452（英）

# APV series intelligent photovoltaic combiner box

# (DC1500V)

Installation and Operation Instruction V1.0

ACREL CO.,LTD

# DECLARATION



This company reserve power of revision of product specification described in this manual, without notice. Before ordering, please consult local anget for the latest specification of product.

# CONTENTS

Note: This manual is a comprehensive introduction to the APV series intelligent photovoltaic combiner box. Users should read it carefully before using it, and fully understand the functions of the device for correct and standardized operation.

# 1 Safety signs, instructions

## 1.1 In order to use the product better, please read the following symbols carefully

Warning：

Irregular operations may be dangerous to the safety of users; precautions or instructions that may cause major hardware damage；

## 1.2 Please read this manual carefully before installation and use

Warning:

All operation and line connection should be operated by professionals；

Warning：

Pay attention to personal and equipment safety during installation；

Warning：

Note the positive and negative polarities of the pv input and the positive and negative polarities of the total output；

Warning：

Installation and use should comply with the relevant national or local standards；

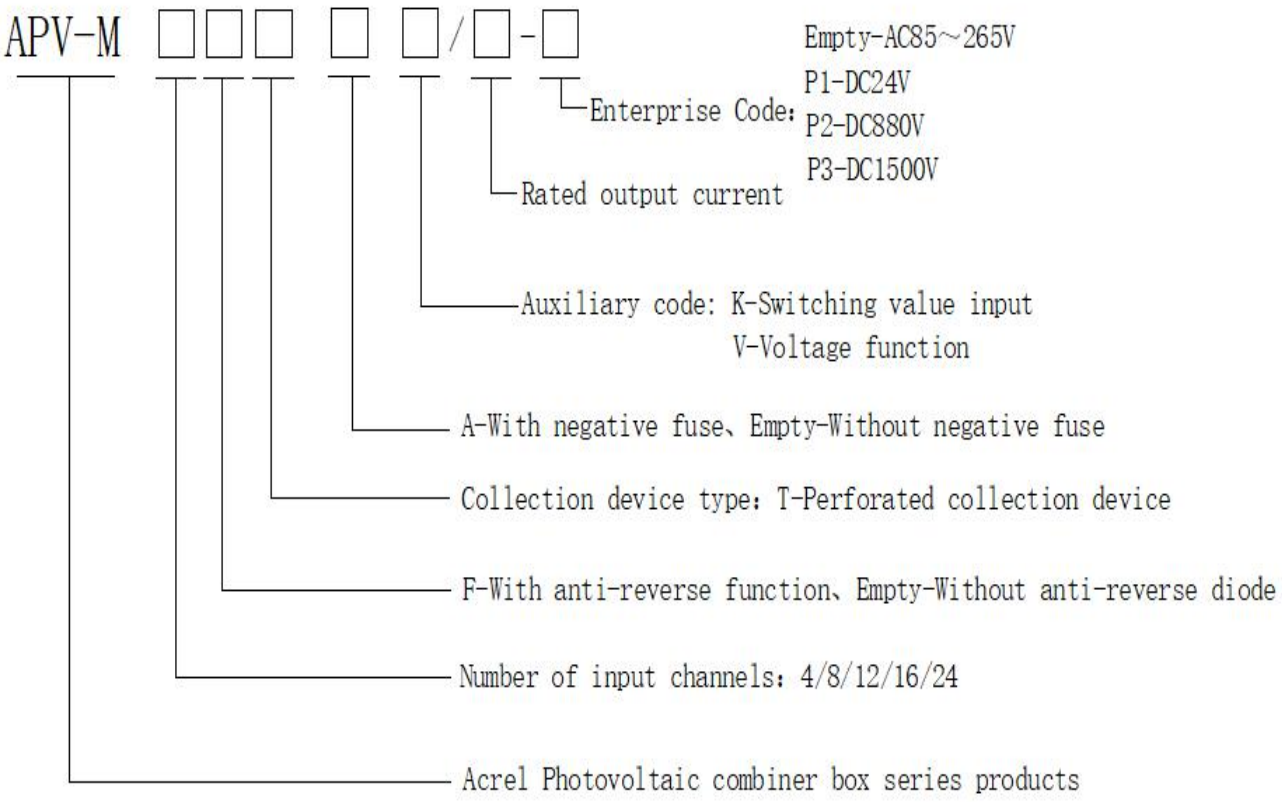
Warning：

The fuse is subjected to high voltage from the inverter and photovoltaic array, and it is strictly forbidden to touch the fuse during operation. Before checking and replacing the fuse, the DC circuit breaker must be disconnected, but note that all terminals of the DC fuse will still have high voltage at this time, and the fuse core of the same level as the original model must be replaced.

## 2 General

In a large-scale photovoltaic power generation system, a large number of photovoltaic cell components are required to be combined in series and parallel to achieve the required voltage and current value, so as to achieve the highest power generation efficiency. The main function of the APV series intelligent photovoltaic combiner box (DC1500V) is to perform first-level confluence on the input of the DC1500V voltage level photovoltaic cell array, which is used to reduce the connection between the photovoltaic cell array and the inverter, optimize the system structure, and improve reliability and reliability. Maintainability, APV series intelligent photovoltaic combiner box (DC1500V) can provide photovoltaic current measurement, monitor the operating status of photovoltaic cells in photovoltaic array, battery voltage, total bus power, branch power, bus power The device is equipped with RS485 interface as standard, which can upload the measured and collected power data and equipment status to the monitoring system.

## 3 Product Naming



## 4 Characteristics

- Meet the technical requirements of "GBT34936-2017" photovoltaic power station combiner box;
- The protection level is IP65, which meets indoor and outdoor installation requirements;
- Using Hall sensor, isolated measurement, maximum 24 inputs;
- Adopt photovoltaic special fuse, withstand voltage DC 1.5KV, fuse current can be selected;
- Optional voltage measurement function, the highest measurement voltage DC 1.5kV;
- With RS485 communication interface, using ModBus-RTU communication protocol;
- A variety of power supply methods (DC1000V, DC1500V) can be selected, suitable for household rooftop solar or professional photovoltaic power station applications;
- According to customer needs, it can be equipped with photovoltaic special DC circuit breakers, photovoltaic special DC fuses, lightning protectors and other components from well-known domestic and foreign brands such as ABB.

## 5 Technical Parameters

| Product model | APV-M4XX | APV-M8XX | APV-M16XX | APV-M24XX |
|---|---|---|---|---|
| Number of input channels | 4 channel | 8 channel | 16 channel | 24 channel |
| Input range | DC ±15A | | | |
| Rated operating voltage | DC1500V | | | |
| The reaction time | 1s | | | |
| Measurement accuracy | Photovoltaic cell measurement class 0.5 | | | |
| Communication | RS485/ModBus-RTU protocol,4800/9600/19200/38400bps | | | |
| Switch input | 3 sets of external state input (optical coupler or dry contact mode) | | | |

| | |
|---|---|
| Temperature /Humidity | Working temperature: -25~+60℃, humidity ≤95%, no condensation, no corrosive gas place |
| Altitude | ≤2000m |
| Insulation resistance | ≥100MΩ |
| Auxiliary power | DC1500V(±10%) |
| Enclosure protection level | IP65 |
| Weight | About 60kg (24 channel with anti-reverse) |
| Volume (W×H×D) | 950*750*200mm（24 channel） |

# 6 Basic structure

## 6.1 Outline dimension

The size of the 24 channel box of this product is 950mm×750mm×200mm(width×height×depth), and the specific installation size is 1000×495mm.

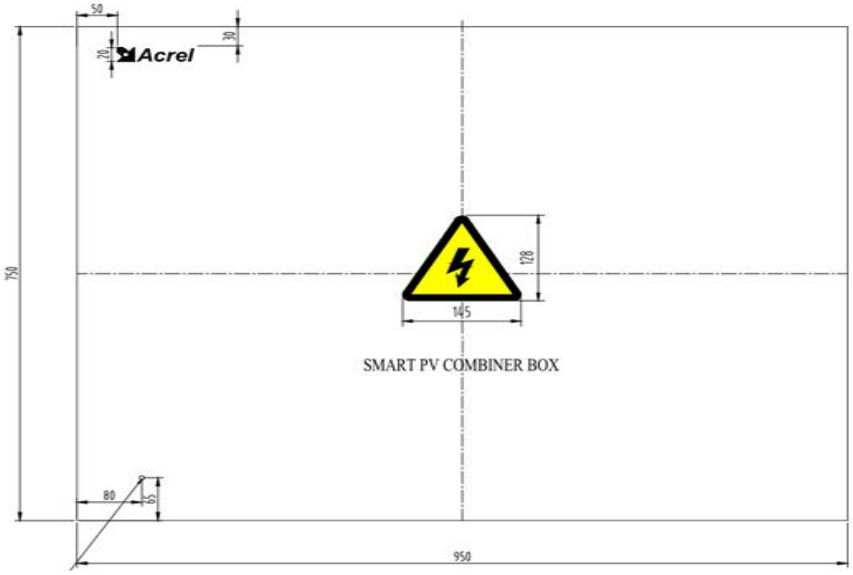



Figure 1 Box size (24 channels)

## 6.2 Perforation type PV combiner box

The combiner box adopts the perforated installation collector collecting device, and the typical structure is shown in Figure 3.

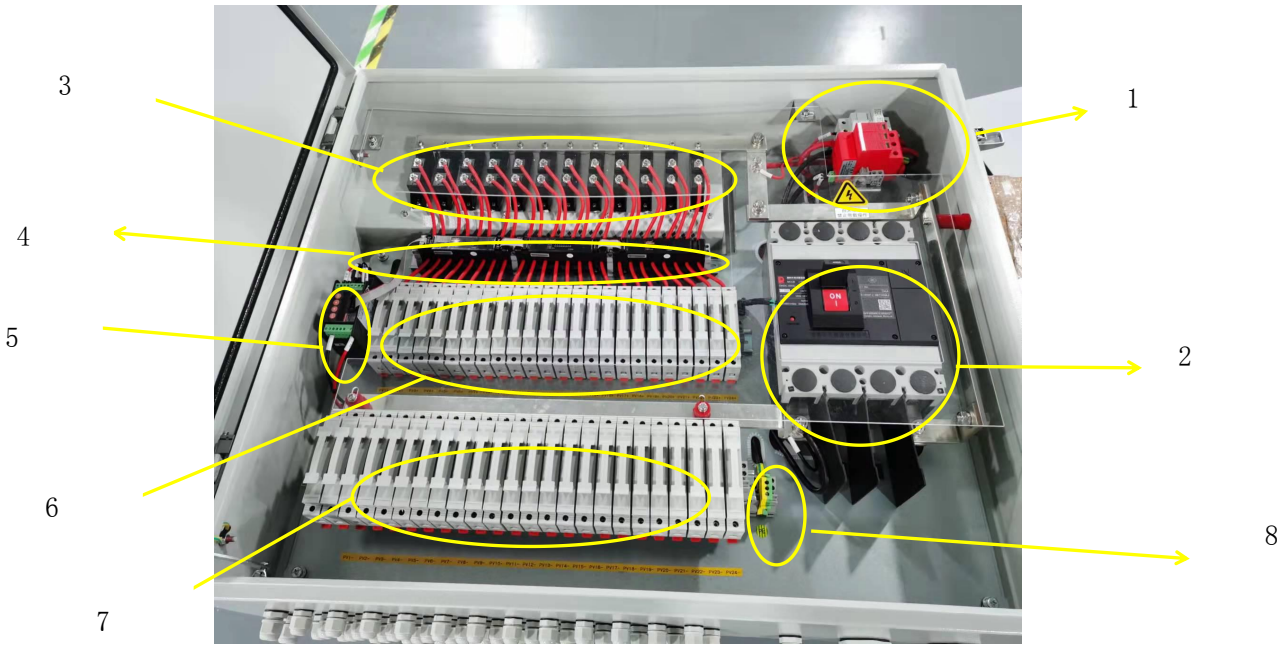


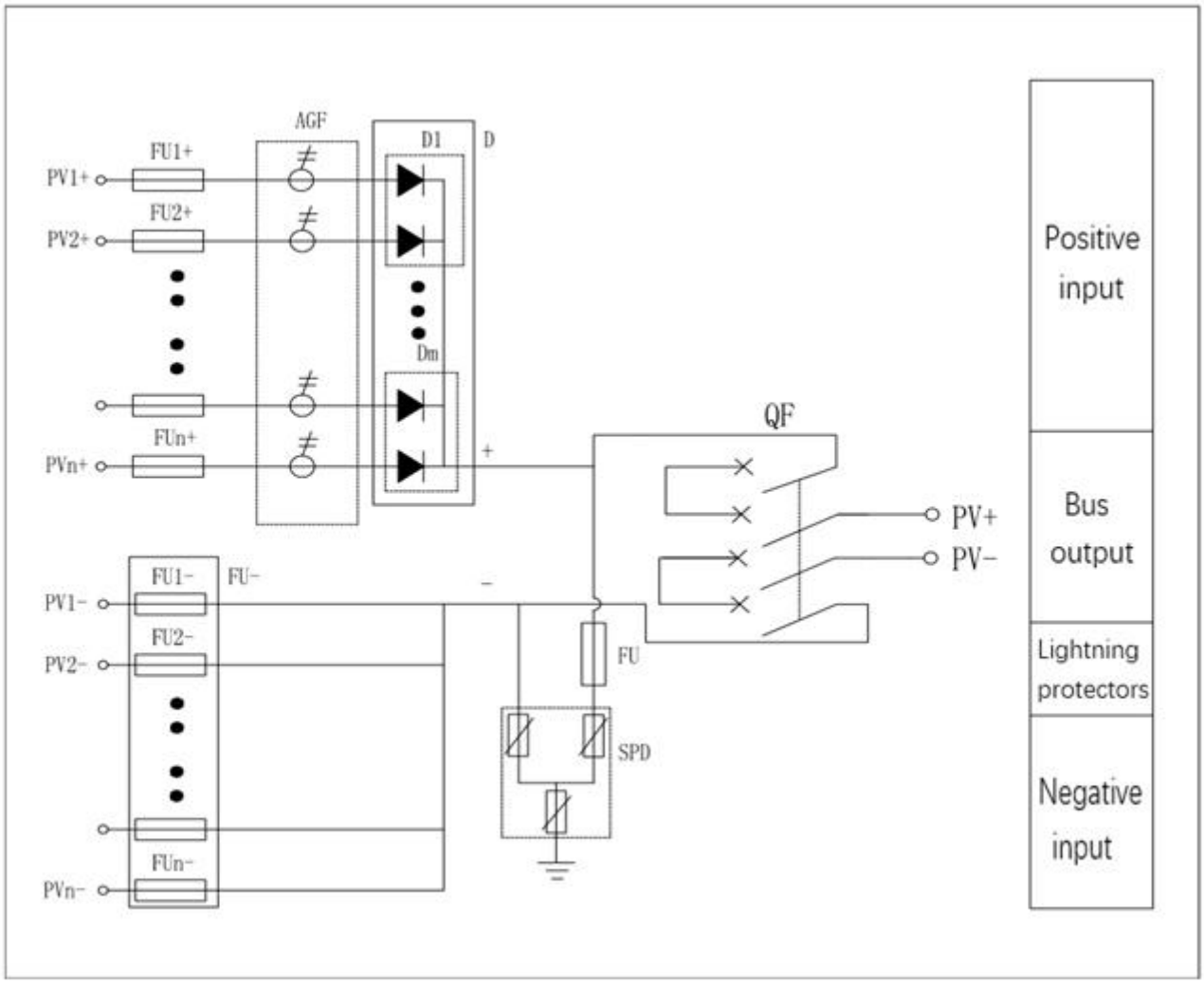

Figure 2 Internal physical map (perforated external radiator with anti-reverse function)

(Typical case, please refer to the actual product for details)

| Number | Part Name | Note |
|---|---|---|
| 1 | Lightning arrester | |
| 2 | DC circuit breaker | |
| 3 | Anti-reverse module (with radiator) | Optional function |
| 4 | Perforation type PV confluence acquisition device | |
| 5 | Power module | |
| 6 | Positive fuse fuse | |
| 7 | Negative fuse fuse core | |
| 8 | Ground terminal | |

# 7 Wiring Schematic

24 in 1 out intelligent photovoltaic combiner box circuit schematic




# 8 Installation and use

## 8.1 Unpacking and inspection

Check for transportation damage: Although we have monitored the product before it leaves the factory, it may be damaged during transportation, so please check it before installation.

If any damage is detected, please contact the transportation company or directly contact Ankerui Electric Co., Ltd. Please provide photos of the damage so that we can serve you faster and better. According to the packing list in the box, the inspection items are:

1. One intelligent photovoltaic combiner box: Whether the appearance of the product is damaged,

whether there are damaged parts, and whether the wiring is loose;

2. One key;

3. One certificate of conformity;

4. One product manual;

5. Factory inspection record one copy;

**8.2 Installation tools**

Installation tools include: Phillips screwdriver, torque wrench, Allen wrench, diagonal pliers, electric drill, wrench, wire stripper, etc.

**8.3 Installation Precautions**

8.3.1 The protection level of the combiner box meets the requirements for outdoor installation. However, the combiner box contains electronic equipment, so try not to place it in a humid place.

8.3.2 The cooling method of the combiner box is natural cooling. In order to ensure the normal operation and service life of the combiner box, try not to install it in an area with direct sunlight or high ambient temperature. Care should be taken during installation to prevent the coating of the box from scratching. Damage and wear will cause the box to rust.

8.3.3 Please make sure that the wall or column where the combiner box is installed has sufficient strength to bear its weight.

8.3.4 The combiner box installed outdoors shall not be unpacked in rainy and snowy days!

8.3.5 When installing wiring during the day, the photovoltaic modules should be covered with opaque materials first. Otherwise, in the sunlight, the photovoltaic modules will generate high voltage, which may lead to the danger of electric shock.

8.3.6 The waterproof terminals at each inlet and outlet hole of the box should be tightened and tightly plugged with fireproof mud.

8.3.7 The combiner box cannot be installed horizontally. It is recommended to use the vertical wall-mounted type: use expansion screws to fix it on the wall through the installation holes on the left and right sides of the combiner box.

### 8.4 incoming and outgoing wires specifications

The user can choose the appropriate cable for different waterproof terminals according to the table below (can be adjusted according to the actual cable size on the customer site).

| Wiring type | Waterproof Terminal Specifications | Cable outer diameter range（mm） |
|---|---|---|
| Ground wire | PG11-10G | 5.5-10 |
| Connection wire | PG11-10G | 5.5-10 |
| Power wire | PG11-10G | 5.5-10 |
| DC positive input | PG9 | 4.5-8 |
| DC negative input | PG9 | 4.5-8 |
| DC positive bus output | PG36-30G | 24-31 |
| DC negative bus output | PG36-30G | 24-31 |

## 8.5 Selection of copper conductors for external wire terminals

### 8.5.1 Cross-sectional area of copper conductors suitable for connection to external conductor terminals

| Rated current | Single or multi-core conductors | | Flexible wire | |
|---|---|---|---|---|
| | Cross-sectional area | | Cross-sectional area | |
| | Minimum | Maximum | Minimum | Maximum |
| A | mm² | | mm² | |
| 6 | 0.75 | 1.5 | 0.5 | 1.5 |
| 8 | 1 | 2.5 | 0.75 | 2.5 |
| 10 | 1 | 2.5 | 0.75 | 2.5 |
| 13 | 1 | 2.5 | 0.75 | 2.5 |
| 16 | 1.5 | 4 | 1 | 4 |
| 20 | 1.5 | 6 | 1 | 4 |
| 25 | 2.5 | 6 | 1.5 | 4 |
| 32 | 2.5 | 10 | 1.5 | 6 |
| 40 | 4 | 16 | 2.5 | 10 |

| | | | | |
|---|---|---|---|---|
| 63<br>80<br>100 | 6<br>10<br>16 | 25<br>35<br>50 | 6<br>10<br>16 | 16<br>25<br>35 |
| 125<br>160<br>200 | 25<br>35<br>50 | 70<br>95<br>120 | 25<br>35<br>50 | 50<br>70<br>95 |
| 250<br>315 | 70<br>95 | 150<br>240 | 70<br>95 | 120<br>185 |
| *Note:<br>1. All incoming and outgoing wires are copper wires.<br>2. Please make wiring according to the above current range. If the above range is exceeded, our company will not be responsible for any accidents caused. | | | | |

### 8.5.2 Before wiring: The circuit breaker is tripped and all fuse boxes must be pulled out.

**fusible core**

### 8.5.3 Wiring attention

- The cold press head needs to be matched to the size of the breaker fixing screws!
- Do not expose excess copper wire, wrap the heat shrinkable sleeve！

### 8.5.4 Input wiring steps

Note: Do not reverse the positive and negative cables.

Note: The output wire should be flattened first, then the length of the cable should be adjusted, and finally the screw at the output end should be tightened to avoid damage to the wiring caused by the flattening of the wire.

① Operation and wiring should only be performed by a professional electrical or mechanical engineer.

② All operations and wiring must comply with the relevant national and local standards.

③ When installing, please do not touch other parts inside the case except the terminals.

④ Before installing the combiner box, use a megohmmeter to test the insulation of its internal components.

⑤ The input and output cannot be reversed, otherwise the post-stage equipment may not work normally or even damage other equipment；

⑥ After the combiner box is connected to the photovoltaic power generation system according to the principle and installation wiring diagram, the grounding end of the combiner box should be reliably connected to the lightning protection ground wire or ground bar. Stranded copper core wire less than 16mm2. The grounding resistance value should not be greater than 4 ohms, otherwise, the grounding grid should be rectified to ensure the lightning protection effect.

⑦ When wiring externally, please ensure that the screws are fastened to prevent the loose wiring from causing local heating and burning. Make sure that the waterproof terminals are tightened, otherwise there is a risk of water leakage leading to failure of the combiner box.

⑧ The wiring requires the use of photovoltaic special cables, which should be neatly arranged and beautiful, and the installation should be firm. The connecting wires between the wires and the electrical appliances must be crimped and filled with tin, and the external thermoplastic tube should be fastened to ensure contact well.

⑨ The user needs to loosen the waterproof terminal when wiring, then connect the wire to the fuse crimp terminal, tighten the screw, fix the connection, and finally tighten the outer waterproof terminal.

The line connected to the combiner box, positive + (usually red line), negative - (usually black line), be sure to tighten the connected line.

Purpose: Distinguish the color wiring, on the one hand, it is conducive to self-inspection, and on the

other hand, it is conducive to the maintenance of the line in the future. All wire connections, make sure the screws are tightened to ensure the normal operation of the equipment.

⑩ The following must be done before closing the fuse box and before closing the circuit breaker：

Step 1：

**Use an insulation resistance meter to measure the insulation of each of the input PV lines and the output cable lines to ensure that the insulation resistance is at least 20 megohms.**

Purpose: To exclude the occurrence of uninsulation of the output and input wiring to ground.

Consequence: If any of the input and output lines are not insulated to ground, this will lead to a discharge to ground and cause damage to the busbar.

Step 2：

**The incoming open circuit voltage must be measured for each way of the incoming line.**

Purpose: To ensure that the open circuit voltage of each channel in the combiner box is equal before closing the fuse holder (the difference is ±10V), and the reverse connection of the positive and negative lines is excluded. Consequences:

•The consequence of the reverse connection of the positive and negative wires is that the fuse holder and the fuse will be quickly burned out；

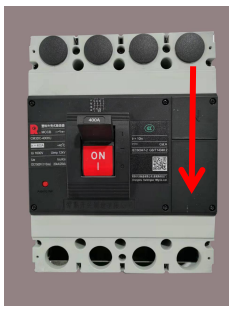
•The open circuit voltage of a certain circuit (several circuits) is zero, and the open circuit voltage of a certain circuit (several circuits) is more than 30V lower than that of the other circuits. In these two cases, when the fuse box is closed before the circuit breaker is closed, it will be generated between the positive and negative poles. Circulating current will generate heat at the fuse wiring. If not handled for a long time, the fuse base will be burned, causing irreversible damage to the equipment.

Step 3：

**The output line of the circuit breaker must be checked to eliminate equipment damage caused by reverse connection of positive and negative poles after confluence.**

### 8.5.5 Closing circuit breaker steps：

Step1:Push the handle down to make the circuit breaker in "OFF" state.





Step2:Push the circuit breaker handle up to make the circuit breaker in the "ON" state, which is the closed state.



### 8.6 Opening and closing the chassis

Chassis shape

Our photovoltaic converters are provided with keys to open and close the chassis. Note that both top and bottom locks must be opened and closed to effectively open and close the chassis.

## 8.7 Input Wiring

The positive photovoltaic bus input terminal is located on the lower side of the bottom of the casing, and the negative photovoltaic bus input terminal is located on the upper side of the bottom of the casing. The user needs to unscrew the waterproof terminal when wiring, and then connect the wire to the bus input terminal, tighten the screw, Secure the connection, and finally tighten the waterproof terminal on the outside (Figure 8-1).

## 8.8 Output Wiring

The output terminal of the combiner box is located in the lower part of the casing, the specific wiring position is shown in the figure below.

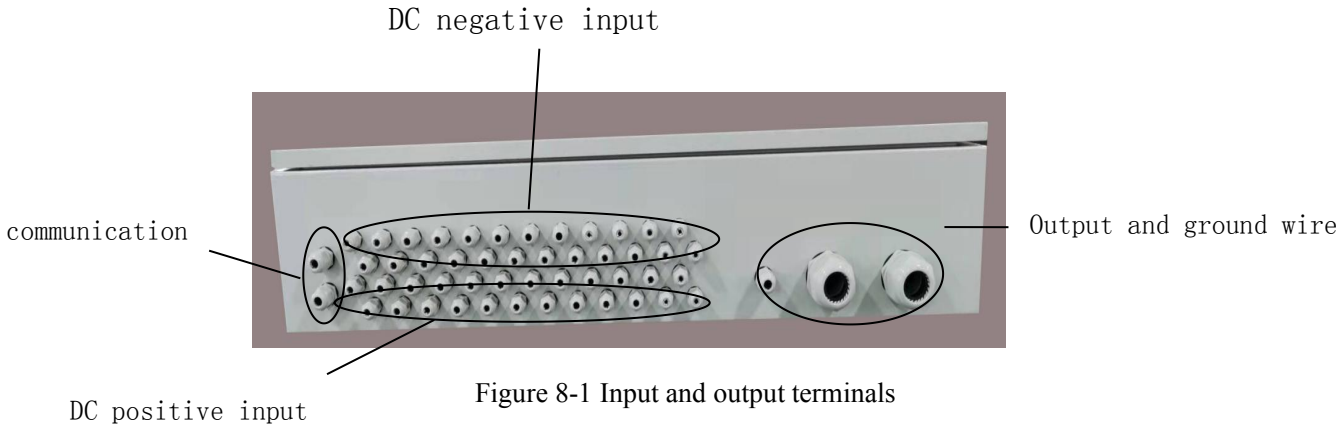



Figure 8-1 Input and output terminals

## 9. Maintenance and Precautions

9.1 The fuse should be checked regularly to prevent the battery panel from being in an open circuit state after the fuse is blown, and the photovoltaic cell power cannot be output;

9.2 When testing or maintaining this equipment, pay attention that the input and output may be charged to prevent electric shock or damage to other equipment;

9.3 The user unit should formulate a lightning protection facility management system and designate a special person to manage it; the photovoltaic combiner box is an electrical product, non-professionals, please do not disassemble it without authorization.

9.4 The PV combiner box does not need special maintenance. In order to prevent the failure of the lightning protection module, its working status should be checked regularly. Especially after the lightning, it should be checked in time.

9.5 The fuse of the same rating as the original model must be replaced! When installing the fuse, make sure the fuse holder is clamped!

9.6 The electrical components installed in the box are specially customized products of the photovoltaic combiner box, and cannot be mixed with ordinary products. If you need to replace it, please contact the seller or manufacturer, and pay attention to prevent the replacement of the fuse core (dedicated DC high voltage fuse). High-voltage electric shock from solar photovoltaic cells hurts people.

9.7 Before repairing, please use a multimeter to measure the voltage of the DC side and confirm that there is no voltage before proceeding.

9.8 After installation or maintenance, please close the DC circuit breaker on the inverter first, and then close the DC circuit breaker on the combiner box. Please follow the sequence of operations, otherwise it may cause damage to the inverter and combiner box.

9.9 Fuse rating: In any power system, fuses are used to protect electrical devices from overcurrent that, if left unprotected, could cause electronic devices to malfunction, overheat, damage, or even catch fire. If the fuse rating is too large, it will not provide protection; if it is too small, the system will not work properly. Therefore, when choosing a fuse, it needs to be determined according to the rating level of the photovoltaic module and the requirements of relevant standards. The minimum rating of the fuse can be calculated from the short circuit current (Isc) of the PV module. If there is no special requirement by local standards, we recommend that the fuses and wiring used in the system be rated to meet a minimum of 1.5 times the Isc value. According to the above description, the user can calculate the fuse level required by the corresponding combiner box by himself/herself from the parameters marked on the nameplate.

# 10 Warranty and after-sales service

## 10.1 Warranty Description

Under the premise of keeping and using, the products produced by our company shall be within 12 months from the date of production (subject to the date marked on the product certificate or the product) or within 12 months from the date of purchase , When the product is seriously damaged or cannot work normally due to manufacturing quality problems, the company is responsible for free repair or replacement. However, the failure caused by the following conditions shall be repaired or replaced with compensation even within the warranty period;

The use of the product does not meet the requirements of the standard specification;

a）Installation and wiring not as specified；

b）Use beyond standard specifications；

c）Self-modification or improper maintenance and other reasons；

d）After the purchase due to drop and damage occurred during the installation and other reasons；

e）Earthquake, fire, lightning strike, abnormal voltage, other irresistible natural disasters and other reasons.

## 10.2 After Sales Service

a）In case of failure, please contact the supplier or our after-sales service department；

b）Repair or replacement during the warranty period：The failure of the combiner box caused by the quality of the company's manufacturing will be repaired or replaced free of charge；

c）Repair or replacement beyond the warranty period, provide paid repair or replacement.

# 11 Disclaimer

This equipment should only be installed and operated by professionals, and the manufacturer will not be held responsible for failures caused by non-compliance with the instructions in this manual.

- Incorrect installation
- Incorrect modification
- Incorrect use or improper operation

•Converter operation in very harsh environments beyond those described in this manual

•Any installation and use beyond the limits specified in the relevant national standards

•Damage caused by abnormal natural environment

**Special Notice:**

We reserve the right to make changes to the product information described in this manual without notice.

Before ordering, please contact your local distributor for the latest information on this product.

Field wiring is subject to national standards.

Headquarters: Acrel Electric Co., LTD.

Address: No. 253, Yulv Road, Jiading District, Shanghai,China

TEL：0086-21-69158338　0086-21-69156052　0086-21-59156392　0086-21-69156971

Fax：0086-21-69158303

Web-site：www.acrel.cn

E-mail：ACREL001@vip.163.com

Postcode：201801

Production base: Jiangsu Ankerui Electric Appliance Manufacturing Co., Ltd.

Address: No. 5 Dongmeng Road, Dongmeng Industrial Park, Nanzha Street, Jiangyin City, Jiangsu Province,China

Tel: 0086-510-86179966

Fax: 0086-510-86179975

Website: www.jsacrel.cn

Email: sales@email.acrel.cn

Postcode: 214405