS by 4 M10×30 bolts
Installation steps:

**Step 3** Measure the distances of the hangers of the PVS.

**Step 4** Mark positions according to the distances measured on the installation surface and then drill holes.

**Step 5** Fix the PVS to the surface according to the sequence of bolt, flat washer, spring washer, PVS hangers, support, and nut. Torque: 18N.m.
Column-mounted steps:

**Step 6** Mark position and drill holes on the frame according to the distance of the hangers on the four corners of the PVS.

**Step 7** Fix the PVS to the surface according to the sequence of bolt, spring washer, flat washer, PVS hangers, support, and nut. Torque: 18N.m.

**Step 8** Check to ensure PVS is installed correctly and securely.
4.4 Electrical installation

4.4.1 Internal structure

The internal structure of the PVS is shown below

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>DC- fuse cartridge</td>
</tr>
<tr>
<td>B</td>
<td>DC+ fuse cartridge</td>
</tr>
<tr>
<td>C</td>
<td>RS485 ports</td>
</tr>
<tr>
<td>D</td>
<td>Grounding terminal</td>
</tr>
<tr>
<td>E</td>
<td>Output of DC positive pole</td>
</tr>
<tr>
<td>F</td>
<td>Output of DC negative pole</td>
</tr>
<tr>
<td>G</td>
<td>DC switch</td>
</tr>
<tr>
<td>H</td>
<td>Switching power supply board and over current protection board</td>
</tr>
<tr>
<td>I</td>
<td>SPD</td>
</tr>
<tr>
<td>J</td>
<td>Push switch (switch between current and communication parameter)</td>
</tr>
<tr>
<td>K</td>
<td>LED display (can display current, baud rate and communication address)</td>
</tr>
<tr>
<td>L</td>
<td>Dip switch (setting communication address)</td>
</tr>
<tr>
<td>M</td>
<td>Setting switch (to set the communication protocol and the actual input numbers)</td>
</tr>
</tbody>
</table>
At most 8 PV strings can be connected to the PVS-8M-HV and at most 16 PV strings can be connected to the PVS-16M-HV. If the actual PV string numbers are less than the nominal numbers, the terminals can be left unconnected. Seal the unconnected terminals with waterproof plug.

A PV special fuse is set for each string as the upstream protection device of the whole PV power generation system. Measure the voltage between the positive and negative polarity of each input before inserting the PVS fuse to make sure the voltage is within the range of 0 – 1500Vdc. Make sure no PV module string is connected reversely.

The monitoring board monitors the current of each string. The monitored current value is sent to the PC through RS485. The PC can judge if a fault is occurred to the module through the set value.

A SPD is quipped inside the PVS to prevent the transient overvoltage caused by lightning. The SPD failure signal can be sent to the PC through the RS485.

It must be grounded properly for overvoltage protection. The PVS provides a ground terminal for equipotential connection.

### NOTICE

The PVS will stop operation and the PVS internal monitoring unit will also stop operation at night or when the sunlight is insufficient and the PV cell therefore cannot reach the minimum power required by the PVS for normal operation.

#### 4.4.2 Water-proof terminals and wirings

Water-proof terminals of PVS are shown as followings.
### 4.4.3 Wiring preparations

#### Step 1 Open the door

<table>
<thead>
<tr>
<th>Step</th>
<th>Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>Insert key</td>
</tr>
<tr>
<td>(2)</td>
<td>Turn the key to vertical direction</td>
</tr>
<tr>
<td>(3)</td>
<td>Remove key</td>
</tr>
<tr>
<td>(4)</td>
<td>Pull down the metal buckle (“A” in above figure)</td>
</tr>
</tbody>
</table>

#### Step 2 Remove the protection cover.

#### Step 3 Turn the switch to “OFF” position.

#### Step 4 Remove fuse

![Fuse Cover Before and After](image)
4.4.4 Input wiring and connections

**DANGER**

High voltage is present inside the device!

- Follow all the warning signs in the device.
- Do not use ordinary ammeter to measure the DC voltage before cable connection. An ammeter with withstanding voltage of 1500V is recommended. Serious consequences may follow if otherwise.
- Respect all the safety instructions in this manual and other documents.

**WARNING**

Incorrect cable connection may cause damages to the PV cells, the PVS and inverter. Respect the following instructions during cable connection:

- Connect by strictly following the circuit diagram;
- Measure the positive and negative polarity of each string by ammeter with withstanding voltage no less than 1500V and make sure there is no reversed connection before cable connection.
- Measure and make sure the string open-circuit voltage meets the requirements of the PVS before inserting the fuse;
- Identify the positive pole and negative pole before connection.

**Step 1** Loosen the union nut of water-proof terminals.

**Step 2** Insert the “PV1+” cable through terminals of positive input area, and connect the cable to the “PV1+” terminal inside the device. Enough wire bending space should be ensured.
Select the terminal according to the cable specification. For example, LT160012 where 16 means that the cable specification is 16mm²; 12 means that the length of the crimping tube is 12mm.

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Cable (e.g. “PV1+”, “PV2+”… “PV1-”, “PV2-” etc.)</td>
</tr>
<tr>
<td>B</td>
<td>Conduit</td>
</tr>
</tbody>
</table>

**Tab. 4-1 Stripping length**

<table>
<thead>
<tr>
<th>Cross-section</th>
<th>Terminal type</th>
<th>Stripped length (mm)</th>
<th>Force (N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.5mm²</td>
<td>LT025008</td>
<td>10±0.5</td>
<td>200</td>
</tr>
<tr>
<td>4mm²</td>
<td>LT040010</td>
<td>12±0.5</td>
<td>270</td>
</tr>
<tr>
<td>6mm²</td>
<td>LT060012</td>
<td>15±0.5</td>
<td>450</td>
</tr>
<tr>
<td>10mm²</td>
<td>LT100012</td>
<td>15±0.5</td>
<td>500</td>
</tr>
<tr>
<td>16mm²</td>
<td>LT160012</td>
<td>16±0.5</td>
<td>1500</td>
</tr>
</tbody>
</table>

**Step 3** Crimp the cable. Insert the stripped cable into the terminal. Crimp the cable using special tool (mouth of the crimping plier should match the cable cross section), see the following figure.

**Step 4** As shown in the following figure, connect the terminal to the corresponding terminal of the PVS.
Step 5 Follow the same procedure to connect rest cables. Comb all the input cables together with cable ties and firm them onto the cable support bar. Appropriate cable bending space shall be ensured.

4.4.5 Output wiring and connections

NOTICE
The copper cable is recommended for the PVS output terminal. If an aluminum cable is selected, a copper aluminum terminal must be used and the specification of the aluminum cable should meet the local technical requirements.

Lift the protective cover upwards. Then loosen the nut from water-proof terminals.

Step 1 Insert the “DC+” cable through “DC Output (+)” terminal. Enough cable bending space should be ensured.

Step 2 Strip off both protective and insulating layers with the help of a hand crimping pliers. The length of cable conductor shall be approx. 25mm.

Step 3 Connect the cable to the proper DT terminal. The cable specification is specified in 8.1 Technical Data.
Step 4 Install the DT terminal according to the following steps.

- Use hexagon spanner to remove the nut;
- Insert DT terminal into the output terminal;
- Use hexagon spanner to tighten the nut.

Step 5 Screw the bolt of the water-proof terminal tight clockwise.

Step 6 Connect cable “DC-” to “DC Output (-)” following the procedures above. Output wiring and connections have been finished.

4.4.6 Ground Connection

**WARNING**

Make sure that the nuts have been screwed into place. If the cable copper core has not been connected firmly to the terminal, the terminal may be burnt after long-time work. Stranded flame-retarded copper core cable shall be used, and its size shall be no less than the recommended value specified in the Appendix.

Nuts of the water-proof terminals must be screwed correctly and firmly. Otherwise, water leakage can damage the PVS.

**WARNING**

Ground cables shall be connected correctly and firmly. Otherwise:

- The electric shock caused by a malfunction can lead to lethal damage.
- The device can be damaged when lightning.
Relevant standards must be followed.

- Ground cables must be connected firmly with both device and ground terminals.
- Ground resistance shall be measured after finishing ground connections, and the measured values should be less than 1Ω.

**Step 1** Loosen the “\(\equiv\)” water-proof terminals of the PVS.

**Step 2** Lead the green-yellow wire through the “\(\equiv\)” water-proof terminal and to the PVS inner cable connection area. Enough wire bending space should be ensured.

**Step 3** Strip off both the protection and insulation layers with the stripped length of approx. 15mm.

**Step 4** Crimp the Euro type tubular terminal following the Step 3 to Step 5 in 4.4.4 Input wiring and connections.

**Step 5** Loosen the tightening bolt of “\(\equiv\)” terminal with the help of a screwdriver.

**Step 6** Insert the wire to the cable connection terminal and screw the tightening bolt with a screwdriver.

**Step 7** Tighten the water-proof terminal clockwise.

### 4.4.7 Communication Connections

Refer to the figure below for communication terminals inside the PVS.

Upper layer connects to input and lower terminal connects to output. User may adjust according to real need.

**Step 1** Unscrew the water-proof terminals “Monitor Input” and “Monitor Output”.

**Step 2** Pull the communication cable inside the PVS through the water-proof terminals.

**Step 3** Strip off the cables’ protection layer and the insulation layer until the copper core is 8mm outside.

**Step 4** Insert the screwdriver inside the input cable terminal holes. Pull the screwdriver until the leaf spring is bounced completely.
Step 5 Insert wires into bottom of wiring holes A1, B1, and FG. Among them:
- Connect communication cable RS485-A to A1;
- Connect communication cable RS485-B to B1;
- Connect communication cable shielding layer to terminal FG.

Step 6 Loosen the screwdriver to let the leaf spring connect to the cable.

Step 7 Follow the same steps to connect the output cables to the A2, B2, and FG to finish the communication terminal connection.

**NOTICE**

Communication cable must be shielded twisted pair cable. Communication unstable or communication failure may follow if otherwise.

Communication cable should be far away from the high voltage cable. Place the communication cables and power cables in parallel or strap them together is strictly forbidden. Communication interface or device damage if otherwise. If not prevented, lead the communication cable through galvanized tube for shielding.
4.4.8 Communication solution

The communication method of PVS is shown below:

- Connect A1 and B1 of first PVS to A1 and B1 of data collector;
- Connect A2 and B2 of first PVS to A1 and B1 of second PVS;
- Connect A2 and B2 of second PVS to A1 and B1 of third PVS;
- And so forth: connect A2 and B2 of previous PVS to A1 and B1 of next PVS;

**NOTICE**

If the PVS is equipped with optional PV internal power supply, monitor can work normally when the PV voltage meet the switch power supply’s nominal work power supply range.

4.4.9 Bottom wirings

The bottom wirings are described in following figure.
4.4.10 Cable Layout

Lay the cables connected the PVS and external devices in the cable trench for easy installation and maintenance. Cable trenches are designed and constructed in accordance to related regulations and the number & dimensions of the devices.

Lay the PVS positive and negative pole output cables, communication cables in different layer of the support arm in the cable trench to avoid short circuit caused by cable insulation layer cracks. See the following picture; user can design the number of supporting arms as per reality.

![Fig. 4-1 Cable trenches](image)

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Cable trench</td>
</tr>
<tr>
<td>B</td>
<td>Positive output cable supporting arm</td>
</tr>
<tr>
<td>C</td>
<td>Negative output cable supporting arm</td>
</tr>
<tr>
<td>D</td>
<td>Communication cable support arm</td>
</tr>
</tbody>
</table>

Note: pictures here is indicative only, user can make adjustment according to real needs.

4.4.11 Communication settings

The communication parameters of the PVS can be set and viewed on the monitoring unit as shown below.
<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>Function</th>
</tr>
</thead>
</table>
| A   | Protocol switch   | Used to switch protocols. The first place switches protocols:  
|     |                   | • “ON” for Modbus protocol;  
|     |                   | • “OFF” for Sungrow protocol  
|     |                   | The second place is used to set the branch connection status.                                                                           |
| B   | Dip switch        | This switch adopts binary code from right to left, i.e. bits 0-7 of binary address code. For setting method, refer to “Tab 4-2”.             |
| C   | LED               | Used to display relevant electrical and communication parameters of PVS. For particular parameter inquiry method, refer to “Tab 4-1”.         |
| D   | Key switch K1, K2 | Press the key switch K1 to display string or the PVS present voltage and current by the first two digits of the LED. For method of operation, refer to “Tab 4-1”.
|     |                   | Press the key switch K2 to display the PVS communication address, baud rate, and internal temperature on the LED. For method of operation, refer to “Tab 4-1”. |
Tab. 4-1 Description of the function of inquiry by push switch (taking 16 lines as an example)

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
</table>
| **Voltage and current display** | ![Display voltage: 700V](image)  
  ![](image)  
  1st current: 10A  
  2nd current: 10A  
  24th current: 10A  
  Note: the LED display can be divided into the first two digits and last three digits. The first two digits is used to display the Nth input of the PVS; the last three digits are used to display the current of this input.  
  For example: 0110.0 means that the current of the 1st input is 10A.  
  But when the first two digits are 00, the last three digits are the voltage. For example: 00700 means that the present voltage is 700V. |
| **Communication display**    | ![Communication address](image)  
  Communication address: A0 007  
  Baud rate: 9600  
  Press K2 to turn screen once |
| **Ambient temperature display** | ![Ambient temperature](image)  
  Ambient temperature: C0 16.8  
  Press K2 to turn screen twice |

Tab. 4-2 Address-setting examples:

<table>
<thead>
<tr>
<th>Dip-switch settings</th>
<th>Binary address</th>
<th>Decimal address</th>
</tr>
</thead>
</table>
| ![Dip-switch settings ON](image)  
  1 2 3 4 5 6 7 8 | 0000 0001 | 1  
  \( (1 \times 2^0 = 1) \) |
| ![Dip-switch settings ON](image)  
  1 2 3 4 5 6 7 8 | 0000 0010 | 2  
  \( (1 \times 2^1 + 0 \times 2^0 = 2) \) |
| ![Dip-switch settings ON](image)  
  1 2 3 4 5 6 7 8 | 0000 0011 | 3  
  \( (1 \times 2^1 + 1 \times 2^0 = 3) \) |
Dip-switch settings | Binary address | Decimal address |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>ON</td>
<td>1111 0111</td>
<td>247 (1×2^7+1×2^6+1×2^5+1×2^4+0×2^3+1×2^2+1×2^1+1×2^0=247)</td>
</tr>
<tr>
<td>ON</td>
<td>If the code is: 1111 1000 1111 1001</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>...... 1111 1111 or 0000 0000, it is deemed 0000 0001</td>
<td></td>
</tr>
</tbody>
</table>

**Setting string input number**

The standard types of Sungrow PVS are:

- PVS-8M-HV
- PVS-12M-HV
- PVS-16M-HV

If the strings input are 8, 12 or 16, there is no need to set any parameter.

- This section introduces the communication setting method of the PVS when the string inputs are 15 (the product user received is PVS-16M-HV).

If the real strings input do not correspond to the abovementioned input number, set the parameters according to the following steps to ensure the normal communication of the PVS.

After power on, the monitoring board on the top left of the PVS internal works normally.

**Step 1** Set the protocol switch 2 to the ON position. If the last three digits of the LED are “P=0” or “P=1”, the PVS is in the setting state as shown below.

![Protocol switch 2 in ON position](image)

**Step 2** Press the key switch A1 to select the input string number, for example 15.

**Step 3** Press the key switch A2 and turn the last digit of the LED to “0”, i.e. “No
Take PVS with 15 inputs for example, the 16th input needs to be set to “No input”. The LED is shown as below.

Step 4 After setting, turn the protocol switch 2 to save the settings.

### 4.5 Start/Stop of operation

PVS runs automatically when power on and stop when power off. User can control the DC output of the PVS manually through the PVS internal DC switch
5 Commissioning

Check if the PVS can operate normally after installation:

**Step 1** Connect the connection terminal of each PV string.

**Step 2** Measure the input voltage of positive pole and negative pole of each input to make sure they are basically same and the positive pole and negative pole are connected correctly.

**Step 3** Fasten the fuse holder.

**Step 4** Close circuit breaker; D6 monitoring unit power indicator “PWR” lights up and “CPU” indicator flashes. When push switch is pressed, if there is a value on the LED digitron, the operation is normal.

**Step 5** Lock the door, remove the key.
6 Routine Maintenance

Due to ambient temperature, relative humidity, windblown dust and vibrations, components of PVS will get aging. It is necessary to do the routine maintenance work periodically on the device.

**WARNING**

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

**NOTICE**

After the maintenance work finished, be sure not to leave screws, washers and the like in the PVS. The device can be damaged!

Only work on the PVS when it is switched off and voltage free.

6.1 Replace the Fuse

**WARNING**

Once the fuse is blown, the damage is irrecoverable. Replace the fuse by qualified operators in time. Replace the fuse with new one with the same model and the same grade.

**WARNING**

Tighten the fuse cover after replacing the fuse.
6.2 Replace the sealing strip

The sealing strip inside the PVS is located in the PVS internal door cover, as shown by A in the figure below. It is advisable to check this sealing strip once every month. If it is damaged by non-human factors, please contact Sungrow immediately to replace the PVS door cover.
This chapter gives the basic troubleshooting methods for customer as a reference.

### 7.1 Before troubleshooting

Please notice the following items before troubleshooting:

- Disconnect the DC switch before operation.
- Please do not touch the bare metal parts of the copper bar under the protection plate.
- Pull the fuse holder for maintenance of the combining busbar and to disconnect the input cable.

**WARNING**

- High voltage still exists after DC breaker is switched off.
- The fuse holders are still live after fuses are removed.

### 7.2 Common faults and troubleshooting

<table>
<thead>
<tr>
<th>Fault</th>
<th>Possible cause</th>
<th>Method of correction</th>
</tr>
</thead>
<tbody>
<tr>
<td>RS485 communication fault</td>
<td>Monitoring power board is fault</td>
<td>Check if fuse inside the monitor power board is broken. Replace the fuse if necessary.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• If the fuse is normal, replace the switch power pack.</td>
</tr>
<tr>
<td>Communication cable interference</td>
<td>Twisted pair shielded cable shall be used, with shielding layer grounded. Install a 120Ω resistor between communication terminals A2 and B2 of the last combiner box. Refer to “4.4.7 Communication Connections”.</td>
<td></td>
</tr>
<tr>
<td>Fault</td>
<td>Possible cause</td>
<td>Method of correction</td>
</tr>
<tr>
<td>-------</td>
<td>---------------</td>
<td>---------------------</td>
</tr>
<tr>
<td>When data logger device or monitor software is working, the D1 LED is off; inquire address and the address of this PVS is the same, D8 is off</td>
<td>RS485 communication fault</td>
<td>Check communication line. Refer to “4.4.11 Communication settings”.</td>
</tr>
<tr>
<td>D6 LED on monitor board is off</td>
<td>No 5V output on switching power supply board</td>
<td>Check voltage on monitoring unit +5V plug, which shall be about 5V; otherwise switching power supply board is faulty and please contact us for repair.</td>
</tr>
<tr>
<td></td>
<td>Faulty CPU board</td>
<td>Contact us for replacement of the monitoring unit</td>
</tr>
<tr>
<td>On the monitoring unit, indicator “SPD” lights up.</td>
<td>Failure of surge protection device</td>
<td>Replace surge protection device in time</td>
</tr>
<tr>
<td>Current of a branch apparently smaller or larger than current of other branches</td>
<td>Abnormal current</td>
<td>• Check size of PV strings of this branch for consistency. • Check if this branch has shaded PV string.</td>
</tr>
<tr>
<td>Display of open circuit fault of a branch</td>
<td>No PV string connected to this branch</td>
<td>Be referencing section “4.4.11 Communication settings”, set this branch to unconnected status.</td>
</tr>
<tr>
<td></td>
<td>Dropped out cable or molten fuse</td>
<td>Check PV cables for disconnection. Or, replace fuse.</td>
</tr>
</tbody>
</table>
The following figure illustrates terminals and layouts of metering board.

If you have any doubt during use of this product, please feel free to contact us.

E-mail: service@sungrowpower.com

For contact, please provide the following information so that we can provide you with help and service more quickly:

- PVS model
- PVS serial number
- Brief description of fault information
## 8 Appendix

### 8.1 Technical data

<table>
<thead>
<tr>
<th>Types</th>
<th>PVS-8M-HV</th>
<th>PVS-12M-HV</th>
<th>PVS-16M-HV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. string number</td>
<td>8</td>
<td>12</td>
<td>16</td>
</tr>
<tr>
<td>Nominal output current</td>
<td>80A</td>
<td>120A</td>
<td>160A</td>
</tr>
<tr>
<td>Nominal system working voltage</td>
<td>1500Vdc</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Working voltage range of the module</td>
<td>500Vdc~1500Vdc</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Max. detection current of the branch</td>
<td>15A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Communication method</td>
<td>RS485</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power consumption of the monitoring module</td>
<td>2.5W</td>
<td>3W</td>
<td></td>
</tr>
<tr>
<td>Enclosure protection rating</td>
<td>IP65</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ambient temperature range</td>
<td>-40℃~+60℃</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relative humidity</td>
<td>0~95%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight approx.</td>
<td>36kg</td>
<td>38kg</td>
<td></td>
</tr>
<tr>
<td>Dimensions (W×D×H) (mm)</td>
<td>650 × 580 × 180</td>
<td>850×620×184</td>
<td></td>
</tr>
</tbody>
</table>

**Optional function**

- String monitoring: Yes
- Load switch working state monitoring: Yes
- Communication interface: RS485

### 8.2 Cable Requirement

<table>
<thead>
<tr>
<th>Types</th>
<th>PVS-8M-HV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input cable</td>
<td>Type : 4~6mm² Stranded flame-retarded copper wire</td>
</tr>
<tr>
<td></td>
<td>Stripped length:10mm</td>
</tr>
<tr>
<td></td>
<td>Bolt:M4</td>
</tr>
<tr>
<td></td>
<td>Tightening torque: 1.5N.m</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Types</th>
<th>PVS-12M-HV</th>
<th>PVS-16M-HV</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note:**
- All specifications are subject to change without notice. For the latest information, please refer to the official Sungrow website or contact the local sales representative.
### Types and Specifications

<table>
<thead>
<tr>
<th>Types</th>
<th>PVS-8M-HV</th>
<th>PVS-12M-HV /PVS-16M-HV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output cable</td>
<td>Type: 50mm$^2$ Stranded flame-retarded copper wire</td>
<td>Type: 70mm$^2$/95mm$^2$ Stranded flame-retarded copper wire</td>
</tr>
<tr>
<td></td>
<td>Stripped length: 25mm, Bolt: M10, Tightening torque: 20N.m</td>
<td>Stripped length: 25mm, Bolt: M10, Tightening torque: 20N.m</td>
</tr>
</tbody>
</table>

### Notice:

The withstanding voltage of the input and output cable must be 1500Vdc.

The copper cable is recommended for the PVS output terminal. If an aluminum cable is selected, a copper aluminum terminal must be used and the specification of the aluminum cable should meet the local technical requirements.

<table>
<thead>
<tr>
<th>Communication cable</th>
<th>Type: 2×1.5(4×1.5)mm$^2$ Four core STP with low resistance</th>
<th>Stripped length: 7mm, Bolt: M3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grounding terminals</td>
<td>Type: 16mm$^2$ Stranded flame-retarded copper wire</td>
<td>Stripped length: 15mm, Bolt: M6, Tightening torque: 4N.m</td>
</tr>
</tbody>
</table>

### 8.3 Quality Assurance

Where any fault occurs during the warranty period, Sungrow will maintain or replace the product for free.

#### Evidence

Sungrow Power Supply Co., Ltd. needs the users to provide the receipt invoice and the date you purchase. Meanwhile the trademark should be clearly legible. Otherwise Sungrow Power Supply Co., Ltd. has the right to exclude liability claims.

#### Conditions

- The original unqualified product should return to Sungrow.
- Users should permit appropriate time to maintenance the device with fault for Sungrow.

#### Exclusion of liability

Guarantee or liability claims for damages of any kind are excluded if they are caused by one or more of the following:
• Improper, inappropriate use or installation of the product
• Installing or operating the product in an inappropriate environment
• Installing or operating the product when ignoring relevant safety regulations in the deployment location
• Ignoring safety warnings and instructions in all documents relevant to the product
• Installing or operating the product under incorrect safety or protection conditions
• Altering the product or supplied software without authorization
• The product malfunctions due to operating attached or neighboring devices beyond permissible limit values.
• In case of unforeseen calamity or accidents

Where fault is caused by any of the above and users have the relevant demand, Sungrow will do the paid maintenance work to the device after judgment.

| Specifications subject to change without notice. |

### 8.4 About Us

Should you have any question about this product, please contact us.

<table>
<thead>
<tr>
<th>Company</th>
<th>Sungrow Power Supply Co., Ltd.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Website</td>
<td><a href="http://www.sungrowpower.com">www.sungrowpower.com</a></td>
</tr>
<tr>
<td>Email</td>
<td><a href="mailto:info@sungrow.cn">info@sungrow.cn</a>, <a href="mailto:service@sungrow.cn">service@sungrow.cn</a></td>
</tr>
<tr>
<td>Address</td>
<td>No.1699 Xiuou Rd., New &amp; High Technology Industrial Development Zone, Hefei, P. R. China.</td>
</tr>
<tr>
<td>Zip</td>
<td>230088</td>
</tr>
<tr>
<td>Telephone</td>
<td>+86 551 6532 7834, +86 551 6532 7845</td>
</tr>
<tr>
<td>Fax</td>
<td>+86 551 6532 7856</td>
</tr>
</tbody>
</table>