NetSure 701 AO2, NetSure 701 AO3 Power Supply System

User Manual

Version	V1.2
Revision date	December 31, 2017
BOM	31013245

Vertiv Tech provides customers with technical support. Users may contact the nearest Vertiv local sales office or service center.

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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. Therefore, the installation and operation personnel must receive strict training and master the correct operations and all the safety points before operation.

When operating Vertiv products, the operation 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

Danger

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 personnel must be licensed to operate high voltage and AC power.

In operation, the installation personnel are not allowed to wear conductive objects, such as watches, bracelets, bangles and rings.

When water or moisture is found on the cabinet, 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.

Danger

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

Warning

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

III. Thunderstorm

Danger

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

Note

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. Short circuit


Danger

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, and 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 muscle tense, so that when tool connection is loosened, the free movement of the human body and tool is reduced to a minimum.

Battery


Danger

Before any operation on battery, read carefully the safety precautions for battery transportation and the correct battery connection method.

Non-standard operation on the battery will cause danger. In operation, precautions should be taken to prevent battery short circuit and overflow of electrolyte. The overflow of electrolyte will erode the metal objects and PCBs, thus causing equipment damage and short circuit of PCBs.

Before any operation on battery, pay attention to the following points:

1. Remove the watch, bracelet, bangle, ring, and other metal objects on the wrist.

2. Use specialized insulated tools.

3. Use eye protection device, and take preventive measures.

4. Wear rubber gloves and apron to guard against electrolyte overflow.

5. In battery transportation, the electrode of the battery should always be kept facing upward. Never put the battery upside down or slanted.

BLVD

The system has battery low voltage disconnection (BLVD) optional function. BLVD means when the mains fail and batteries supply power, the controller cuts the load off when the battery voltage drops down to below 43.2V to prevent over-discharge. The BLVD voltage is settable. Refer to *NCU User Manual* for setting method.

The factory setting is enabling BLVD, which means that if power outage lasts for a long time or the power 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 of these loads to insure reliability of the power supply.

The method of disabling BLVD is:

Set “SMDU LVD”-“LVD1 Enable” item of the controller to “N”. Refer to *NCU User Manual* for setting method.

Notice

The advantage of enabling BLVD is protecting the batteries from over-discharge when the battery voltage is low. The disadvantage of enabling 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 software disabling BLVD is prolonging the power supply of priority loads. The disadvantage is that software disabling cannot prevent unwanted power failure due to misoperation or power system failure.

Others

I. Sharp object

Warning

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

II. Power cable

Note

Please verify the cable labels before connection.

III. Signal cables

Note

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

Contents

Chapter 1 Introduction

This chapter introduces the model information, overview and components of the NetSure 701 AO2 and NetSure 701 AO3 power supply system ("power supply system" for short).

1.1 Model Information

NetSure 701 AO2 and NetSure 701 AO3 power supply system are composed of rectifier cabinet and DC distribution cabinet (optional). Taking NetSure 701 AO2 power supply system as an example, the model information is shown in Figure 1-1.

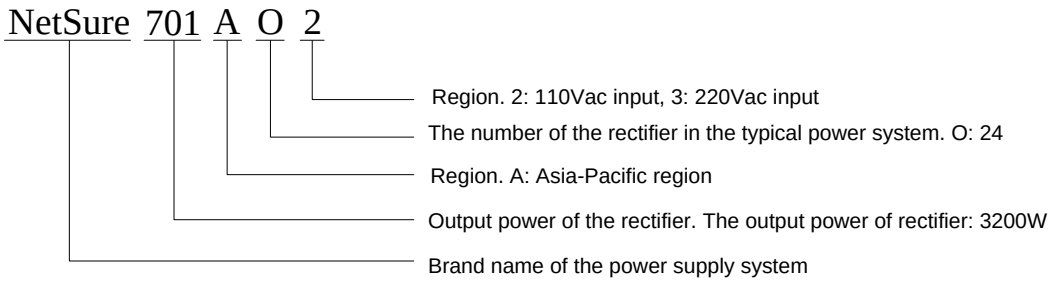


Figure 1-1 Model information of the power supply system

The model information of NetSure 701 AO2-T1 rectifier cabinet is shown in Figure 1-2.

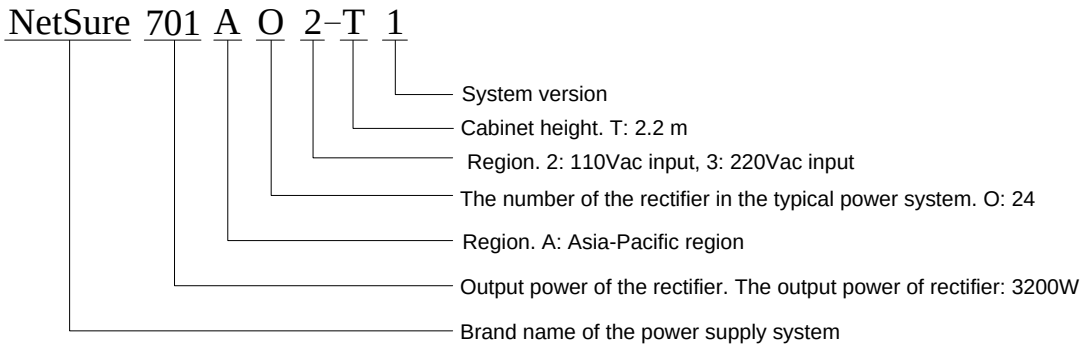


Figure 1-2 Model information of the rectifier cabinet

The model information of PD48/2000DD DC distribution cabinet is shown in Figure 1-3.

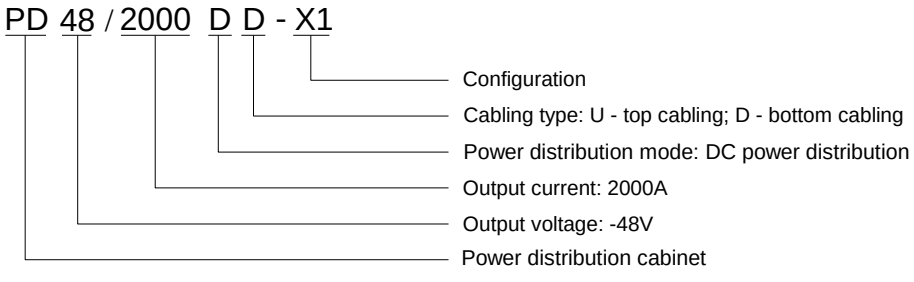


Figure 1-3 Model information of the DC distribution cabinet

1.2 Overview

NetSure 701 AO2 and NetSure 701 AO3 power supply system is a new generation of telecom power supply with exceptional reliability and performance. It is designed by Vertiv incorporating years of experience in development and equipment operation on power network.

NetSure 701 AO2 and NetSure 701 AO3 power supply system is composed of rectifier cabinet and DC distribution cabinet (optional). NetSure 701 AO2 power supply system is composed of NetSure 701 AO2-T1 rectifier cabinet and

PD48/2000DD or PD48/2000DU DC distribution cabinet (optional), applicable for 110V/120V phase voltage and 220V line voltage power grid. NetSure 701 AO3 power supply system is composed of NetSure 701 AO3-T1 rectifier cabinet and PD48/2000DD or PD48/2000DU DC distribution cabinet (optional), applicable for 220V phase voltage power grid.

The number of DC distribution cabinet and rectifier cabinet can be configured according to customer requirement. The capacity of the power supply system can be expanded up to 2640A. The power supply system composed of one DC distribution cabinet and one rectifier cabinet is shown in Figure 1-4.

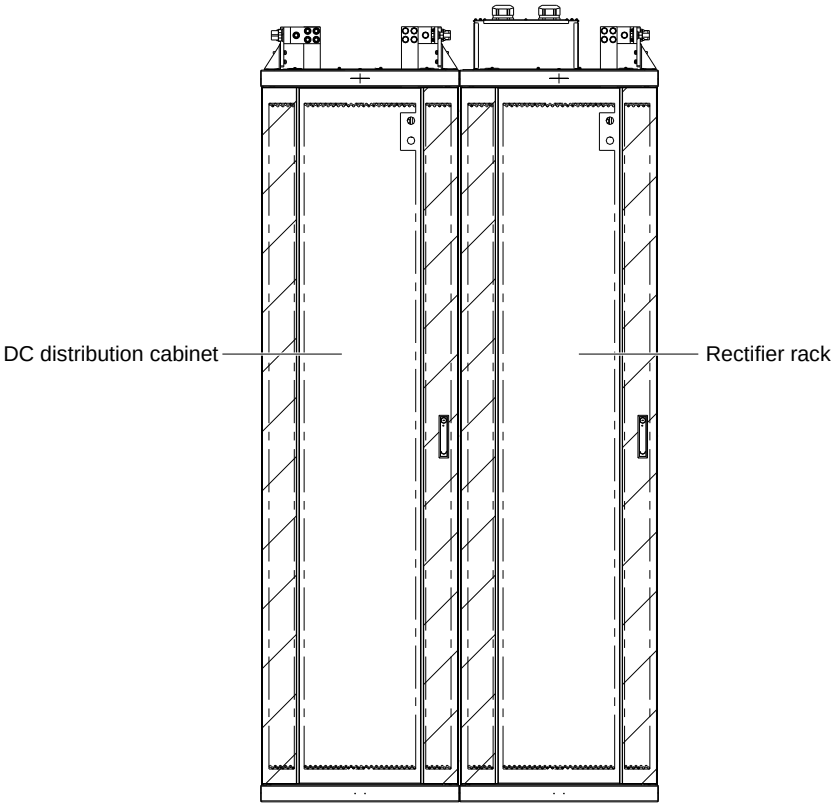


Figure 1-4 Structure of the power supply system

The configurations of DC distribution cabinet and the rectifier cabinet are given in Table 1-1, and the mechanical parameters are given in Table 1-2.

Table 1-1 Configurations of rectifier cabinets and DC distribution cabinets

Type	Model	Configuration	Options
DC distribution cabinet	PD48/2000DU	Cabling type: top cabling Maximally configured with 1 battery distribution unit, 6 high ohmic distribution units (HOD), or 6 low ohmic distribution units (LOD), or 3 fuse units	/
	PD48/2000DD	Cabling type: bottom cabling Maximally configured with 1 battery distribution unit, 6 HODs, or 6 LODs, or 3 fuse units	
Rectifier cabinet	NetSure 701 AO2-T1	Cabling type: top cabling 1. Controller M830D: 1 piece 2. Rectifier R48-3200: 2 ~ 24 pieces or R48-3500e:2~22pieces 3. DC distribution: maximally configured with 1 battery distribution unit, 2 HODs, or 2 LODs, or 1 fuse unit	Temperature sensor
	NetSure 701 AO3-T1		

Table 1-2 Mechanical parameters of rectifier cabinets and DC distribution cabinets

Cabinet or component	Dimensions (H × W × D, unit: mm)	Weight (kg)
PD48/2000DD DC distribution cabinet	2200 × 600 × 600	< 260
PD48/2000DU DC distribution cabinet	2350 × 600 × 600	< 260
NetSure 701 AO2-T1 & NetSure 701 AO3-T1 rectifier cabinet	2350 × 600 × 600	< 270 (excluding rectifiers and controller)

1.3 Components

1.3.1 DC Distribution Cabinet

The DC distribution cabinet is available in two models: PD48/2000DU and PD48/2000DD. The appearance of PD48/2000DD DC distribution cabinet is shown in Figure 1-5. The appearance of PD48/2000DU DC distribution cabinet is shown in Figure 1-6.

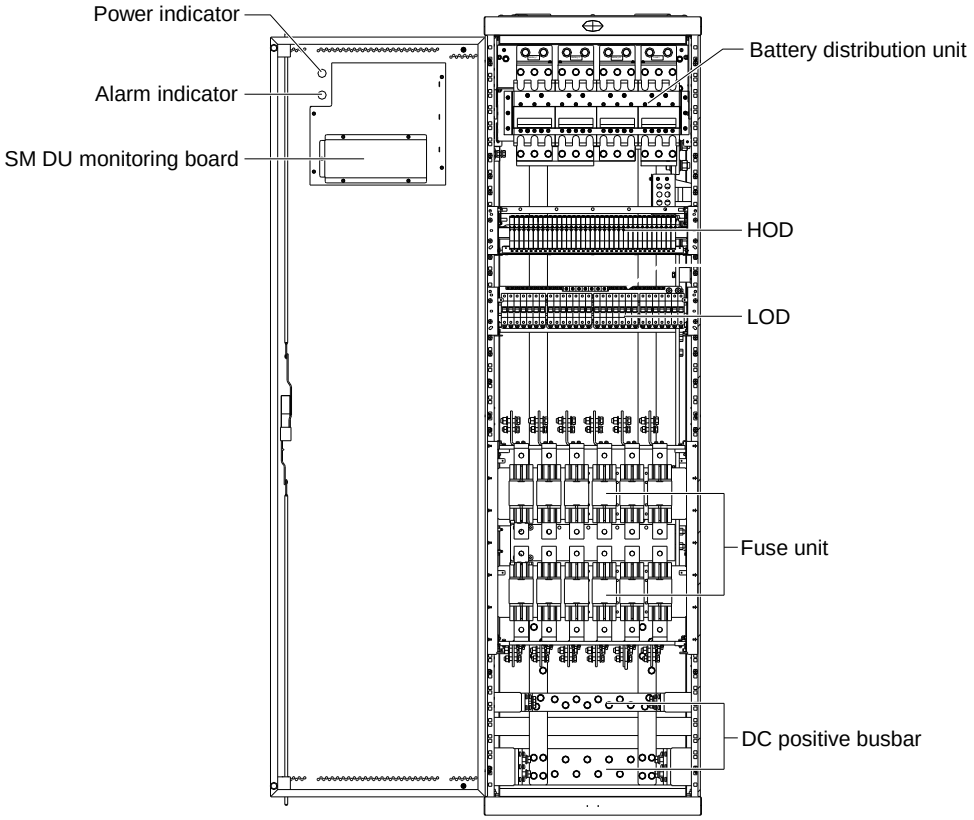


Figure 1-5 PD48/2000DD DC distribution cabinet (panels removed)

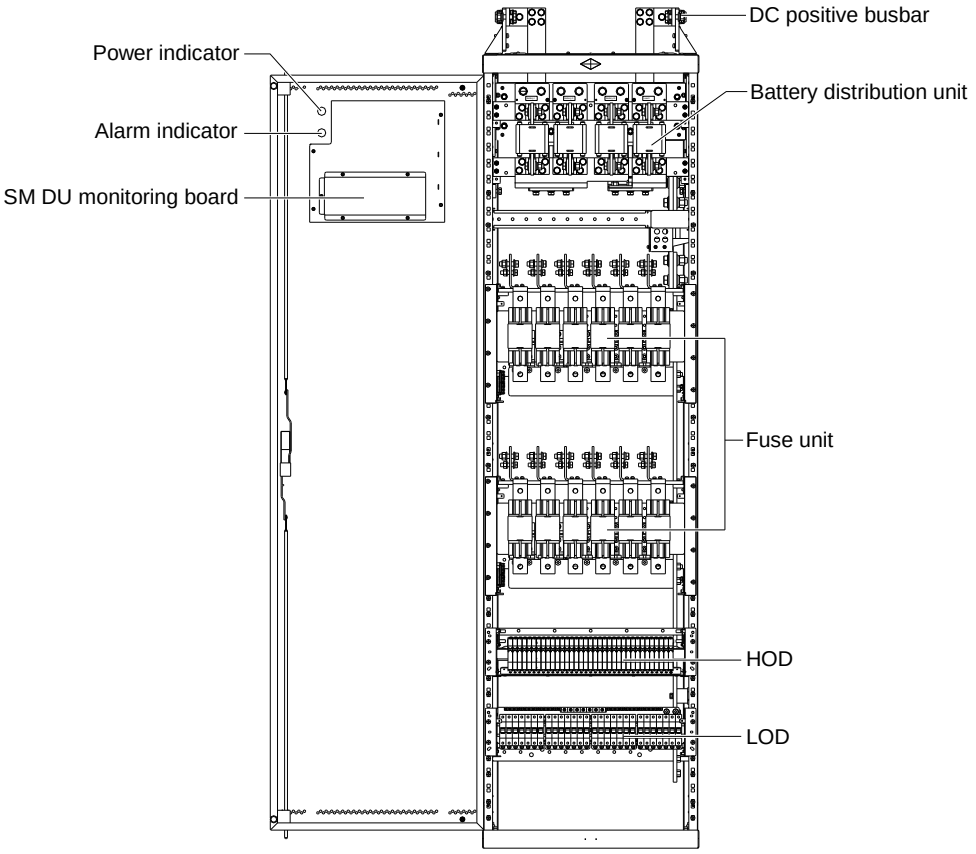


Figure 1-6 PD48/2000DU DC distribution cabinet (panels removed)

DC distribution cabinet is composed of DC distribution unit and battery distribution unit. See the following descriptions for details.

DC distribution unit

1. High ohmic distribution unit (HOD)

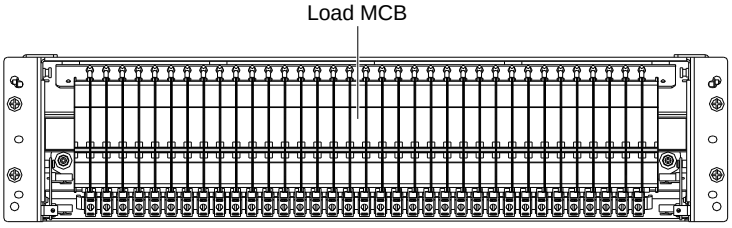
Dimensions (unit: mm): 132.5 (H) × 584 (W) × 250 (D)

Weight: 9.3kg

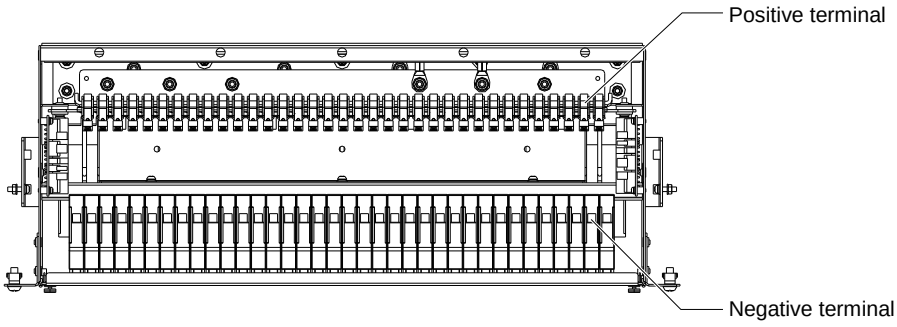
Rated current: 200A

The rated current of the MCB is 16A, and the breaking capacity is 10kA. A high ohmic resistor is series connected to each MCB route. It is recommended that the load current be smaller than 70% of the rated current, that is, 10A. Every two MCBs can be parallel connected to form a larger power distribution circuit through adding high ohmic resistor and connection terminals, so as to conduct up to 20A current. The cable cross-sectional area (CSA) of a single circuit should be at least 4mm^2.

Each HOD can be equipped with at most thirty-five MCBs of which the width is 13mm and the capacity is 16A. Each MCB is series-connected to a 40MΩ resistor, as shown in Figure 1-7.



(a) Front view



(b) Top view

Figure 1-7 HOD

2. Low ohmic distribution unit (LOD)

Dimensions (unit: mm): 132.5 (H) × 584 (W) × 250 (D)

Weight: 9.3kg

Rated current: 360A

In a standard LOD, the rated current of one MCB can be 6A ~ 40A (breaking capacity 6kA), or 50A ~ 63A (breaking capacity 4.5kA), or 80A ~ 125A (breaking capacity 10kA).

Each LOD can be equipped with at most twenty-eight 18mm MCBs or eighteen 27mm MCBs, as shown in Figure 1-8.

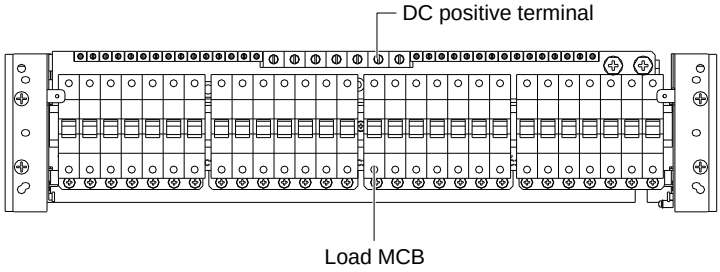


Figure 1-8 LOD

3. Fuse unit

Rated current: 1600A

The breaking capacity of NT00, NT2 and NT3 fuses is 100kA. Four types of fuse units are described below:

1) Type 1

Dimensions (unit: mm): 427 (H) × 584 (W) × 353.5 (D)

Fuse unit type 1 is suitable for NT2 and NT3 fuses. It can accommodate at most six NT2 or NT3 fuses, or six fuses combined of NT2 and NT3 fuses, as shown in Figure 1-9.

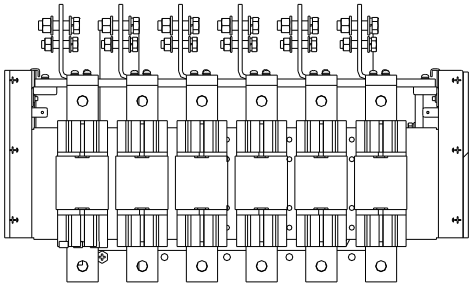


Figure 1-9 Fuse unit type 1

2) Type 2

Dimensions (unit: mm): 325 (H) × 584 (W) × 353.5 (D)

Fuse unit type 2 is suitable for NT00 fuses. It can accommodate at most 11 NT00 fuses, as shown in Figure 1-10.

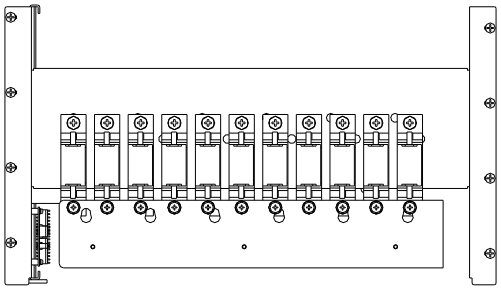


Figure 1-10 Fuse unit type 2

3) Type 3

Dimensions (unit: mm): 750 (H) × 584 (W) × 353.5 (D)

Fuse unit type 3 has two layers, and is suitable for NT2 and NT3 fuses. It can accommodate at most 12 NT2 or NT3 fuses, or 12 fuses combined of NT2 and NT3 fuses. This fuse unit is only applicable for bottom cabling DC distribution cabinet, as shown in Figure 1-11.

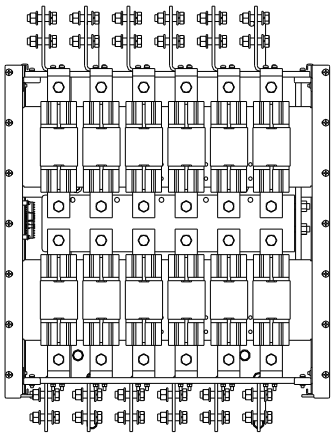


Figure 1-11 Fuse unit type 3

4) Type 4

Dimensions (unit: mm): 648 (H) × 584 (W) × 353.5 (D)

Fuse unit type 4 has two layers, and is suitable for NT00, NT2 and NT3 fuses. The top layer can accommodate at most 11 NT00 fuses. The bottom layer can accommodate at most six NT2 or NT3 fuses, or six fuses combined of NT2 and NT3 fuses. This fuse unit is only applicable for bottom cabling DC distribution cabinet, as shown in Figure 1-12.

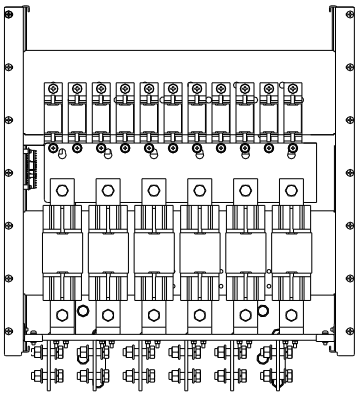


Figure 1-12 Fuse unit type 4

Battery distribution unit

There are two kinds of battery distribution units: battery distribution unit with low voltage disconnection (LVD) contactor and battery distribution unit without LVD contactor.

1. Battery distribution unit without LVD contactor

Dimensions (unit: mm): 298.5 (H) × 554 (W) × 149.7 (D)

Four types of battery distribution units without LVD contactors are provided, as shown in Figure 1-13 to Figure 1-16. The breaking capacity of the NT4 fuse is 100kA, and the breaking capacity of the MCCB is 10kA. The nominal current of the MCCB is 600A.

Battery distribution unit type 1 can accommodate fuses, which can be two battery fuses plus two load fuses, or four battery fuses. The labels of the former are Battery I, Battery II, Load I, Load II from left to right; the labels of the latter are Battery I, Battery II, Battery III, Battery IV from left to right, as shown in Figure 1-13.

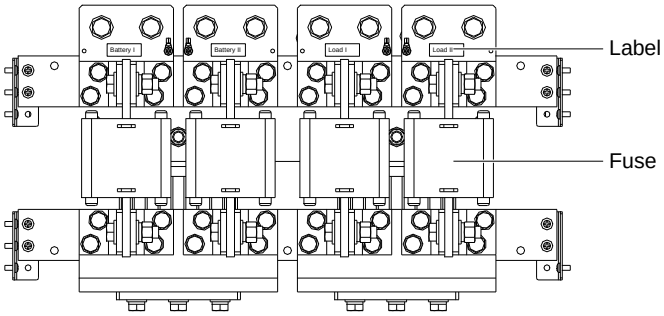


Figure 1-13 Battery distribution unit type 1

Battery distribution unit type 2 can accommodate fuses, which are three battery fuses plus one load fuse. The labels from left to right are Battery I, Battery II, Battery III, Load I, as shown in Figure 1-14.

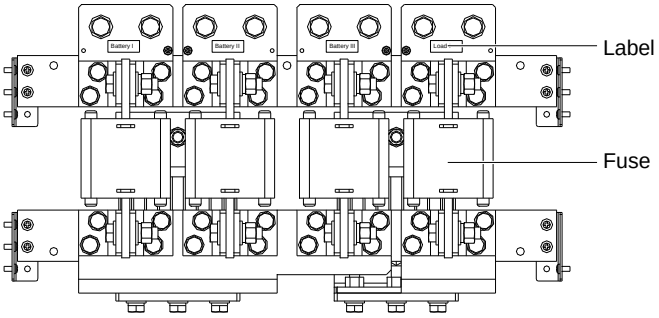


Figure 1-14 Battery distribution unit type 2

Battery distribution unit type 3 can accommodate MCCBs, which can be two battery MCCBs plus two load MCCBs, or four battery MCCBs. The labels of the former are Battery I, Battery II, Load I, Load II from left to right; the labels of the latter are Battery I, Battery II, Battery III, Battery IV from left to right, as shown in Figure 1-15.

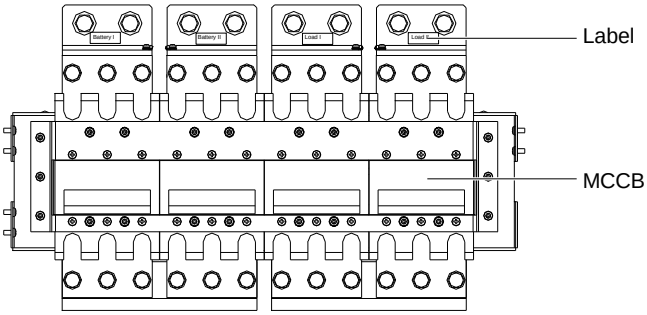


Figure 1-15 Battery distribution unit type 3

Battery distribution unit type 4 can accommodate MCCBs, which are three battery MCCBs plus one load MCCB. The labels from left to right are Battery I, Battery II, Battery III, Load I, as shown in Figure 1-16.

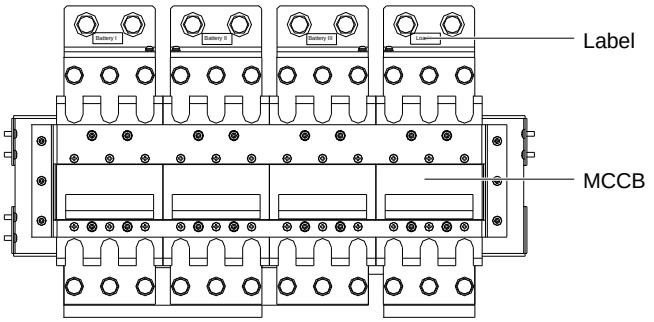


Figure 1-16 Battery distribution unit type 4

2. Battery distribution unit with LVD contactor

Dimensions (unit: mm): 383.5 (H) × 554 (W) × 190 (D)

Three types of battery distribution units with LVD contactors are provided, as shown in Figure 1-17 to Figure 1-19.

Battery distribution unit type 5 can accommodate fuses. The labels of the two battery fuses and two load fuses are Battery I, Battery II, Load I, Load II from left to right, as shown in Figure 1-17.

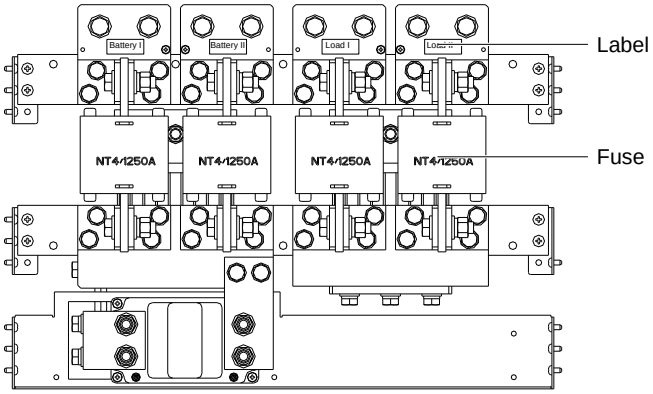


Figure 1-17 Battery distribution unit type 5

Battery distribution unit type 6 can accommodate fuses. The labels of the three battery fuses and one load fuse are Battery I, Battery II, Battery III, Load I from left to right, as shown in Figure 1-18.

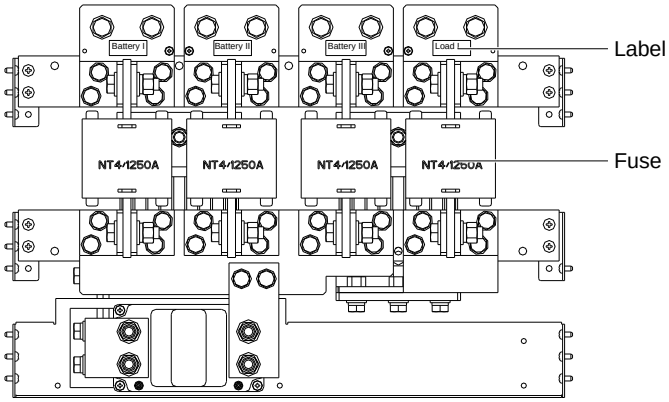


Figure 1-18 Battery distribution unit type 6

Battery distribution unit type 7 can accommodate fuses. The labels of the four battery fuses are Battery I, Battery II, Battery III, Battery IV from left to right, as shown in Figure 1-19.

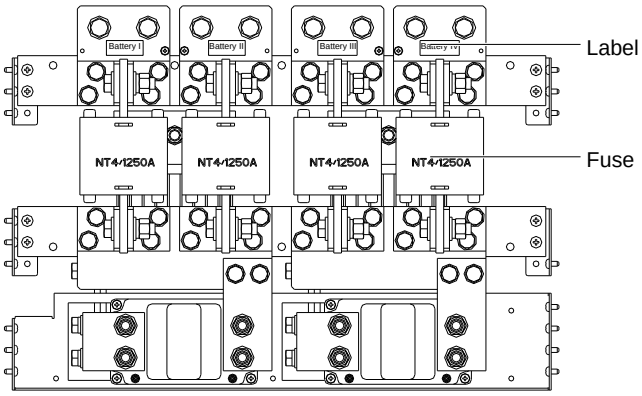


Figure 1-19 Battery distribution unit type 7

1.3.2 Rectifier Rack

The rectifier cabinet is available in two models: NetSure 701 AO2-T1 and NetSure 701 AO3-T1. The appearance of NetSure 701 AO2-T1 and NetSure 701 AO3-T1 rectifier cabinet is shown in Figure 1-20.

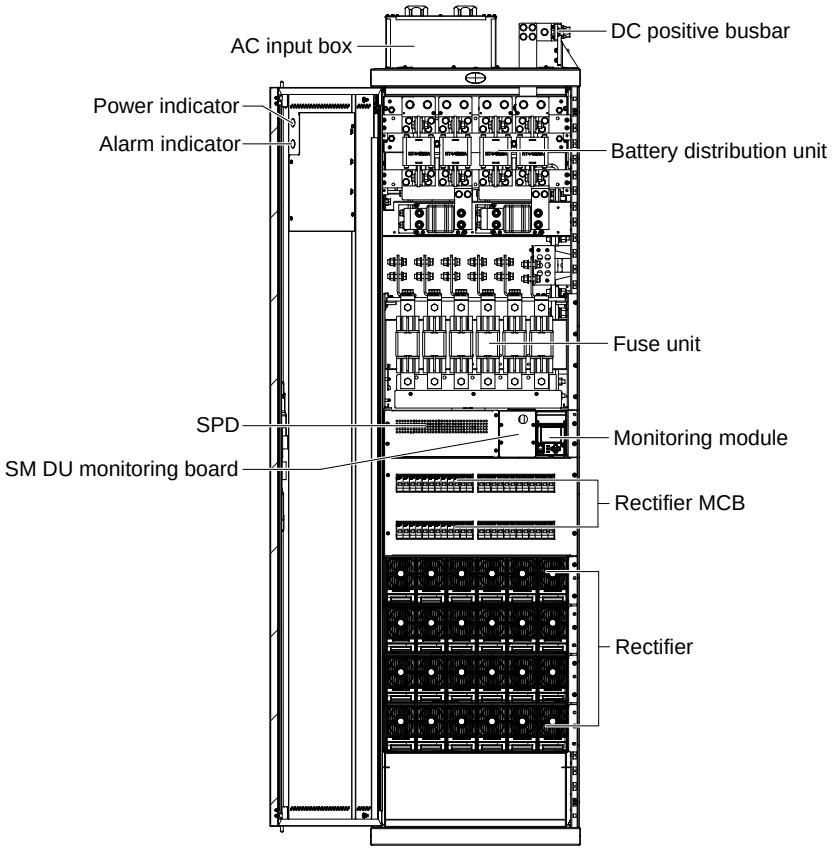


Figure 1-20 NetSure 701 AO2-T1 and NetSure 701 AO3-T1 rectifier cabinet

The power supply system using bottom cabling method should be composed of rectifier cabinet and PD48/2000DD DC distribution cabinet. The input and output cables of the rectifier cabinet should be routed through the DC distribution cabinet. It is recommended not to configure the rectifier cabinet with HOD, LOD, fuse unit or battery distribution unit, so as to reduce the amount of cables routed through the DC distribution cabinet. If battery low voltage disconnection (BLVD) function is required, the rectifier cabinet should be configured with battery distribution unit with LVD contactor.

Rectifier cabinet is composed of rectifier, controller, DC distribution unit and battery distribution unit. See the following descriptions for information of rectifier and controller. See *1.3.1 DC Distribution Cabinet* for information of DC distribution unit and battery distribution unit.

Rectifier

There are LEDs and handle on the front panel, and AC input socket, DC output socket and communication port on the rear panel of R48-3200、R48-3500e rectifier. The front panel is shown in Figure 1-21, and functions of indicators are given in Table 1-3:

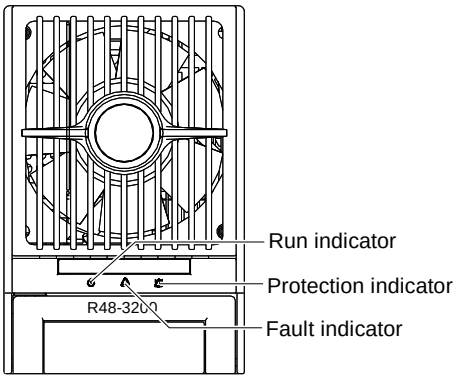


Figure 1-21 Rectifier front panel

Table 1-3 Rectifier indicator descriptions

Indicator	Normal state	Abnormal state	Fault cause
Power indicator (green)	On	Off	No input or output, auxiliary power failure
		Flashing	Being operated through the host
Protection indicator (yellow)	Off	On	AC input undervoltage/ overvoltage, rectifier PFC output undervoltage/ overvoltage, high-temperature, current sharing imbalance
		Flashing	Rectifier communication failure
Fault indicator (red)	Off	On	Output overvoltage, serious current imbalance (≥ ± 5%), rectifier addresses contradictory
		Flashing	Faulty fan

Controller

There are LCD, functional keys, indicators and handle on the front panel. The front panel of the controller is shown in Figure 1-22.

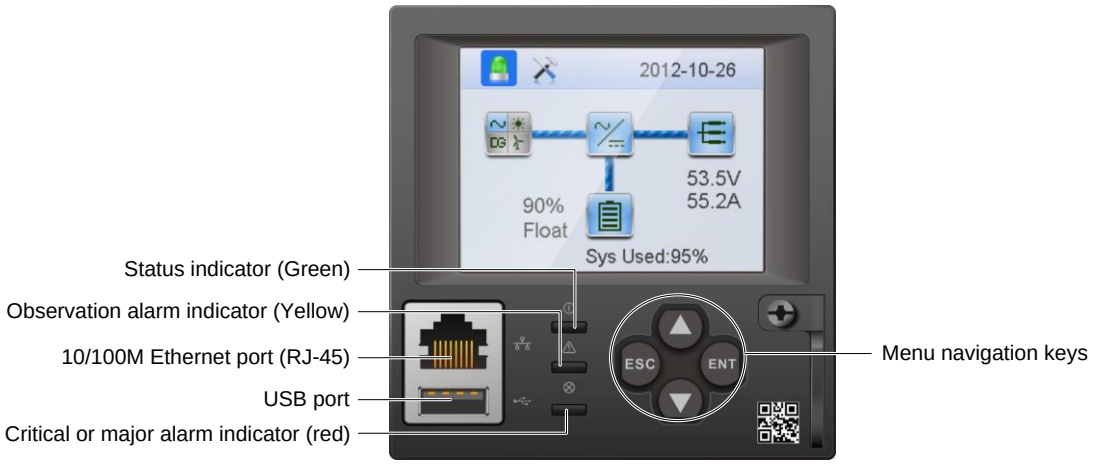


Figure 1-22 Controller

Functions of LED indicators are illustrated in Table 1-4.

Table 1-4 Controller indicator descriptions

Indicator	Normal status	Abnormal status	Cause
Status indicator (Green)	On	Off	No power supply
Observation alarm indicator	Off	On	The power supply system has at least an observation

Indicator	Normal status	Abnormal status	Cause
(Yellow)			alarm
Critical or major alarm indicator (Red)	Off	On	The power supply system has at least a major alarm or critical alarm

Chapter 2 Installation Preparation

This chapter introduces storage conditions, installation requirements, installation preparation and unpacking inspection.

2.1 Storage Conditions

The product should be kept in the packing box prior to use. The warehouse ambient temperature should range between -40°C and 70°C, and the relative humidity should be not higher than 95%. Toxic gas, flammables, explosives, corrosives, severe vibration, shock and strong magnetic field are not permitted in the warehouse.

2.2 Installation Requirements

2.2.1 Environmental Requirements

The environmental conditions listed in Table 2-1 must be considered when users locate the equipment.

Table 2-1 Environmental conditions for the equipment room

Environmental conditions	Recommended range
Ambient temperature	-10°C ~ 55°C (derating from 40°C)
Humidity	≤ 90%RH, no condensation
Dust density	≤ 1mg/m^3
Sunlight	No direct sunlight
Corrosive materials	No pollutants, such as salt, corrosive materials, or smoke
Vibration	≤ 1.5m/s^2
Harmful organisms	None
Mould	None
Dampness	The shelter should be waterproof

The power supply system may be prematurely damaged if dust or sand accumulates in it. The following measures are recommended for dirty environment:

1. The power supply system should be installed in an airtight and air-conditioned room. The air conditioner filter should be adequately maintained without being obstructed. To reduce the dust in the equipment room, unattended equipment room is recommended.

2. Clean the air filter periodically to provide clean air.

2.2.2 Layout Requirements Of The Equipment Room

Air exhaust and ventilation

When the power supply system is working, the main exothermic part is the rectifier. To ensure free airflow around the power supply system, a 0.8m clearance must be kept in front of the power supply system.

Cabling

If top cabling is used, wiring rack should be provided in the equipment room. It is recommended that the wiring rack be at least 0.3m above the power supply system. For bottom cabling system, cable trough should be provided in the equipment room, which should be not wider than the spacing between the cabinet mounting holes.

Note

To prevent electric coupling, AC cables should be laid separately from DC cables and signal cables.

Antistatic

As for antistatic requirement, the absolute value of the static voltage of the equipment, wall and people to the ground should be less than 200V. Raised floor or antistatic ceramic tile is highly recommended for the equipment room. The antistatic earth resistance should be not greater than 10Ω. Care should be taken regarding antistatic during unpacking, transportation and operation.

Lighting

Lighting in equipment room can be classified into general lighting and partial lighting. General lighting provides light for the whole room, while partial lighting is installed above the cabinet or workstation to provide light for a restricted area. It is recommended to provide both lightings in the equipment room.

Clearance

At least 1.5m clearance should be kept between the front of the cabinet and the wall. At least 0.8m clearance should be kept between the sides of the cabinet and the wall. At least 1.5m clearance should be kept between the back of the cabinet and the front of another piece of equipment. The back of the cabinet can be installed against another piece of equipment. Maintenance passage should be kept between equipment, which should be not less than 2m wide. Refer to Figure 2-1 for the above requirements:

At least 0.2m clearance should be kept between battery and the wall, and at least 0.8m clearance should be kept between batteries.

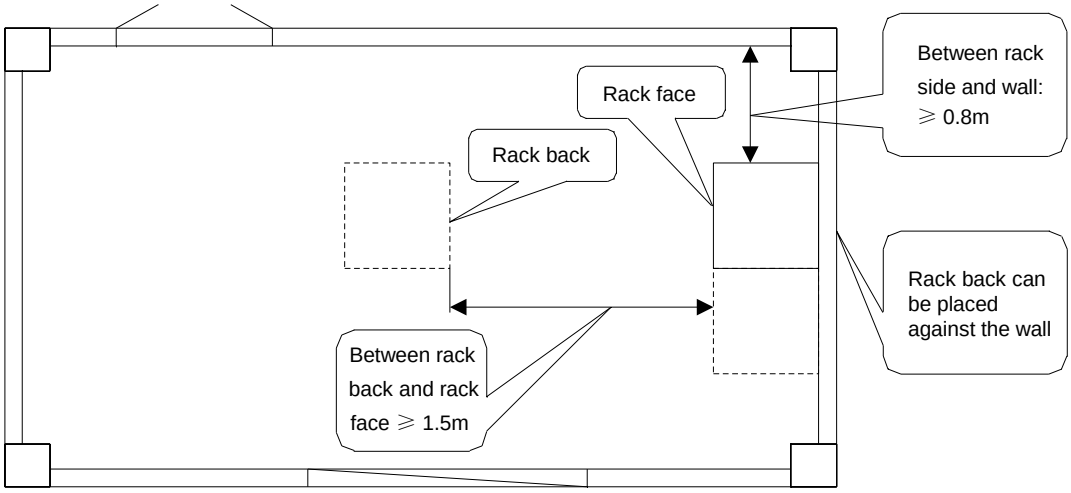


Figure 2-1 Locating cabinet

Weight capacity and shockproof

When installing the power supply system in areas subject to frequent earthquakes, shockproof measures should be taken. Firstly, expansive bolts should be used to fix the power supply system. Secondly, the power supply system should be reinforced as shown in Figure 2-2 to enhance its shockproof ability. Because the power supply system is relatively heavy, the weight capacity of the equipment room should meet relative requirements and is determined based on the equipment configuration.

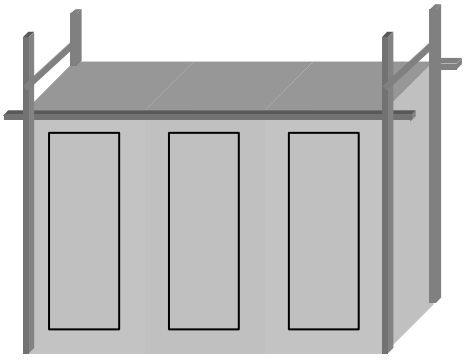


Figure 2-2 Reinforcing the cabinet for shockproof purpose

Fire protection facility

The power system is stationary equipment, please fixed on concrete or other non-combustible surface. Also enough space must be kept around equipment from combustible things.The equipment room should comply with relevant fire protection regulations and requirements for power distribution, and provide adequate fire protection facility, such as dry-chemical extinguisher and automatically explosive fire protection ball.

2.2.3 Power Supply

General

Mains power should be used as main AC source; backup batteries and generator should be provided according to actual power source conditions. AC source composed of mains power and user-provided generator should use centralized power supply mode to supply power, and low voltage AC power supply system should use three-phase five-line (neutral line invalid) mode.

The AC power cables should be copper core cable and sized to suit for the load. It is recommended that the power cables outside the equipment room should be buried directly under the ground or by means of cable pipe. Power cables should be laid separately from signal cables.

Capacity requirements

1. Power transformer

Because of the particularity of switch-mode power supply system, the power supply system should provide relatively large redundancy. If the capacity of the power transformer is small, operation of other electric equipment may be affected. Calculated based on full configuration of the power supply system, the capacity of a dedicated transformer should exceed 1.25 times the total capacity of the power supply system. So, considering other electric equipment such as air conditioner, the capacity of the transformer should be even larger, and the upper capacity level should be selected according to the specifications.

NetSure 701 AO2-T1、NetSure 701 AO3-T1 rectifier cabinet is not supposed to be directly connected to the secondary side of a transformer with capacity greater than 800kVA. An extra distribution cabinet should be used between NetSure 701 AO2-T1、NetSure 701 AO3-T1 rectifier cabinet and the transformer for shortcircuit protection.

2. Generator

It is recommended to use generator whose capacity twice that of the power supply system as backup power source. It should be calculated based on the apparent power. A simple calculation of the generator capacity is: output voltage (taken as 60V) × output current (take the final configuration) × 2.

The power factor and excitation model of the generator should also be taken into consideration when selecting a generator. Brushless generator of fundamental wave excitation model should be used with caution.

2.2.4 Safety Protection

Lightning protection & surge protection

The lightning protection and earthing system of telecom stations should comply with relevant standards.

The power supply system has optional Class-C SPD. If users have more strict requirements on surge protection, it is recommended to use an additional Class-B SPD. We suggest users choose Vertiv SPD box as Class-B SPD:

Table 2-2 Recommended Class-B SPD

BOM	Description	Model
02470018	Surge Protective Device, surge protective device, VT150TA385B, 385Vac, 60kA, 150kA, three phases box with counter, 450mm × 330mm × 150mm, wall mounting, ROHS	VT150TA385B
02470037	Surge Protective Device, surge protective device, VT110TA385B, 385Vac, 40kA, 110kA, three phases box with counter, 450mm × 330mm × 150mm, wall mounting, ROHS	VT110TA385B

The mounting of Class-B SPD is shown in Figure 2-3.

It is recommended that the cable between the Class-B SPD and the AC distribution unit of the power supply system range between 5m ~ 10m. This section of cable should be routed indoors to avoid direct lightning strike. When mounting the Class-B SPD, attention should be paid to the cross-sectional area (CSA) and length of the cable connecting the Class-B SPD: the CSA should be not less than 25mm^2; the cable should be as short as possible,

especially the earth cable of the Class-B SPD. The SPDs should be inspected periodically to ensure their normal operation.

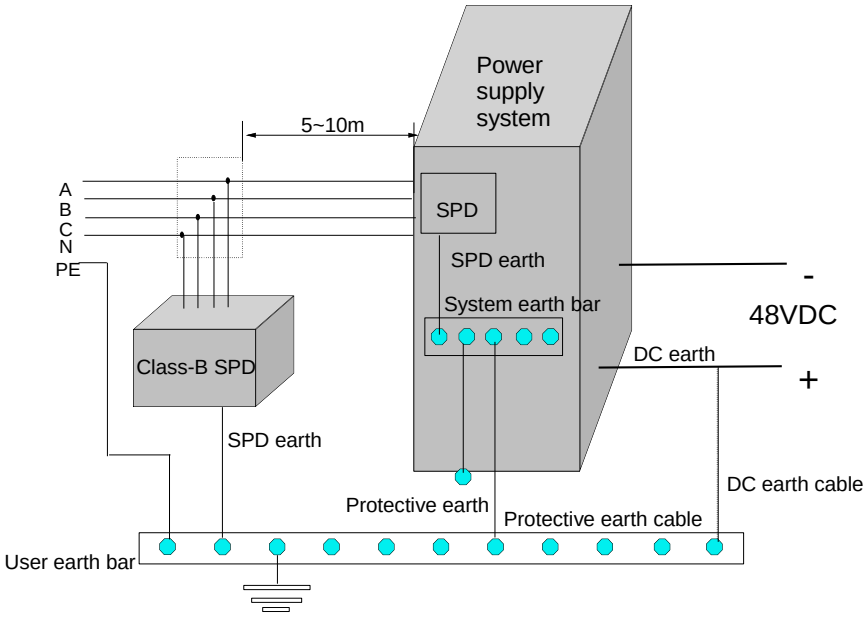


Figure 2-3 Diagram of SPD mounting & system earthing

Earthing requirement

The earthing system in the communication equipment room is generally designed on the principle of common earth, that is, DC operation earth, SPD earth and protective earth sharing the same earth. The earth resistance should be in accordance with the specifications listed in Table 2-3.

Table 2-3 Earth resistance requirements for communication station

Earth resistance	Application range
< 1Ω	Integrated building, international telecom bureau, tandem station, SPC switching office above 10000 lines, toll office above 2000 lines
< 3Ω	SPC switching office above 2000 lines and below 10000 lines, toll office below 2000 routes
< 5Ω	SPC switching office with less than 2000 lines, optical cable terminal station, carrier wave repeating station, earth station, microwave junction center, mobile communication machine station
< 10Ω	Microwave relay station, optical cable relay station, small-sized earth station
< 20Ω	Microwave passive relay station
< 10Ω	Suitable for those whose earth resistance rate is less than 100Ω·m, SPD earth in the interface between electric cable and aerial electric line
< 15Ω	Suitable for those whose earth resistance rate is 100 ~ 500Ω·m, SPD earth in the interface between electric cable and aerial electric line
< 20Ω	Suitable for those whose earth resistance rate is 501 ~ 1000Ω·m, SPD earth in the interface between electric cable and aerial electric line
Note: the content in the table is adapted from Installation Design Specifications for Communication Power Supply Equipment	

The basic method of common earth is to short the earth bar and DC earth of the power supply system to the user earth bar in the equipment room. The SPD earth and protective earth of the power supply system should be connected to the earth bar of the power supply system taking the shortest route possible, as shown in Figure 2-3.

When the AC neutral line is repeatedly earthed, the earth cable should be led out from the earth device. It is strictly prohibited to connect the AC neutral line to the earth bar inside the cabinet of the power supply system or the earth point on the cabinet. The protective earth cable of 3-phase 5-line system and single-phase 3-line system can be directly connected to the earth bar of the power supply system.

2.3 Installation Preparation

2.3.1 Field Check

Construction survey must be conducted to the equipment room before installation, which should be focused on:

1. Checking the wiring devices, such as cable trenching, wiring rack, floor, and cabling holes.

2. Checking the environmental conditions, such as temperature, humidity, and dust density.

3. Checking the conditions for installation construction, such as power supply and lighting.

2.3.2 Tools And Materials Preparation

1. Prepare tools required for installation, including electric drill, wire cutter, wire presser, various wrenches, screwdriver, electrician knife, tinning furnace, staircase and steel saw. See *7.1.2 Maintenance Tools And Equipments* for the specifications of the tools. The tools must be well insulated and antistatic handled before they are used.

2. Prepare cables. The cables accessories are given in Table 2-4. Other cables should be prepared by users in accordance with relevant specifications in the electrical industry, including AC cables, DC load cables, battery cables, earth connection cables and earth cables. No splice, damage or scratch on the cables is permitted.

Table 2-4 Accessory cables used in cable connection

BOM	Description	Length
04111819	W24GASL057 cable suite (CAN communication cable)	4.2m
04115520	W74C5FSL1 cable suite (temperature sensor cable)	10m

The power supply system uses 3-phase AC source. Copper core cables are recommended for the AC input cables, and their CSA should suit the load capacity. When the wiring distance is less than 30m, users should take 2.5A/mm^2 of economical current density to calculate the CSA of the AC cables. For NetSure 701 AO2-T1、NetSure 701 AO3-T1 rectifier cabinet, the maximum current of each phase is 141.4A. The CSA of AC input cable is 25mm^2 ~ 35mm^2. For NetSure 701 AO2-T1、NetSure 701 AO3-T1 rectifier cabinet, the maximum current of each phase is 81.6A. The CSA of AC input cable is 16mm^2 ~ 25mm^2. If two routes are connected together to supply power, the capacity doubles, and the cable CSA increases correspondingly. The width of the cable terminal should be not larger than 22mm, as shown in Figure 2-4.

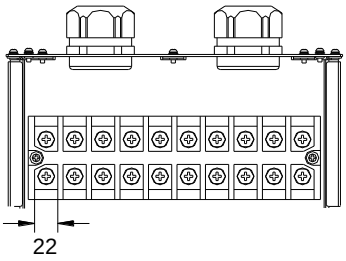


Figure 2-4 AC input terminal dimension (unit: mm)

The CSA of the load cables and battery cables should be computed with the following formula:

$A=\Sigma I \times L / (K \times \triangle U)$

In this formula: A is the CSA of the cable (mm^2), ΣI is the total current (A) passing through the lead, L is the length (m) of the lead loop, △ U is the permitted voltage drop in the lead, while K is the conductivity factor. K_{copper}=57. For the sake of distribution safety, the voltage drop on the cables connecting battery and load should be compliant with relevant standard.

The CSA of the earth connection cables (including DC earth cable) shall exceed 95mm^2.

Note

Generally, in design the total current passing through the lead is calculated based on full load configuration.

Select the battery cable CSA according to Table 2-5. Select the load cable CSA according to Table 2-6.

Table 2-5 Battery cable CSA selection

Battery fuse rated current	Max. battery current	Min. cable CSA	Terminal specs	Max. cable length (allowable voltage drop: 0.5V)
1250A	1250A	2 × 240mm²	M12 or M16 OT terminal	10m
1000A	1000A	2 × 240mm²	M12 or M16 OT terminal	13m
800A	800A	2 × 185mm²	M12 or M16 OT terminal	13m
Note: 1. The specs are applicable at ambient temperature of 25°C. If the temperature is higher or lower than this, the CSA of the cable should be increased. 2. The battery cable should reach at least +90°C heat durability. It is recommended to use double-insulated copper-core flame retardant cable as battery cable				

Table 2-6 Load cable selection

Load route rated current	Max. output current	Min. cable CSA	Max. cable length (volt drop: 0.5V, with min. CSA)	Max. cable CSA	Max. cable length (volt drop: 0.5V, with max. CSA)
630A	630A	240mm²	10m	300mm²	13m
500A	500A	240mm²	13m	300mm²	17m
400A	400A	185mm²	13m	300mm²	21m
315A	315A	120mm²	11m	240mm²	22m
250A	250A	95mm²	10m	185mm²	21m
160A	160A	70mm²	12m	95mm²	16m
100A	100A	35mm²	10m	50mm²	14m
50A	50A	25mm²	14m	35mm²	20m
32A	32A	16mm²	14m	25mm²	22m
25A	25A	10mm²	11m	16mm²	17m
16A	16A	6mm²	11m	10mm²	17m
10A	10A	4mm²	12m	10mm²	27m
6A	6A	4mm²	19m	10mm²	45m
Note: The specs are applicable at ambient temperature of 25°C. If the temperature is higher or lower than this, the CSA of the cable should be increased					

The MCB/fuse capacity should be strictly limited so that it can function properly upon load over-current. The recommended MCB/fuse capacity is 1.5 ~ 2 times the load peak capacity.

The CSA of the system earth cable should be the same with that of the largest power distribution cable and not less than 95mm².

Load fuse with capacity of above 160A should use M12 or M16 OT terminals for connection. Load fuse with capacity of 160A or below should use M8 OT terminals for connection. Load MCBs use H shaped tubular terminals for connection.

3. Purchase materials according to the construction material list and inspect the materials. For example, check the heat durability, moisture resistance, flame resistance, and pressure resistance of the cables.

4. For the materials that need to be processed by other factories, the materials and the processing drawings should be provided in advance for processing.

5. Prepare the auxiliary materials for installation, including expansive bolts, cable lugs, cable ties, and insulating tape.

2.3.3 Equipment Running Environment Checklist

After the installation preparation, check the equipment running environment against the checklist given in Table 2-7.

Table 2-7 Equipment running environment checklist

No.	Item	Index	Pass
1	Ambient temperature in equipment room	-10°C to +55°C	Yes/No
2	Humidity in equipment room	≤ 95%	Yes/No
3	Lighting in equipment room	70Lux to 200Lux	Yes/No
4	Height of equipment room	≥ 3m	Yes/No
5	Static electricity in equipment room	Lay antistatic floor or antistatic rubber	Yes/No

No.	Item	Index	Pass
6	Weight capacity and quakeproof ability	Accord with Level 8 quakeproof, and safety must be ensured	Yes/No
7	Radiation	No blockage in equipment radiation passage	Yes/No
8	Damp proof	No mildew breeding conditions	Yes/No
9	Dust-proof	No conductive dust and gas which deteriorate insulation	Yes/No
10	Fire protection	Fire fighting equipment such as fire extinguisher	Yes/No
11	Earth resistance	In accordance with relevant standards	Yes/No
12	CSA of SPD earth cable	Not less than 25mm^2, the shorter the better	Yes/No
13	Colour of protective earth cable	Green-yellow	Yes/No
14	Earth nut	Copper, not smaller than M8	Yes/No
15	Tablet, symbol, tag of customer equipment	Complete and clear	Yes/No
16	Violent vibration and shock	None	Yes/No
17	CSA of AC distribution cables	According to design specifications	Yes/No
18	Fluctuation range of AC input voltage	According to equipment input specifications	Yes/No
19	Frequency fluctuation range	45Hz to 65Hz	Yes/No
20	Voltage of neutral line to ground	Smaller than 10V	Yes/No
21	Power of backup power source	Twice the actual capacity	Yes/No
22	Pollution or interference in power network	None	Yes/No
23	Colour code of AC bus	Yellow, green, red, light blue or marked with identifier	Yes/No
24	Capacity of the customer AC distribution cabinet	Meet equipment requirements	Yes/No
25	Wiring of AC distribution cables	According to specifications	Yes/No
26	Colour code of DC load cables	According to specifications	Yes/No
27	CSA of DC distribution cables	According to requirements	Yes/No
28	Earth wiring	According to specifications	Yes/No

2.4 Unpacking Inspection

The power supply system is packed up in several boxes and delivered by set. Each box is pasted with a printed packing label. The packing list is placed in the box with a red label which reads ‘packing list storage case’.

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 Vertiv Tech 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.

Chapter 3 Installation

This chapter introduces installation and cable connection. Before installation, please read through the safety regulations, and then follow the instructions in this chapter to carry out the installation and cable connection.

3.1 Safety Regulations

Certain components in this power system carry hazardous voltage and current. To protect the personnel safety, always follow the instructions below:

1. Only adequately trained personnel with satisfactory knowledge of the power system can carry out the installation. The *Safety Precautions* listed before the *Contents* of this manual 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 operation is carried out within the system cabinet.

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

5. The power distribution cables should be reasonably wired with protection measures so that the cables are kept away from the system operators.

3.2 Placing Cabinets

3.2.1 Layout Of Large Capacity System Cabinets

The power supply system can be expanded up to 2640A, composed of two rectifier cabinets and one DC distribution cabinet. If the power supply system uses bottom cabling, it can be configured with two DC distribution cabinets. As the max current carrying capacity of single parallel connection bar is 2000A, when the power supply system capacity exceeds 2000A, the cabinets should be arranged in the way that the max current of one parallel connection bar does not exceed 2000A.

It is recommended to place the cabinets in the way of “Rectifier cabinet- DC cabinet- Rectifier cabinet”. If users parallel connect rectifier cabinets or DC distribution cabinets instead of placing rectifier cabinet and DC distribution cabinet in alternation, contact Vertiv for technical support.

3.2.2 Placing DC Cabinet Separate From System

The power supply system uses distributed monitoring. The DC distribution cabinet can be placed separate from the power supply system, and typically where loads are grouped, for example, on different floors. In this case, the DC distribution cabinet is connected to the power supply system through cables. Pay attention to the following points:

- Use cables rather than copper bars to connect between the DC distribution cabinet and the power supply system. The connecting points are the installation holes of the parallel connection copper bar, enabling the power supply system to measure load current.
- Communication inside the power supply system uses CAN mode.

3.3 Installing Cabinet

3.3.1 Installation On The Floor

Step 1: mark the installation position

Determine the installation position of the cabinet in the equipment room according to the installation drawing. Based on the mechanical parameters (see Figure 3-1) of the installation holes of the power supply cabinet, determine the exact position of the center points of the installation holes on the floor, and mark them with a pencil or oil pen.

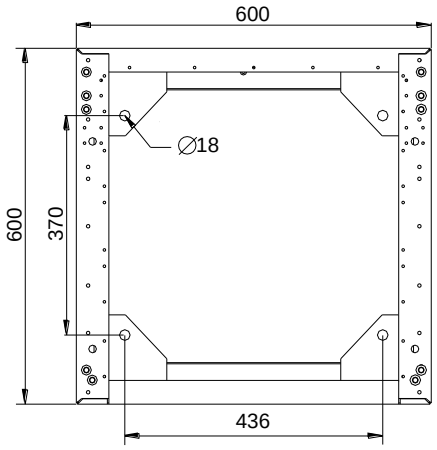


Figure 3-1 Installation size of the rectifier cabinet and the DC distribution cabinet (unit: mm)

Step 2: drill reserved holes

Use Φ12 electric drill to drill 35mm-deep holes at the center points of the installation holes marked on the floor. To avoid being off-center, be careful not to shake the drill, and try to keep it as vertical as possible to the floor.

Step 3: install expansive pipes

Clean the dust, and insert the M10 × 30mm expansive pipe delivered with the power supply system into the reserved hole. Knock it down gently using a hammer until the top of the expansive pipe is level with the ground.

Step 4: place cabinet in position

Move the cabinet to the installation position aligning the installation holes of the cabinet with the reserved holes on the ground.

Step 5: fix the cabinet

After the cabinet is in position, make some horizontal and vertical adjustments. Insert some iron pieces under the lower edge and corner of the cabinet to adjust the vertical obliquity of the cabinet within 5 degrees. Finally, screw down the bolt with plain washer into the drop in nut, and tighten it with wrench. The cabinet fixation is illustrated in Figure 3-2.

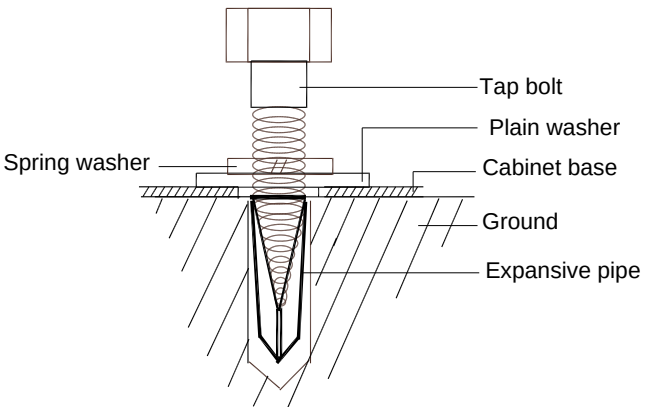


Figure 3-2 Fixing cabinet with bolt

3.3.2 Installation On Supporting Rack

If antistatic floor is laid in the equipment room, users may purchase a supporting rack from Vertiv.

Step 1: place supporting rack in position

Install the supporting rack on the floor as shown in Figure 3-3. The installation steps are the same as the first three steps in *3.3.1 Installation On The Floor*.

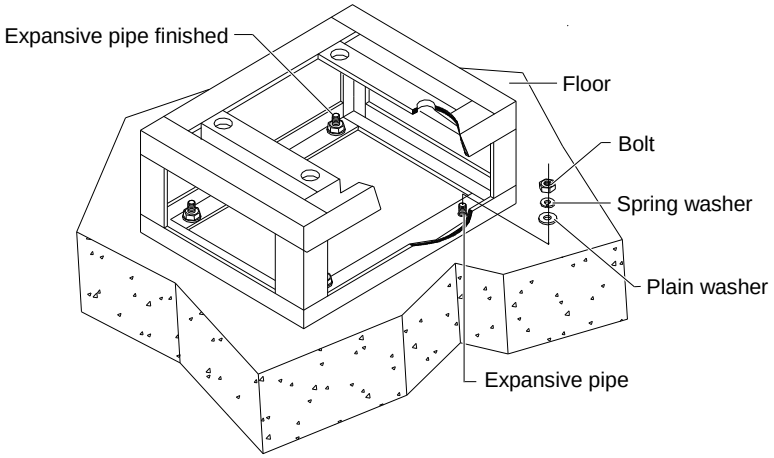


Figure 3-3 Installing supporting rack

Step 2: fix the cabinet

Install the cabinet on the supporting rack, as shown in Figure 3-4.

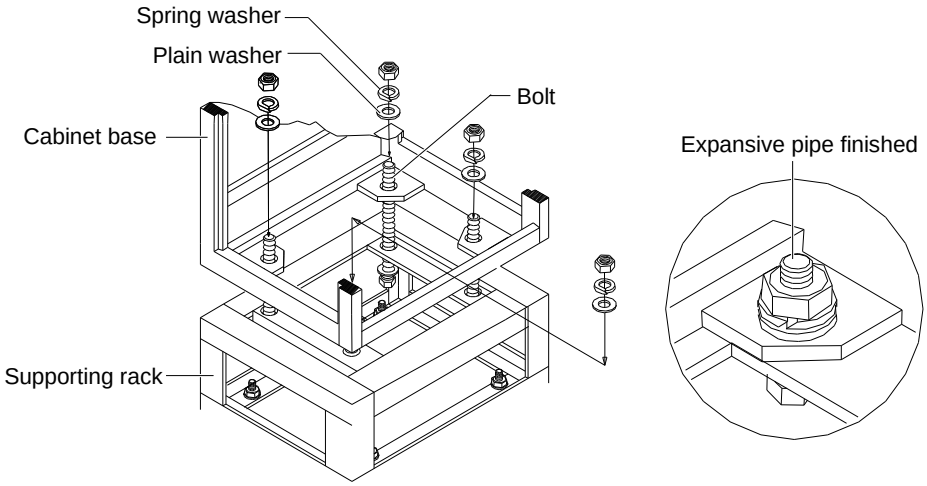


Figure 3-4 Installing power cabinet on supporting rack

After the cabinet is installed, shake the cabinet from different directions. No obvious shake should be felt.

3.3.3 Parallel Connection Between Cabinets

Parallel connections between cabinets are all achieved by means of parallel connection copper bars. Copper bar is an accessory. The BOM of the copper bar is 21170409, and the description is “Conductor, DMBM4.104.561MX, Connecting Busbar Subassembly for Parallel System, for W14GAZ, ROHS”.

If several cabinets are parallel connected, it is recommended to place rectifier cabinet and DC distribution cabinet in alternation. The connection procedures are as follows:

1. Remove the side panels of the connection side from the cabinets. Remove the knockout panel in the side panel, and then restore the side panels.

2. If the cabinet has a top cover, remove it.

3. Use the connection straps to fix adjacent cabinets at the top, as shown in Figure 3-5. The connection straps are accessories.

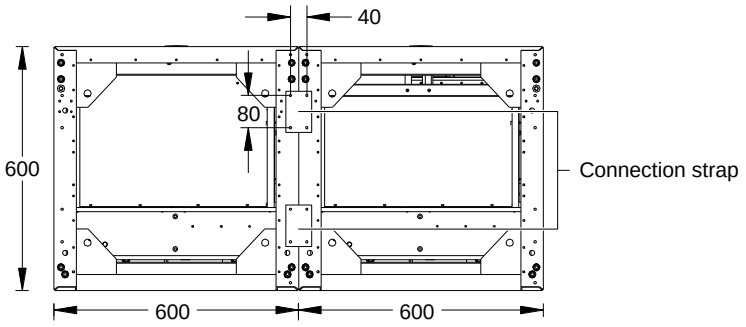


Figure 3-5 Parallel connection between cabinets (top view, unit: mm)

4. Connect the positive bars and negative bars inside the cabinet respectively by copper bars and screws, as shown in Figure 3-6 and Figure 3-7.

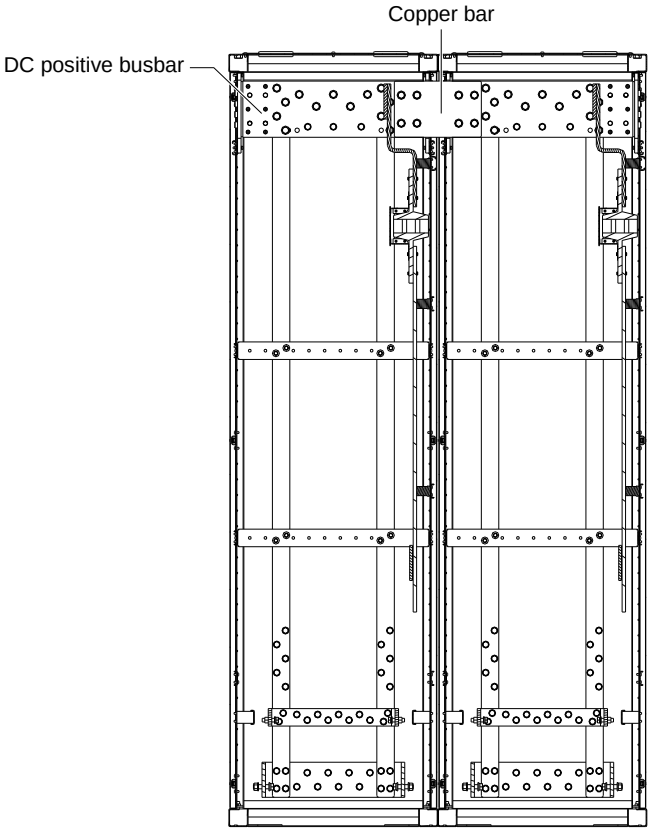


Figure 3-6 Parallel connection (back view)

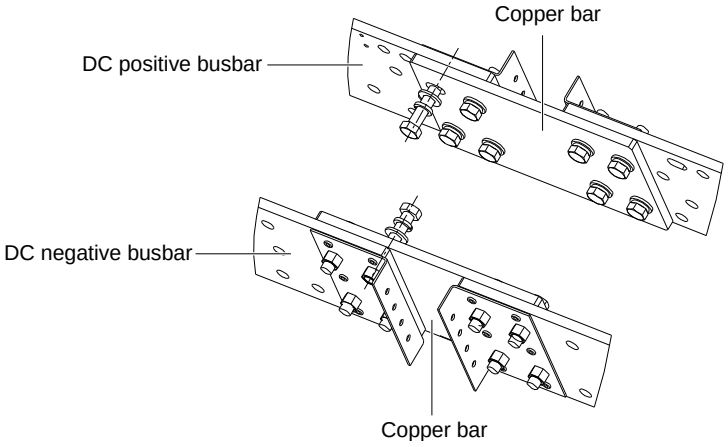


Figure 3-7 Parallel connection of copper bars

3.4 Connecting Power Cables

Note

Before electrical connection, turn off all the switches and fuses.

3.4.1 Connecting Earth Cable

The power supply system uses common earth. The connection procedures are described as follows.

1. Use an earth connection cable to connect the earth terminal of the rectifier cabinet to the earth terminal of the DC distribution cabinet, as shown in Figure 3-8.

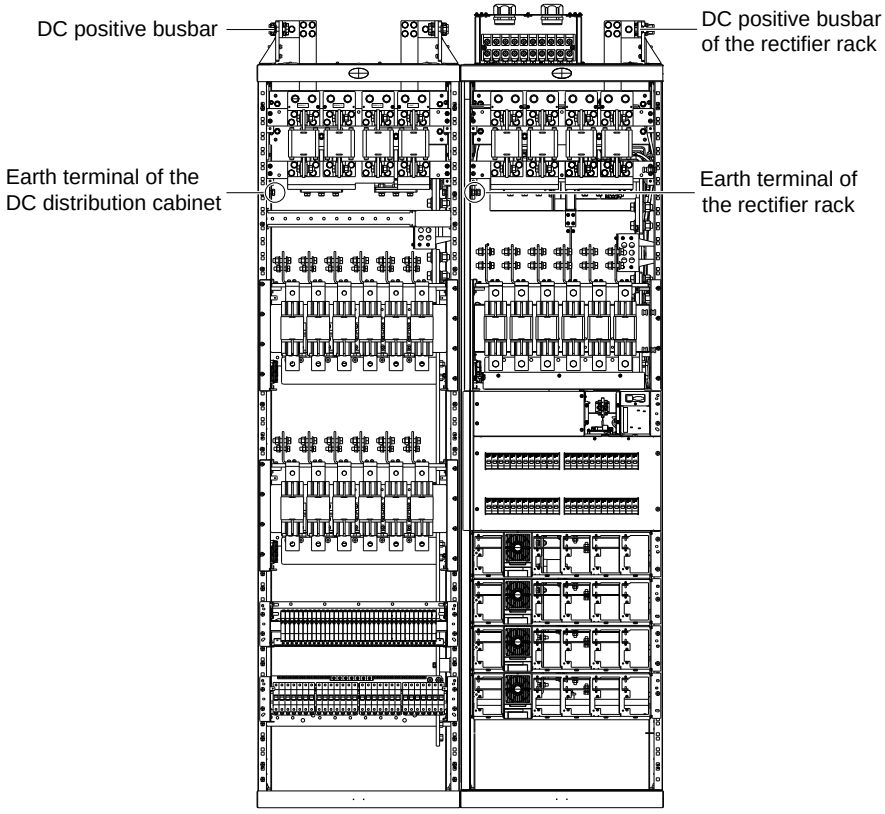


Figure 3-8 Earth terminal of the rectifier cabinet and the DC distribution cabinet

2. Use earth cable to connect the positive busbar of the DC distribution cabinet with the earth bar in the equipment room. If only configuration the rectifier cabinet, connected the earth cable to the positive busbar of the rectifier and earth bar in the equipment room. The positive busbars of the DC distribution cabinet and the rectifier cabinet are shown in Figure 3-8.

3.4.2 Connecting AC Input Cables

Connection requirements

1. The AC in cables are wired from the distribution switch, and connected to the output terminal when the power is to be switched on. The AC input is fitted with overcurrent, short circuit and lightning protection devices. The capacity of the distribution switch should be not less than 1.5 ~ 2 times the load capacity.

2. The yellow, green, red, and light blue AC cables correspond respectively to AC phase A, B, C and neutral lines. If the cables are the same color, they should be numbered or identified with insulating tape of different colors at both cable ends.

3. The sectional area of the corresponding AC input cable is 25mm^2 ~ 35mm^2. The width of the cable terminal should be not larger than 22mm, as shown in Figure 3-9.

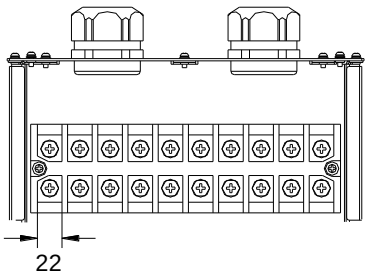


Figure 3-9 AC input terminal dimension (unit: mm)

4. The AC cables should be run separate from the DC cables, with separation exceeding 150mm.

5. No splice, damage, or scratch on the cables is permitted.

Connection procedures

The AC cables can enter the power supply system from either the cabinet top from wiring rack or the cabinet bottom from cable trenching. Only rectifier cabinets working together with PD48/2000DD DC distribution cabinet can use bottom cabling method to lead in AC cables. The cable connection procedures are described below:

1. Remove the fixing screws of the AC input box cover, and remove the cover, as shown in Figure 3-10.

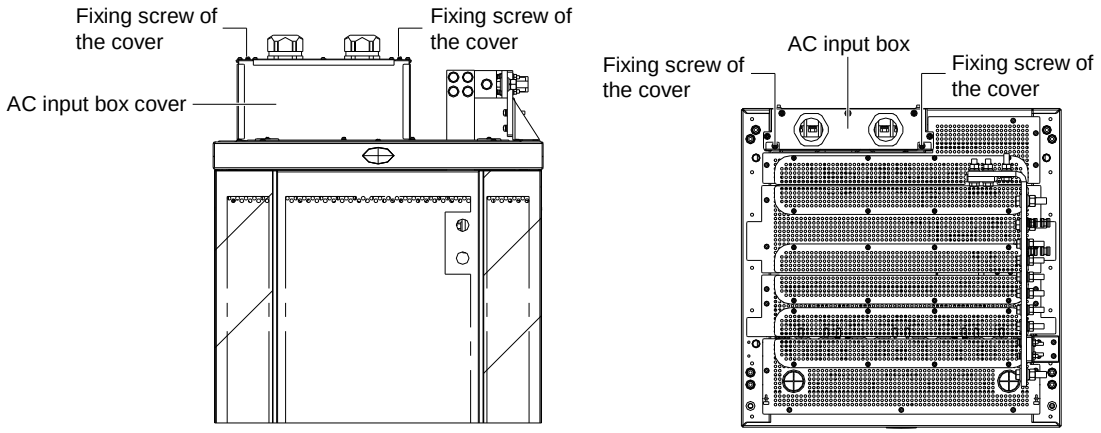


Figure 3-10 Removing the AC input box cover

2. The AC cables are connected to the AC input terminals through the cable tubes, as shown in Figure 3-11. One five-core cable (3P + N + PE, for Netsure 701 AO3-T1) or four-core cable (3P+ PE, for Netsure 701 AO2-T1) can be fed into each cable tube. The phase of the cable should be in accordance with the phase of the AC input terminals.

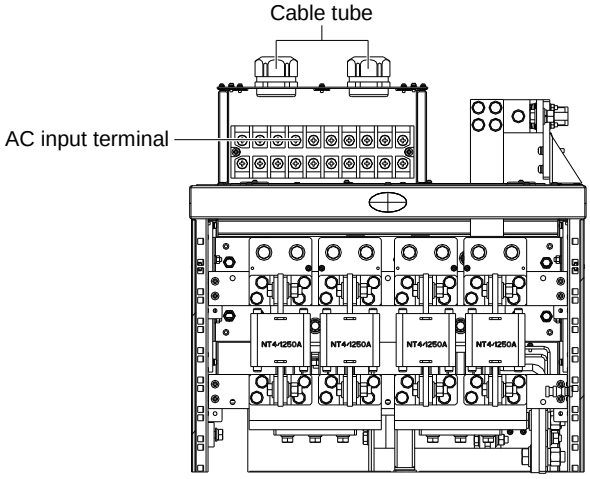


Figure 3-11 AC cable connection

Note

Users should add protection switch at the AC input side of the rectifier cabinet. At full load, one C200A/3P switch is recommended for one AC input route of NetSure 701 AO2-T1 rectifier cabinet. One C125A/3P switch is recommended for one AC input route of NetSure 701 AO3-T1 rectifier cabinet.

3.4.3 Connecting DC Load Cables

The connection method of DC load cable connected to the rectifier cabinet and that of DC load cable connected to the DC distribution cabinet are the same. Taking the DC distribution cabinet for example, the connection procedures are described below:

1. Add cable lugs to both ends of the cables.

2. Select the DC output branch that matches the load capacity.

Load should be connected to the MCB/fuse of suitable capacity to avoid their failure to function in the case of overload. The capacity of the MCB/fuse is recommended to be about 1.5 ~ 2 times the peak value of the load capacity.

Note

Before connecting, pull out the DC output fuse with fuse puller or turn off the MCB.

3. If using top cabling method, users should cut the corresponding protective covers (material: yellow epoxy resin) in the top cover according to the cable routes before using top cabling method to route the cables. The protective covers are shown in Figure 3-12.

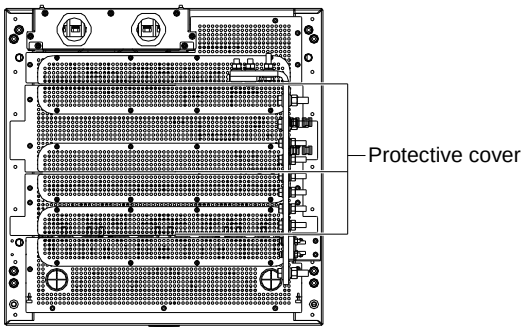


Figure 3-12 Top cover

4. Loosen the fixing screws of the HOD panel and the LOD panel, as shown in Figure 3-13. Open the panels.

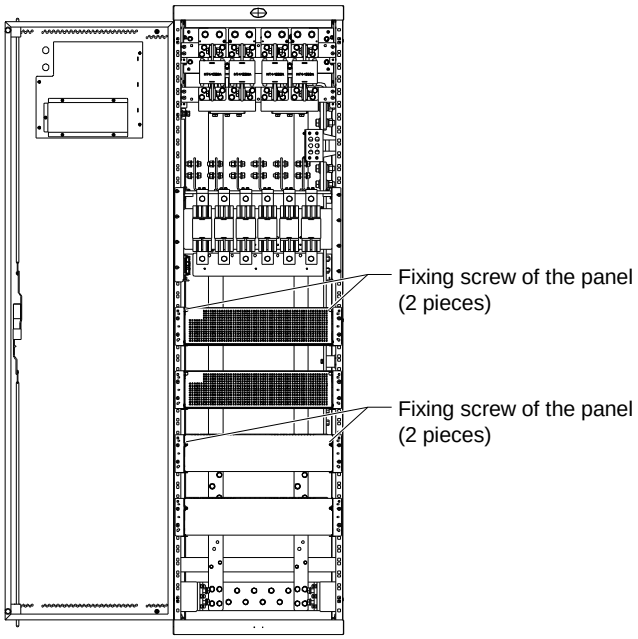


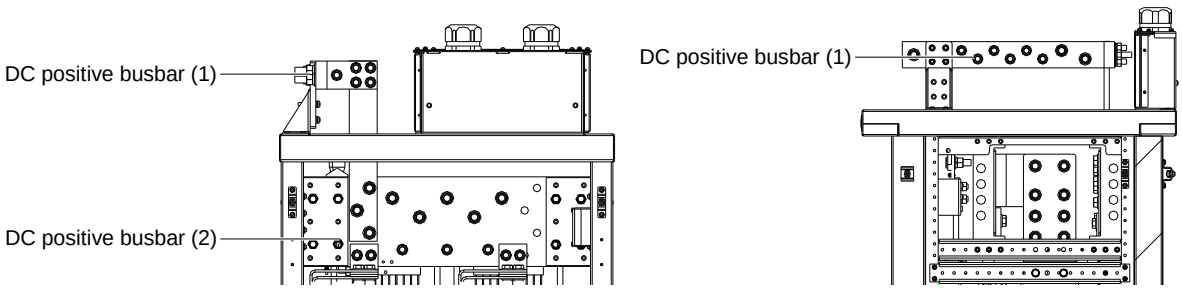
Figure 3-13 Fixing screws of the panel

5. Follow the procedures below to connect DC load cables.

1) Fuse unit

Connect the negative load cable to the output terminal of the fuse, and the positive load cable to the DC positive busbar.

The DC positive busbars of the NetSure 701 AO2-T1、NetSure 701 AO3-T1 rectifier cabinet are shown in Figure 3-14. The maximum current of DC positive busbar (1) is 1000A, and the maximum current of DC positive busbar (2) is 2000A.



(a) Back view *(b) Left view*

Figure 3-14 DC positive busbar of the rectifier cabinet

The DC positive busbars and connection terminals of the PD48/2000DU DC distribution cabinet are shown in Figure 3-15. The maximum current of DC positive busbar is 1000A.

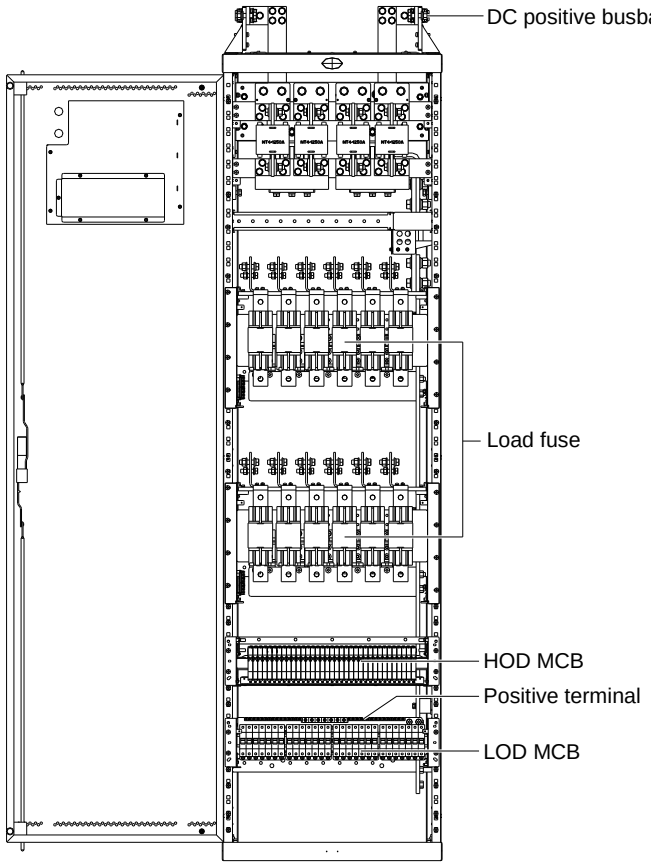


Figure 3-15 Connection terminal of top- cabling DC positive busbar

2) LOD

Connect the negative load cable to the load MCB of the LOD, and the positive load cable to the DC positive terminals, as shown in Figure 3-15.

3) HOD

Connect the negative load cable to the negative terminal of the HOD, and the positive load cable to the positive terminals, as shown in Figure 3-16.

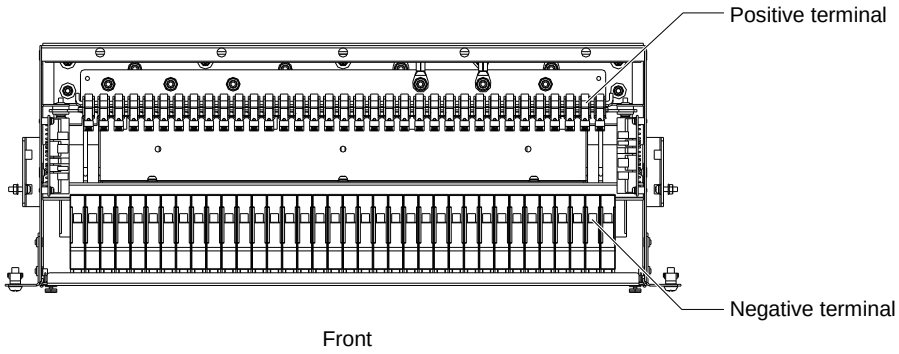


Figure 3-16 HOD (top view)

The DC positive busbar of the PD48/2000DD-X1 DC distribution cabinet locates at the bottom of the cabinet, as shown in Figure 3-17. The load cable connection of the bottom cabling cabinet is the same as that of the top cabling cabinet.

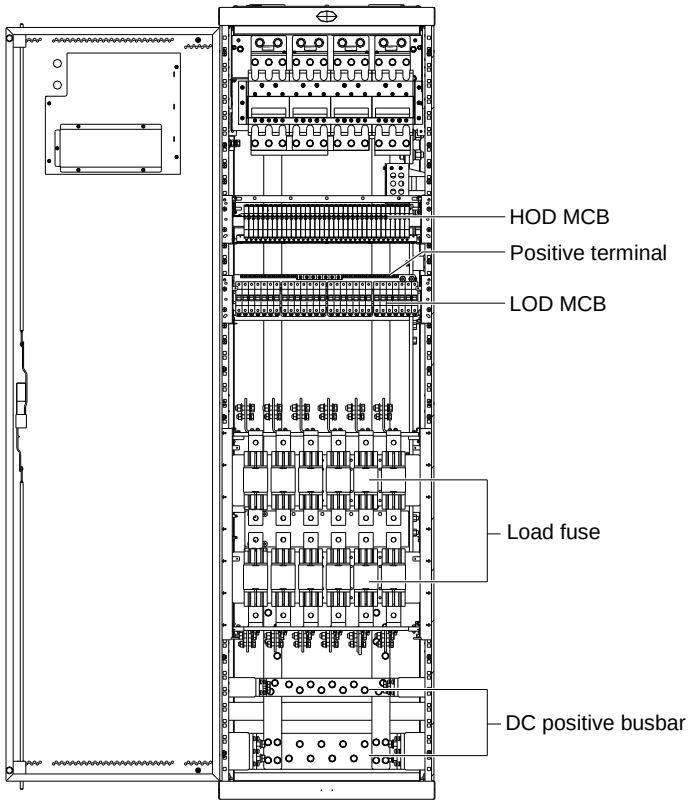


Figure 3-17 Load cable connection of the bottom cabling cabinet

3.4.4 Connecting Battery Cables

Note

1. Connect battery cables according to the labels in the battery distribution unit (for example, Battery I, Battery II, Battery III and Battery IV).

2. The capacity of the fuse or the MCB should accord with that of the battery. The breaking capacity of the NT4 fuse is 100kA, and the breaking capacity of the MCB is 10kA.

The procedures of connecting battery cables are as follows:

1. Route and number the cables of the batteries and mark their polarities.

2. Connect one end of the negative cable to the output terminal of the battery fuse or MCB and one end of the positive cable to the DC positive busbar of the rectifier cabinet. Add cable lugs to the other end of the positive and negative cables, bind the cable lugs with insulating tape, and put them beside the battery. Connect the cables to the battery when the DC distribution is to be initially tested, as shown in Figure 3-18.

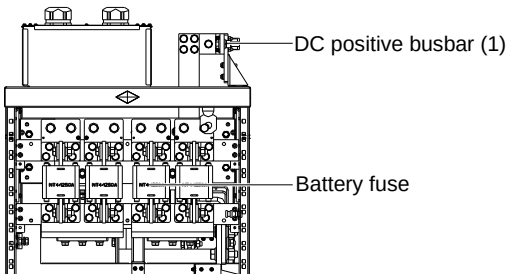
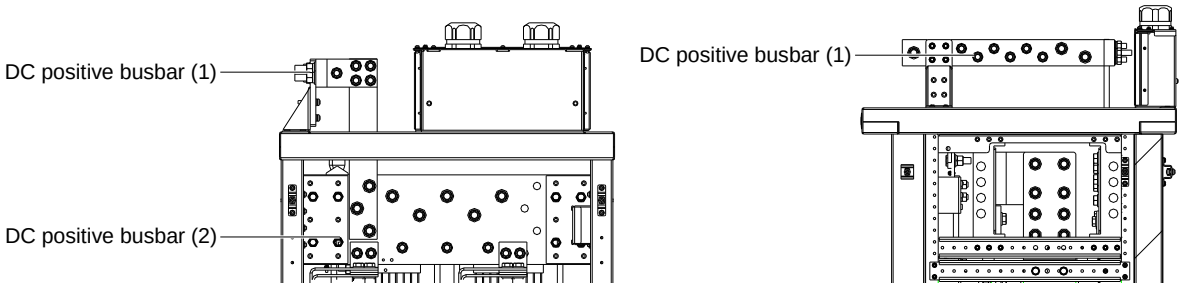


Figure 3-18 Battery cable connection in rectifier cabinet

The DC positive busbars of the NetSure 701 AO2-T1、NetSure 701 AO3-T1 rectifier cabinet are shown in Figure 3-18and Figure 3-19. The maximum current of DC positive busbar (1) is 1000A, and the maximum current of DC positive busbar (2) is 2000A. It is recommended to connect positive battery cable to DC positive busbar (2).



(a) Back view *(b) Left view*

Figure 3-19 DC positive busbar of the rectifier cabinet

3.5 Installation Checklist

After installation, security check should be conducted using the following checklist.

Table 3-1 Installation checklist

No	Standards and requirements	Pass	Note
1	The power supply system is constructed according to the design plan	Yes/No	
2	The cabinets are fixed with expansive screws	Yes/No	
3	The cabinets are aligned	Yes/No	
4	The installation equipment is clean	Yes/No	
5	The installation equipment facilitates wiring	Yes/No	
6	Cable wiring is covert	Yes/No	
7	Cable is wired with consideration of the wiring of other systems	Yes/No	
8	Cable pipe is laid in cable trenching	Yes/No	
9	Cable labels are clear and accurate	Yes/No	
10	Connector coat peeling is tidy and consistent	Yes/No	
11	Type O or U terminal is used for the connection of signal lines	Yes/No	
12	Cable lug is reasonably used in cable connection	Yes/No	
13	DC power earth and protective earth are connected correctly	Yes/No	
14	Leeway is left for the length of connection cable and the cable wiring is covert	Yes/No	
15	The cable lugs and cable connectors are well connected	Yes/No	
16	The screws in all cable connection points are firmly fixed	Yes/No	
17	The original environment is restored which has been destroyed due to the construction	Yes/No	
18	Scratch traces by marking pencils are left on the equipment	Yes/No	
19	The busbar connection on the rack top for connection of parallel cabinets is up to requirements	Yes/No	
20	The cables and cable trenching are level horizontally or vertically.	Yes/No	
21	Distances between line cable ties are equal and consistent	Yes/No	
22	Leeway is left in cable trenching	Yes/No	
23	Separation measures are taken in cross wiring	Yes/No	
24	Wiring is far from high temperature equipment and corrosive liquid pipe	Yes/No	
25	Wiring on wiring rack is in accordance with the original wiring style	Yes/No	
26	DC distribution branches and fuses are properly selected according to the corresponding loads	Yes/No	

No	Standards and requirements	Pass	Note
27	Surplus parts of the cable ties are left uncut	Yes/No	
28	The placement of the equipment facilitates cabinet expansion and maintenance	Yes/No	
29	The cabinet assembly is well-fixed and quakeproof-handled	Yes/No	
30	Paint and galvanized layer on the cabinet are not peeled	Yes/No	
31	No crumple or crack at the turning points of bus	Yes/No	

3.6 Installing Rectifier And Controller

System assembly involves the installation of rectifier and controller.

3.6.1 Installing Rectifier

The installation steps of rectifier are as follows:

1. Press the handle of the rectifier, as shown in Figure 3-20. The handle will pop out automatically, and the positioning pin will retract into the rectifier.

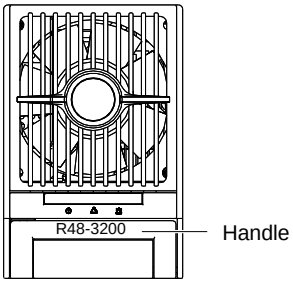


Figure 3-20 Handle and fixing screw positions

2. Put the rectifier onto the guide rail gently, and push the rectifier slowly along the guide rail until it is completely in the cabinet. Do not put more force on the rectifier during the installation. Otherwise the positioning pin may be damaged.

3. Push the handle into the front panel to pop out the positioning pin and lock the rectifier to the cabinet. If the number of the rectifier is smaller than 24, install fake plate at empty slots.

3.6.2 Installing Controller

Pull out the handle of the controller, and put the controller onto the installation position (see Figure 3-21). Push the controller completely into the cabinet.

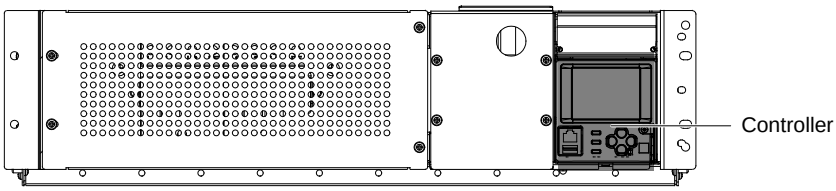


Figure 3-21 Fixing the controller in the cabinet

3.7 Connecting Signal Cable

The cables accessories are given in Table 3-2.

Table 3-2 Accessory cables used in cable connection

BOM	Description	Length
04111819	W24GASL05 cable suite (CAN communication cable)	4.2m
04115520	W74C5FSL1 cable suite (temperature sensor cable)	10m

3.7.2 Connecting CAN Communication Cable

If the power supply system is composed of two or more cabinets, users need to connect communication cables between them. Users need to connect CAN communication cables between master rectifier cabinet(with NCU controller), slave rectifier cabinet(without NCU controller),DC distribution cabinet.

The CAN communication cable is shown in Figure 3-22.

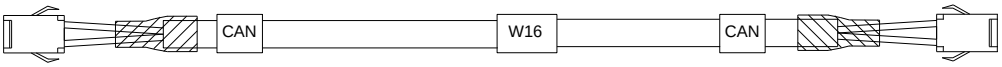


Figure 3-22 CAN communication cable

The connection method is as follows:

1) Remove the panel of the SM DU.

2) Remove the matched resistance of the CAN communication cable of the master rectifier cabinet SM DU from J3.port

3) Connect the CAN communication cable to the CAN cable connectors in the SM DU's J3 port of the two adjacent cabinets, and then connect the matched resistance to the end of CAN communication cable.

4) Reinstall the panel of the SM DU..

3.7.3 Connecting Signal Cables Of User Connector Board

Note

1. J11 and J12 are temperature sensor ports.
2. J2 is I^2C interface, and provides the power.

The position of the user interface board is shown in Figure 3-23.

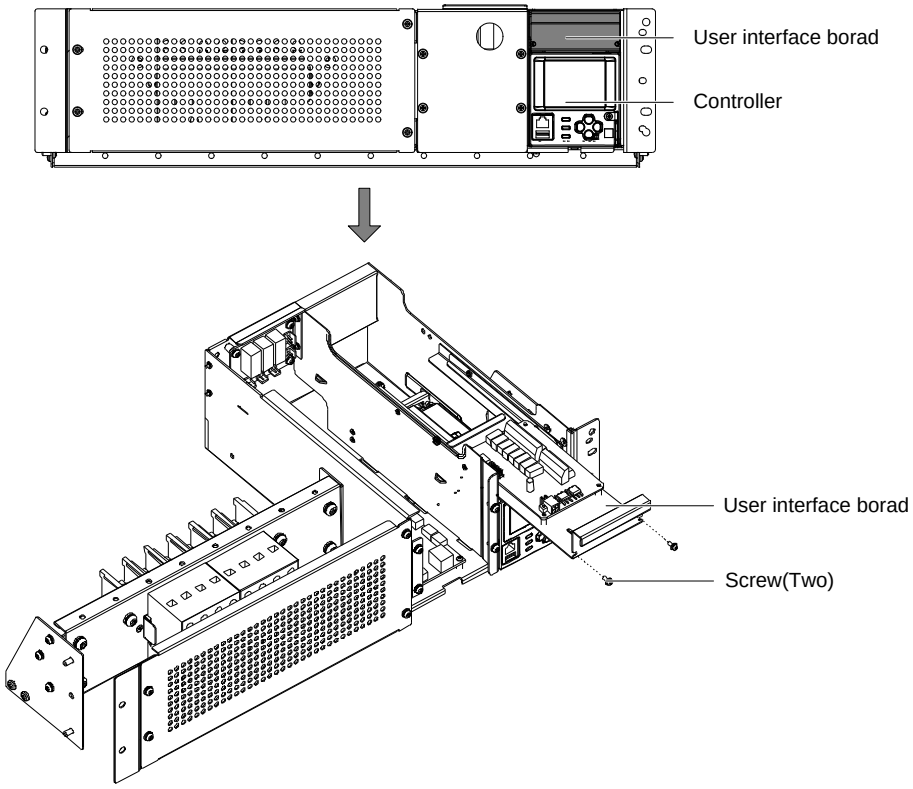


Figure 3-23 User connector board position

IB2 extension board has eight DI and eight DO port. The interfaces of the user interface board are shown in Figure 3-24.

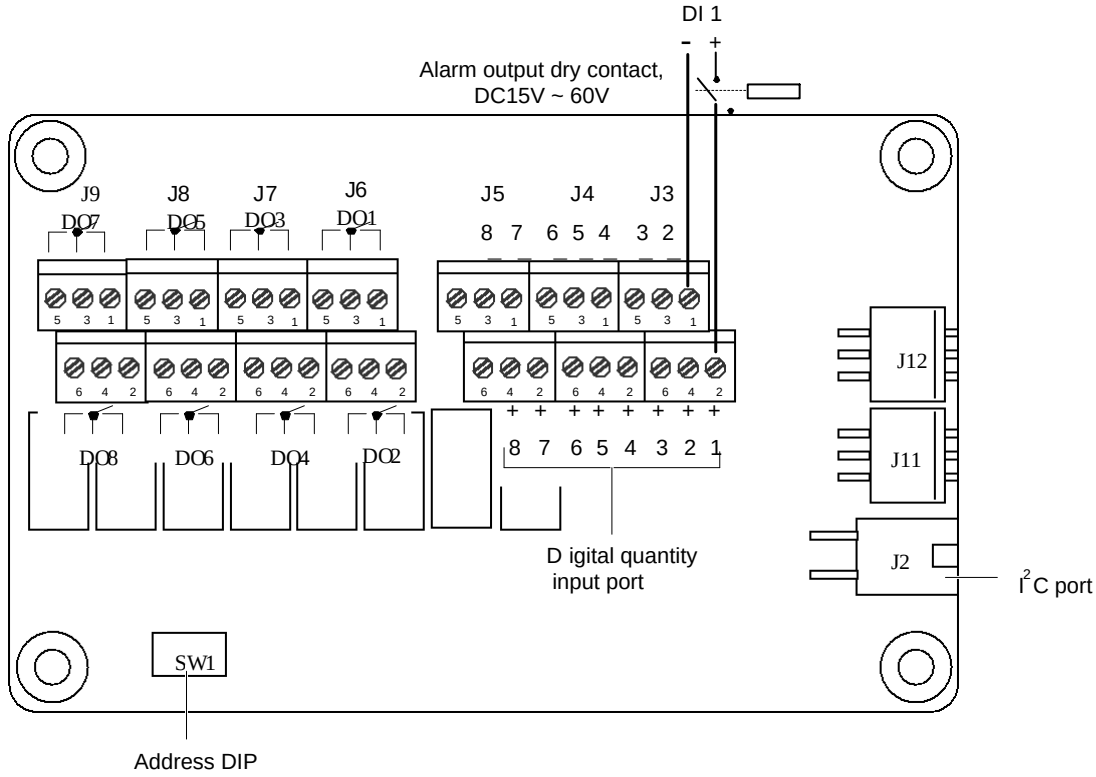


Figure 3-24 User connector board

The functions of the interfaces are shown in Table 3-3.

Table 3-3 Dry contact terminal definition

Name of double-layer port	Pin No.	Pin name	Definition
J3	1	DI1-	Digital input 1-
	2	DI1+	Digital input 1+
J3	3	DI2-	Digital input 2-
	4	DI2+	Digital input 2+
	5	DI3-	Digital input 3-
	6	DI3+	Digital input 3+
J4	1	DI4-	Digital input 4-
	2	DI4+	Digital input 4+
	3	DI5-	Digital input 5-
	4	DI5+	Digital input 5+
	5	DI6-	Digital input 6-
	6	DI6+	Digital input 6+
J5	1	DI7-	Digital input 7-
	2	DI7+	Digital input 7+
	3	DI8-	Digital input 8-
	4	DI8+	Digital input 8+
	5	NA	/
	6	NA	/
J6	1	DO1_NC	NC contact of relay 1
	2	DO2_NC	NC contact of relay 2
	3	DO1_COM	Common contact of relay 1
	4	DO2_COM	Common contact of relay 2
	5	DO1_NO	NO contact of relay 1
	6	DO2_NO	NO contact of relay 2

Name of double-layer port	Pin No.	Pin name	Definition
J7	1	DO3_NC	NC contact of relay 3
	2	DO4_NC	NC contact of relay 4
	3	DO3_COM	Common contact of relay 3
	4	DO4_COM	Common contact of relay 4
	5	DO3_NO	NO contact of relay 3
	6	DO4_NO	NO contact of relay 4
J8	1	DO5_NC	NC contact of relay 5
	2	DO6_NC	NC contact of relay 6
	3	DO5_COM	Common contact of relay 5
	4	DO6_COM	Common contact of relay 6
	5	DO5_NO	NO contact of relay 5
	6	DO6_NO	NO contact of relay 6
J9	1	DO7_NC	NC contact of relay 7
	2	DO8_NC	NC contact of relay 8
	3	DO7_COM	Common contact of relay 7
	4	DO8_COM	Common contact of relay 8
	5	DO7_NO	NO contact of relay 7
	6	DO8_NO	NO contact of relay 8

3.8 Installing Temperature Sensor

AD592BN temperature sensor is an option. The wiring steps are shown as follows:

1. Connect the P101-3 socket of the temperature sensor to J11 or J12 terminals of IB2 user connect board, the positions of J11 and J12 is shown in Figure 3-24.The temperature sensor is shown in Figure 3-25.

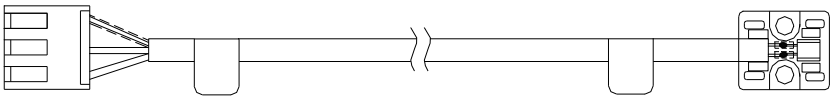


Figure 3-25 Temperature sensor

3. The temperature probe should be put in the battery room where it can best incarnate the environment or battery temperature. When fixing it, do not connect it to any other exothermic equipment or metal conductor.

Chapter 4 Testing

This chapter mainly introduces the notes on testing, system power-on, parameter setting, inquiry of alarm and operation information.

4.1 Notes On Testing

Before putting the power supply system into operation, testing must be conducted strictly following the testing steps. The following safety precautions must be observed in testing.

- The test requires extensive technical knowledge, therefore the test engineers must have had relevant technical training. Be sure the test is conducted in accordance with the instructions in this manual.
- The test involves working with live wires, therefore, during the test, stand on dry insulated objects, use insulated tools, and do not wear watch, necklace or any other metal objects.
- Avoid touching two live objects with different potentials.
- Before the switch-on operation, check whether the conditions of appropriate parts are normal.
- During operation, a warning sign “No switch-on, in operation” should be posted on the equipment to prevent inadvertent operation.
- Close observation is required during test. The power supply system should be turned off immediately when any malfunction occurs. The cause of the malfunction must be found out before resuming the operation.

4.2 Power-On

Inspection before power-on

1. Check that the earth cables of the cabinets are connected reliably and that the wiring and screws in the cabinet are fastened.

2. Feed the mains supply to the power supply system. Measure the phase voltage of the three phases with a multimeter to confirm the mains condition. If everything is normal, proceed with the next step.

3. Close the upstream input MCB of the rectifier cabinet.

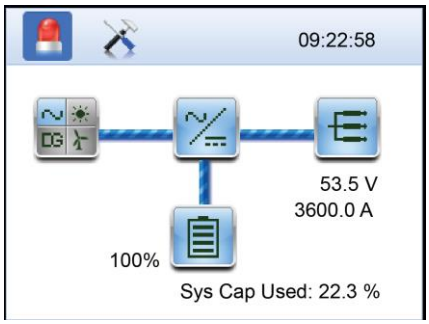
Preliminary test of rectifier

After introducing the AC mains, turn on one rectifier MCB in the middle of the rectifier cabinet. The power indicator of the corresponding rectifier should be on and the fan begins to run. After a while, the controller will display 53.5V rectifier output voltage. Turn off the MCB of this rectifier. Check the other rectifiers one by one through turning on and off the rectifier MCBs and see if they can work normally.

Preliminary test of controller

After the controller is powered on, it will do self test without needing any operation. After about 50s, the M830D should start and display the following screen.

The first screen of M830D is the language selection screen. Users can press ▲ or ▼ to select English or other languages. Then press ENT to enter default interface, as the following figure.



Preliminary test of DC distribution and battery connection

Please connect the battery to the power supply system according to the following steps.

1. Measure the battery voltage with multimeter and keep a record.

2. Turn on one rectifier. Set the rectifier voltage to a value with less than 0.5 V difference from the battery voltage through the controller.

3. Use insulated tools to connect the battery cables to the batteries according to the instructions of the battery manufacturer. The other end of the battery cables have already been connected to the battery fuse as required in *3.4.4 Connecting Battery Cables*.

Danger

Before access the battery, check with a multimeter that the battery polarities are correct. When connecting the battery, careful attention is required to prevent short circuit of the positive and negative poles of the battery. If two batteries are connected at one time, battery mutual charging due to unequal terminal voltages of the two batteries should be avoided.

4. Set the power supply voltage to the required battery float voltage through the controller (in this case, the rectifier should not be in current limiting state).

4.3 Setting Basic Parameters

4.3.1 Setting DIP Switch

Note

If users purchase a single DC distribution cabinet, they need to set its address by setting the DIP switch on the SM DU. Otherwise users do not need to set the DIP switch.

If users purchase a single DC distribution cabinet, they need to set its address by setting bit 1 ~ bit 3 of the S1 DIP switch on the SM DU. The default address of the DC distribution cabinet is 3, users should set the address according to the practical situation.

Position ON represents 0, and OFF represents 1. The DIP switch is shown in Figure 4-1.

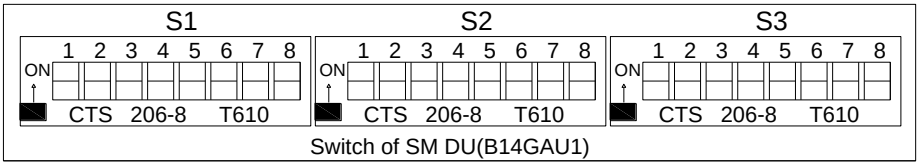


Figure 4-1 DIP switch

Bits 1 to 3 of S1 DIP switch are used to set the addresses. The setting explanation is given in Table 4-1.

Table 4-1 Setting list of S1 DIP switch bits 1 to 3

Bit 1	OFF	OFF	OFF	OFF	ON	ON	ON	ON
Bit 2	OFF	OFF	ON	ON	OFF	OFF	ON	ON
Bit 3	OFF	ON	OFF	ON	OFF	ON	OFF	ON
Description	Addr 8#	Addr 1#	Addr 2#	Addr 3#	Addr 4#	Addr 5#	Addr 6#	Addr 7#

The illustration of setting the address to 2 is shown in Figure 4-2. The black block in the figure illustrates the position of the DIP switch.

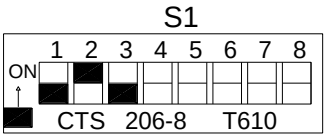


Figure 4-2 Address setting illustration

Bits 4 to 8 of S1 DIP switch are described in Table 4-2 and Table 4-3.

Table 4-2 Setting list of S1 DIP switch bits 4 to 5

Bit 4	OFF	OFF	ON	ON
Bit 5	OFF	ON	OFF	ON
Description	Full- range voltage of the shunt: 75mV (default)	Full- range voltage of the shunt: 25mV	Full- range voltage of the shunt: 50mV	Full- range voltage of the shunt: 60mV

Table 4-3 Setting list of S1 DIP switch bits 6 to 8

Bit 6	OFF	OFF	OFF	OFF	ON	ON	ON	ON
Bit 7	OFF	OFF	ON	ON	OFF	OFF	ON	ON
Bit 8	OFF	ON	OFF	ON	OFF	ON	OFF	ON
Description	Shunt coefficient: 500A (default)	Shunt coefficient: 100A	Shunt coefficient: 200A	Shunt coefficient: 300A	Shunt coefficient: 400A	Shunt coefficient: 1000A	Shunt coefficient: 1500A	Shunt coefficient: 2000A

Bit 1 ~ bit 2, bit 3 ~ bit 4, bit 5 ~ bit 6 and bit 7 ~ bit 8 correspond to settings of shunt 1 to shunt 4 respectively. Taking bit 1 ~ bit 2 for example, the setting description is given in Table 4-4.

Table 4-4 Setting list of S2 DIP switch bits 1 to 2

Bit 1	OFF	OFF	ON	ON
Bit 2	OFF	ON	OFF	ON
Description	Shunt 1 invalid	Shunt 1 for battery	Shunt 1 for load	Software setting

The S3 DIP switch setting is given in Table 4-5.

Table 4-5 Setting list of S3 DIP switch bits 1 to 8

DIP switch	Description
Bit 1	OFF: shunt coefficient set by DIP switch; ON: shunt coefficient set by software
Bit 2	OFF: bistable contactor; ON: monostable contactor
Bit 3	OFF: LVD control disabled upon communication failure; ON: LVD control enabled upon communication failure
Bit 4	OFF: LVD2 for contactor control; ON: LVD2 for alarm indicator output
Bit 5 ~ bit 8	Reserved

4.3.2 Setting Basic Parameters For Controller

Before putting the power supply system into service, system setting must be done through the controller according to the actual system configuration, battery group number, battery nominal capacity, charge current limit and other function requirements. Otherwise, the power supply system information display and output control cannot function normally.

For detailed parameter setting method of this controller, refer to *NetSure™ Control Unit (NCU) User Manual, UMM830B (Issue AA, June 3, 2014)*.

1. Set the controller according to the practical connection of DC distribution cabinet address and quantity.

2. According to the battery manufactures requirement, set temperature compensation coefficient. The default value is 72mV/°C. (There will be no this item if temperature sensor is not configured.)

3. Set battery current limit point. The default value is 0.1C10.

4. According to float voltage and boost voltage recommended by the battery providers. The float voltage fault value is 53.5V and the boost voltage is 56.4V. For free boost battery, users can set its boost voltage to 0.1V higher than the float voltage.

5.If temperature sensor is connected to J11 or J12 of IB2，IB2 temperature 1 or 2 should be enabled and TempComp Sensor should set to be IB2 temperature 1 or 2 according to the actual configuration.

Note

The distribution unit of the battery in the system is managed by the SMDU distribution monitoring, and then report to power controller. Choose the corresponding parameters from the SMDU to set the battery group number, nominal capacity, shunt and LVD parameter.

4.4 Checking Alarm And Operation Status

4.4.1 Testing AC Distribution

AC distribution test is to test the AC alarm, AC display and other functions. AC distribution test must be conducted using the following procedures.

1. Turn off the preceding AC input switch to simulate AC mains failure; the power supply system will generate mains failure alarm.

2. Turn on the preceding AC input switch to simulate mains restoration, the power supply system will start normally and the alarm will disappear.

3. Measure the voltage of each phase of AC input at the AC input terminal with a quad bit-half voltmeter and keep records. Query the real time AC data through the controller and see if the displayed phase voltages agree with the measured values.

After completing the test, restore the mains voltage of the 2 mains inputs to the normal range.

4.4.2 Testing Controller

The controller can be tested after the parameter setting is completed based on the actual system configuration and battery management requirements

Communication test

When the power supply system is in normal operation, disconnecting the communication cable of any unit (DC distribution cabinet and rectifier) will interrupt the communication between the controller and this unit as well as other units in serial connection with this unit, and cause the controller to generate communication failure alarm. By reconnecting the communication cable, the power supply system will recover automatically.

Boost charge and float charge changeover

Set the ‘Auto/Man State’ of parameter set menu to ‘Manual’. When the power supply system is in float charge state, change the battery charge state to ‘boost charge’ through the controller, the power supply system will enter into boost charge state, and the rectifiers will output boost charge voltage. Change it back to ‘float charge’ and the power supply system will return to float charge state.

Rectifier adjustment

After making sure that the power supply system is in ‘Manual’ mode, enter into the control menu of a specific rectifier:

1. Test the switching-on/off of the rectifier, the rectifier switching-on/off should be under control and normal;

2. Set the float/boost voltage, the rectifier voltage should be normally adjustable;

3. Under the condition that all the rectifier outputs are normal, observe and record the rectifier current-sharing characteristics at different total loads.

Communication with host

If the power supply system is equipped with a host computer, connect it with controller through wires.

First, observe whether the data in IE webpage are correct, then perform boost/float charge changeover and rectifier switching-on/off on the IE webpage. Last, observe whether the maintain functions are correct, and simulate fault alarm on the power supply system. Observe whether the IE webpage displays the corresponding alarm.

4.4.3 Testing DC Distribution

Connect some loads to the power supply system and test the battery protection characteristics using the following steps.

1. Raise the output undervoltage alarm point to 52V, and reduce the load, then open the AC input MCB of the rectifier, the battery will discharge to the load, and the output voltage will decrease. When the battery output voltage drops below the undervoltage alarm point, the controller will generate battery undervoltage alarm.

2. Close the rectifier AC input MCB. When the entire rectifiers begin to work normally, the rectifier startup process can be observed. The time for rectifier output current reaching a steady state varies depending on the battery capacity, rectifier quantity and load capacity. By that time, the mains failure alarm will disappear automatically. With the output voltage rising to above the undervoltage alarm recovery point, the battery undervoltage alarm will disappear automatically.

3. After finishing the test, restore the undervoltage alarm point to the original value.

4. Lower the overvoltage alarm point (for example, 52V), when the output voltage of the rectifier exceeds the overvoltage alarm point, the controller should generate audible and visual output overvoltage alarms. Restore the overvoltage alarm point to its original value and the output overvoltage alarm should automatically disappear.

5. Connect a small load between the output terminal of a fuse link and the positive busbar (10kΩ resistance recommend), and pull out this fuse link, the controller should display ‘DC ROUTE XX FAULT’ alarm. Plug in the fuse link again, and the power supply system will resume normal.

By now, the test is completed and the power supply system is in normal operation.

Chapter 5 Use Of Controller

M830D controller support local LCD interface and web operation.. See *NetSure™ Control Unit (NCU) User Manual, UMM830B (Issue AA, June 3, 2014)* for more information.

Chapter 6 Adding Load And Rectifier

This chapter introduces the operation of adding loads and rectifiers.

6.1 Adding Load

Generally, the power supply system is not fully loaded at the initial operation stage. Due to the nature of telecom loads, power interrupt is not allowed once the load is put into operation. Therefore, load adding must be a live operation.

Before adding the DC load, a good construction design must be worked out. Select the load fuse or MCB, process and lay the load cables, and attach SN and polarity labels to the cables. Cable connection should start from the load end by connecting the earth cable first, and then the -48V output fuse or the MCB. The tools used must be insulated and preventive measures against possible accidents must be worked out in advance. Refer to *3.4.3 Connecting* DC Load Cables for the connection of DC load cables.

6.2 Adding Rectifier

The procedures of adding rectifiers are as follows.

1. Remove dummy plates in the empty rectifier guide rails of the rectifier cabinet.
2. Insert the new rectifier into position along the guide rail and fix it. See *3.6.1 Installing Rectifier*.
3. Close the corresponding AC input switch to feed AC power to this rectifier.
4. Reset parameters for controller.

Note

Connection and disconnection of rectifier's external input cables should be done by maintenance personnel, and the cables must be connected before switching on the rectifier, and disconnected after switching off the rectifier. The rated current of the rectifier input MCB is 20A, and its breaking capacity is 6kA.

Chapter 7 Maintenance

This chapter introduces basic maintenance requirements, routine maintenance items, maintenance operations, basic fixing methods and emergency treatment.

Note

1. The maintenance must be conducted under the guidance of related safety regulations.
2. Only trained personnel with adequate knowledge about the system can maintain the inner part of the system.
3. There is a danger in the primary circuit, and multiple power inputs, please disconnect all power supplies and battery input before maintenance
4. Use the product according to rated power, when the module in the system has fault, please return it to manufacturer for repair.
5. Ensure the type is the same when replacing the fuse link and fuse.

7.1 Maintenance Requirements

7.1.1 General

To ensure quality power supply and guarantee stable and reliable operation of the communication system, operation management and maintenance are necessary to the power supply system. Basic requirements for maintenance of power supply system include:

1. Guarantee uninterrupted quality power supply to the communication equipment.
2. Carry out periodic inspection and overhaul to ensure stable and reliable operation of the power supply system and prolong its operational life span.
3. Conduct effective troubleshooting to reduce the loss caused by faults.
4. Keep the equipment and environment clean to ensure that the environment in the equipment room conforms to the basic requirements of equipment operation.
5. Use new technologies and improve maintenance methods to achieve centralized monitoring, little or even no attendance.

To sum up, the power supply system maintenance includes routine maintenance, periodic inspection and technological reform. And the maintenance must be carried out in compliance with applicable industry standards and local regulations.

7.1.2 Maintenance Tools And Equipments

The common tools and instruments used in maintenance of power supply system are separately listed in Table 7-1 and Table 7-2.

Table 7-1 Common tools for power equipments maintenance

Name	Quantity	Applications
Joint pliers	1 piece	Shape and coil the naked pins and help to weld and assemble the surface of intensive device
Diagonal cutting pliers	1 piece	Cut extra leads, pins of welding surface, and nylon binding clips
Tweezers	1 piece	Help to weld and clean, pick up mini components, and coil tiny leads
Blade screwdriver	1 set	Drive and remove plain screws and open boxes
Cross screwdriver	1 set	Drive and remove cross screws
Wrench (double end wrench or fork wrench)	1 set	Wrench 6-angle or 4-angle bolts and nuts
Socket wrench	1 set	A kind of spinning tool used when there is no space for operation on the screw surface
Adjustable wrench	1 set	Wrench 6-angle or 4-angle bolts and nuts. Note: when in use, the adjustable tongue shall turn to the inside of the spinning direction.
Electric soldering iron	1 piece	Weld components

Name	Quantity	Applications
Wash brush	1 piece	Clean the equipment and dust inside boxes
Handsaw	1 piece	Saw the bus and cables. Note: The saw blade shall not turn to the handle.
Electrician knife	1 piece	Peel off the skin of cables, etc.
Electrician rubber mallet	1 piece	Rectify cables or equipment location
Auxiliary materials (non-spare parts)	Commonly-used auxiliary materials include insulating tape, self-adhesive label, soldering tin, nylon bandage, etc.	

Table 7-2 Common instruments for power equipments maintenance

Name	Quantity	Applications
Multimeter	2 to 3 pieces	Measure AC/DC voltage, current and resistance
Earth resistance tester	1 piece	Measure the earth resistance
Megommeter (500V and 1000V withstand voltage)	1 piece/each	Dielectric strength test
AC/DC clamp-on ampere meter	1 piece	Measure current
Contact Thermometer	1 piece	Measure the temperature of the surface and junction points of equipment
High/low-frequency noise tester	1 piece	Measure noise
*Ampere-hour meter	1 piece	Measure battery capacity
*AC/DC load meter	1 piece	Measure and test the load capacity of power net, rectifier and batteries
Note*: Those instruments marked with * may be configured or not to those relatively less-equipped equipment room according to actual requirements		

7.1.3 Reference Technical Specification For Maintenance

The power supply system consists of AC power supply, DC power supply and earthing system. To ensure communication quality and power supply security, the power supply quality must conform to some basic quality standards. Reference standards for AC, DC and earth resistance are shown in Table 7-3, Table 7-4 and Table 7-5.

Table 7-3 Quality standards for DC power supply

Standard voltage (V)	Voltage variation range at the receiving end of telecom equipment (V)	Noise voltage (mV)			Maximum permissible voltage drop of power supply circuit (V)
		Psophometrically weighted noise	Peak-peak value noise	Wide frequency noise (effective value)	
-48	-40 to -57	≤ 2mV	≤ 200mV 0 to 20Mhz	< 50mV 3.4kHz to 150kHz 150kHz to 30Mhz	3
Note: The voltage drop at the connectors of DC power supply circuit (including the fuse of the feed line output from the discharging busbar, and battery connectors) shall be in conformity with the following requirements or the temperature rise shall not exceed the permissible value: 1. If under 1000A, every hundred-ampere ≤ 5mv; 2. If above 1000A, every hundred ampere ≤ 3mv					

Table 7-4 Quality standards for AC power supply

Nominal voltage (V)	Voltage variation range at the receiving end (V)	Nominal frequency (Hz)	Variation range of frequency (Hz)	Power factor	
				Below 100kVA	Above 100kVA
380	323 ~ 418	50	± 2.5	≥ 0.85	≥ 0.9
Remark: The voltage imbalance of three-phase power supply shall not exceed 4%					

Table 7-5 Earth resistance reference standards for communication station

Name of the communication station	Earth resistance (Ω)
Comprehensive building, international telecom administration, tandem office, program control exchange with over 10 thousand lines, and toll exchange with over 2,000 lines.	< 1
Program control exchange with more than 2,000 lines but less than 10 thousand lines, and toll exchange with less than 2,000 lines.	< 3
Program control exchange with less than 2,000 lines, fiber terminal station, carrier repeater station, ground satellite station, and microwave junction station	< 5
Microwave relay station, fiber relay station	< 10
Microwave passive relay station	< 20 (may be up to 30Ω in the case of high soil resistivity)

7.2 Routine Maintenance Items

This chapter introduces routine maintenance items for power supply system and maintenance operation methods. The power supply system maintenance items are list in Table 7-6.

Table 7-6 Maintenance items for power supply system

No.	Item	Test standard	Test tools	Test method
1	System current sharing	After each rectifier is over half load, the output current imbalance between rectifiers should be less than ± 3%		Calculate the imbalance based on the output current of each rectifier displayed on the controller; or the rectifier output current displayed on each rectifier
2	Display of voltage / current	The difference between the rectifier voltage, busbar voltage and various output voltages displayed on the controller shall be less than 0.2V; the difference between the sum of the displayed currents of all rectifiers and the sum of charge current and total load current shall be within the specified error range		Read the voltage and current values displayed on the controller and rectifiers, and make judgement according to the above standards
3	Parameter setting	Conduct compliance check according to the record of the previously setting parameters (parameter table)		Reset those parameters not in conformity with the specified requirements. The operation method of parameter setting can refer to *NetSure™ Control Unit (NCU) User Manual, UMM830B (Issue AA, June 3, 2014)*
4	Communication function	The communication between each system unit and the controller shall be normal and there shall be no record of frequent communication interrupt between one certain unit and the controller in the historical alarm record		
5	Alarm function	Alarm should be given out in case of fault		Check the testable items on the spot. Testable items include AC mains failure, damage to SPDs (SPDs with alarm indicator or alarm contact), module failure and DC fuse blowout (test shall be conducted on unload fuse)
6	Protection function	Conduct compliance check according to factory parameters or parameters set through the controller		This item is generally not easy to test when the power supply system is in the operation. It is usually conducted when the protection function of the power supply is abnormal due to frequent occurrence of AC or DC protection. Test methods including testing the AC under/overvoltage protection function through external voltage regulator and testing the DC under/overvoltage protection function by forced discharge
7	Management function	The calculation, storage and battery auto-management functions performed by the controller. The historical alarm record can be queried, and the battery auto-management function is testable		1. Storage function: simulate an alarm, the controller will record the alarm information. 2. Battery auto-management: the battery charge mode and charge current can be adjusted and various protections can be implemented through the controller according to the data set by the user

No.	Item	Test standard	Test tools	Test method
8	Internal connection	The socket shall be well connected; the cables shall be well laid out and fixed; there shall be no cables that have been squeezed out of shaped by metal components; and there shall be no partial overheat or aging of connection cables		
9	Vent duct and dust deposit	There shall be no blockage or dust deposit in the vent ducts of rectifier fans or vent ducts in the cabinets	Hairbrushes, leather bellows, etch	Remove, clean and wash the guard boards of the vent ducts and the fan; replace them after they have been dried
10	DC cables	The permissible voltage drop determined in circuit design is generally less than 0.5V (low impendence distribution)		Note down the maximum current flowing through the cables, look up the CSA and wiring length of the cable in the design plan, calculate the voltage drop and check whether it meets the design requirements
11	Configuration of DC circuit breakers	The rated current of the DC circuit breaker should not be more than twice of the maximum load current. The rated current of the circuit breaker in each special equipment room should not more than 1.5 times the maximum load current		Check the adaptability of the circuit breakers according to the recorded maximum current of each load
12	Voltage drop and temperature rise of nodes	If below 1000A, the voltage drop should be ≤ 5mV for every hundred ampere; if above 1000A, the voltage drop should be ≤ 3mV; and the temperature rise of node should not exceed 70°C	Multimeter, semiconductor thermometer	Use multimeter to measure the voltage drop between the buses and cables at the two terminals of the node; and judge the rationality of the voltage drop of the node based on the current flowing through the node. Use the semiconductor thermometer to measure the temperature rise of the node. The measurement results should meet the temperature rise limitation and voltage drop limitation requirements

7.3 Routine Maintenance

Routine maintenance of power equipment mainly involves management of the equipment room environment and inquiry of the equipment running status. The basic requirements for the management of the equipment room environment have been presented in detail in the previous section. Inquiry of the equipment running status is a part of the routine logs, generally including the following items:

1. The inquiry of the operating status of the power supply equipment can be completed through the controller. The status parameters that can be inquired include mains voltage, mains frequency, DC output voltage, boost charge/float charge status, charge/discharge current, total load current, voltage and current of each rectifier, historical alarm record, etc. For inquiry methods, refer to *NetSure™ Control Unit (NCU) User Manual, UMM830B (Issue AA, June 3, 2014).*

2. Streamlined logs of the power supply status. The power equipment can measure mains voltage and record mains failure alarms, but cannot complete statistical work. To conduct statistical analysis of the operating status of the power grid, there shall be a detailed streamlined log of the status of the power net. In general, the status of the power grid shall be recorded once about every 2 hours, including the voltage and current of each phase of the power grid, the start and recovery time of mains failure, and the startup time and break time of the generator, etc.

3. Streamlined logs of the DC power supply status. The requirements for the streamlined logs of the DC power supply status are similar to those for the streamlined logs of the AC power supply status. Log items include DC output voltage, current of main loads, charge/discharge voltage and current, total load current, etc.

4. Faults maintenance. Overhaul and maintenance of other equipment shall be conducted in accordance with the requirements and methods provided by the manufacturer. But, during the routine maintenance, be sure to write down

the fault causes and the maintenance results in the ‘equipment calendar’. An equipment calendar shall be kept for each piece of equipment in the equipment room.

7.4 Basic Inspection

7.4.1 Handling Controller Fault

When the faults of the controller affect the DC power supply, turn off the controller.

7.4.2 Handling Rectifier Fault

Fault phenomenon and handling method

The symptoms of usual rectifier faults include: Run indicator (green) off, Protection indicator (yellow) on, Protection indicator blink, Fault indicator (red) on and Fault indicator blink, as shown in Figure 7-1. The indicators are shown in Table 7-7.

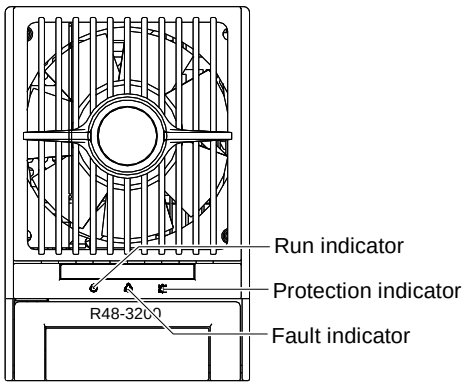


Figure 7-1 Rectifier indicator

Table 7-7 Indicator fault description

Symptom	Controller alarms	Causes	Handling method
Run indicator off	No alarm	No input/output voltage	Make sure there is input/output voltage
		Assistant power source of the rectifier fails	Replace the recitifier
Run indicator blinks	No alarm	The monitoing module performs operations upon the rectifier	No actions need to be taken
Protection indicator on	Rect Protect	AC input voltage abnormal	Make sure the AC input voltage is normal
	Rect Protect	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
Protection indicator on	Load share Alarm	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
	Rect Protect	Power factor compensation internal under voltage or over voltage	Replace the rectifier
Protection indicator blinks	Rect Not Respond	Rectifier communication interrupted	Check whether the communication cable is in normal connection
Fault indictor on	Rect HVSD	Rectifier over-voltage	Reset the rectifier. If the protection is triggered again, replace the rectifier
	Rect Failure	Two or more recitifiers have the same ID number	Contact Vertiv for maintenance
Fault indictor on	Rect Failure	Serious current sharing imbalance (> ± 5%)	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

Symptom	Controller alarms	Causes	Handling method
			protection indicator is on, replace the rectifier
Fault indicator blinks	Rect Fan Fails	Fan fault	Replace the fan

Fault description

1. Internal short-circuit of rectifier

The rectifier will automatically exit the power supply system in case of internal short-circuit.

2. Damage to partial rectifier

In case of damage to partial rectifiers, if the remaining undamaged rectifiers are able to meet the power supply requirements of loads, just turn off the AC input switches of the damaged rectifiers.

3. Rectifier output overvoltage

The overvoltage of a single rectifier will not cause the overvoltage protection of all rectifiers. However, if overvoltage protection occurs to all rectifiers, the power supply system cannot recover automatically.

Treatment: turn off the AC input switches of all rectifiers and remover the rectifier to disconnect it. At this time, the voltage should be below 56.4V. Then insert rectifier one by one and turn on the AC input switches to observe the output current of it. When the AC input MCB of a certain rectifier is switched on, its output current is obviously bigger than that of the others. When the voltage is higher than 56.4V, the rectifier with bigger output must be faulty Replace it. If all the rectifiers show the same symptom, users must turn off the monitoring and rectifiers and then restart the rectifiers.

Note

During the treatment of rectifier fault, delete the address code of the closed rectifier in the rectifier parameters setting through the controller and set the rectifier quantity as the number of the rectifiers that operate normally, then the rectifier fault alarm will be eliminated.

Replacing rectifier fan

If the rectifier fan is faulty and does not work, it should be replaced. See the following procedures:

1. Use a cross screwdriver to remove the three screws from the fixing holes and pull out the front panel, as shown in Figure 7-2.

2. Unplug the power cable of the fan and remove the fan. Install a new fan.

3. Plug the fan power cable. Put the front panel back and fasten it with the three screws.

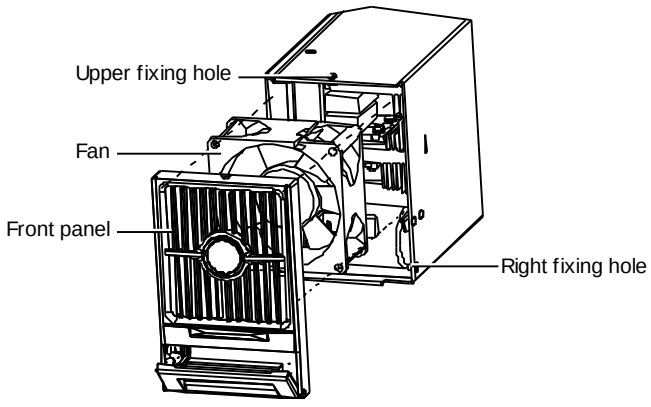


Figure 7-2 Disassembling the front panel

Replacing rectifier

Except replacing the fan, it is recommended not to repair any other part of the module. When faulty, the module should be replaced, not repaired. See the following procedures to replace the rectifier.

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

2. Pull out the faulty rectifier from the rack by grabbing its handle.

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

3. By holding the rectifier handle, push the new rectifier into the slot just vacated and make sure the connection is good. After a brief delay, the rectifier run indicator will turn on and the fan will start running.

4. Check whether the new rectifier works normally. Users should make sure that:

1) The controller 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 controller displays the alarm.

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

5. Push the handle back into the front panel to fix the rectifier with the positioning pin.

Note

If a rectifier is pulled out or there is faulty rectifier, users should reset the controller. Or else the batteries cannot be boost charged.

7.4.3 Replacing SM DU

Note

SM DU is an important component. Improper setting will lead to serious results, even system breakdown. Users should to carry out the replacement following the procedures strictly.

Setting software parameter

1. Connect one end of the RS232 crossover cable to the RS232 port of the new SM DU, and the other end to the RS232 port of the computer.

2. Install and start the PowerKit configuration software according to the *PowerKit Configuration Software User Manual*.

3. Double-click the shortcut icon  on the desktop.

After the software is started, the dialog box below will appear:

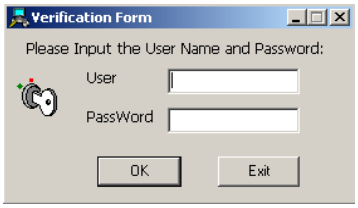


Figure 7-3 Verification form

4. Enter the user name ‘admin’ and password ‘123’ and click **OK**. The following screen will appear.

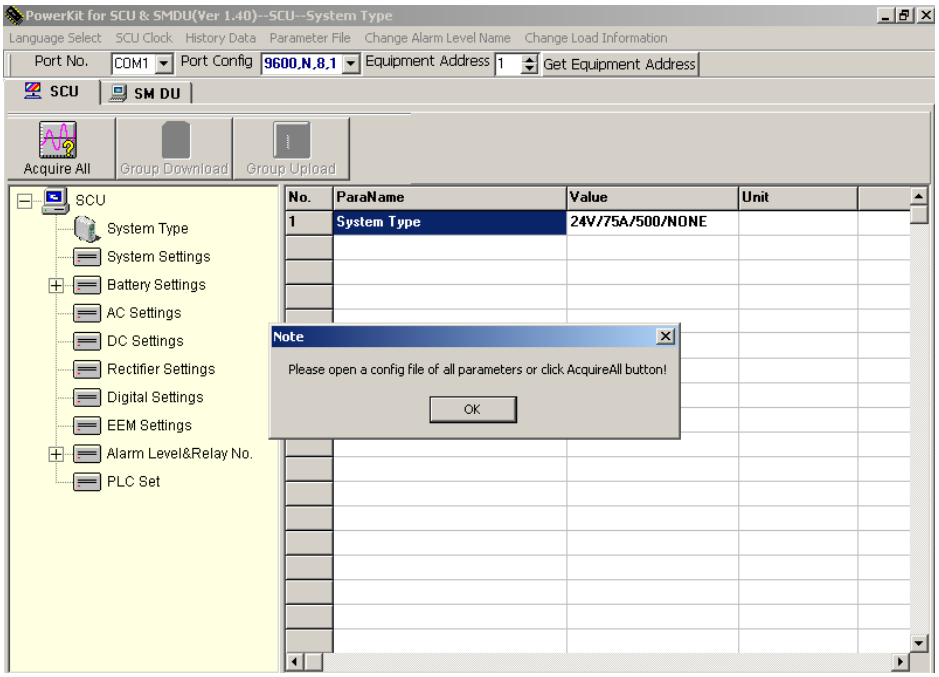


Figure 7-4 First screen

5. In Figure 7-5, click **SM DU** in the top left corner (illustrated '1'), input the port no. (illustrated '2'), and click **Get Equipment Address** (illustrated '3').

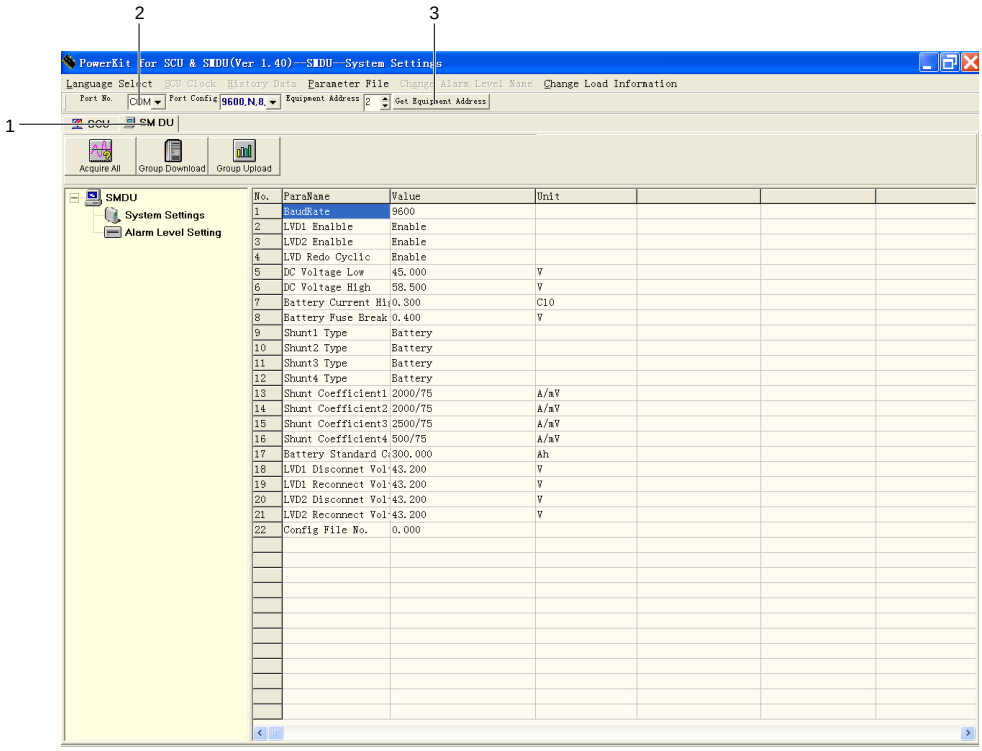


Figure 7-5 Get Equipment Address

6. Click  , the screen will prompt, 'This operation will take a few minutes. Are you sure?' Click **Yes** to confirm. The screen will prompt, 'Uploading data, please wait…' when the upload is finished, click **ok** to confirm.

7. Change the shunt coefficient 1 to '2000/75', click Enter, as shown in Figure 7-6.

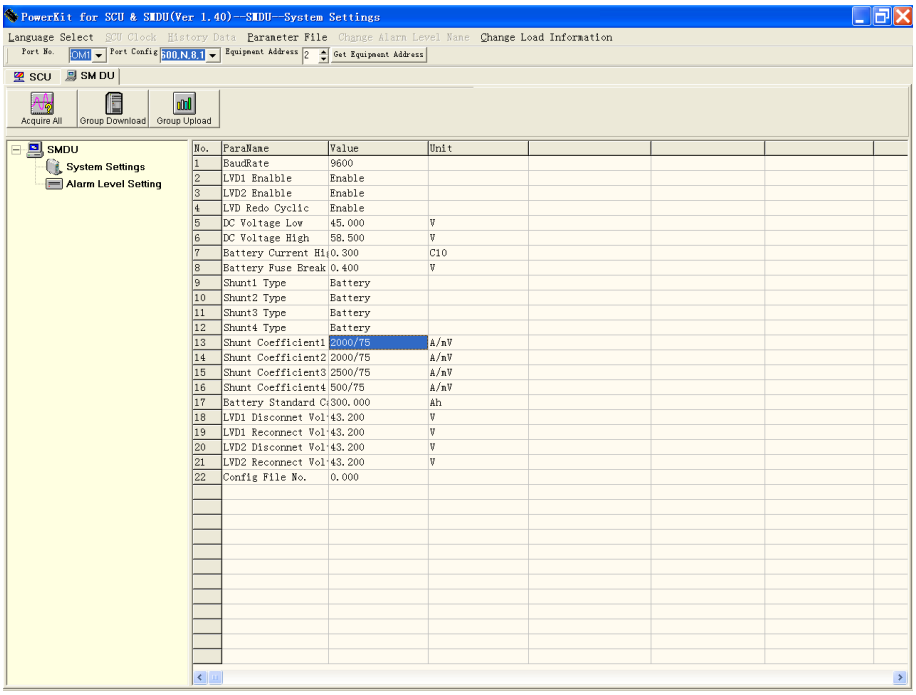


Figure 7-6 Changing parameter

8. Click the right mouse button. Select **Download** to download shunt coefficient 1 to SM DU, as shown in Figure 7-7.

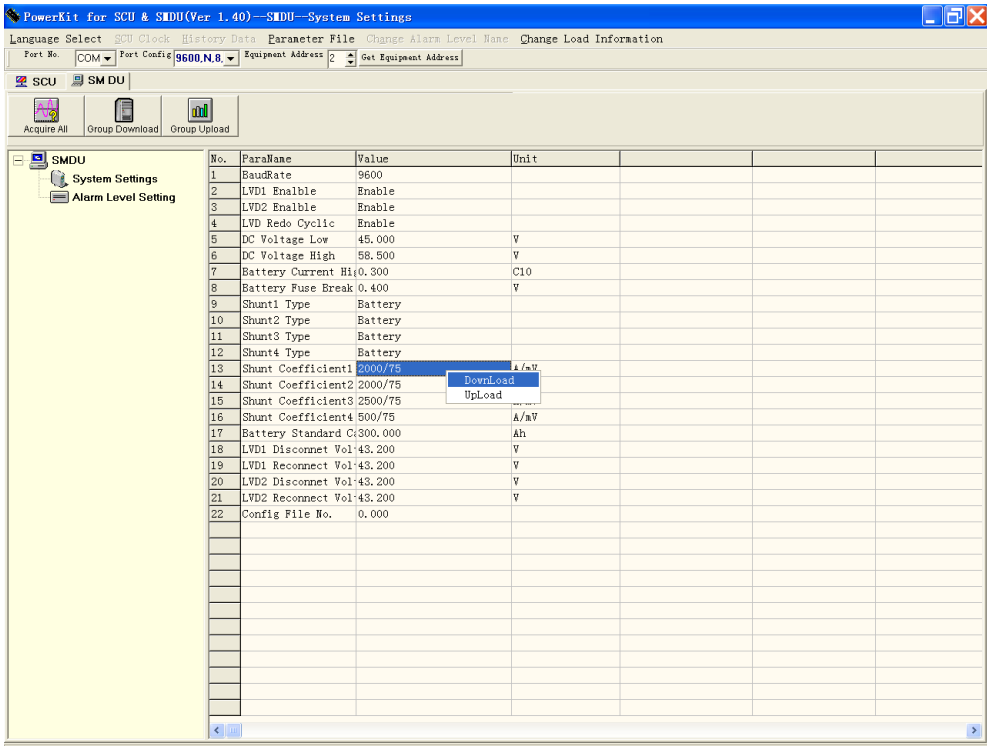


Figure 7-7 Download parameter

After the download, the screen will prompt **Success**, click **OK** to confirm.

9. Click the right mouse button. Select **Upload** to upload the SM DU parameter, as shown in Figure 7-8.

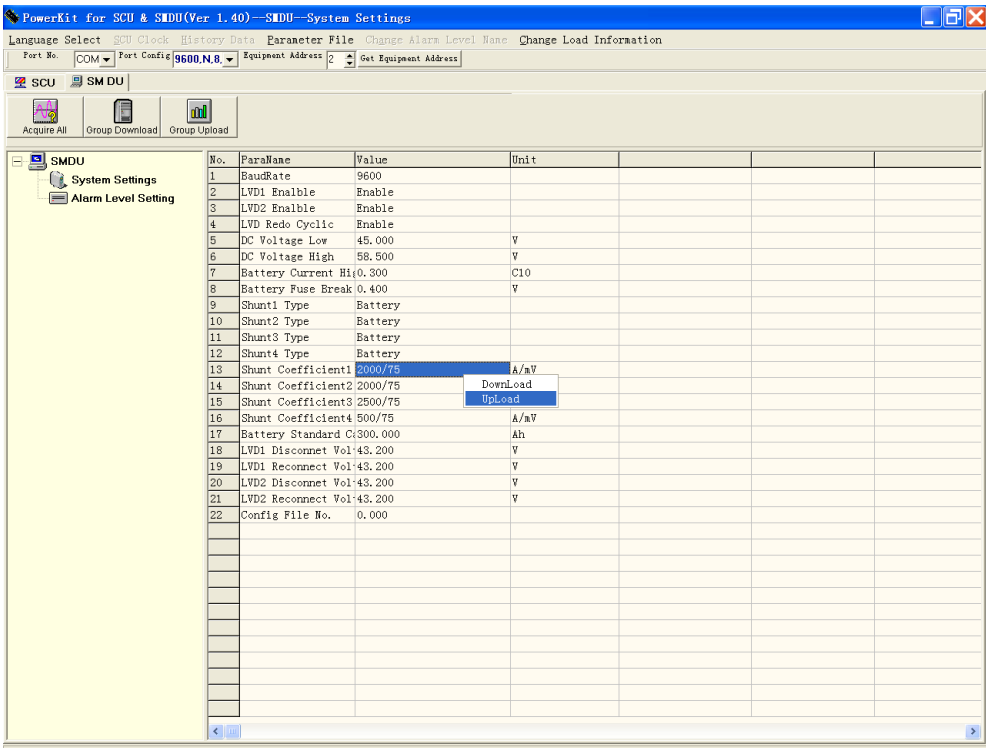


Figure 7-8 Upload parameter

After the upload, the screen will prompt **Success**, click **OK** to confirm.

10. Repeat procedures 7 ~9 to change the shunt coefficient 2 to ‘2000/75’ and the shunt coefficient 3 to ‘2500/75’.

Setting DIP switch

Set the DIP switch according to the label on the panel of the SM DU. The black block in the figure illustrates the position of the DIP switch. The illustration of the DIP switch is shown in Figure 7-9.

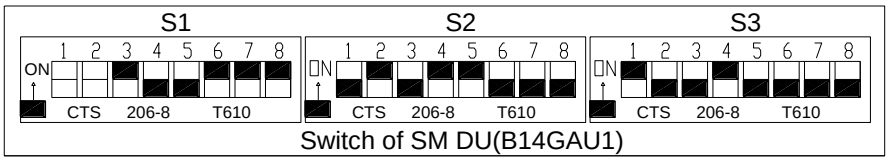


Figure 7-9 Illustration of the DIP switch

Install SM DU

1. Remove the panel of the SM DU and remove the damaged SM DU.

2. Check that the setting of the DIP switch is the same as the setting illustrated in the panel label. Install the SM DU.

3. Insert the terminals of the signal and communication cables to the ports of the SM DU. Check that the controller communicates with the SM DU.

4. Reinstall the panel of the SM DU.

7.5 Emergency Treatment

In order to keep uninterrupted DC power supply of the power supply system, some emergency measures shall be taken to cope with the faults that threaten DC power supply.

Faults that may occur in the power supply system and cause output interrupt mainly include unrecoverable damage to AC distribution circuit, short circuit of DC load or DC distribution, system shutdown due to breakdown of the controller, and blockage of rectifier due to DC output overvoltage, etc.

Emergency treatment of AC distribution

In case of failure of AC power supply to rectifier due to AC distribution fault, the AC mains can be directly introduced into the input switch of the rectifier.

Emergency treatment of DC distribution

Partial short-circuit of load

Disconnect the branch fuse that corresponds to the damaged loads. Replace the faulty fuse. If the fuse link is replaced for other reasons, it must make clear whether the load circuit where the fuse link is located permits power disconnection.

Power failure

AC power failure is the general case in the operation of power supply system. If the continuous time is not long, the batteries are feed to DC. However, if the power failure is not clear or the continuous time is too long, restart the generator to power. And then transfer to feed the power supply system after 5min in order to reduce the effects to the power supply equipments during the process from starting to transition for generator.

Disastrous accidents

Disastrous accidents refer to communication equipment faults arising from disasters such as lightning strike, flood, earthquake and fire. For those disasters that may severely affect the safety of communications, emphasis shall be mainly laid on prevention. Meanwhile, communication exchanges shall have adequate human and material resources and work out effective countermeasures to deal with these disasters. They shall also prepare emergency management regulations and grave accidents rush-repair rules.

Appendix 1 Technical Parameter

Table 1 Technical parameters

Parameter Category	Parameter	Description
Environmental	Operating temperature range	-10°C to 55°C (derating from 40°C)
	Storage temperature range	-25 ~ 55℃
	Transport temperature range	-40 ~ 70℃
	Relative humidity	5%RH ~ 95%RH
	Altitude	≤ 2000m (derating is necessary above 2000m)
	Over-voltage level	Level II
	Pollution level	Level II, No conductive dust and corrosive gas. No dangerous of explosive
AC input	AC input system	3-phase 4-wire or 3-phase 5-wire
	Rated input phase voltage	NetSure 701 AO2: 110Vac/120Vac NetSure 701 AO3: 220Vac
	Rectifier input voltage range	85Vac ~ 290Vac
	Input AC voltage frequency	45Hz ~ 65Hz
	Max input current	≤20.4A × n (n representing the amount of the rectifier), at 176Vac ± 5Vac input
DC output	Rated voltage	-53.5Vdc
	Output DC voltage	-42.3Vdc ~ -57.6Vdc
	Max output current	≤ 55A × n (n representing the amount of the rectifier)
	Total regulation	≤ 1%
	Efficiency	≥ 90%
	Noise voltage (peak-peak	≤ 200mV (0 ~ 20MHz)
	Telephone psophometrically weighted noise voltage	≤ 2mV (300Hz ~ 3400Hz)
	Wide frequency noise voltage	≤ 100mV (3.4kHz ~ 150kHz); ≤ 30mV (150kHz ~ 30MHz)
	Discrete noise	≤ 5mV (3.4kHz ~ 150kHz); ≤ 3mV (150kHz ~ 200kHz); ≤ 2mV (200kHz ~ 500kHz); ≤ 1mV (0.5MHz ~ 30MHz)
AC input alarm and protection	AC input overvoltage alram point	Default: 25%, (NetSure 701 AO2 is the line voltage，NetSure 701 AO3 is the phase voltage) configurable through controller
	AC input undervoltage alarm point	Default:25%, configurable through controller
	AC input overvoltage/undervoltage alarm hysteresis	Fixed ≤ 5%
	AC input overvoltage protection point	Default: 295Vac ± 5Vac (idem), configurable through controller, hysteresis is more than 10Vac
	AC input undervoltage protection point	Default: 80Vac ± 3Vac (idem), configurable through controller, hysteresis is more than 15Vac
DC output alarm and protection	DC output overvoltage 2 alarm point	Default: -58.5 ± 0.3Vdc
	DC output overvoltage 1 alarm point	Default: -55.7 ± 0.3Vdc
	DC output undervoltage 1 alarm point	Default: -45.0 ± 0.3Vdc
	DC output undervoltage 2 alarm point	Default: -42.0 ± 0.3Vdc
DC output alarm and protection	DC input overvoltage/undervoltage alarm hysteresis	Fixed : 0.5Vdc

Parameter Category	Parameter	Description	
Rectifier	Current sharing	Rectifiers can work in parallel and share the current. The unblanceness is better than ±3% rated current. Test current range: 10% ~ 100% rated current	
	Derate by input (45°C)	At 176Vac input, the rectifier outputs 100% power At 120Vac input, the rectifier outputs 50% power At 85Vac input, the rectifier outputs 18.75% power	
	Output delay startup	The startup time is configurable through controller. The time is 8s at 90% rated load, and 90s at 100% rated load	
	Fan controlling	Rectifier fan speed can be increased when the rectifier temperature and output current is raising. The fan speed will reach full speed when ambient temperature is more than 45°C or full loads output. If the PFC bus voltage exceeds the normal range, for example in the case of low bus voltage, the fan will stop to work	
	Overvoltage protection mode	The rectifier provides overvoltage hardware and software protection. The hardware protection point is 59.5V ± 0.5V, and it requires manual resetting to restore operation. The software protection point is between 56V and 59V, and can be set through the controller When the output voltage of rectifier is higher the overvoltage protection point, the rectifier will shutdown. The overvoltage protection point is between 56V and 59V, and can be set through the controller. The alarm indicator (red) will be on when rectifier occurs overvoltage protection. The protection event will be set to the controller which will deal with this alarm. If the rectifier happens four times overvoltage in 5min, it requires manual resetting to restore the operation There are two software setting modes through the controller on rectifier: 1. Restart by hand 2. Restart automatically after overvoltage protection in 5s	
	Temperature derating	The rectifier can start at -40°C.Temperature below 45°C, outputs full power 3200W for R48-3200, outputs full power 3500W for R48-3500e. Temperature above 45°C, outputs power derated.	
EMC	Conducted emission	Class A EN300386	
	Radiated emission		
	Immunity to ESD	Criterion B EN/IEC 61000-4-2	
	Immunity to EFT	Level 3 EN/IEC 61000-4-4	
	Surge	Level 4 EN/IEC 61000-4-5	
	Immunity to radiation	Criterion A EN/IEC 61000-4-3	
	Immunity to conduction	Criterion A EN/IEC61000-4-6	
Other	Safety regulation	Compliant with IEC60950	
	Noise	The noise is not more than 60dB (A) when ambient temperature is 25°C	
	Insulation resistance	At temperature of 15°C ~ 35°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 10MΩ	
	Insulation strength	Remove the SPD, controller and rectifiers from the power supply system before the test AC circuit to earth: 50Hz, 2,500Vac; AC circuit to DC circuit: 50Hz, 3,000Vac DC circuit to earth: 50Hz, 1,000Vac Assistant circuit (not directly connected to the host circuit): 50Hz, 500Vac For all the four tests above, there should be no breakdown or flashover within 1min, with leakage current not bigger than 10mA	
	ROHS	Compliant with R5 requirement	
Mechanical	Dimension (mm)	NetSure 701 AO2-T1、NetSure 701 AO3-T1 rectifier cabinet	2000 (H) × 600 (W) × 600 (D) Contains the height of the top section
		PD48/2000DU DC distribution cabinet	2350 (H) × 600 (W) × 600 (D) Contains the height of the top section
		PD48/2000DD DC distribution cabinet	2200 (H) × 600 (W) × 600 (D)
		M830D controller	87.5 (H) × 85 (W) × 287 (D)
		R48-3200/R48-3500e rectifier	132.3 (H) × 85.3 (W) × 287 (D)
Mechanical	Weight (kg)	Rectifier cabinet (excluding rectifier and controller)	270
		DC distribution cabinet	260
		M830D controller	0.8
		R48-3200/R48-3500e rectifier	3.5

Appendix 2 Engineering Design Diagram

Engineering design diagram of DC distribution cabinet

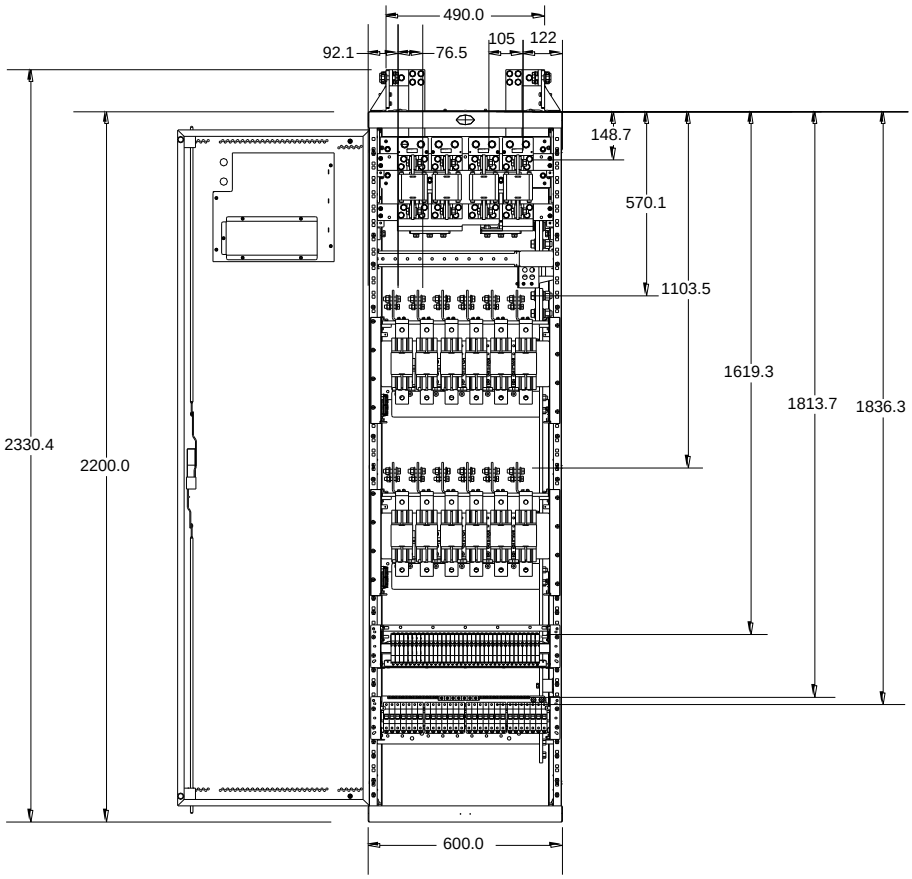


Figure 1 PD48/2000DU engineering design diagram (front view, unit: mm)

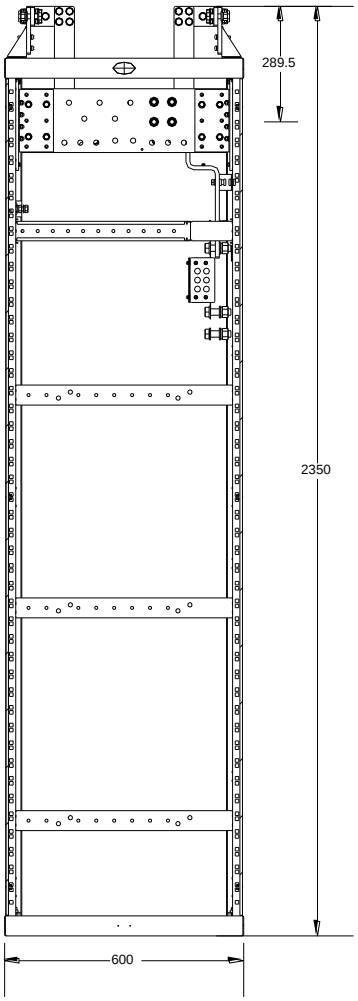


Figure 2 PD48/2000DU engineering design diagram (rear view, unit: mm)

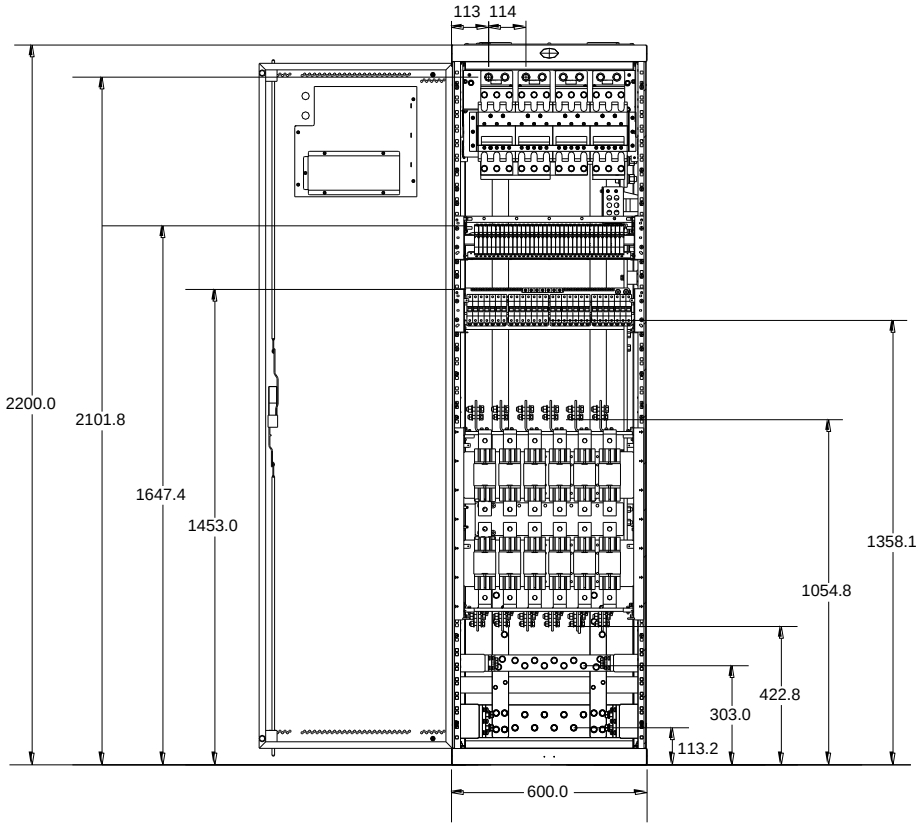


Figure 3 PD48/2000DD engineering design diagram (front view, unit: mm)

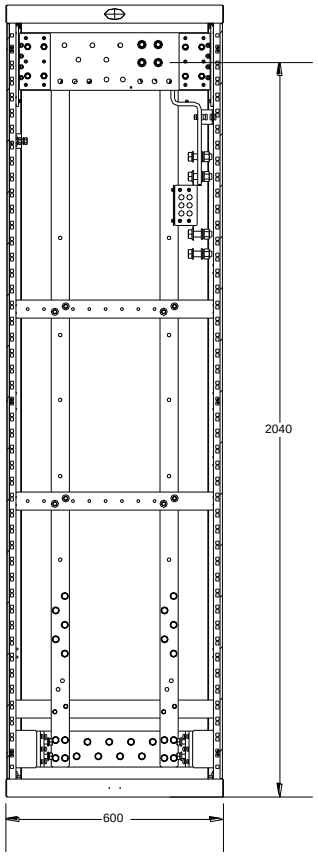


Figure 4 PD48/2000DD engineering design diagram (rear view, unit: mm)

Engineering design diagram of rectifier cabinet

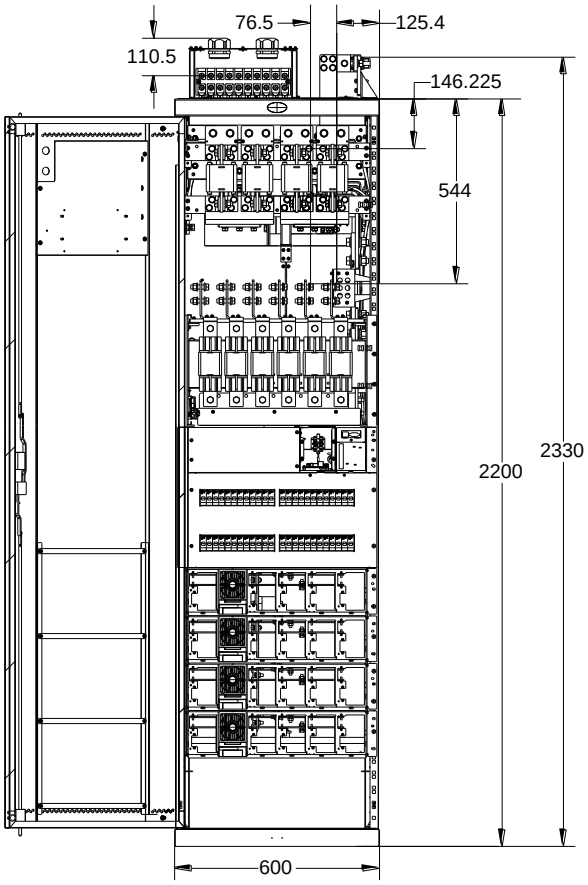


Figure 5 NetSure 701 AO2-T1 rectifier cabinet engineering design diagram (front view, unit: mm)

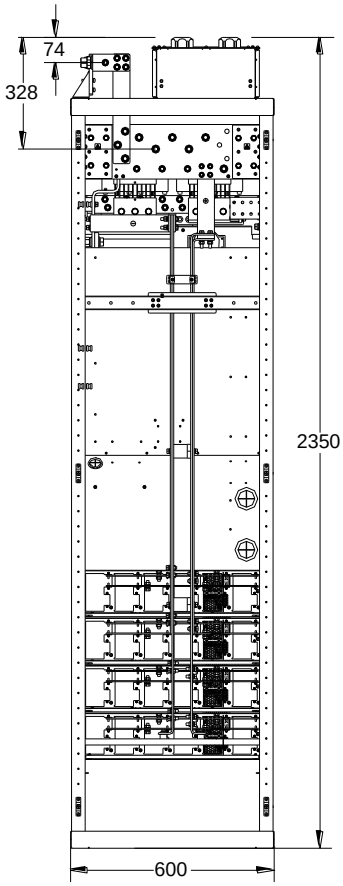


Figure 6 NetSure 701 AO2-T1 rectifier cabinet engineering design diagram (rear view, unit: mm)

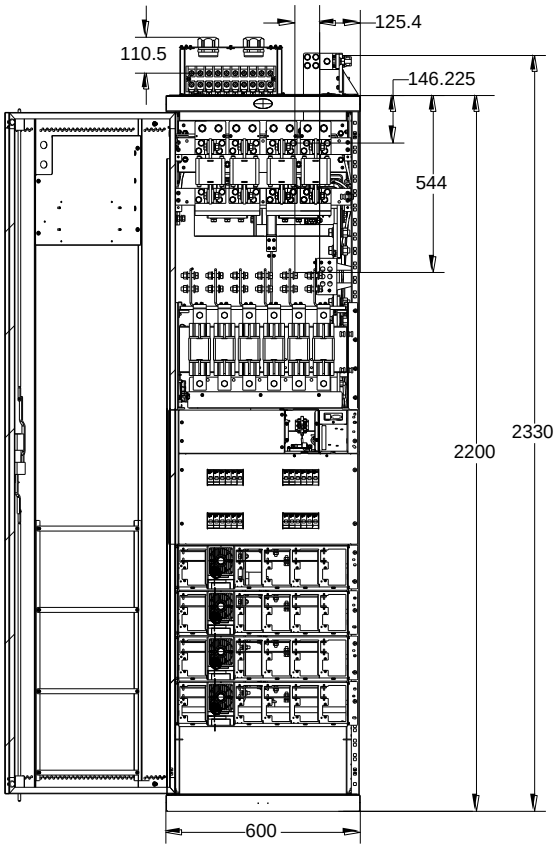


Figure 7 NetSure 701 AO3-T1 rectifier cabinet engineering design diagram (front view, unit: mm)

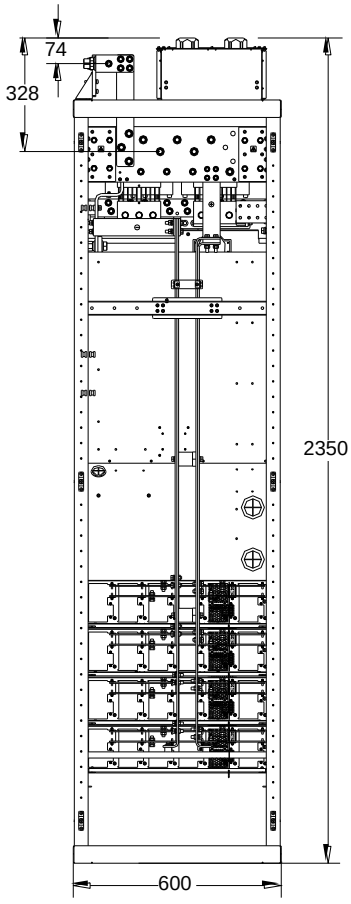


Figure 8 NetSure 701 AO3-T1 rectifier cabinet engineering design diagram (rear view, unit: mm)

Appendix 3 Spare Part List

Spare part list is given in Table 2 (rectifier and controller not included):

Table 2 Spare part list

Cabinet	BOM	Description
Rectifier cabinet	02350709	Supervision board, Distribution Unit Supervision Board,(SM DU),ROHS
	03034923	Finished Board -MA4C5U31 user IB2 interface board -
	03027881	Manufactured Board, W148AA2, W148AZB2 LVD Board For Battery MCCB, {R5}
DC distribution cabinet	02350709	Supervision board, Distribution Unit Supervision Board,(SM DU),ROHS

Appendix 4 Wiring Diagram

Wiring diagrams of the rectifier cabinet

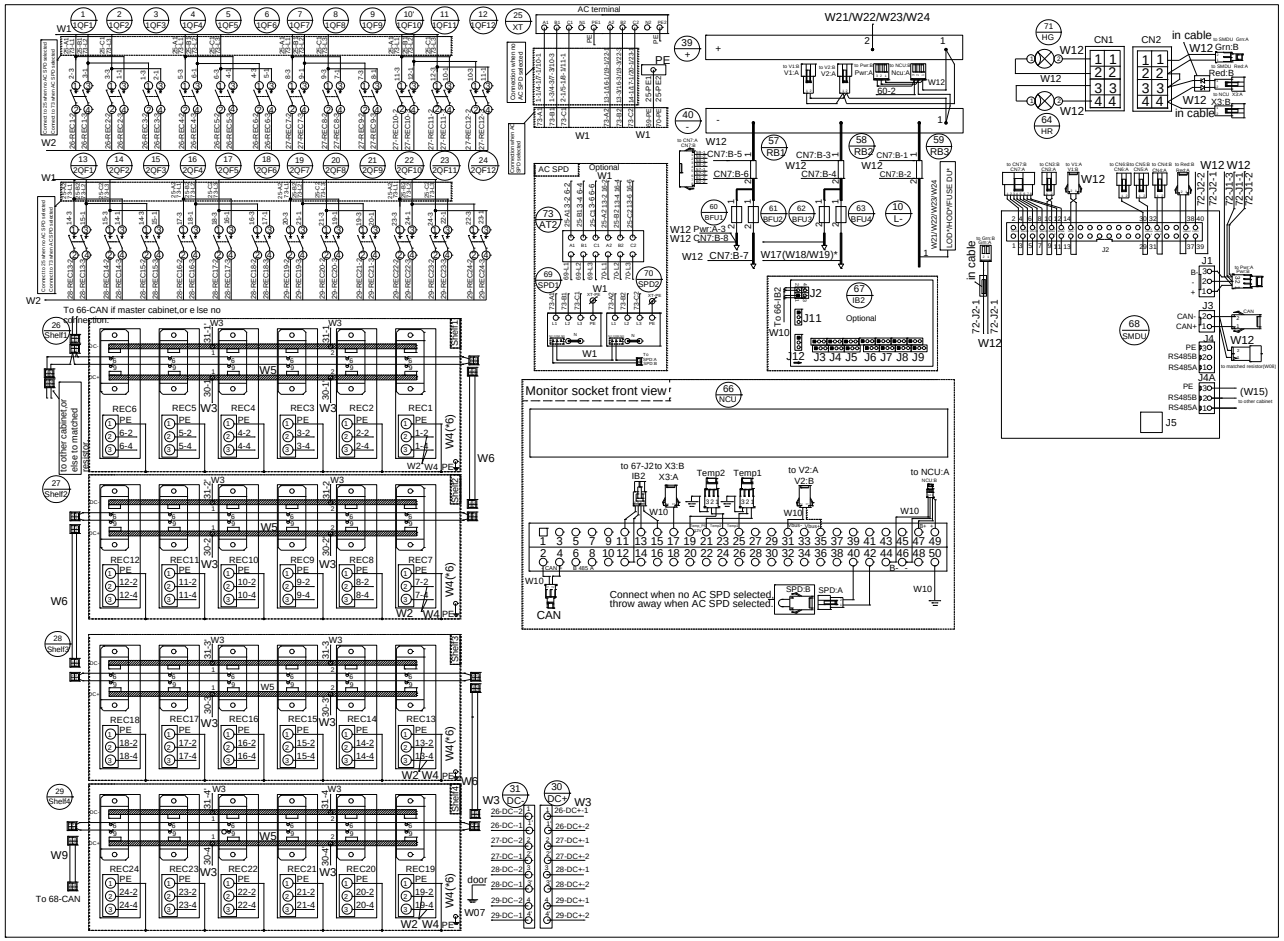


Figure 9 NetSure 701 AO2-T1 rectifier cabinet wiring diagram (1)

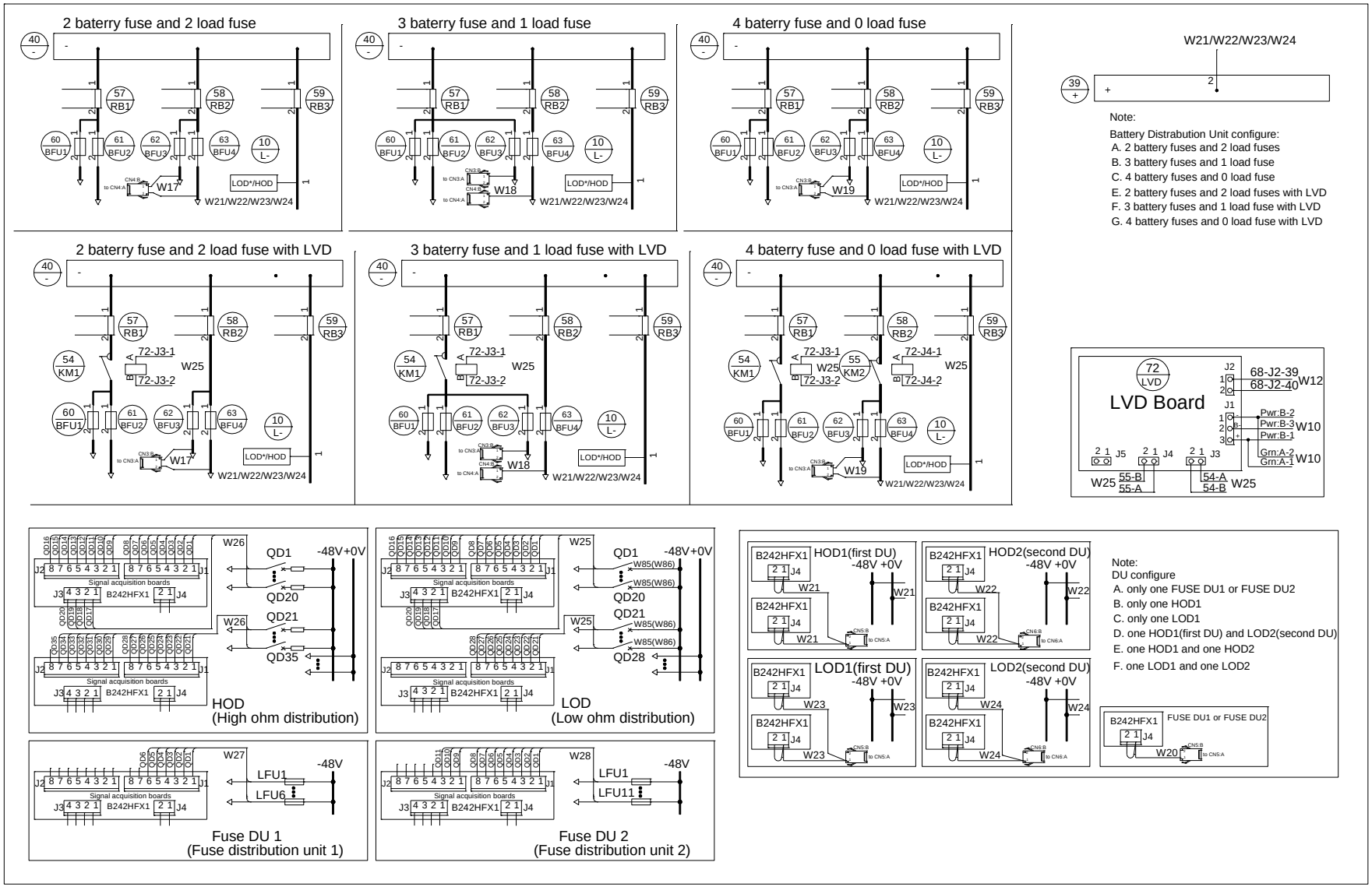


Figure 10 NetSure 701 AO2-T1 rectifier cabinet wiring diagram (2)

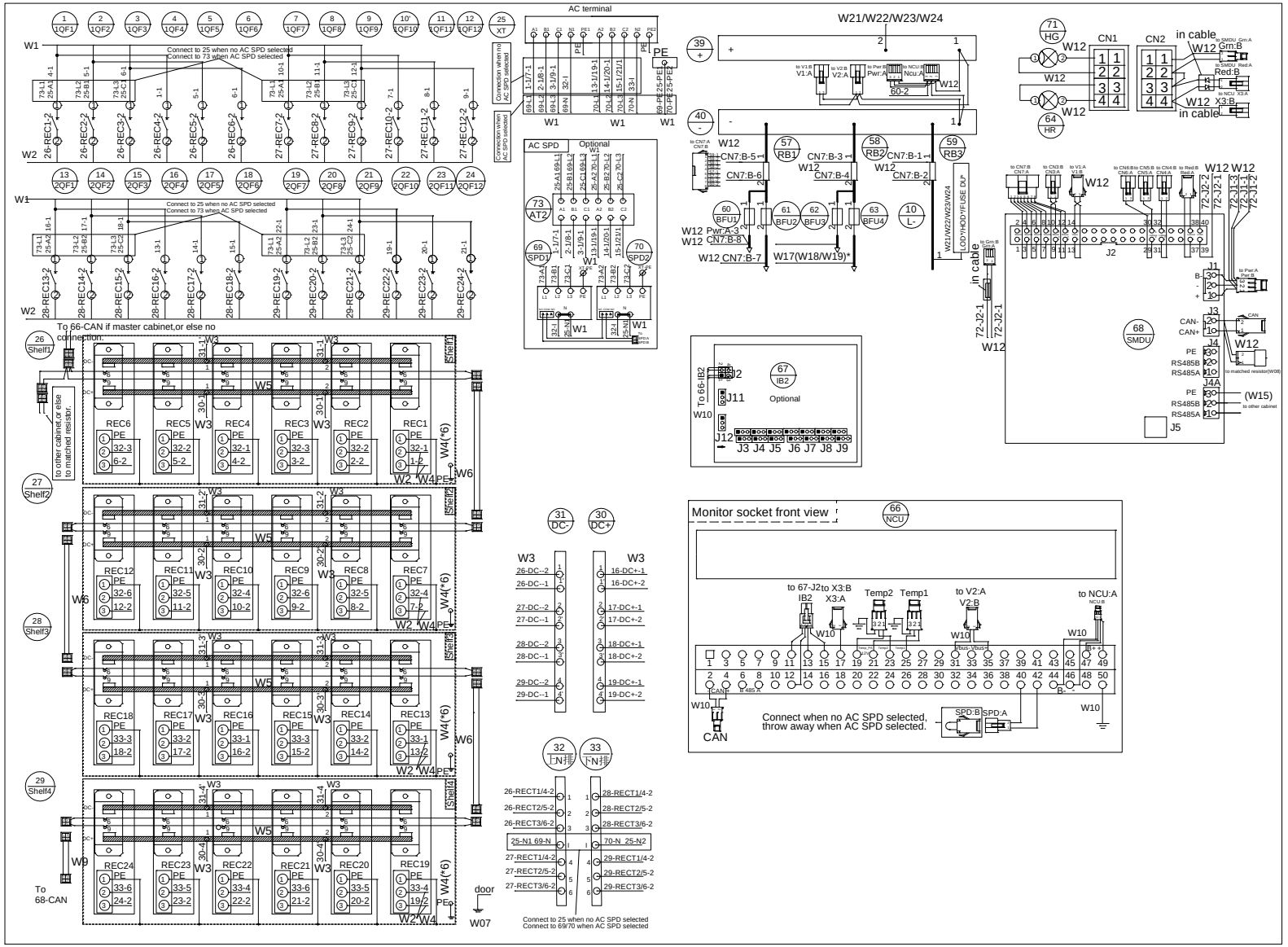


Figure 11 NetSure 701 AO3-T1 rectifier cabinet wiring diagram (1)

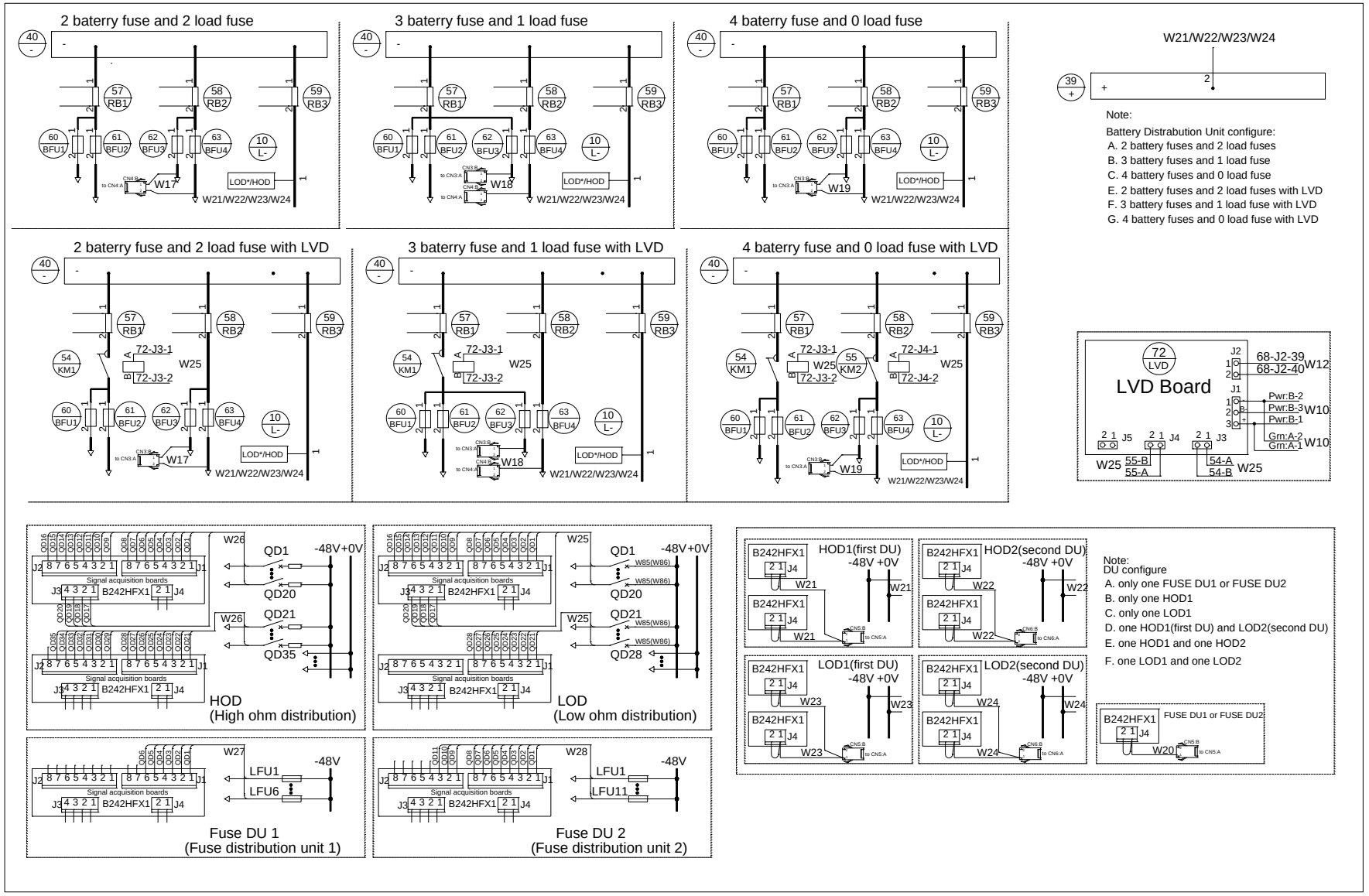


Figure 12 NetSure 701 AO3-T1 rectifier cabinet wiring diagram (2)

Wiring diagrams of the DC distribution cabinet

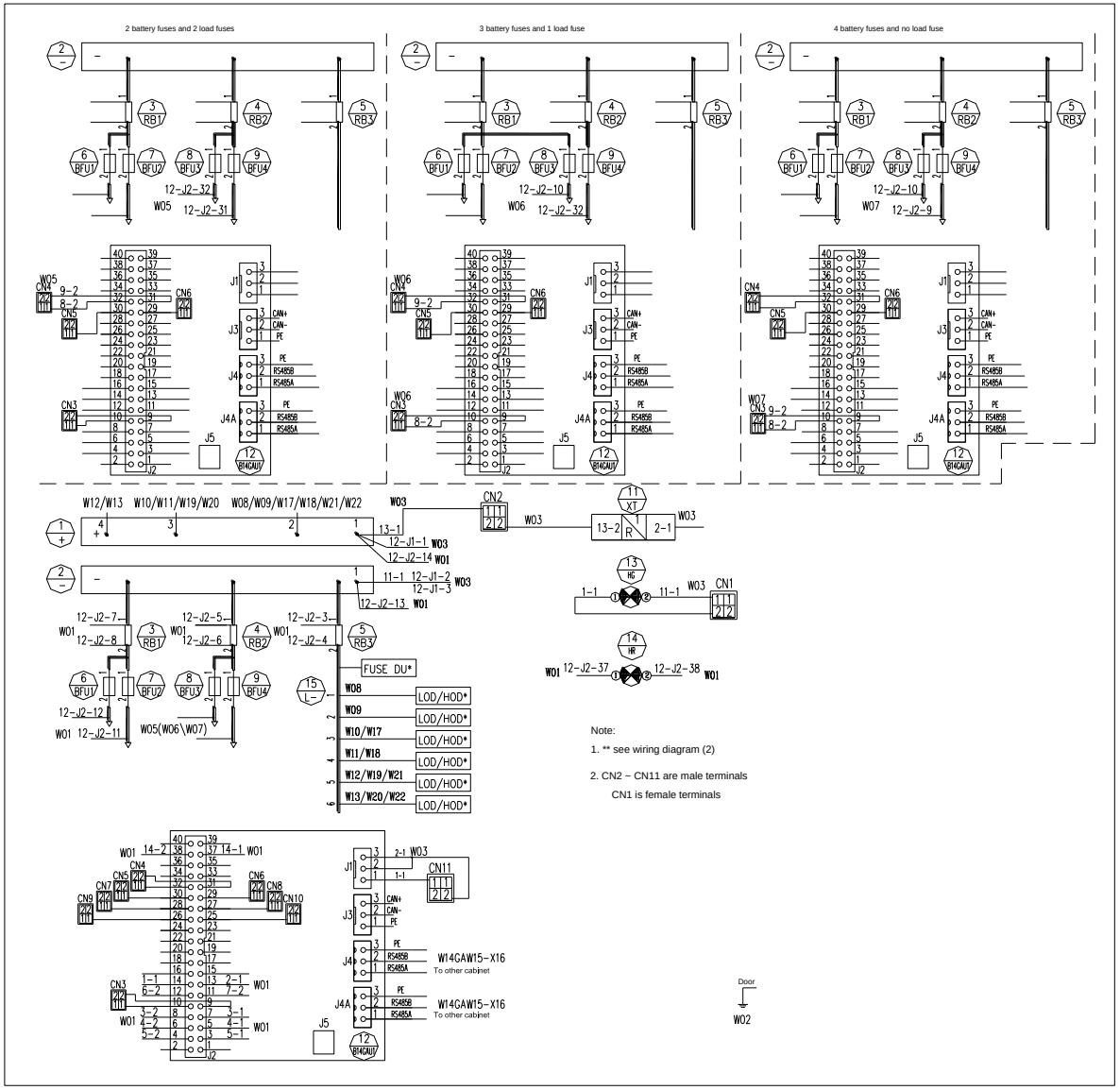


Figure 13 PD482000DU DC distribution cabinet wiring diagram (1)

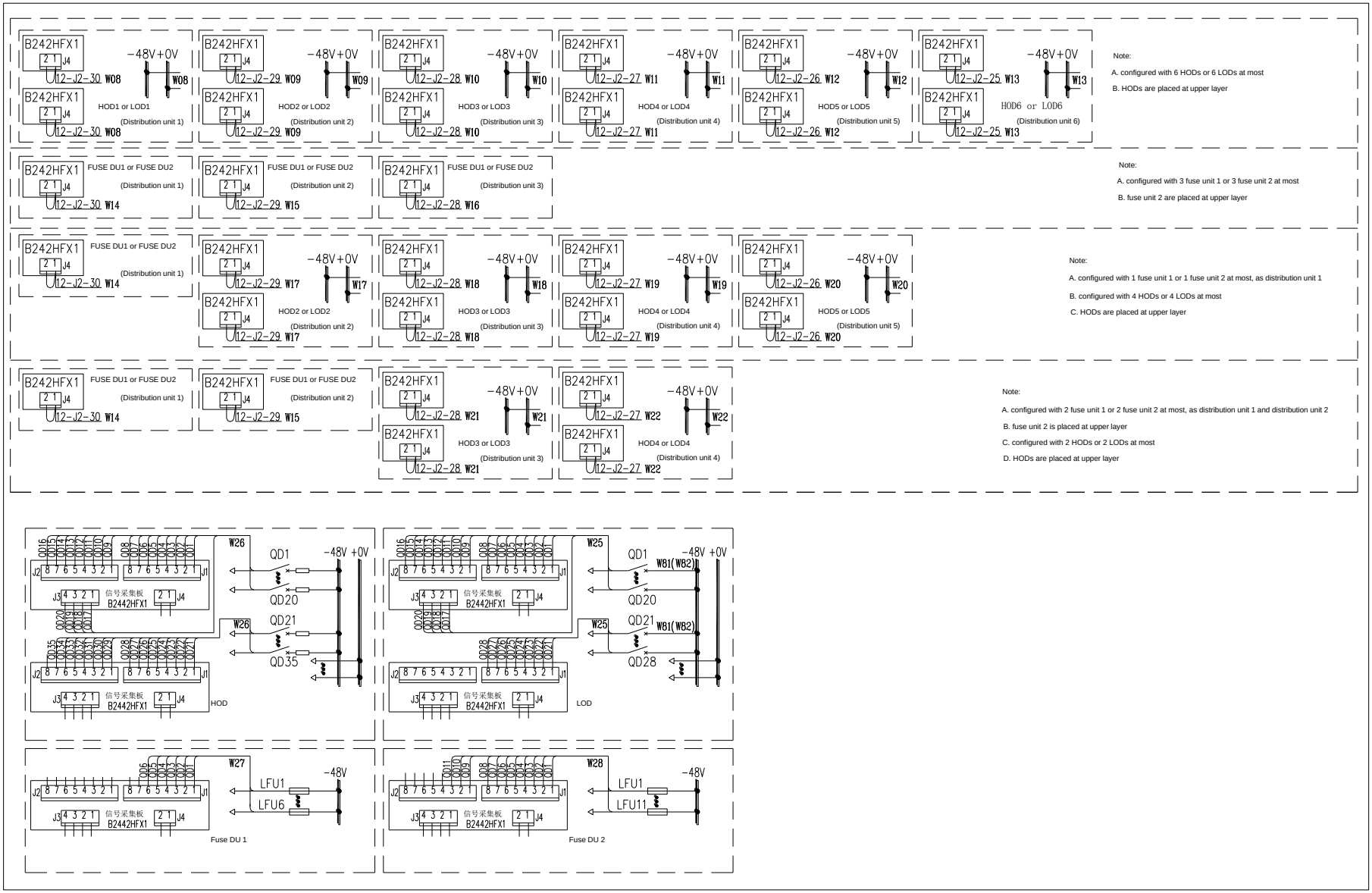


Figure 14 PD482000DU DC distribution cabinet wiring diagram (2)

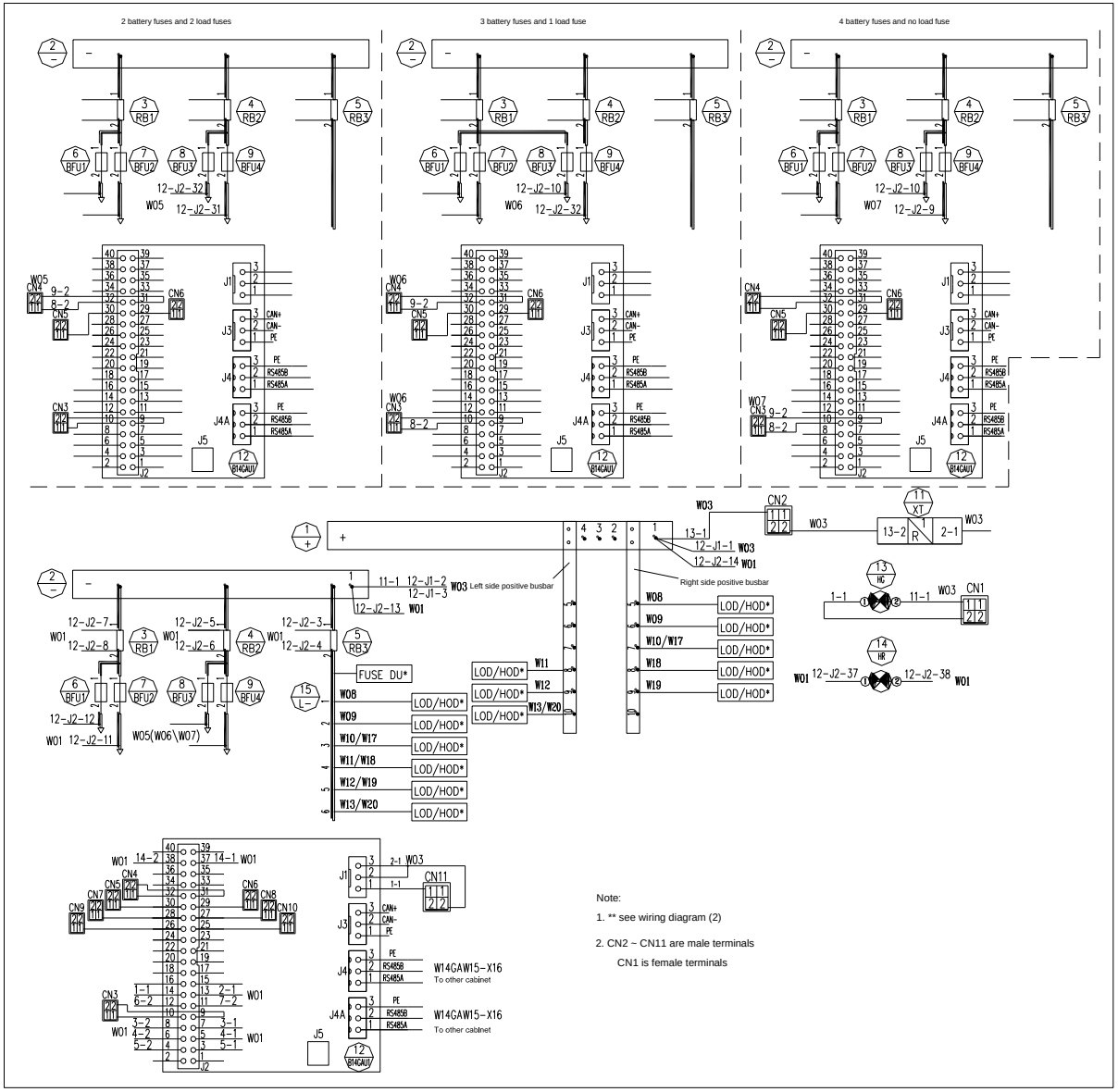


Figure 15 PD482000DD DC distribution cabinet wiring diagram (1)

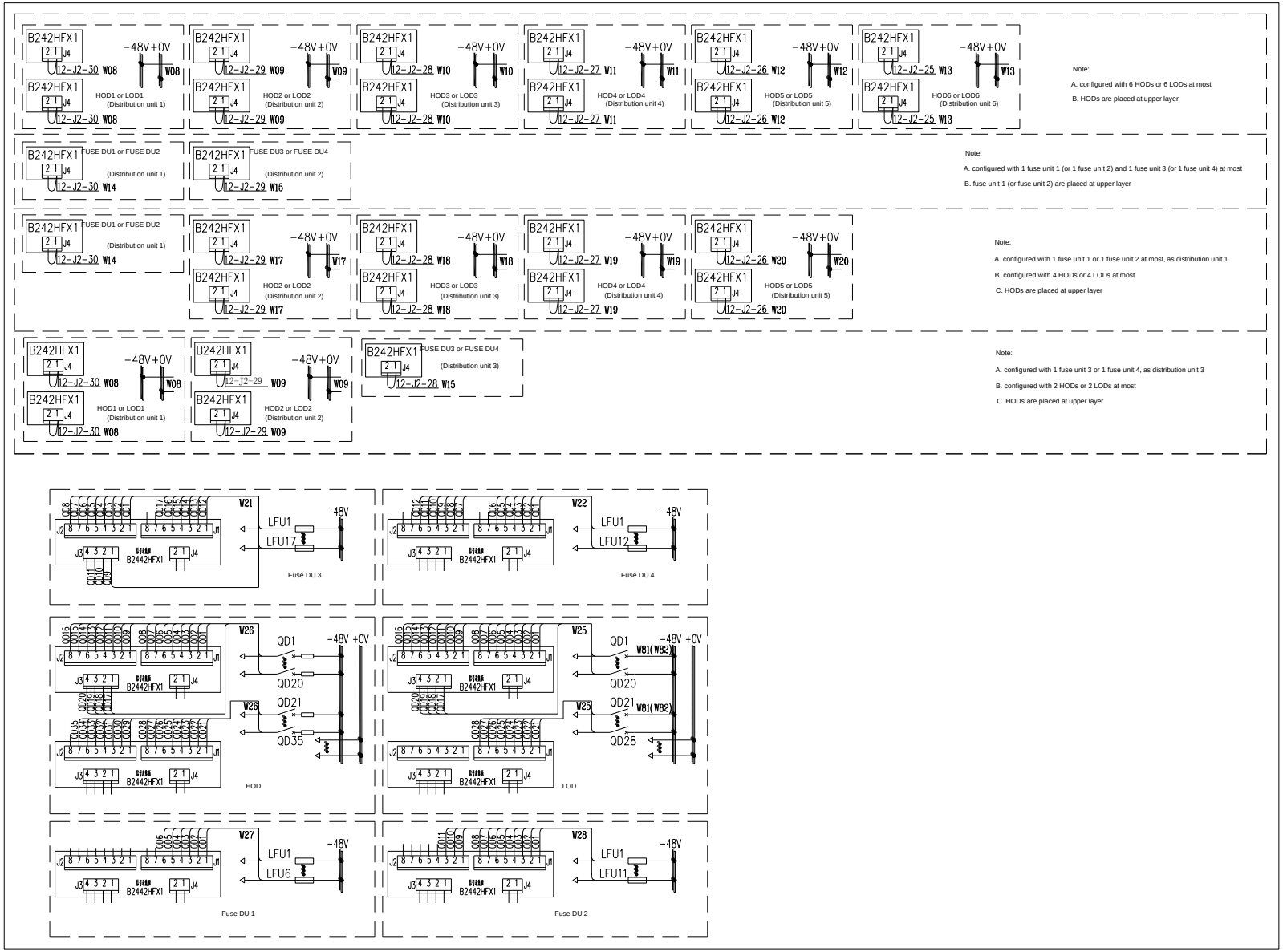
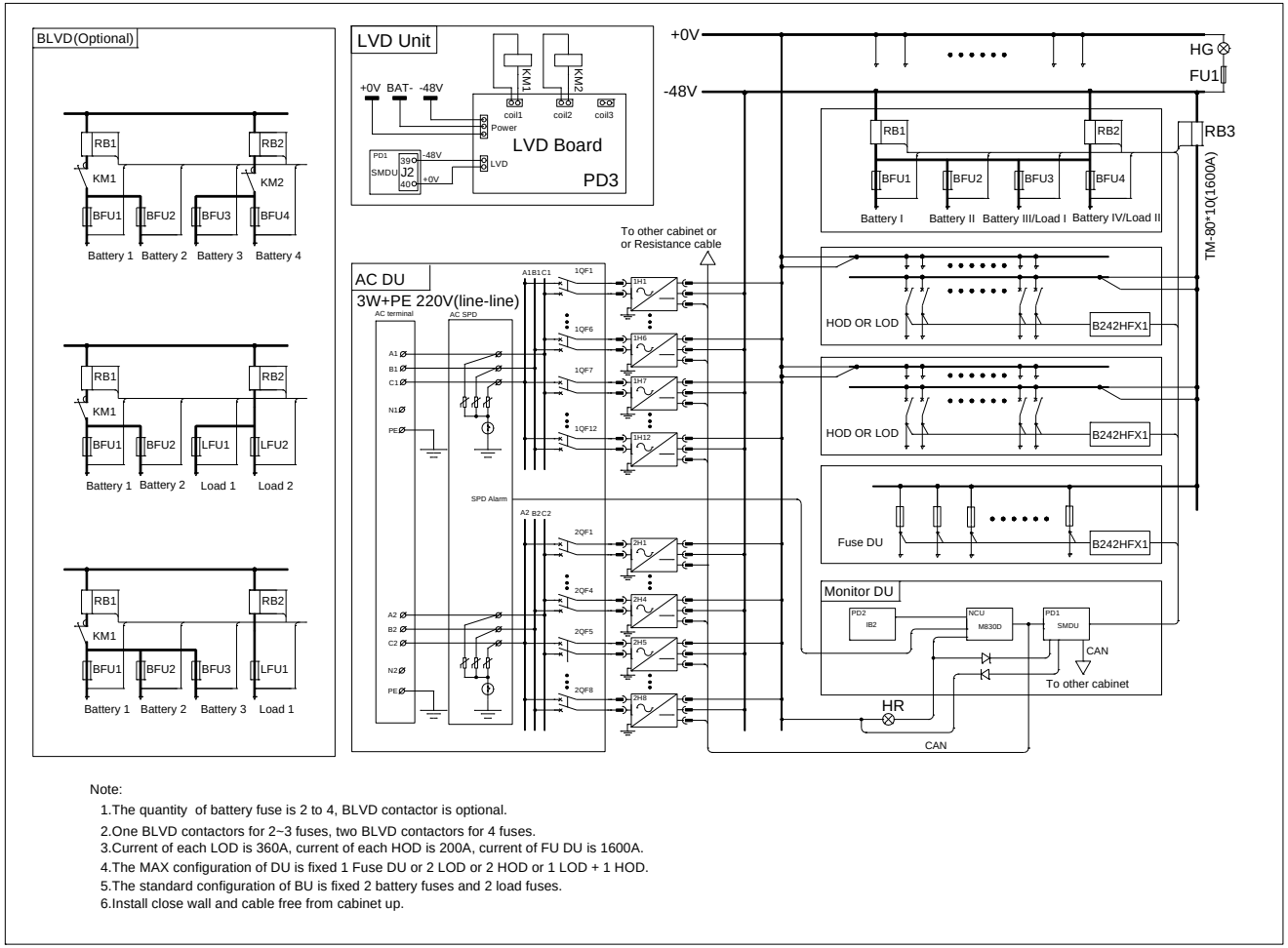


Figure 16 PD482000DD DC distribution cabinet wiring diagram (2)

Appendix 5 Schematic Diagram



Note:

1.The quantity of battery fuse is 2 to 4, BLVD contactor is optional.

2.One BLVD contactors for 2~3 fuses, two BLVD contactors for 4 fuses.

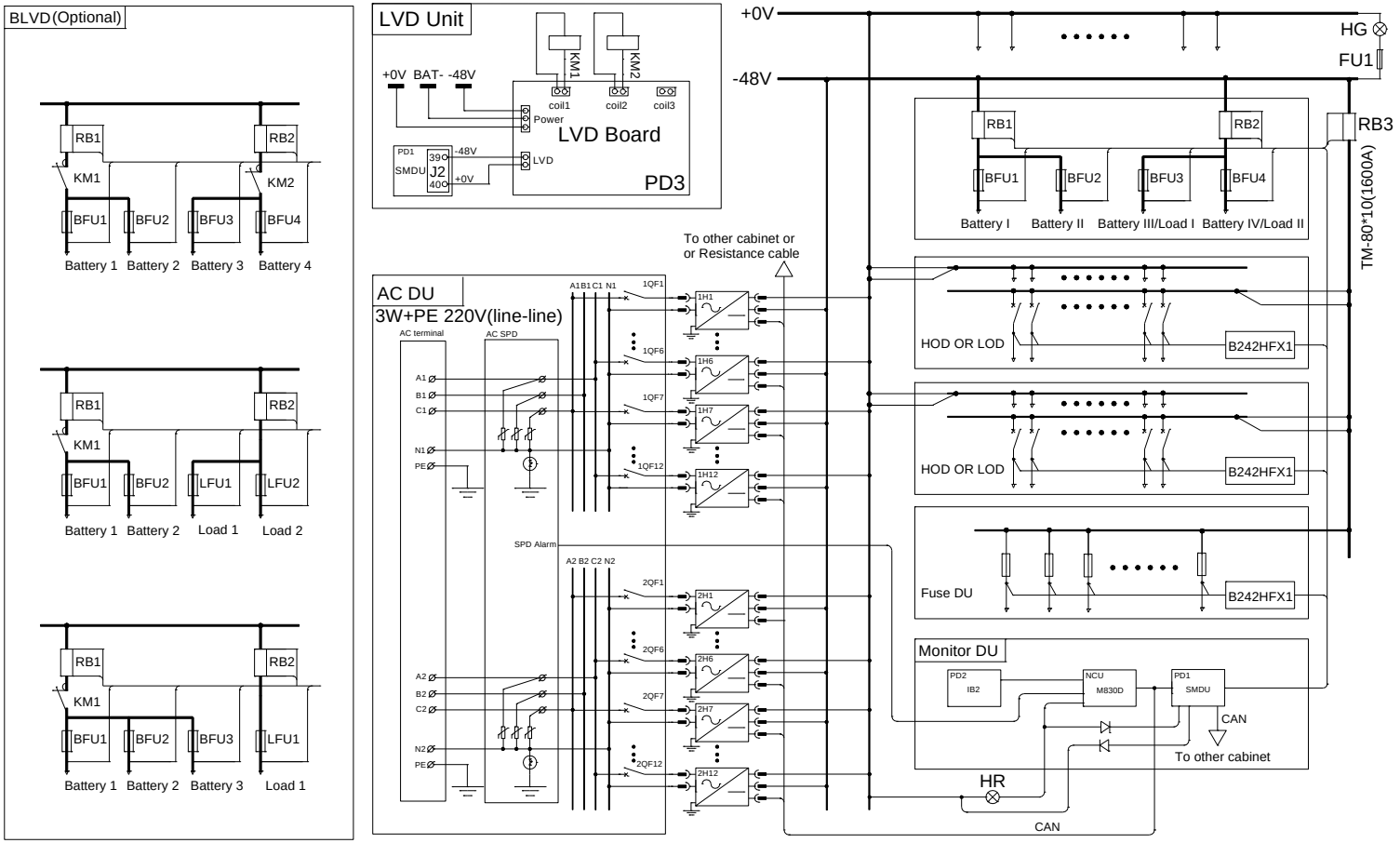
3.Current of each LOD is 360A, current of each HOD is 200A, current of FU DU is 1600A.

4.The MAX configuration of DU is fixed 1 Fuse DU or 2 LOD or 2 HOD or 1 LOD + 1 HOD.

5.The standard configuration of BU is fixed 2 battery fuses and 2 load fuses.

6.Install close wall and cable free from cabinet up.

Figure 17 Schematic diagram of the NetSure 701 AO2



Note:

1.The quantity of battery fuse is 2 to 4, BLVD contactor is optional.

2.One BLVD contactors for 2~3 fuses, two BLVD contactors for 4 fuses.

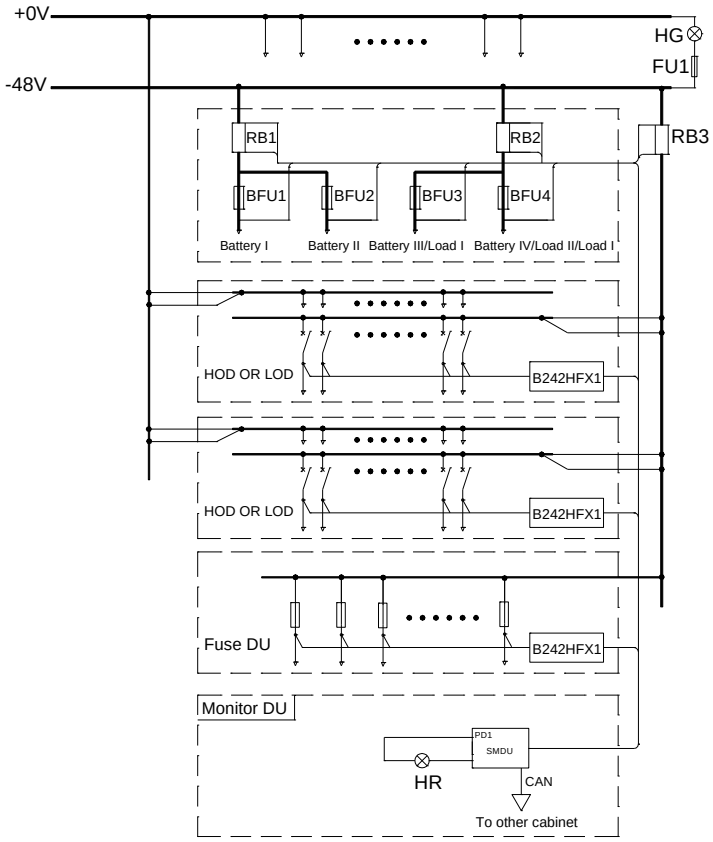
3.Current of each LOD is 360A, current of each HOD is 200A, current of FU DU is 1600A.

4.The MAX configuration of DU is fixed 1 Fuse DU or 2 LOD or 2 HOD or 1 LOD + 1 HOD.

5.The standard configuration of BU is fixed 2 battery fuses and 2 load fuses.

6.Install close wall and cable free from cabinet up.

Figure 18 Schematic diagram of the NetSure 701 AO3



Note:

1.The quantity of battery fuse is 2 to 4.

2.Current of each LOD is 360A.

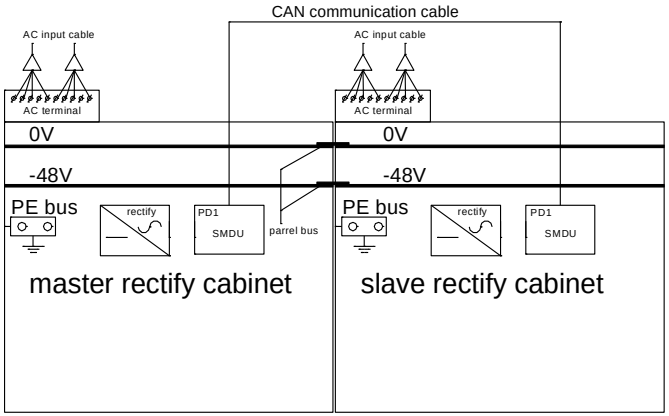
3.Current of each HOD is 200A.

4.The max configuration of DU IS fixed 3 Fuse DU or 6 LOD or 6 HOD.

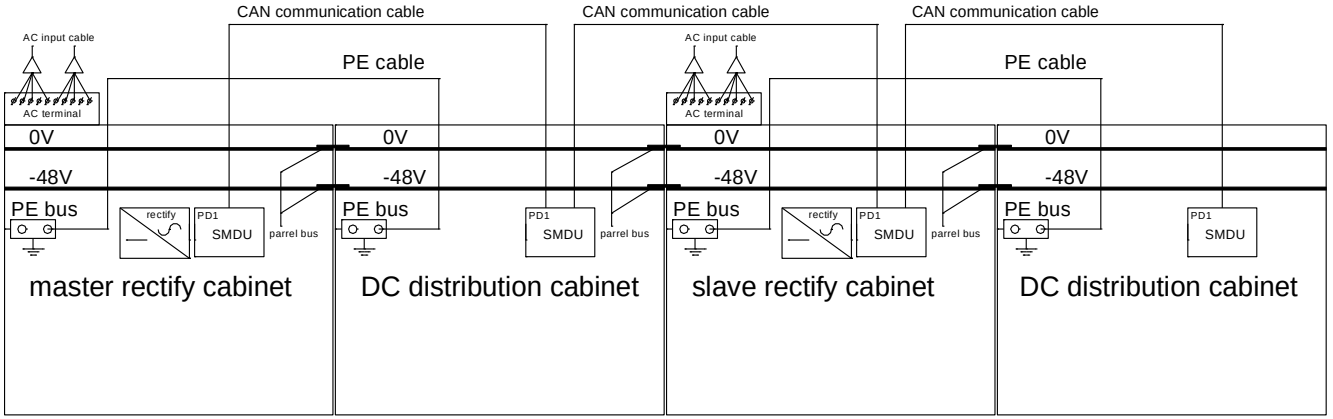
5.Install close wall and cable from cabinet up or bottom.

Figure 19 Schematic diagram of the DC cabinet

1.The max configuration of rectify cabinet is fixed 2 cabinets



2.The type configuration of rectify cabinet and DC distribution cabinet is fixed 2 rectify cabinets and 2 DC distribution cabinets



Note:

1.The rectify cabinet and DC distribution cabinet must be staggered when they are parreled.

Figure 20 Schematic diagram of the cabinet parallel connection