PV DC Combiner Box

User Manual
<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>About the user manual</td>
<td>1</td>
</tr>
<tr>
<td>1.1</td>
<td>Symbolic Interpretation</td>
<td>1</td>
</tr>
<tr>
<td>1.2</td>
<td>Application Scope</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>Safety Instructions</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>Product Introductions</td>
<td>3</td>
</tr>
<tr>
<td>3.1</td>
<td>System Introduction</td>
<td>3</td>
</tr>
<tr>
<td>3.2</td>
<td>Nameplate Introduction</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Figure 3-2 nameplate</td>
<td>9</td>
</tr>
<tr>
<td>4</td>
<td>Fundamental structures</td>
<td>10</td>
</tr>
<tr>
<td>5</td>
<td>Installation</td>
<td>14</td>
</tr>
<tr>
<td>5.1</td>
<td>Check transportation damage before installation</td>
<td>14</td>
</tr>
<tr>
<td>5.2</td>
<td>Mechanical installation</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>5.2.1 Installation environment requirements</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>5.2.2 Safety instructions</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>5.2.3 Installation requirements</td>
<td>15</td>
</tr>
<tr>
<td>5.3</td>
<td>Electrical connection</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td>5.3.1 Cable requirements</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td>5.3.2 External connection diagram</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td>5.3.3 PV input connection and requirements</td>
<td>18</td>
</tr>
</tbody>
</table>
5.3.3.1 PV array input MC4 terminal connection........ 18
5.3.3.2 Brief instructions about making PV input/output wiring.................................................................................. 20
5.3.4 Output connection and requirements...................... 21
5.4 Power on and off function of Combiner Box............... 22
6 key operation, mode settings and display functions of the monitoring device................................................................. 23
  6.1 key operation.............................................................................................................................. 23
  6.2 Mode setting and Display Function................................................................. 24
7 Connection of communication wiring and troubleshooting communication problems.......................................................... 31
  7.1 RS485 connection of communication line............................... 31
  7.2 Troubleshooting communication problems................................. 31
  7.3 How to use ModScan32 software......................................................... 33
8 Technical data............................................................................................................. 35
9 Appendix............................................................................................................... 36
  9.1 Quality Assurance.......................................................................................... 37
1 About the user manual

1.1 Symbolic Interpretation

In order to use the manual well, please read the following instructions carefully:

**Warning!**

The content of this symbol identification, improper operation should be avoided, or it may bring danger to the user's security or serious damage to the equipment.

**Attention!**

The content of this symbol identification is what we should pay our attention during normal working status of the system.

**Electric shock!**

This symbol identifies the place where there is a risk of electric shock, may be dangerous to the user's security, please do not touch.

**Grounding!**

This symbol identifies grounding protection.
1.2 Application Scope

This user manual provides the following detailed product information and installation instructions of intelligent PV array combiner box.

<table>
<thead>
<tr>
<th>Input channels</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. 4</td>
<td>ZF-4; ZF-4S</td>
</tr>
<tr>
<td>No. 6</td>
<td>ZF-6; ZF-6S</td>
</tr>
<tr>
<td>No. 8</td>
<td>ZF-8; ZF-8S</td>
</tr>
<tr>
<td>No. N</td>
<td>ZF-N; ZF-NS</td>
</tr>
</tbody>
</table>

This manual is designed for people who are installing and operating combiner box. These people shall have the relevant professional knowledge, be able to identify electronic components and electrical schematic symbols, even have standard electrical distribution experience.

2 Safety Instructions

Please read the user manual carefully before installation, if not in accordance with the manual for installation and equipment damaged, the company shall have the right not to comply with quality assurance.

**Warning!**

Before installing and using the device, please read the safety instructions carefully.

- Please make sure professional electrical or mechanical engineers for all operations and wiring.
Please do not move the other components inside of machine in addition to the terminal.

In addition to using the switch of circuit-breaker, please do not move the other components of the cabinet.

All operations and wiring must comply with the relevant standards of the host country and local requirements.

When installing during the daytime, we should use opaque material to cover PV modules, or PV modules will produce high voltage which may cause electric shock when exposing to the sunlight.

In order to prevent high-voltage electric shock, please use the plastic insulation clamp to operate fuses of combiner box.

3 Product Introductions

3.1 System Introduction

1. The Application of PV Combiner Box

Solar PV industry has become one of the most concerned emerging industries in the world today. Photovoltaic power generation is an effective way to absorb solar radiation energy by using solar energy and semiconductor electronic devices, and make it into electric energy directly, is the mainstream way for solar power. Photovoltaic power generation needs no fuel, no gas emission, it belongs to the green industry, has the advantages of no pollution, safety, long service life, simple maintenance, inexhaustible resources and a wide range of resource distribution, is considered to be the most important new energy in 21st century, can be widely used in aerospace, communications, energy, agriculture, office facilities, transportation, houses and other fields. It is noteworthy that where there is a faster development in solar photovoltaic industry, there will be often the costliest natural disaster areas. In the user...
manual, the design method of photovoltaic DC combiner box is proposed in the number of PV array modules, complicated wiring, high cost of the inverter, and heavy losses of lightning strike, which has extensive applicability and application prospects.

The DC combiner box is used for connecting the photovoltaic array and the inverter, providing lightning and over-current protection, and monitoring the single string current, voltage, temperature of the photovoltaic array, and the state of the lightning protection device. The photovoltaic DC combiner box added the function of the circuit breaker trip when over-temperature or high pv string current, which can effectively prevent the damage caused by the external short circuit. In the solar photovoltaic power generation system, in order to reduce the connection between the PV array and the inverter, the user can use a certain amount photovoltaic batteries and connect them in series to form a photovoltaic tandem, then connect photovoltaic serials with intelligent photovoltaic combiner box in parallel (See Figure 3-1), through the output of DC circuit breaker, so as to form the complete PV generation system to connect with power grid. In order to improve the reliability and practicability of the system, you can configure dedicated DC lightning-proof modules, DC fuses and circuit breakers in the PV intelligent combiner box, and set the working status indicator, lightning counter, etc. It is convenient for the user to grasp the working situation of photovoltaic cells widely and accurately to ensure solar photovoltaic generation system for maximum effectiveness.

For large photovoltaic grid-tied generation system, in order to reduce the connection wiring between PV modules and inverters, simplify maintenance, and improve reliability, it generally needs to increase the DC box between PV modules and the inverter device.

When using photovoltaic DC combiner box, the user can turn the same specifications and number of PV modules that are connected in series into a PV
module serial according to the DC input voltage range from inverter, and then connect the numbers of serials into the lightning PV array combiner box, which bring output through lightning protector and the circuit breaker, it is also convenient for facilitating the access to inverter connection.

2. Physical Design

The structure of the combiner box and the manufacturing quality of the cabinet itself, the connection of the main circuit, the secondary line and the installation of electrical components shall meet the following requirements:

1) Relevant parts for rack assembly shall comply with the respective technical requirements;

2) The box should be firm and flat, the surface should be smooth, no peeling, corrosion, cracks and other phenomena;

3) Rack panels should be flat, words and symbols require clear, tidy, standard and correct;

4) Signs, labels and markings should be complete and clear;

5) All kinds of switches should be easy to operate, flexible and reliable;

The design of photovoltaic DC combiner box should have the following characteristics:

1) Meet the requirements of outdoor installation;

2) At the same time, it can access to the 16 strings PV array, each with 15A, 1000Vdc fuses (optional with other grades);

3) Equipped with special high-voltage photovoltaic lightning protection device, positive and negative sides are all equipped with lightning protection function;
4) Use the four DC circuit breakers whose positive and negative are connected in series;

5) Monitoring the current of input array, and the machine is with LED display and output current generated by the way of RS485;

6) Monitor the combiner voltage, and a machine is with LED display and output voltage generated by the way of RS485;

Attention!

Electrical diagram of the above models are all setting 16 Strings as an example, the customer should choose according to physical resources.

(a) ZF-16 electrical schematic of combiner box
(b) ZF-16S electrical schematic of combiner box
Figure 3-1 electrical schematic of combiner box

(c)ZF-16S electrical schematic of combiner box
3.2 Nameplate Introduction

PV SMART COMBINER BOX

Model: ZF-xxS
Serial No:
Production Date:
Max. system voltage: d.c. 1000V
Range of operating DC voltage: d.c. 200-1000V
Max. Number of DC input strings: xx
Max. input current per string: d.c. 10A
Max. input fuse rating: d.c. 1000V, 15A
Max. continuous output current: d.c. xxA
Protective class: II
Ingress protection Grade: IP65
Over voltage Grade: III(PV)
Ambient temperature range: -25°C…+50°C
Standard: IEC 62109-1, IEC 61439-1, IEC 61439-2
EN 62109-1, EN 61439-1, EN 61439-2

Figure 3-2 nameplate
4 Fundamental structures

The internal structure of the combiner box is different because of its different functions, the combiner box will be introduced about its internal structure according to the different functions, customers can choose the corresponding structure for reference according to the objects.

(1) The internal structure diagram of the combiner box in ZF-xx

![Internal Structure Diagram]

Each part number in the box:

<table>
<thead>
<tr>
<th>No.</th>
<th>instruction</th>
<th>No.</th>
<th>instruction</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>DC circuit breaker</td>
<td>6</td>
<td>PV array combiner output copper “+”</td>
</tr>
<tr>
<td>2</td>
<td>SPD</td>
<td>7</td>
<td>PV array combiner output</td>
</tr>
</tbody>
</table>
(2) The internal structure diagram of the combiner box in ZF-xxS

Figure 4-2 the internal structure diagram of the combiner box in ZF-xxS
Each part number in the box:

<table>
<thead>
<tr>
<th>No.</th>
<th>Instruction</th>
<th>No.</th>
<th>Instruction</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>DC circuit breaker</td>
<td>8</td>
<td>Special solar fuse (for voltage acquisition)</td>
</tr>
<tr>
<td>2</td>
<td>Special solar lightning arrester</td>
<td>9</td>
<td>PV array combiner output copper “+”</td>
</tr>
<tr>
<td>3</td>
<td>Photovoltaic DC power supply</td>
<td>10</td>
<td>PV array combiner output copper “-”</td>
</tr>
<tr>
<td>4</td>
<td>Intelligent controller</td>
<td>11</td>
<td>Ground wire copper platoon</td>
</tr>
<tr>
<td>5</td>
<td>PV+ combiner copper platoon</td>
<td>12</td>
<td>RS485 and grounding terminals</td>
</tr>
<tr>
<td>6</td>
<td>PV- combiner copper platoon</td>
<td>13</td>
<td>Electrical insulator</td>
</tr>
<tr>
<td>7</td>
<td>Special solar fuse</td>
<td>14</td>
<td>Secondary coil cabling channel</td>
</tr>
</tbody>
</table>
（3）The internal structure diagram of the combiner box in ZF-xxS

![Diagram of the combiner box in ZF-xxS](image)

Figure 4-3 the internal structure diagram of the combiner box in ZF-xxS

each part number in the box :

<table>
<thead>
<tr>
<th>No.</th>
<th>Instruction</th>
<th>No.</th>
<th>Instruction</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>DC circuit breaker</td>
<td>8</td>
<td>Special solar fuse</td>
</tr>
<tr>
<td>2</td>
<td>Special solar lightning arrester</td>
<td>9</td>
<td>Special solar fuse (for voltage acquisition)</td>
</tr>
<tr>
<td>3</td>
<td>Anti back diode</td>
<td>10</td>
<td>PV array combiner output copper “+”</td>
</tr>
<tr>
<td>4</td>
<td>Photovoltaic DC power supply</td>
<td>11</td>
<td>PV array combiner output copper “-”</td>
</tr>
</tbody>
</table>
5 Installation

The general conditions for the design of PV combiner box are:

a) Ambient temperature: -25 °C ~ + 55 °C (no direct sunlight); relative humidity ≤95%, no condensation;

b) Comply with 6.1.2.3 in GB 7251.1 contamination level of ≤3;

c) Altitude ≤2000m;

d) No violent vibration impact, and vertical inclination ≤5°;

e) Air should not contain corrosive and explosive particles and gases.

When installing during the daytime, we should use opaque material to cover PV modules, or in the sunlight, PV modules will produce high voltage which may cause electric shock.

5.1 Check transportation damage before installation
Although we have carefully tested and inspected before delivery, damage may be caused in transportation, so please recheck before installation. If any damages are detected, please do not hesitate to contact the express company or contact us directly. Please provide photos of the damage, we will offer the best service in time.

5.2 Mechanical installation

5.2.1 Installation environment requirements

Although the ingress protection grade of this product is IP65, it can be installed outdoor, because it belongs to electronic equipment, so try not to place it in the humid place.

5.2.2 Safety instructions

As electronic products, it will bring danger when you have unintentional direct contact with hazardous live parts. The maximum DC input voltage of this product can reach to 1000V, max output current up to 250A.

<table>
<thead>
<tr>
<th>Warning!</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ensuring combiner box is power off before installation and maintenance.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Attention!</th>
</tr>
</thead>
<tbody>
<tr>
<td>This device must be installed under the guidance of a professional electrician.</td>
</tr>
</tbody>
</table>

5.2.3 Installation requirements

- Installation site
This product can be wall-mounted, the mounting surface should be smooth and mounting, the bracket should bear three times the weight of the combiner box. Enough space should be left around the combiner box for maintainer to operate and maintain when installing.

- **Installation method**

The combiner box bracket required stainless steel hex bolts (M8x30), flat pad (Ø 8), spring pad (Ø 8). Combiner box installation schematic diagram, as shown in Figure 5-1, the torque is 11 N • m, and tightening the nut make combiner box firmly mounted on a bracket.

![Installation diagram](image)

(a)

(b)

Figure 5-1 Installation diagram
Combiner box can also be installed on other sheet-metal stents, the installation should pay attention to this manual as well as the provisions of note matters.

5.3 Electrical connection

5.3.1 Cable requirements

When doing the corresponding connection of the input and output ends, the following requirements are needed for each connecting cable:

Table 5-1 cable diameter requirements

<table>
<thead>
<tr>
<th>cable</th>
<th>Cable diameter (mm²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PV array input PV +</td>
<td>4</td>
</tr>
<tr>
<td>PV array input PV -</td>
<td>4</td>
</tr>
<tr>
<td>PV array output PV +</td>
<td>35～95</td>
</tr>
<tr>
<td>PV array output PV -</td>
<td>35～95</td>
</tr>
<tr>
<td>Ground wiring</td>
<td>16</td>
</tr>
<tr>
<td>Communication cable</td>
<td>0.75～2.5</td>
</tr>
</tbody>
</table>

5.3.2 External connection diagram

![Figure 5-2 combiner box terminals](image-url)
5.3.3 PV input connection and requirements

Combiner box inputs as shown in Figure 5-2, most allowing 8/12/16 channels input. Users need to unscrew the waterproof terminals when connecting, the cable should be through the water into the terminal box and connect to the corresponding electrodes, then tighten the waterproof terminal nut. In order to guarantee ingress protection grade IP65, and ensure that there is no gap between the terminal and the wiring.

5.3.3.1 PV array input MC4 terminal connection

The ZF-xxS standard combiner box of the external connection terminal use MC4 PV quick connector, it has been connected to the input electrode cable to the MC4 terminal before leaving the factory. The simple plug terminals can be made in order to access the corresponding position when connecting. The following issues should be noted in making and using external MC4 terminals:

(1) Make sure that external MC4 terminals are reliable

In order to ensure the quality of MC4 terminal connections, if you can hear a slight "click" after inserting the wiring into inner core of the MC4 terminals and connect with the plastic shell of the terminals, which indicates that the core has been inserted correctly in the terminal, and then gently pull
with hands, and tension cannot exceed 2.5 N, check whether the internal parts fit firmly. If it cannot be pulled out, it means you can use, or you are recommended to change the MC4 terminals. It should be noted that the internal core of MC4 terminal we choose which has 3mm selection of activities. The terminal may appear to be out of the 3mm distance when pulling, but not be pulled out, but this is a normal phenomenon.

(2) Pay attention to the length of external MC4 terminal connections

MC4 terminal is not strong mechanical device which is only used for cable connection, so when connect with the MC4 terminal on the combiner box, you need to leave a certain length of the cable to avoid tensile force. The length of the cable is required to be confirmed according to the environmental conditions of the construction site. The following figure is the wiring diagram.

Figure 5-3 cable wiring diagrams
（3）Pay attention to the strength when MC4 terminals are connecting with the combiner box.

Our MC4 terminal is customized products and the internal core position. MC4 terminals has a range of activities. Maybe the terminals are not flat, please do not force to insert at the moment, and you need to swing the terminals so that the core can be smoothly connected to the internal connection, or it will be easily driven out with great physical strength.

5.3.3.2 Brief instructions about making PV input/output wiring

Table 5-2 PV terminals instructions

<table>
<thead>
<tr>
<th>procedure</th>
<th>OI</th>
<th>specific operational view</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The cable wire stripping 8 mm at one end</td>
<td><img src="image1" alt="Diagram 1" /></td>
</tr>
<tr>
<td>2</td>
<td>The red and the black lines are respectively connected to the tube type terminals according to the corresponding relations in the diagram, and</td>
<td><img src="image2" alt="Diagram 2" /></td>
</tr>
</tbody>
</table>
then press it.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Tube-type terminals and plugs are installed together</td>
</tr>
</tbody>
</table>

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Tighten fastening sheath</td>
</tr>
</tbody>
</table>

5.3.4 Output connection and requirements

The output of the combiner box as shown in figure 5-4, output terminals include output PV terminals, earth terminal, RS485 communication terminals after confluence. You need to unscrew the waterproof terminals when connecting, the cable should be through the water into the terminal box and connect to the corresponding electrodes, then tighten the waterproof terminal nut. In order to guarantee ingress protection grade IP65, and ensure that there is no gap between the terminal and the wiring.

Combiner box output terminals are connected directly on the output of copper platoon by cold-press terminal bolt. the size of cold terminal can be selected according to the actual situation, and the connection mode is as follows:
Attention!

After the cold terminal connecting to the line, heat shrinkable tubing wrapped connection is needed. The connection torque of cold pressed terminal bolt can not exceed 11N•m.

5.4 Power on and off function of Combiner Box

In order to improve the reliability and security, each photovoltaic DC combiner box has the key that help us to open and shut case.

Warning!

Fuses bear high voltage from the inverter and PV arrays, replacement is strictly forbidden when machine is working.

Attention!

DC circuit breaker must be disconnected before replacing the fuse. But
6 key operation, mode settings and display functions of the monitoring device

6.1 key operation

The monitoring device has four key buttons: “ESC”、“-”、“+”、“SET”. The key “ESC” is used to return to the default interface or cancel the setting of parameters. The key “SET” is used to enter the parameter setting interface, choose the parameter that to be configured, or complete the setting. The keys “+” and ”-” is used to scroll the screen, or adjust the value of the parameters. Press the keys “SET” and “ESC” at the same time will enter the mode selecting interface. If no key is pressed in 10 seconds, the LCD will jump to the default interface and the brightness of backlight will decrease after 5 seconds. If the key “ESC” is pressed, the interface will jump to the default interface immediately.

The monitoring device supports the histogram display of the detected current, digital display of the detected current and generated energy, parameters' setting interface, the wireless node state interface in the FWB.
GATEWAY mode. The plentiful interfaces make it convenient to operate the device. Below is the description of interface and operation for every mode.

6.2 Mode setting and Display Function

When the monitoring device is power on, the P/T light will be bright to show that the device is working, then the LCD monitor will display LOGO picture for about 5 seconds.

Figure 6-2 selecting interface of working mode

In figure 6-2 “*”: The selecting cursor that can be adjusted up and down through pressing “+” and “-”keys.

FWB NODE: Actually, it is a wireless mode. FWB means Field Wireless Bus, which is robust filed wireless communication protocol designed by CanBang. In this mode, the modbus interface is also active.

FWB GATEWAY: The device is the wireless gateway of FWB network. In this mode, the modbus interface is also active.

MODBUDS NODE: In this mode, only the modbus interface is active, and the wireless is disabled.

CLEAR ALL: Actually, it is not a work mode, which is just used to clear all the generated energy data that stored in the device in the past.
When a different mode is selected and the key “SET” is pressed, the device will reboot to enter the selected mode. If mode is changed from MODBUS mode to other two modes, then the parameters of the modbus communication will be reserved for RS485 communication.

**MODBUS mode**

The default mode of the device is MODBUS mode, when communicating with PC through RS485, the LED lights R and P/T will twinkle to indicate that the communication is normal.

**Histogram interface:** The histogram interface will come up after the interface of LOGO, histogram interface is the default interface of MODBUS mode, it will be shown like below:

![Figure 6-3 histogram display(default interface)](image)

The histogram shows the current value of every channel, the current value ranges from -2A to 10A. The hall sensors we use which have four channel sensors, so in the histogram every four channels will be indicated from another four channels which means that from left to right is channels 1-4, channels 5-8, channels 9-12 and so on. If there is no button operation in 15 seconds, the brightness of the LCD will decrease.

**Parameters setting interface:** When the key “SET” is pressed in the histogram interface, the device will enter into MODBUS parameter setting interface, MODBUS communication can be proceed through RS485 in the other two modes(wireless mode and gateway mode), but the related parameter
should be set in the MODBUS mode. MODBUS parameter setting interface comes up as below.

Figure 6-4 modbus parameters setting interface

**BPS**: MODBUS communication baud rate, the optional rate are 2400, 4800, 9600 (default rate), 19200, 38400.

**PARITY**: The parity of MODBUS communication, the optional parity none parity (NONE), odd parity (ODD), even parity (EVEN) (default none parity).

**ADDRESS**: The address of the MODBUS slave device ranges from 1 to 247 (default 1).

**Digital display interface**: When the key “+” or “-” is pressed in the histogram interface, the digital display interface will come up to show the current values and generated energy values. When press key “+” first, then firstly shows the current value of the first four channels, when press key “-” then firstly shows the generated energy of the last four channels. Then go on pressing the “+” or “-” key will scroll the screen to show current or generated energy value of other channels. The generated energy value will come up at the end of current value, the current value will come up after generated energy value on the reverse direction. Note that the top line is the same with histogram interface.
Figure 6-5 interface of the digital current

Figure 6-6 interface of the digital generated energy

In figure 6-6 “CH1” means accumulative power generation of channel 1 is “0.000KWh”, and so forth.

Note: The display content in last line is the same as the one in histogram.

FWB NODE mode

Select FWB NODE mode in the mode selecting interface, the device will reboot after pressing the key “SET” if the current mode is not FWB NODE mode, and then it will enter into FWB NODE mode.

Histogram interface: The histogram interface will come up after the interface of LOGO, histogram interface is also the default interface of FWB NODE mode, it will be shown the same as the MODBUS mode.
**Parameters setting interface:** When the key “SET” is pressed in the histogram interface, the device will enter into FWB NODE parameter setting interface. FWB NODE parameter setting interface comes up as below:

![Figure 6-7 parameters setting interface](image)

**ADDRESS:** The address of the wireless node, every device in FWB NODE mode will get an unique address in the frequency indicated by FREQ, the address ranges from 1 to 216.

**FREQ:** The frequency that the device used to communicate with other device, ranges from 900MHz to 928MHz, step by 200KHz.

**Digital displaying interface:** When the key “+” or “-” is pressed in the histogram interface, the digital display interface will come up, the digital display interface is consistent with the NODE MODBUS mode

**FWB GATEWAY mode**

Select FWB GATEAY mode in the mode selecting interface, if the current mode is not FWB GATEWAY mode, the device will reboot after the pressing of the key “SET”, and then enter into FWB ATEWAY mode. When communicate with PC through RS485, the LED lights R and 15 P/T will twinkle to indicate that the communication is in normal status.

**Wireless node connecting status interface:** The wireless node connecting status interface will come up after the interface of LOGO, wireless node
connecting status interface is the default interface of FWB GATEWAY mode, it will be shown as below:

![Figure 6-8 wireless node connecting status interface](image)

The underline number on the left side stands for the online number of wireless node, the left column number(except the first number) stands for hundreds digit and tens digit of the address, the top line number(except the most left number “2” stands for units digit ”). As the address of wireless node starts from Number “1”, “000” is not supported, it will display “*”. Other figures in the matrix represent the distance between the node and the gateway of the corresponding address, if the figure is “zero”, that indicates the node is offline. Current code is online in last figure, the address is “010”, and the distance between wireless node and gateway is “1”. The maximum node number of wireless gateway is “239”, so 4 screen wireless node status can be displayed at a time. You can operate and check all nodes status by pressing “+” or “-”.

**Note:** What is the distance between wireless node and gateway?

The distance is “1” if wireless node and gateway communicate directly.
The distance is “2” if a route forwarding is needed.

**Histogram interface:** The histogram interface will come up when pressing the key “+” till the end of wireless node connecting state interface, if the supported number of the wireless node is more than 60, then flip the screen, go on pressing “+” after flipping, the histogram interface will come up, histogram interface is consistent with the NODE MODBUS mode.

**Digital display interface:** When the key “+” or “-” is pressed in the histogram interface, the digital display interface will come up, which is the same as digital display interface in MODBUS mode.

**Parameters setting interface:** Press the key “SET” in wireless node connecting state, interface will turn to FWB GATEWAY setting interface which will be shown as below (Figure 6-9)

![GateWay Setting](image)

Figure 6-9 parameters setting interface

**NODE QTY:** The max supported number of the wireless node by this gateway, default number is “30”, ranges from “1” to “216”. Generally, please try to keep the figure as small as possible, because the communication cycle will become longer when the figure increase.

**FREQ:** The frequency that the device used to communicate with other devices ranges from 315MHz to 928MHz, step by 200KHz.
7 Connection of communication wiring and troubleshooting communication problems

7.1 RS485 connection of communication line

RS485 communication terminals in combiner box has RS485-A, RS485-B, RS485-GND, the construction need to be properly connected to communication wiring.

(1) The RS485 communication wiring of each combiner box must be attached to the corresponding place, such as A-A, B-B.

(2) RS485 connection terminals in each combiner box, the red wire is A.

(3) Communication cable shielding received RS485-GND terminal.

Special attention is that Communication lines must be a standard shielded twisted-pair which cannot be grounded but only connecting with the RS485-GND Terminal.

7.2 Troubleshooting communication problems

If there are any combiner box communication problems when debug the combiner box and the monitoring software, the following troubleshooting steps are recommended:

Step 1: Investigation of the inverter room communication cabinet

The key node for connecting the two devices is the communication access points between Combiner box communication and inverter, we can troubleshoot problems by doing communications test here

<table>
<thead>
<tr>
<th>Operation method</th>
<th>Communication status</th>
<th>Problem troubleshooting</th>
<th>Approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disconnect the</td>
<td>The</td>
<td>The communication of</td>
<td>Contact with</td>
</tr>
</tbody>
</table>
RS485 cable from the communication cabinet, and make the RS485 communication test by ModScan32 software.

<table>
<thead>
<tr>
<th>RS485 cable from the communication cabinet, and make the RS485 communication test by ModScan32 software.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communication cable from the communication cabinet, and make the RS485 communication test by ModScan32 software.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>combiner box is normal, physical line connection is normal, maybe there is a problem inside of the inverter communication cabinet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continue to troubleshoot the combiner box</td>
</tr>
</tbody>
</table>

Step 2: Troubleshoot problems at the combiner box

After the failure of the inverter communication test, further test will be needed.

<table>
<thead>
<tr>
<th>Operation method</th>
<th>Communication status</th>
<th>Problem troubleshooting</th>
<th>Approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computers communicate with the single combiner box</td>
<td>There is normal communication between two sides</td>
<td>The communication of combiner box is normal, then can infer the communication lines may have problems</td>
<td>Contact with communication equipment manufacturers</td>
</tr>
<tr>
<td></td>
<td>The two sides can’t communicate properly</td>
<td>There is something wrong with the communication module of combiner box</td>
<td>Contact our company for replacement</td>
</tr>
</tbody>
</table>

After confirming the problems, we recommend the following wiring for investigation:

1. Checking whether the communication of A, B, GND wire and lines of combiner box are properly connected to the communication wiring;
(2) Checking whether the communication of A, B, GND line meet the case of open circuit;

(3) Check whether the communication A, B and communication line is short circuit

(4) Check whether communications ground wires are connected with the ground.

7.3 How to use ModScan32 software

(1) It connects the computer with the combiner box through RS485 connector, then opens MODBUS communication software:

快捷方式 到 ModScan32.exe.1nk

(2) We set up the communication COM port and baud rate at first, then left click “Connect” under Connection menu (see chart below), will enter setting interface baud rate and COM port.

Figure 7-1 Connection menu interface

In setting interface baud rate and COM port, the baud rate is set to 9600, port choose corresponding COM port according to the computer, and click OK, then enter into the address, length, function setting interface.
Then press the Red Lebel Chart to set the address, length, function, do not modify other data after setting, click the connection switch to communicate. Note: the actual data length sees communication protocol for reference.

At present, our combiner box communication data length is 43;

Address Device ID needs to be the same as the actual combiner box address.

(3) After the correct connection settings, you can determine whether it is in normal communication status.
If normal, the following interface will be displayed:

![Figure 7-4 address setting](image)

**Note:** the software can be downloaded from the Internet

### 8 Technical data

<table>
<thead>
<tr>
<th>Electrical parameters</th>
<th>8/12/16/18 strings</th>
</tr>
</thead>
<tbody>
<tr>
<td>The current number of combiner box</td>
<td></td>
</tr>
<tr>
<td>Maximum DC input voltage ($U_{\text{DC, max}}$)</td>
<td>DC1500V</td>
</tr>
<tr>
<td>Maximum single channel DC input current</td>
<td>15A</td>
</tr>
<tr>
<td>Maximum convergence output current</td>
<td>125/200/250A</td>
</tr>
<tr>
<td>(I_{PV,max})</td>
<td></td>
</tr>
<tr>
<td>----------------</td>
<td>---</td>
</tr>
<tr>
<td>Lightning protection device fault detection</td>
<td>Optional</td>
</tr>
<tr>
<td>DC over voltage surge protection</td>
<td>Yes</td>
</tr>
<tr>
<td>Battery short circuit protection</td>
<td>Yes</td>
</tr>
<tr>
<td>Circuit breaker switching state detection</td>
<td>Optional</td>
</tr>
</tbody>
</table>

**Communication (optional)**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>RS485 reliable transmission distance</td>
<td>9600bps/1.2Km</td>
</tr>
</tbody>
</table>

**Mechanical parameters**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Input array wiring diameter</td>
<td>4mm²</td>
</tr>
<tr>
<td>Confluence output wiring diameter</td>
<td>35~95 mm²</td>
</tr>
<tr>
<td>GND</td>
<td>16mm²</td>
</tr>
<tr>
<td>Communication wiring diameter</td>
<td>0.75~2.5mm²</td>
</tr>
</tbody>
</table>

**Environmental parameters**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Protection level (EN60529)</td>
<td>IP65</td>
</tr>
<tr>
<td>Environment temperature</td>
<td>-25℃ ~ 50℃</td>
</tr>
<tr>
<td>Environment humidity</td>
<td>0%~95%</td>
</tr>
<tr>
<td>Maximum altitude</td>
<td>3000m</td>
</tr>
<tr>
<td>Cooling way</td>
<td>Natural cooling</td>
</tr>
<tr>
<td>Noise</td>
<td>No</td>
</tr>
</tbody>
</table>

**9 Appendix**
9.1 Quality Assurance

Warranty

The warranty of combiner is 12 months, or 14 months after delivery to the installer from the factory, the contract shall prevail. Otherwise all terms shall be subjected to the signed contract.

Evidence

Within the warranty period, the customer is required to show purchase date and the invoice of the product. Trademarks should be clearly visible on the product at the same time, or we have the right to refuse quality assurance.

Conditions

- We will repair or replace the product for free if there are any breakdown products during the warranty period.

- The replacement of unqualified products should be returned to the factory directly;

- The customer shall set aside a reasonable time for our factory to repair the faulty equipment.

In the following circumstances, the company shall have the right to make no quality assurance:

- Transportation damage

- Improper installation

- Improper modification

- Improper use

- Beyond the very harsh environment described in this manual
• Any installation and use scope beyond the relevant standards
• Abnormal damage caused by the natural environment

If the dimension and parameters of products are changed, please check our latest documents for reference. No further notice for some updated issues.