Smart HELSYS N1540180R48 Power Supply System

User Manual

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2018-09-12	1.1	Modify system parameter setting	Fairy Zhang

Safety Precautions

To reduce the chance of accident, please read the safety precautions very carefully before operation. The "Caution, Note, Warning, Danger" in this book and on the product do not represent all the safety points to be observed, and are only supplement to various safety points. So anybody who will install or operate the system has to get strictly trained and master the correct ways and all the safety points before operation.

When operating DPC products, the personnel must observe the safety rules in the industry, the general safety points and special safety instructions specified in this book.

Electrical Safety

I. Hazardous voltage

Some components of the power supply system carry hazardous voltage in operation. Direct contact or indirect contact through moist objects with these components will result in fatal injury.

Observe safety rules in the industry when installing the power supply system. The installation and operation personnel must be licensed to operate high voltage and AC power.

In operation or installation, any conductive objects, such as keys, tools, watches, bracelets, bangles and rings are forbidden to be hung or ware.

When you spot the cabinet with water or moisture, turn off the power immediately. In moist environment, precautions must be taken to keep moisture out of the power supply system.

"Prohibit" warning label must be attached to the switches and buttons that are not permitted to operate during installation.

High voltage operation may cause fire and electric shock. The connection and wiring of AC cables must be in compliance with the local rules and regulations. Only those who are licensed to operate high voltage and AC power can perform high voltage operations.

II. Tools

In high voltage and AC operation, specialized tools must be used.

III. Thunderstorm

Never operate on high voltage, AC, iron tower or mast in the thunderstorm.

In thunderstorms, a strong electromagnetic field will be generated in the air. Therefore the equipment should be well earthed in time to avoid damage by lightning strikes.

IV. ESD

The static electricity generated by the human body will damage the static sensitive elements on PCBs, such as large-scale ICs. Before touching any plug-in board, PCB or IC chip, ESD wrist strap must be worn to prevent body static from damaging the sensitive components. The other end of the ESD wrist strap must be well earthed.

V. Hotsurface

When the power converter is running in the environment of high temperature, the surface of the converter is hot. Please be careful when you plug or extract the converter. At the same time, you may be injured by falling converter.

VI. Fire

Please obey the standard operation rules when you connect any cable connectors and ensure reliable connection to avoid an accident, such as fire and damage of equipment.

Please do the similarly operation when you connect AC cable, or it will make the SPD on fire or damage when phase line and zero line are in wrong connection.

VII. Short circuit

During operation, never short the positive and negative poles of the DC distribution unit of the power supply system or the non-grounding pole and the earth. The power supply system is a constant-voltage DC power device; short circuit will result in equipment burning and endanger human safety.

Check the polarity of the cable and connection terminal when performing DC live operations.

As the operation space in the DC distribution unit is very tight, please carefully select the operation space.

Never wear a watch, bracelet, bangle, ring, or other conductive objects during operation.

Use insulated tools.

In live operation, keep the arm, wrist and hand tense, so that when the tool in operation slips, the movement of the human body and tool is reduced to a minimum.

BLVD

The power supply system has battery low voltage disconnection (BLVD) function. BLVD means when battery voltage drops down to 43.2V, the power supply system cuts the load off to prevent over-discharge.

BLVD is enabled before delivery, which means that if power outage lasts for a long time or the power supply system fails, there might be BLVD. Users should classify the loads and connect the priority loads to BLVD routes. For vital loads, users can disable BLVD to ensure reliability of the power supply.

The advantage of BLVD is protecting the batteries from over-discharge. The disadvantage of BLVD is that when the battery voltage drops down to a certain value, all the loads (including non-priority loads and priority loads) will be cut off due to battery disconnection.

The advantage of disabling BLVD is prolonging the power supply of priority loads. The disadvantage is that disabling cannot prevent unwanted power failure due to mis-operation or power supply system failure.

Others

I. Safety

When replacing power input fuses of monitoring module and power distribution units, use the same type fuses to meet the safety requirement.

II. Sharp object

When moving equipment by hand, wear protective gloves to avoid injury by sharp object.

III. Power cable

Please verify the cable labels and the silkscreen of the power supply before connection.

IV. Signal cables

The signal cables should be routed at least 150mm away from power cables.

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Chapter 1 Overview

This chapter introduces model description, composition and configuration, and features of Smart SYS N1540180R48 embedded power supply system (abbreviated as ‘system’ hereinafter).

1.1 Model Description

The model description of the system is given in Figure 1-1.

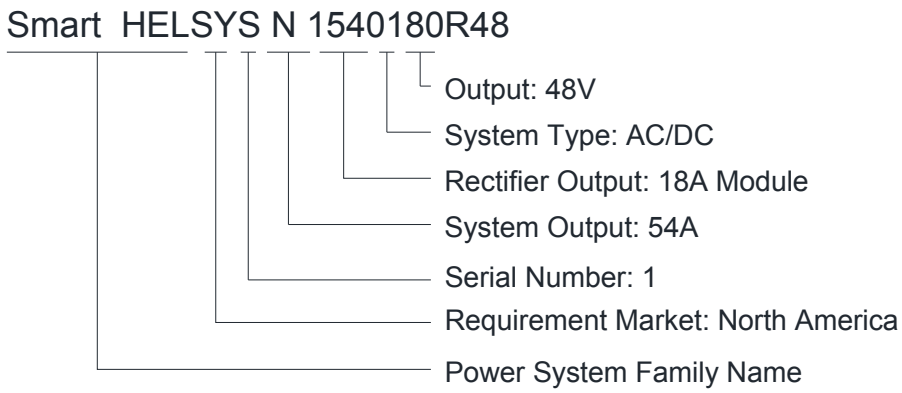


Figure 1-1 Model description

1.2 Composition and Configuration

The appearance and the definition of connection is shown in Figure 1-2.

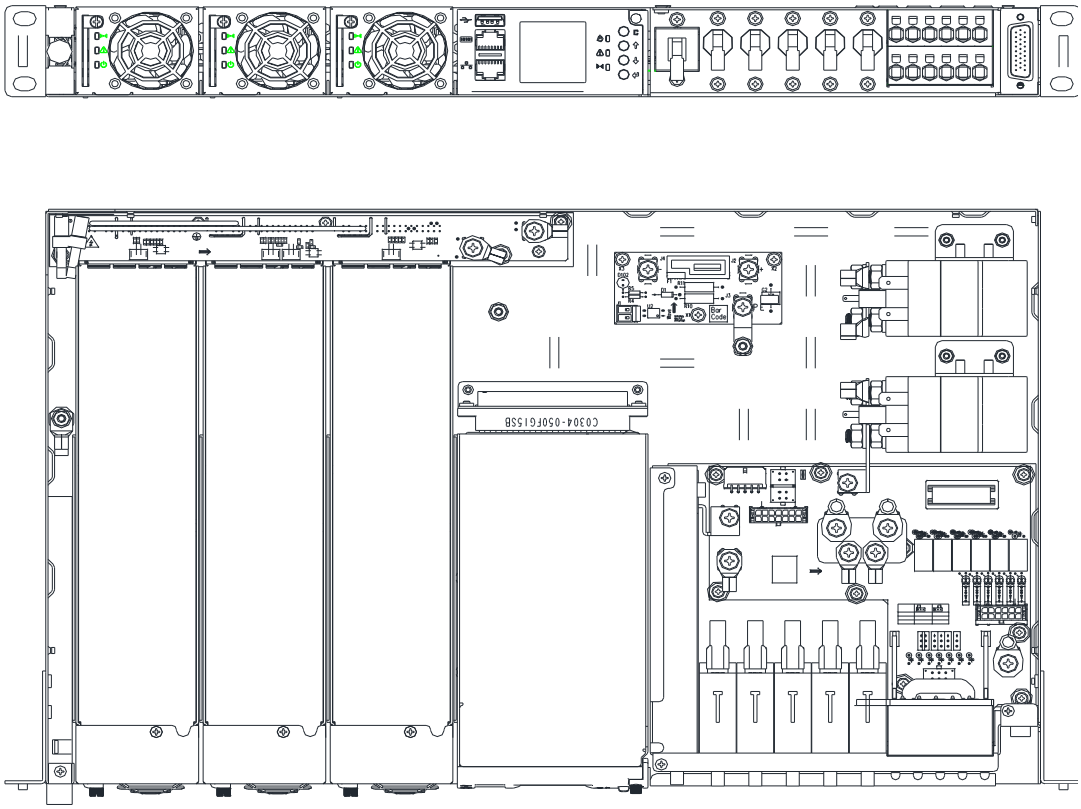


Figure 1-2 Appearance of 1U system

The configuration of the system is listed in Table 1-1.

Table 1-1 Configuration of the system

Item	Smart HELSYS N1540180R48
Rectifier	Smart Power Ⅲ 48/1000HE 1~3pcs
AC power terminal	Reserved AC cable for AC input in front panel，1PH，L＋N＋PE/220V
AC SPD	Not configured in the system, it will be configured outside of the system by customer.
DC power distribution	LLVD/ Non-Priority (80A): 30A*2,, MCBs BLVD/ Priority (80A):10A*2, MCBs Load positive cables and negative cables are directly connected to the green connector in front panel.
Controller	SC501
Battery routes	Battery MCBs: 1*50A/1P+1* 30A/1P. Battery positive and negative direct access to the green connector.
Relay output	6 relay outputs, NO and COM as default
Digit Input	6
Temperature sensor	2

Note: The system capacity is 3kW in designing.

But different types of rectifiers have different characteristics and efficiency. Customers can choose any rectifier to meet requirements.

1.3 Features

- The rectifier uses the active Power Factor Compensation (PFC) technology, the power factor is up to 0.99.
- The system has wide AC input voltage range: 85ac - 300Vac.
- The rectifier uses soft switching technology, the efficiency is up to 96%.
- The rectifier design can meet EMC requirement and safety requirement in CE standard.

- The rectifier safety design complies with UL and CE standards.
- The rectifier is of high power density.
- The rectifier is hot pluggable. It takes less than 1min to replace a rectifier.
- The rectifier has two optional over-voltage protection methods: hardware protection and software protection.
- The controller will manage the system include battery charge and discharge, LLVD, BLVD, temperature compensation, auto voltage regulation, current limitation, battery capacity calculation and on-line battery test, alarms, and etc.
- The controller can save up to 10000 historical alarm records and 10000 run information.
- RS485, Ethernet will be available for remote communication and controlling, relay outputs are available, too.
- The system has complete fault protection and fault alarm functions.

1.4 Operating Principles

The mains AC input will connect to the terminals on the backboard. All the rectifiers will work in parallel to one bus-bar to power the loads and charge the batteries. When mains fail, the batteries will discharge to power the loads automatically.

Two levels of LVDs are configured in the system for protect the battery from over-discharging. One is for non-priority loads(LLVD) and another is for priority loads(BLVD). The batteries will discharge when mains fail, if the DC voltage drop to pre-set value of LLVD, LLVD will disconnect the non- priority loads; when the DC voltage drop to the pre-set BLVD value, the priority loads will be disconnected.

When the mains restore, rectifiers will restart. LLVD and BLVD will connect when the DC voltage is over 52.5V. (settable, 5V higher than active value).

When output MCB trips, “Load Branch1 Trip” or “Load Branch2 Trip” alarm will be generated by the controller.

The controller SC501 will monitor and manage the system.

The system has the battery temperature compensation function. With the battery temperature increase/decrease, the system output voltage will be decrease/increase accordingly. This kind of output voltage change is no more than 2V DC.

The controller has the RS485 port and the Ethernet port to monitor and manage the system remotely.

The schematic diagram of the power system refers to < Appendix 3 Wiring Diagram>.

1.5 Main Function

The main functions of the power system as below:

- AC/DC rectifiers management
- DC distribution
- AC over voltage and under voltage alarm and protect
- DC over voltage and under voltage alarm and protect
- LLVD and BLVD
- Battery management
- Fault alarm and protection
- Monitor and management, remote communication and remote control function

1.5.1 Menu Tree

The menu tree shows as Figure 1-3, and this is the basic menu, when set parameters, sub-tree should be open and set.

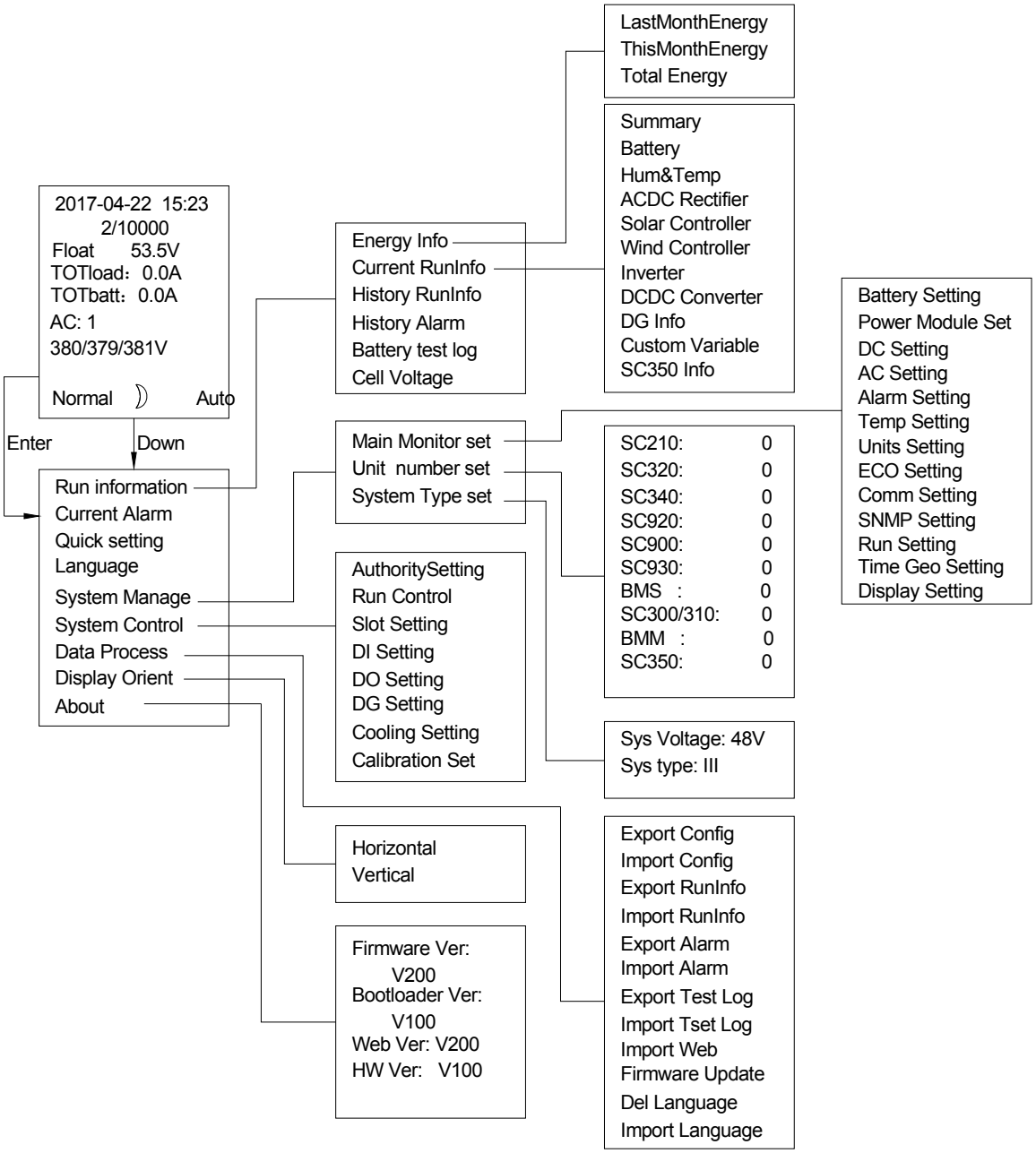


Figure 1-3 Menu tree

The system is easy to expand to get more function, when expanded parts used in the system, “unit number set” should be set at first.

System type and voltage are determined by system structure, for Smart HELSYS N1540180R48, it should be 48V-III.

1.5.2 Quick Setting

Quick setting shows as Figure 1-4, it is used to set the value of the system. It includes the most frequently used information.

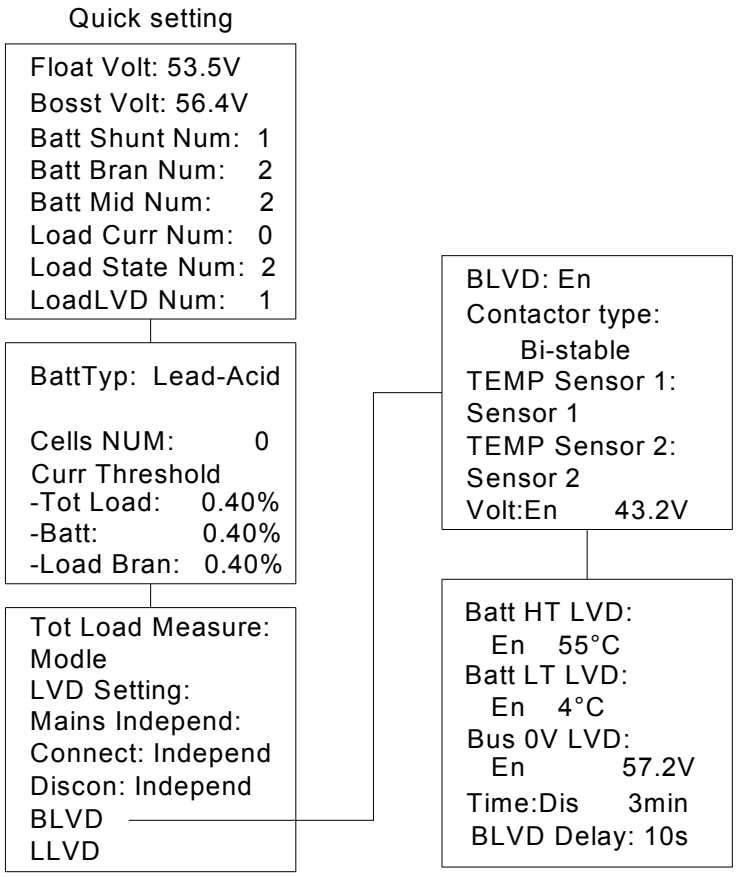


Figure 1-4 Quick Setting

Choose the right item and set the right parameter, then press the enter key to confirm.

When only one battery shunt is used in the system, the capacity of battery should be the sum capacity of all battery strings; When more than two including two battery shunts are used in the system, it should be each battery capacity.

LVD means Low Voltage Disconnection, when it connects to non-critical load, it's called LLVD; when it connects to critical load, it's called BLVD.

The LVD contactor will active according to the set conditions. Different conditions can be used in different applications, and anyone can be disabled.

When the system configures LLVD or BLVD function, the LVD parameters should be set as below Table 1-2:

Table 1-2 LVD Parameters Setting Instructions

Name	Setting Range	Default	Setting Instructions
LLVD	NA,EN,DIS	EN	EN: LLVD function is available; DIS: LLVD function is unavailable.
BLVD	NA,EN,DIS	EN	EN: BLVD function is available; DIS: BLVD function is unavailable.

Name	Setting Range	Default	Setting Instructions
LVD-Mode	Time,Volt,Temp	Volt	Volt: Based on battery group's voltage to control the LVD function. Time: Based on battery group's discharge-time to control the LVD function. Temp: Based on battery temperature, high temperature or low temperature to control the LVD function
LLVD Time Active	3-1000min	300min	The LLVD branch will be disconnected when battery group discharge-time reach the setting time value, but only when the LVD-Mode is "Time".
BLVD Time Active	3-1000min	600min	The BLVD branch will be disconnected when battery group discharge-time reach the setting time value, but only when the LVD-Mode is "Time".
LLVD Voltage Active	30V-57.6V	44.0V	The LLVD branch will be disconnected when battery group's voltage lower than the setting voltage value, but only when the LVD-Mode is "Volt".
BLVD Voltage Active	30V-57.6V	43.2V	The BLVD branch will be disconnected when battery group's voltage lower than the setting voltage value, but only when the LVD-Mode is "Volt".
LLVD High Temperature Active	25℃-55℃	35℃	High temperature disconnection.
BLVD High Temperature Active	25℃-55℃	35℃	High temperature disconnection.
LLVD Low Temperature Active	-33℃-0℃	-15℃	Low temperature disconnection.
BLVD Low Temperature Active	-33℃-0℃	-15℃	Low temperature disconnection.

1.5.3 Battery Management

The relationship between the floating and boosting as below Figure 1-5 :

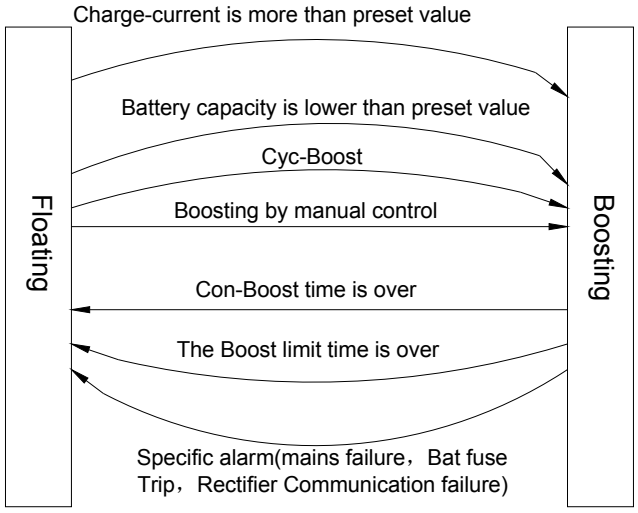


Figure 1-5 The transformation of floating and boosting

When the system configures battery management function, the specific parameters should be set as below.

Charge Management

In battery setting, all the parameters could be setting here, here just shows the charge management as Figure 1-6.

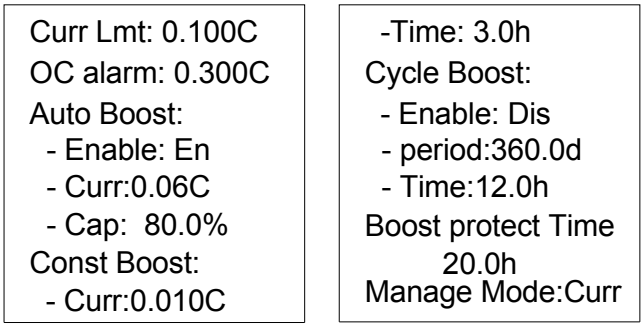


Figure 1-6Charge management setting

Choose the right item and set the right parameter, then press the enter key to confirm. The Charge-Manage' parameter setting range, factory default value, and setting instructions see below Table 1-3.

Table 1-3 Charge-Manage Parameter Setting Instructions

Name	Setting Range	Default	Setting Instructions
Float Volt	43.2V-58V	53.5V	Output voltage of the Rectifier in floating.
Boost Volt		56.4V	Output voltage of the Rectifier in boosting, and the value must be set more than the "Float-Volt" value.
Limit Rate	0.1-0.4C10	0.1C10	The battery group charge current is based on the setting value and less than the setting value. C10 -- The nominal capacity for lead-acid batteries. The suggestive value is 10-20% capacity of single battery group.
OCP	0.1C10-0.35C10	0.3C10	OCP means the Over Charge Current Point. An alarm should be triggered if the charge current is more than the "OCP" setting value.
Auto-Boost	EN,DIS	EN	EN: Function is available; DIS: Function is unavailable.
Cyc-Boost		DIS	
Cyc-Boost Perd	1-360d	360d	Cyc-Boost Perd: Time between twice Cyc-Boost. When Cyc-Boost is running, the battery charge voltage is the setting value of the "Boost Volt" and the charge time is the setting value of the "Cyc-Boost Time".
Cyc-Boost Time	0.5-24h	12h	
Auto-Boost Curr	0.05-0.08C10	0.06C10	In the auto-boost condition, the monitor should control the system running under boosting when the capacity of battery group is lower than the "Auto-Boost Cap" or when the charge current is more than the "Auto-Boost Curr", at this moment, the battery charge voltage is "Boost Volt" setting value.
Auto-Boost Cap	10%-95%	80%	
Con-Boost Curr	0.002-0.02C10	0.01C10	During the boosting, if the charge current is lower than the "Con-Boost Curr" and after a period of "Con-Boost Time" , then the system should start floating automatically.
Con-Boost Time	0.5-24h	3h	
Boost Limit Time	0.5-48h	6h	During the boosting, if the boosting time meets the "Boost Limit Time" setting value, at this moment, the system should start floating automatically.

1.5.4 Energy saving management (ECO)

Operating principle:

The rectifier will get higher efficiency at 40% to 90% load rate. So we want to make the rectifier works at a higher load rate condition to reduce the loose of the power.

Energy-saving function is dedicated designed for this.

If the rectifier system has excess capacity of the current, more than the sum of load current, the system will turn rectifiers off and on to ensure the remaining rectifiers will operate in the most efficient zone of the output efficiency characteristic. If the load increases, the rectifiers shall automatically be turned on to avoid battery discharge.

The ECO function shall have a ‘Shuffle rectifier’ setting. This function will sequentially rotate which rectifiers are switched on. The interval of rotation shall be programmable. Furthermore, during the rotation cycle, 1 rectifier turns on and after a ‘delay period’, the longest running rectifier will then be turned off. The ‘delay period’ shall be programmable.

The energy saving function is not allowed when the battery is unavailable.

The energy saving function will be interrupted when AC overvoltage/undervoltage, phase failure, DC overvoltage/undervoltage, rectifiers fault, controller fault, boosting charge, battery test, and such as these important things happen.

Setting Param-ECO

Enter the “Main Monitor Set” –“ECO Setting”, as below Figure 1-7

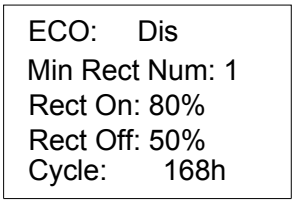


Figure 1-7 Parameter-ECO Setting

Starting Condition

- Set “ECO” to “EN”
- Set “Min Rect Num: X”, that means at least X rectifier(s) in the system when ECO running
- Set rectifiers turn on and turn off point
- Set shift cycle of rectifiers

Note: The ECO function is not allowed when the number of the battery shunt is zero.

1.5.5 Alarm and Protection

The system has lots of alarms, including internal alarms and external alarms.

The internal alarms mainly are the alarm happened in the system; the external alarms mainly come from external input.

Internal alarms include, load fuse/MCB trip, battery fuse/MCB trip, DC overvoltage/undervoltage, battery discharge, high temperature, low temperature, LVD active, rectifier/other power module fault, and so on.

External alarms include, Digit input, external sensors such as temperature…

When an alarm occurs, it can be sent to the host by communication or relay output.

For protection,

The system controller will control the system to avoid over charging the battery, over discharging the battery;

When AC over voltage happens, the rectifiers will turn off automatically;

When AC under voltage happens, the rectifiers will de-rate until to turn off automatically;

When DC over voltage happens, the rectifiers will turn off automatically by themselves or by controller automatically if software protection is enabled.

Chapter 2 Installation Instruction

This chapter introduces installation and cable connection. Before installation, please read through safety precaution and safety regulations, and then follow this instruction to carry out the installation step by step.

2.1 Safety Regulations

Certain components in this system carry hazardous voltage and current. Please read the safety caution in the user manual and always follow the instructions below before do any operation or installation:

1. Only the adequately trained personnel with satisfactory knowledge of the power system can carry out the installation. The most recent revision of these safety rules and local safety rules in force shall be adhered to during the installation.

2. All external circuits that are below -48V and connected to the power system must comply with the requirements of SELV as defined in IEC 60950.

3. Make sure that the power (mains and battery) to the system is cut off before any operations can be carried out within the system cabinet.

4. The power cabinets shall be kept locked and placed in a locked room. The key keeper should be the one who are responsible for the system.

5. The wiring of the power distribution cables should be arranged carefully so that the cables are kept away from the maintenance personnel.

2.2 Preparation

Unpacking inspection

The equipment should be unpacked and inspected after it arrives at the installation site. The inspection shall be done by representatives of both the user and DPC Co., Ltd.

To inspect the equipment, you should open the packing case, take out the packing list and check against the packing list that the equipment is correct and complete. Make sure that the equipment is delivered intact.

Cables

The cable should be selected in accordance with relevant industry standards.

The sectional area of DC cable depends on the current flowing through the cable, the allowable voltage drop, load peak current, and the ambient.

The cable rated temperature should be more than 90℃. Select the battery cable sectional area according to Table 2-1. Select the load cable sectional area according to Table 2-2.

Table 2-1 Battery cable CSA selection

Battery fuse/MCB rated current	Max. Battery current	Max. Battery current	Min. cable CSA	Max. cable length (volt drop: 0.5V, with max. CSA)
30A	30A	30A	4.0 mm^2	1.86m
50A	50A	50A	10 mm^2	2.79m

Table 2-2 Load cable CSA selection

Load route rated current	Max. output current	Min. cable CSA	Max. cable length (volt drop: 0.5V, with min. CSA)
30A	30A	4.0mm^2	1.86m
10A	10A	1.5mm^2	2.1m

The MCB of this system should be derated, it should be derated to rating of 80% to insure reliable power supply for different environment temperature or different way to install MCB.

Select the cable sectional area according to the table 3B of EN60950 《Safety of information technology equipment》.

Usually, we use copper wire cable. If aluminum wire cable is replaced, please use the recommended value correctly to prevent accidents for heating cables.

Longer cable in the same sectional area can be used when more voltage drop is allowable.

Farther transmission distance can be got when bigger sectional area cable is used.

2.3 Mechanical Installation

1. Install brackets.

Fix the brackets on the left and right side of subrack power system with screws. Users can choose proper installation position according to actual instance.

2. Install subrack power supply.

Fix the subrack in the cabinet with fixing screws. The installation dimensions are shown in Figure 2-1.

3, Install rectifiers and controller into subrack

Inset the rectifiers and controller into subrack. After the modules were pushed into the cases completely, close their handles and fix the screws well.

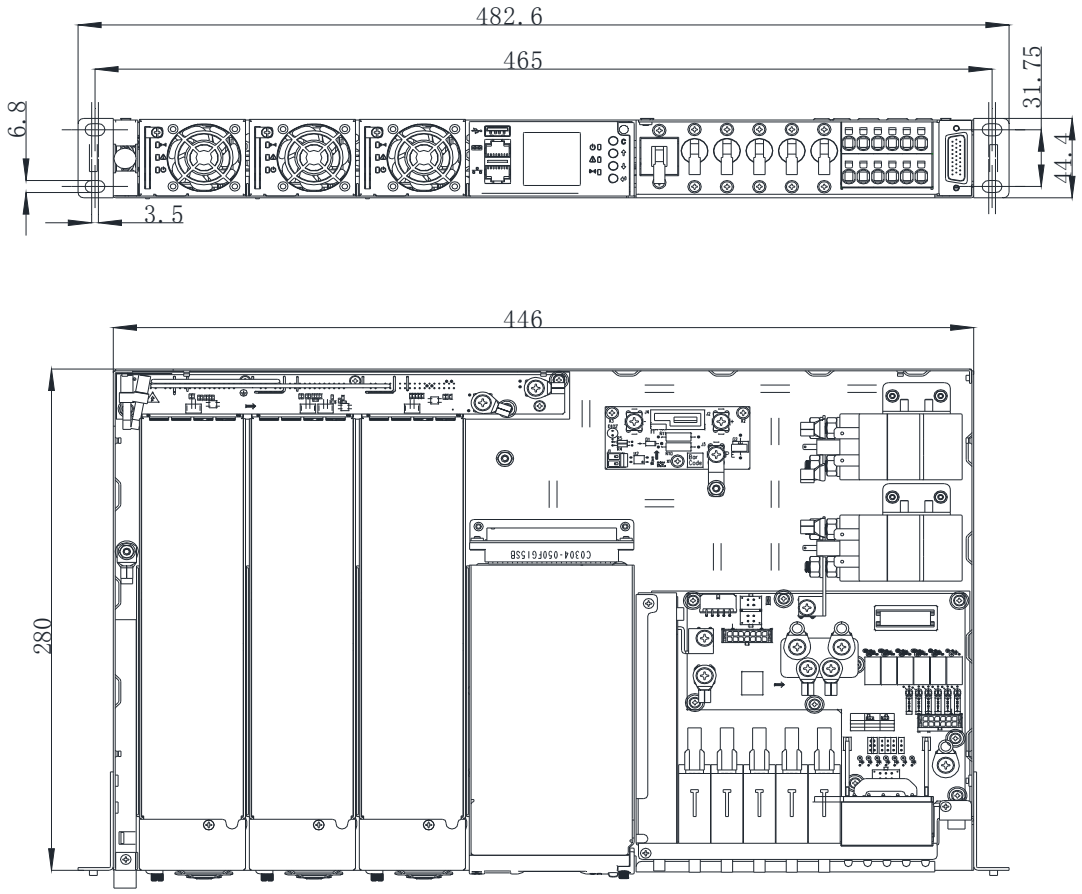


Figure 2-1 Installation Dimension

2.4 Electrical Installation

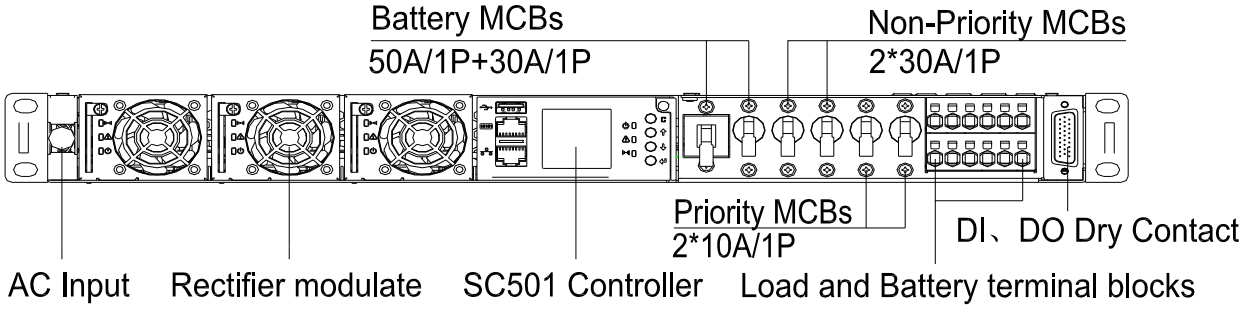
2.4.1 Connecting Power Cables

Danger

1. Switch off all MCBs before the electrical connection.
2. Only the qualified personnel can do the power cable connection.
3. The batteries may have dangerous current. Before connecting battery cables, make sure that the battery fuses at the battery side and battery MCBs at the system side are switched off. If there are no battery fuses at the battery side, you should disconnect any one of the connectors between battery cells to avoid live state of the system after installation.
4. Be careful not to reversely connect the battery. Otherwise, both the battery and the system will be damaged!
5. AC cables must be connected according to the silkscreen of the back insulation cover plate and this manual.

When connecting the AC cables, connect the AC PE to the main grounding screw and the locking screw. Then connect the AC L and N cables to the AC input terminals on the backboard to ensure that L and N are not reversed and the installation is reliable.

When connecting the DC cables, connect the battery positive cable and the load positive cable to the connector DC + in Figure 2-2 and the cable crimp-style terminal into the battery. Then connect the negative battery cable and negative load cable respectively to Figure 2-2 The negative terminal (BAT1-, BAT2-, F1-, F2-, F3-, F4-) for the connector. Be sure to tie the cable after the connection is completed to ensure that the connection point between the cable and the system is free from external forces.



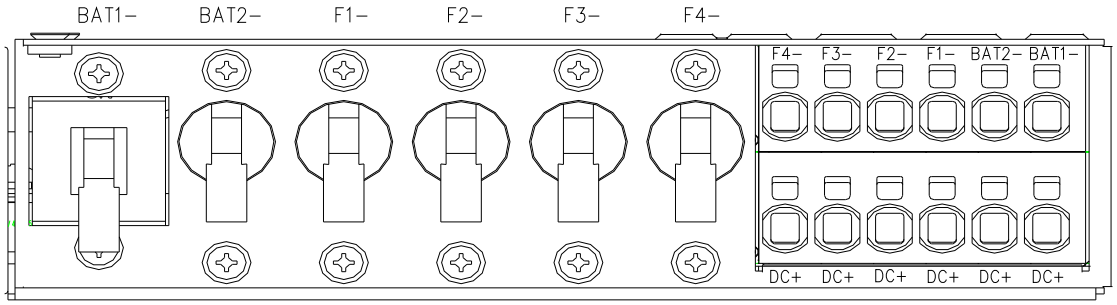


Figure 2-2 Terminals' Position of 1U system

Load connector wiring as follows:

1, The connector crimping range ≤ 6.0 mm^2

2, Connect the load, first remove the power cable head sheath, crimp good tube terminal directly into the connector's corresponding interface .

3, After the cable is connected, pull the cable lightly to test the connection of the cable. Do not apply excessive force to avoid pulling off the cable.

4. When you need to pull out the power cable, use a flat-blade screwdriver or similar tool to insert the square hole in the upper part of the connector to hold it in and press it down, and then loosen the shrapnel and pull out the cable.

2.4.2 Connecting Signal Cables

Power system DB26 plug dry contact and temperature sensor is defined as shown in Figure 2-3: DB26 control signal cable (optional), length 3 meters

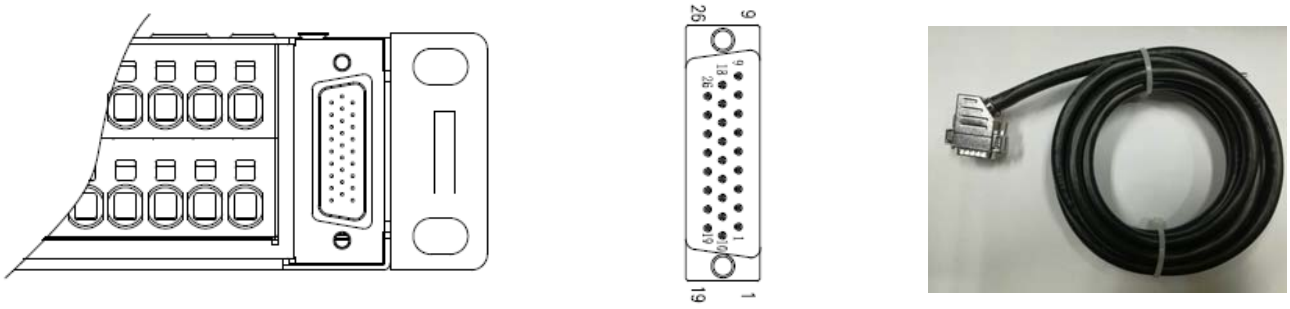


Figure 2-3 Terminal block diagram

DB26 connector pin correspondence between the table below:

PIN	Corresponding signal cable color	Signal	Description
1	Purple	DI1	Digital input 1
2	Yellow/Green	DI2	Digital input 2
3	Light Green	DI3	Digital input 3
4	Green/Black	DI4	Digital input 4
5	Grey	DI5	Digital input 5
6	Red	DI6	Digital input 6
7	Yellow/Black	DI_COM	Digital input reference
8	Brown/White	DI_COM	
9	Purple/White	V_BAT1_M	Battery 1 middle point voltage sample
10	Orange/Black	COM1	Relay outputs common 1
11	Orange	COM2	Relay outputs common 2
12	Green	COM3	Relay outputs common 3
13	Pink	COM4	Relay outputs common 4
14	Grey/Black	COM5	Relay outputs common 5
15	Light Blue	COM6	Relay outputs common 6
16	White/Black	TEMP_PS	Connect temperature sensor (NTC) between Temp1 or Temp2 and this Pin
17	Yellow	TEMP_PS	
18	Blue/White	V-BAT2_M	Battery 2 middle point voltage sample
19	Black	N1	Relay outputs 1 （NO and COM）
20	Blue	N2	Relay outputs 2 （NO and COM）
21	Light Green/Black	N3	Relay outputs 3 （NO and COM）
22	Pink/Black	N4	Relay outputs 4 （NO and COM）
23	Red/Black	N5	Relay outputs 5 （NO and COM）
24	Brown	N6	Relay outputs 6 （NO and COM）
25	White	TEMP1	Temperature measurement 1
26	Light Blue/Black	TEMP2	Temperature measurement 2

Note:

①□ Dry contact leads to the signal cables and terminals and temperature sensors configured by the customer, you need to provide the Division stated in the order.

②□ The capacity of the dry contact is 30VDC/2A or 125VAC/0.5A.

③□ TEMP_PS, TEMP1, TEMP2 temperature detection signals are forbidden to touch the chassis, otherwise it will be damaged.

2.4.3 Connecting RS485 Cable

The position of the RS485 port is on top of SC501 controller unit. Customers can manufacture the cable by themselves according to the detail information as below;

1) For RS485 terminal, the definitions show as Figure2-4.

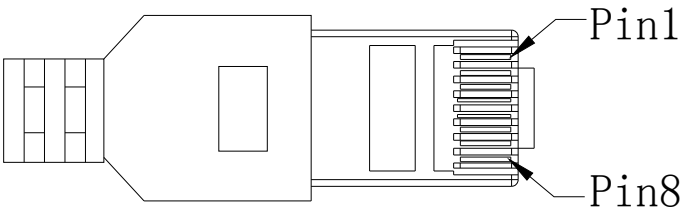


Figure2-4 *The RS485 terminal definitions*

2) But in Ethernet port, it has two RS485 terminals, and the definition are same with RS485 port, see Table2-3. If RS485 used, any port is suitable.

Table2-3 Definitions of Ethernet & RS485

RS485		Ethernet	
Pin	Signal	Pin	Signal
1	NA	1	TX+
2	NA	2	TX-
3	NA	3	RX+
4	485_1_A	4	NA*(485_1_A)*
5	485_1_B	5	NA*(485_1_B)*
6	NA	6	RX-
7	485_2_A	7	NA*(485_2_A)*
8	485_2_B	8	NA*(485_2_B)*

Chapter 3 Installation Testing

This chapter introduces procedures of installation testing. The corresponding safety rules shall be obeyed by in the test.

3.1 Installation Check and Startup

Before the test, inform the chief manufacturer representative. Only the trained electrical engineer can maintain and operate this equipment. In operation, the installation personnel are not allowed to wear conductive objects such as watches, bracelets, bangles and rings.

During operation, parts of this equipment carry hazardous voltage. Any misoperation can result in severe or fatal injuries and property damage. Before the test, check the equipment to ensure the proper grounding. Installation check must be done before testing. Then the batteries can be charged for the first time.

Make sure that the AC input MCBs and load MCBs are switched off. Make sure that all the devices are properly installed.

Installation check

Check item	OK	Comments
Check all the MCBs are disconnected.		
Check all the MCBs, fuse and cables.		
Check the input and output cable connection, and connection between the power system and the system grounding		
Check if the number and connections of the batteries are correct. Check the polarity of the battery string with a voltmeter		
Make sure all the connections are firm and reliable		
Make sure all the communication cables and alarm cables are connected to the monitoring module. Check that the temperature sensor, if any, has been installed		

Startup preparations

Check item	OK	Comments
Make sure that all the MCB are switched off and all the fuses are removed		
Measure the AC input voltage. Make sure the input voltage is within the allowable range		Umin=___V
Check that the battery string circuit is not closed		
Connect the disconnected batteries to the battery string circuit		
Measure with a voltmeter across the connection points of each battery and make sure that the polarity is right. For a lead-acid battery with 24 cells, the voltmeter should be 2.0 - 2.1V/cell or 48 - 52.8V/battery. If the voltage of certain cell is lower than 2.0V, that cell must be replaced		Umin=___V
Check with an ohmmeter that there is no short circuit between the positive & negative distribution bus-bars, or between the positive & negative battery poles (Note: Pull out all modules before the check and restore them after the check)		

Startup

Check item	OK	Comments
Switch on the system AC input MCB and DC output MCB. Insert one rectifier. The monitoring module will show the voltage and current		
The green LED on the rectifier will be on and the fan will start running after a certain delay. The monitoring module will show that the power supply voltage is 53.5V(Or float voltage setting value).		
Set the battery capacity as same with the actual capacity. The capacity in this system is the sum of capacity of all battery strings. Then turn on the battery MCBs.		
When the battery voltage is lower, the bus-bar volt maybe under 53.5V because of current limit.		

Check the system voltage with a voltmeter. The voltage difference between the measured value and displayed value should be less than ±0.2V		
Start and stop each rectifier of the system by inserting and unplugging the rectifier. Check their output voltages		

3.2 Basic Settings

3.2.1 Parameter setting

When the system starts to use, the parameters of system should be preset according to the actual system configuration (refer to Appendix 2), such as battery number, battery charge factor and other functional requirements, but the battery capacity should be set by user according to the actual situation.

We maybe update the controller for easy using, such as adjust the display interface, add new function, but this manual maybe not be updated.

3.2.2 Login & Password

For security, there are two default passwords in the monitoring module show as below, please reset the passwords when using. Any operation for monitoring module must be qualified or you can only browse the system information.

Project password (Low Authorized): 1031

Admin password (High Authorized): 170313

The max password length is nine characters, it can be set as numbers or letters, and the way to enter the password as below:

For example, password is "170313", see below Figure 3-1.

Firstly, you need to enter these six numbers (1, 7, 0, 3, 1, 3.) according to press the "↓" button, "↑" button and "enter" button;

Secondly, if your password is less than nine characters, a blank need to be enter after the last number "3" according to press "↓" button as below figure.

Finally, press "enter" button to confirm, then you will log in and can modify some parameters.

Figure 3-1 Login Screen

3.2.3 Other

For more information about SC501 controller, please refer to < SC501 USER MANUAL>.

3.3 Alarm Check and System Operation Status

Alarm

Check that all functional units can trigger alarms that can be displayed on the monitoring module.

Check item	OK	Comments
Pull out one rectifier. The 'RecN lost' alarm should be triggered. Insert the rectifier in. The alarm should disappear. Repeat the same procedures on other rectifiers		
Switch off the battery fuse/MCB that has been connected to the battery. The 'BatFuse N Trip' alarm should be triggered. Insert the battery fuse. The alarm should be cleared.		
Switch off a load MCB that has been connected to the load. The alarm 'Load Branch1 Trip' should be triggered. Switch on the MCB, and the alarm should be cleared. Repeat the same on the other load MCBs		
Keep the rectifiers in operation. Enter the system control menu at the controller. Set the operate mode from "Auto" to 'Manual', then set BLVD 'Disconnect' and confirm it. The battery protection contactor should be open, and the 'BLVD' alarm should be displayed at the monitoring module		

System operation status

There should be no alarms during normal system operation. The system operation status check can be conducted through the controller.

Check item	OK	Comments
The system setting is correct		
The controller should display the correct AC voltage		
The controller should be able to display the DC voltage. The difference between the displayed voltage and that measured at the busbar with should be less than ±0.2V		
The controller should display the battery current. The difference between the displayed and measured battery current should be less than 1%		
Check the number of the rectifier through the controller. The number should be consistent with the actual number		
Check the voltage, current, current limiting factor of rectifiers through the controller.		
For the system configured with temperature sensor, the controller should be able to display the battery/ambient temperature. Hold the probe of the temperature sensor with hand and watch the monitoring module, which should display the change of temperature		

3.4 Final Steps

Check item	OK	Comments
Make sure that materials irrelevant to the equipment have been all removed	☐	
Fill in the installation report and hand it over to the user	☐	
Fill in FAILURE REPORT if any question occurred	☐	

If any defect is found in this equipment, inform the personnel who is responsible for the contract.

If repairing is needed, please fill in the FAILURE REPORT and send the report together with the defective unit to the Service center.

Chapter 4 Alarm Handling

This chapter describes the handling of alarms, as well as the preventive maintenance of the system during system daily operation.

The maintenance personnel must have adequate knowledge about the system.

🕮 **Note**

1. The maintenance must be conducted under the guidance of related safety regulations.
2. Only the trained personnel with adequate knowledge about the system can maintain the inner part of the cabinet.

4.1 Alarms

The monitoring module alarms are classified in two types: major alarm, observation.

Major alarm (MA for short): this type of alarm has strong impacts on the system performance. Whenever these alarms are generated, users are supposed to handle them immediately. The alarm indicators will be on and audible indication will be given.

Observation alarm (OA for short): when this type of alarm is raised, the system maintains normal output for a while. If the alarm occurs during watch time, it should be handled immediately. If the alarm occurs during non- watch- time, handle it during watch time. The alarm indicators will be on when observation alarm occurs.

If alarms are set as 'no alarm' by the users, no visible or audible indication will be generated and the system works normally.

The meaning and degree of normal alarms are given in Table 4-1.

Table 4-1 System setting parameter description

No.	Alarm	Meaning	Fault handling	Class
1	AC Overvoltage	AC input voltage is higher than the pre-set value. Alarm disappears when AC input reach to 10Vac lower than the *pre-set value.*	Check AC input voltage	OA
2	AC Undervoltage	AC input voltage is lower than the pre-set value. Alarm disappears when AC input reach to 10Vac higher than the *pre-set value.*	Check AC input voltage	OA
3	AC Lost	When AC lost or all rectifier turn off because of AC fail	Check AC input voltage	CA
4	AC SPD	When AC SPD faults	Check SPD status, maybe need replaced.	MA
5	DC Overvoltage	DC voltage is higher than pre-set value. Alarm disappears when DC voltage reach to 0.5Vdc lower than the pre-set value	Check DC voltage	MA
6	DC Undervoltage	DC voltage is lower than preset value. Alarm disappears when DC voltage reach to 0.5Vdc higher than the *pre-set value*	Check DC voltage	MA
7	LLVD	LLVD alarm	Check AC input and battery voltage	CA
8	LLVD Failure	LLVD contactor misoperation	Check if all the routes are disconnected. Otherwise it maybe need to replace the contactor1.	CA
9	BLVD	BLVD alarm	Check AC input and battery voltage	CA
10	BLVD Failure	BLVD contactor misoperation	Check if all the routes are disconnected. Otherwise it maybe need to replace the contactor2.	CA

No.	Alarm	Meaning	Fault handling	Class
11	Bat Fuse1 trip	Battery routes MCB/Fuse trip/blowout alarm	Check the relevant MCB state, insure the system has not overload or short circuit	CA
12	Load Branch1 trip	Load MCB/Fuse trip/blowout alarm	Check the relevant MCB state, insure the system has not overload or short circuit	MA
13	Rectifier fault		Refer to Section 4.2 below.	MA
14	Amb/Bat HT/LT	The temperature is abnormal and overrun alarm(system equipped with environment sensor)	Check the cooling system and the temperature	OA

All alarms could be set, such as class, sound, validity, related relay, and so on.

4.2 Handling Rectifier Fault

Handling indicator fault

The symptoms of usual rectifier faults include: green indicator (run indicator) off, yellow indicator (protection indicator) on, yellow indicator blink, red indicator (fault indicator) on and red indicator blink.

The indicators are shown in Figure 4-1 and handling methods of the rectifier are given in Table 4-2.

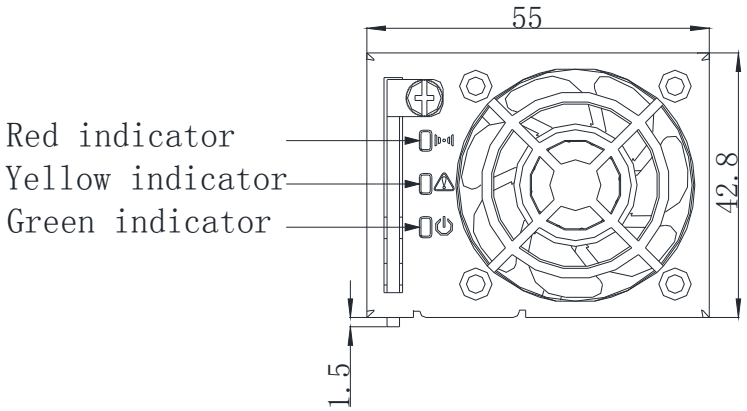


Figure 4-1 Rectifier indicator

Table 4-2 Handling methods of the rectifier

Symptom	Monitoring module alarms	Causes		Handling method
Run indicator off	No alarm	No input voltage		Make sure there is input voltage
		Assistant power source of the rectifier fails		Change the position of the faulty module with normal module. If the faulty module cannot work normally, replace it
Run indicator blinks	No alarm	The monitoring module performs operations upon the rectifier		
Yellow indicator on	Rect over temp	AC input voltage abnormal		Make sure the AC input voltage is normal
		Over-temperature protection due to:	Fan blocked	Remove the object that blocks the fan
			Ventilation path blocked at the inlet or vent	Remove the object at the inlet or vent
			Ambient temperature too high or the inlet too close to a heat source	Decrease the ambient temperature or remove the heat source

Symptom	Monitoring module alarms	Causes	Handling method
Yellow indicator on	Rect protect	Current sharing imbalance	Check whether the rectifier communication is normal. If not, check whether the communication cable is in normal connection. If the communication is normal while the protection indicator is on, replace the rectifier
		Power factor compensation low voltage or output external over voltage	Change the position of the faulty module with normal module. If the faulty module cannot work normally, replace it
		AC input over-voltage	Ensure AC input voltage normally
	Rect Not Respond	Rectifier communication interrupted	Check whether the communication cable is in normal connection
	Output external short circuit	Output external short circuit	Check whether the system or the load is short circuit.
Yellow indicator blinks	Rect Output current limit	Rect Output current limit	Check whether the setting values of current-limit parameters in the monitor are right or keep the load-rate in the right range.
Red indictor on	Rect HVSD	Rectifier over-voltage	Reset the rectifier. If the protection is triggered again, replace the rectifier
	Rect Failure	Power factor compensation over voltage	Change the position of the faulty module with normal module. If the faulty module cannot work normally, replace it
		Output inside short circuit or over load	
		Inside over temperature	Pull out the rectifier and after a period of time, re-test when the temperature is normal, if the failure still exist, replace it.
		Hot plug(Position signal detection)	Re-plug the rectifier in.
		Two or more rectifiers have the same ID number	Contact DPC for maintenance
	Rect Fan Fails	Fan fault	Replace the fan

Replacing rectifier fan

If the rectifier fan is fault, it should be replaced. Refer to Figure 4-2, for the replacing procedures:

1. Use a screwdriver to remove the one fixing screws and pull out the front panel.
2. Unplug the power cable of the fan and remove the fan.
3. Plug in the power cable of a new fan.
4. Install the new fan, with fan blowing-direction inward.
5. Restore the front panel.

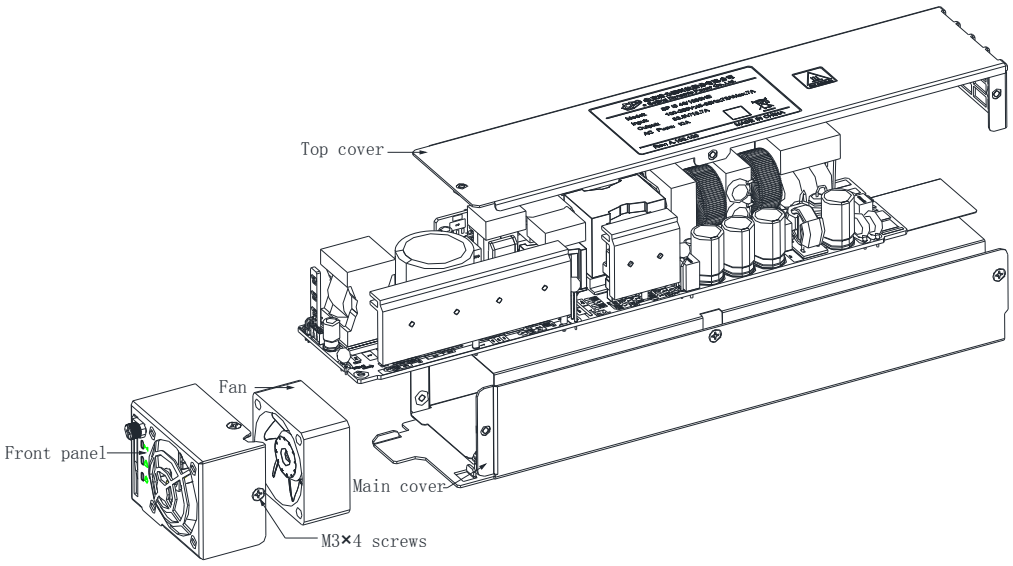


Figure 4-2 Disassembling the front panel

Replacing rectifier

1. Take a new rectifier and check it for any damage.

2. Loosen the fixing screw of the handle of the rectifier with a Phillips screwdriver.

3. Pull out the fault rectifier from the rack by grabbing its handle.

Be careful with the rectifier just pulled out from the system, as it could be very hot due to long-term operation. Do not let it slip away and get damaged.

4. Hold the rectifier handle, push the new rectifier into the slot and make sure the connection is good.

After a brief delay, the rectifier RUN indicator will turn on and the fan will start running.

5. Check that the new rectifier works normally.

You should make sure that:

1) The monitoring module recognizes the new rectifier.

2) The new rectifier shares current with other rectifiers.

3) When this new rectifier is pulled out, there is a corresponding alarm and the monitoring module displays the alarm.

If the new rectifier passes all the above tests, the replacement is a success.

6. Push the handle back into the front panel to lock the rectifier.

Appendix 1 Technical Data

Table 1 Technical data

Parameter category	Parameter	Description
Environmental	Operating temperature	-5°C - 40°C
	Storage temperature	-40°C - 70°C
	Relative humidity	5%RH - 90%RH
	Altitude	≤ 2000m (derating is necessary above 2000m)
	Others	No conductive dust or erosive gases. No danger of explosion
	Pollution level	Level 2
AC input	Input phase voltage	220Vac
	Input voltage range	100Vac - 240Vac
	Input AC voltage frequency	45Hz - 65Hz
	Max input current per rectifier	7A
	Power factor	≥0.99
	Overvoltage Category	Ⅱ
DC output	Rated output voltage	-53.5Vdc
	Output DC voltage	-42Vdc - -58Vdc
	Output current	≤56A
	Voltage set-point accuracy	≤ ±1%
	Efficiency	≥ 95%
	Noise (peak-peak)	≤ 200mV
	Weighted noise	≤ 2mV
AC input alarm and protection	AC input over-voltage alarm point	Default: 264Vac, configurable through monitoring module
	AC input over-voltage alarm recovery point	10Vac lower than the AC input over-voltage alarm point
	AC input under-voltage alarm point	Default: 176Vac, configurable through monitoring module
	AC input under-voltage alarm recovery point	10Vac higher than the AC input under-voltage alarm point
	AC input over-voltage protection point	Default: 305Vac
	AC input over-voltage protection recovery point	More than 5Vac lower than the AC input over-voltage protection point
	AC input under-voltage protection point	Default: 75Vac
	AC input under-voltage protection recovery point	More than 10Vac higher than the AC input under-voltage protection point
DC output alarm and protection	DC output over-voltage alarm point	Default: 57.6Vdc, configurable through monitoring module
	DC output over-voltage alarm recovery point	1Vdc lower than the over-voltage alarm point
DC output alarm and protection	DC output under-voltage alarm point	Default: 45.0Vdc, configurable through monitoring module
	DC output under-voltage alarm recovery point	0.5Vdc higher than the under-voltage alarm point
Rectifier	Current sharing	The imbalance is better than ± 5% rated output current. Test current range: 10% - 50% rated current. The imbalance is better than ± 3% rated output current. Test current range: 50% - 100% rated current

Parameter category	Parameter		Description
	Derated by input (45°C)		Input voltage:154Vac - 300Vac, rectifier max. output power: full power, Input voltage: 85Vac - 154Vac, rectifier output power: linear decreasing to 50% full power.
Rectifier	Output delay		Output voltage can rise slowly upon rectifier start up. The rise time is configurable
	Fan speed		Rectifier fan speed can be adjusted automatically
	Over-voltage protection		The rectifier provides over-voltage hardware and software protection. The hardware protection point is between 59V and 60V, and it requires manual resetting to restore operation. The software protection point is between 56V and 59V, and can be set through the monitoring module. There are two software protection modes, which can be selected through the software at the host: 1. Lock out at the first over-voltage Once the output voltage reaches protection point, the rectifier will shut off and hold that state. It requires manual resetting to restore the operation. 2. Lock out at the second over-voltage When the output voltage reaches the software protection point and the current is bigger than 5A, the rectifier will shutdown, and restart automatically after 5 seconds. If the over-voltage happens again within a set time (default: 5min. Configurable through monitoring module), the rectifier will shut off and hold that state. It requires manual resetting to restore the operation. If the rectifier output current is smaller than 5A, the rectifier will not shut down, no matter whether the software protection point is reached or not. Manual resetting: Resetting can be done manually through the monitoring module, or by removing the rectifier from system
	Temperature derating		-40°C -65°C, outputs full power 65°C - 75°C, output linear derating power. > 75°C, output power is 0W
EMC	CE		Class A EN55022
	RE		
	Immunity to EFT		Level 4 EN61000-4-4
	Immunity to ESD		Level 3 EN61000-4-2
	Immunity to Surges		Level 4 EN61000-4-5
	Acoustic noise		≤60dB (When the ambient temperature is 25°C)
	Insulation resistance		At temperature of 20°C - 30°C and relative humidity not bigger than 90%RH, apply a test voltage of 500Vdc. The insulation resistances between AC circuit and earth, DC circuit and earth, and AC and DC circuits are all not less than 2MΩ
	Insulation strength		(Rectifiers and monitoring module from the system before the test.) AC to DC circuits, 50Hz, 3000Vac (RMS). AC circuit to earth: 50Hz, 2500Vac (RMS). DC circuit to earth: 50Hz, 1000Vac (RMS). Assistant circuit (not directly connected to the host circuit): 50Hz, 500Vac (RMS). For all the three tests above, there should be no breakdown or flashover within 1min, with leakage current not bigger than 10mA
Mechanical	Size (W ×D ×H) (mm)	System	482.6×280×44.4
		Rectifier	55×250×41.6 （no plug including）
	Weight (kg)	System	No more than 5 Kg (no rectifier)
		Rectifier	No more than 1.1 Kg

Appendix 2 System Parameter Setting

Table 2 System basic parameters set value range and the default

Item	Name	Setting Range	Preset Value	Description
A. Quick Setting				
1	System Volt Level	24V/48V/240V/336V/500V/750V	48V	
2	System Type	I/II/III	III	
3	Total Load Current Measure	Module/total Load Shunt/DC branch Shunt	Module	
4	Battery Shunt Number	0～8	1	Please keep the battery shunt number set to “0” when there’s no battery on using.
5	LLVD Number	0-7	1	
6	Load Branch Current Number	0～72	0	
7	Load Branch State Number	0～72	2	
8	Battery Branch Number	0～8	2	Please set the battery branch number according to the actual situation; Please keep the battery branch number set to “0” when there’s no battery on
9	Battery Middle Voltage Number	0～8	2	
10	Float Voltage	(BTRM Voltage&Prediction charge end voltage~Boost Voltage)	53.5V	
11	Boost Voltage	Boost Voltage-60V	56.4V	
12	Battery Type	VRLA/LFP	VRLA	
13	Battery Cells Number	0-240	0	
14	Connect Interdependency	Dependent/Independent	Independent	
15	Disconnect Interdependency	Dependent/Independent	Independent	
16	BLVD Control	Enable/Disable	Enable	Please set to “Enable” when a BLVD contactor installed and the BLVD function need to use; Please set to “Disable” when a BLVD contactor installed and the BLVD function no need;
17	BLVD Disconnected Voltage Active	Enable/Disable	Enable	Please set to “Enable” when a BLVD function according to the voltage control;
18	BLVD Disconnected setting Voltage value	41V~（Reconnect Voltage-5V）	43.2	
19	BLVD Disconnected Time Active	Enable/Disable	Disable	Please set to “Enable” when a BLVD function according to the time control;
20	BLVD Disconnected High Temperature Active	Enable/Disable	Disable	Please set to “Enable” when a BLVD function according to the high

Item	Name	Setting Range	Preset Value	Description
21	BLVD Disconnected Low Temperature Active	Enable/Disable	Disable	Please set to “Enable” when a BLVD function according to the low temperature control;
22	BLVD Disconnected Bus Over Voltage Active	Enable/Disable	Disable	
23	BLVD Reconnected setting Voltage value	（“BLVD Disconnected setting voltage value” plus 5V）～60V	52.5	
24	LLVD Active	Enable/Disable	Enable	Please set to “Enable” when a LLVD contactor installed and the LLVD function need to use; Please set to “Disable” when a LLVD contactor installed and the LLVD function no need;
25	LLVD Disconnected Voltage Active	Enable/Disable	Enable	Please set to “Enable” when a LLVD function according to the voltage control;
26	LLVD1 Disconnected setting Voltage value	41V～（“LLVD1 Reconnected setting voltage value” minus	44	
27	LLVD Disconnected Time Active	Enable/Disable	Disable	Please set to “Enable” when a LLVD function according to the time control;
28	LLVD Disconnected High Temperature Active	Enable/Disable	Disable	Please set to “Enable” when a LLVD function according to the high
29	LLVD Disconnected Low Temperature Active	Enable/Disable	Disable	Please set to “Enable” when a LLVD function according to the low temperature
30	LLVD1 Reconnected setting Voltage value	（“LLVD1 Disconnected setting voltage value” plus 5V）～60V	52.5	
B. ***AC Setting***				
31	AC Sample	Enable/Disable	Enable	
32	AC Pharse	Single-Phase/Three-Phase	Single-Phase	
33	AC Voltage Display	Phase Voltage/Line Voltage	Phase Voltage	
C. ***DC Setting***				
34	Temp1 Setting	Ambient1~5/Battery1~5/NO	Ambient1	
35	Temp2 Setting	Ambient1~5/Battery1~5/NO	Battery1	
D. ***Battery Setting***				
36	Battery 1 Total Capacity	10～15000Ah	200Ah	This item is available only when the battery shunt number set to “1”, and the Capacity’s setting value is according to the sum of all the batteries’ capacity.
37	Battery management mode	Voltage/Current/Disable	Current	Please set to “Disable” when there’s no battery on using.
38	Battery Full Charge Limit Current	Enable/Disable	Disable	
39	Battery Fuse Break Over Current Protection	Enable/Disable	Disable	
40	Battery Capacity Prediction	Enable/Disable	Disable	
41	Float Voltage	BTRM Voltage～Boost Voltage	53.5V	
42	Boost Voltage	Float Voltage-60V	56.4V	
43	Output Voltage Compensation	Enable/Disable	Disable	
44	Current limit factor	0.1～$2C_{10}$	0.1	
45	Over-Charge current factor	0.1～$3C_{10}$	0.3	

Item	Name	Setting Range	Preset Value	Description
46	Boost protection time	0.1～48h	20h	
47	Quit boost charge when module lost	Enable/Disable	Disable	
48	Auto-boost	Enable/Disable	Enable	
49	Auto-boost start current	0.05～0.08C_{10}	0.06	
50	Auto-boost start capacity	10～95%	80	
51	Constant boost current	0.002～0.02C_{10}	0.01	
52	Constant boost time	0.1~24hour	3	
53	Cycle boost	No/Yes	No	
54	Prediction charge enable	Enable/Disable	Disable	
55	Temperature compensation control	No/Yes	No	
E. ***Alarm Setting***				
56	System SPD Fault	Enable/Disable	Disable	
F. DI Setting				
57	DI1 No alarm State	NO/NC	NO	No alarm State set to “NO” means the alarm state is NC.
58	DI2 No alarm State	NO/NC	NO	
59	DI3 No alarm State	NO/NC	NO	
60	DI4 No alarm State	NO/NC	NO	
61	DI5 No alarm State	NO/NC	NO	
62	DI6 No alarm State	NO/NC	NO	
63	DI1 Name	User-defined		
64	DI2 Name	User-defined		
65	DI3 Name	User-defined		
66	DI4 Name	User-defined		
67	DI5 Name	User-defined		
68	DI6 Name	User-defined		
G. ***SC501 Setting***				
69	Battery 1 Shunt Current	25～3000	100	
70	Battery 1 Shunt voltage	25~50	50	
H. Language Setting				
71	Language Setting	Chinese、English	English	

Appendix 3 Wiring Diagram