



# Delta Power Conditioning System (PCS100HV)

Installation Manual



Version: 1.0.4

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# About this Manual

## Version Control

**Table 1: Version Control**

Rev.	Change Description	Date
1.0.0	First release.	29Apr2021
1.0.1	1. updated description about automatic disconnection device; 2. added description about AC and DC disconnect switch; 3. added description about noise level and protection.	13May2021
1.0.2	1. updated description about grid-tied and off-grid mode operation 2. added description about of SPD tape	11Jun2021
1.0.3	1. add noise symbol and instruction in page4 2. add prevent flood safety instruction in page4 3. add M12 expansion bolts (not provided with PCS100HV) note in page8 4. change voltage rating of IO wire from 600V to 300V, in page26 5. add multi-core shield cable note in page30 6. change wire diameter of auxiliary power input from AWG 16-22 to AWG 16, in page32 7. update distance requirement above the PCS in page11 8. add BMS connection methods and corresponding terminal and TR description 9. add attery temperature sensor connector in page33 10. correct some grammatical errors	29Jul2021
1.0.4	1. add notes about setting power quality response modes in page6	10Aug2021

## Purpose

The purpose of this Installation Manual is to provide an explanation and standard procedure for installing the Delta Power Conditioning System PCS100HV series product.

## Scope

The manual provides safety guidelines, detailed planning and setup information, the standard procedure of installing the PCS. It does not provide details of batteries.

## Audience

The manual is intended for anyone who needs to install Delta PCS100HV. Installers should be certificated technicians or electricians.

## Organization

This manual is organized into the following chapters:

- Chapter 1: "About the Manual"
- Chapter 2: "Introduction"
- Chapter 3: "Installation"
- Chapter 4: "Wiring Instructions"
- Chapter 5: "Warranty"
- Chapter 6: "Appendix"



## Important Safety Instructions

### Save these Instructions

#### General Safety Instructions (EN)

This manual contains important instructions for PCS that should be followed during installation and maintenance.

PCS is designed and tested to meet all applicable International safety standards. However, like all electrical and electronic equipment, safety precautions must be observed and followed during installation and operation of PCS to reduce the risk of personal injury and to ensure a safe installation.

Installation, commissioning, service, and maintenance of PCS must only be performed by qualified personnel that are licensed and/or satisfy state and local jurisdiction regulations.

Before starting installation or commissioning of the PCS, read through the entire manual and note all DANGER! WARNING! CAUTION! and NOTICE! Statements.

All electrical installations must comply and be in accordance with all the state, local, and utility regulations.

## Safety Symbols and Terminologies



#### Note:

Indicates additional information that is relevant to the current process or procedure.



#### WARNING!

Warning information appears before the text it references to emphasize that the content may prevent damage to the device or equipment.



#### CAUTION!

CAUTIONS APPEAR BEFORE THE TEXT IT REFERENCES. CAUTIONS APPEAR IN CAPITAL LETTERS TO EMPHASIZE THAT THE MESSAGE CONTAINS VITAL HEALTH AND SAFETY INFORMATION.



INFORMATION provided that when known and used will ensure optimal operation of the system.



HIGH VOLTAGE WARNING! Indicates hazardous high voltages are present, which, if not avoided, will result in death or serious injury. Thus, only authorized and trained personnel should install and/or maintain this product.



Hot surface



Equipment grounding conductor (PE)



Wait for a prescribed amount of time before engaging in the indicated action.



The product generates loud noises. When working on the product, wear hearing protection

## Safety Instructions

The PCS installation must be performed by an authorized electrician as per the Australian Standard or local requirements.

- The PCS section does not contain user-serviceable parts. For all service and maintenance, a Delta repair technician or authorized service partner is required for onsite maintenance services.
- Read all of these instructions, cautions, and warnings for the PCS and associated PCS documentation.
- Before connecting the PCS to the AC distribution grid, approval must be received by the appropriate local utility as required by national and state interconnection regulations and must be connected only by qualified personnel.
- In operation, the PCS wiring and connections can have hazardous high voltages and currents present, thus only authorized and qualified personnel shall install and/or maintain the PCS.
- In some operation instances, the PCS chassis and heat sink surfaces may become hot.
- The product generates loud noises. When working on the product, wear hearing protection.
- The lowest height of electrical components in the cabinet is away from the bottom of the base is 130mm. When installing on site, the foundation of the basement shall be designed to consider preventing flood to the PCS.

# Introduction

## Overview

Delta's Power Conditioning System (PCS) is a bi-directional conversion system that converts power between energy storage and grid, along with energy and grid power quality management features.

It supports demand charge management by peak shaving, enables load shifting for time-of-use savings, and provides real power and reactive power compensation to improve power quality by power command from site controller or EMS.

With Delta's PCS solution you can realize the fullest value of an energy storage system.

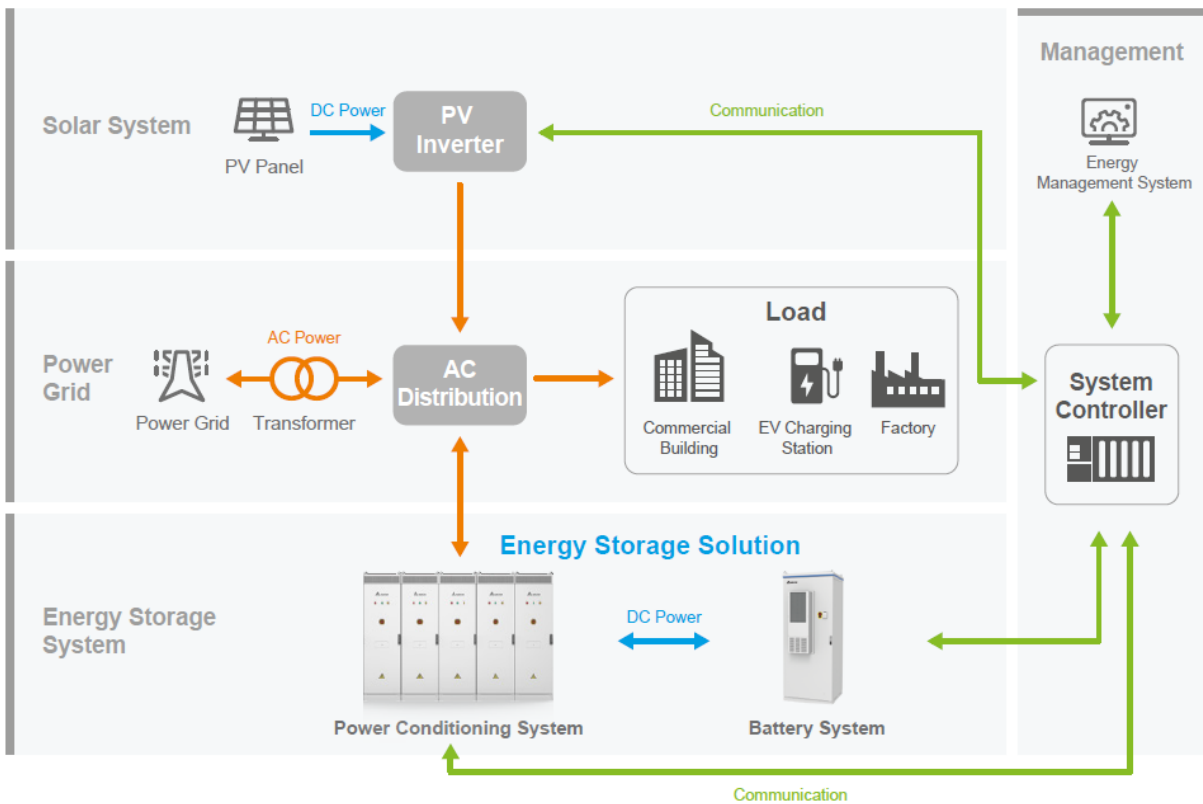


Figure 1. System Architecture

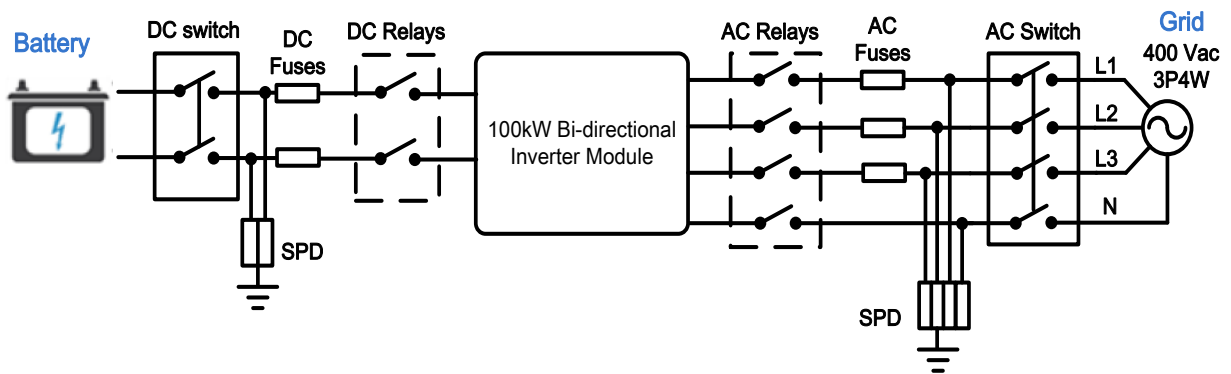


Figure 2. Delta PCS100HV System Block Diagram

## Features

- Power capacity: 100 kW; AC voltage: 400 Vac
- High voltage input: up to 1350Vdc
- High efficiency: Peak 98%
- High power density: 167 W/l, 435 W/kg
- Quick power transfer time (<20 ms)
- IP55 design for outdoor application
- Scalable with multiple units in the configuration
- Black start capability for power backup
- Support 3 phase 4 wire load without transformer
- Support both off-grid mode and grid-tied mode operation

## Applications

- Real and reactive power compensation
- Off-grid operation for power backup
- Demand charge management/peak shaving
- Load shifting for time-of-use savings



### Note:

1. The PCS supports operation in grid-tied mode only. The internal relays inside PCS are designed as an automatic disconnection devices. When grid voltage or frequency is abnormal, the internal relays will automatically disconnect with the grid according to AS4777.2 requirements.
2. The PCS supports operation in off-grid (power back up) mode only. There is only one couple of AC output ports of PCS to supply the local load when PCS is operating in off-grid mode.
3. The PCS do not support grid-tied mode and off-grid mode transition by itself, since there is only one couple of AC ports of PCS. In off-grid operation, the internal relays shall be closed to supply voltage to the local load, an external automatic disconnection device shall be used to disconnect PCS and local load with the grid when grid voltage or frequency abnormal. This external automatic disconnection device shall meet AS4777.2 requirements. And this external automatic disconnection device is not in Delta supply scope.



### Note:

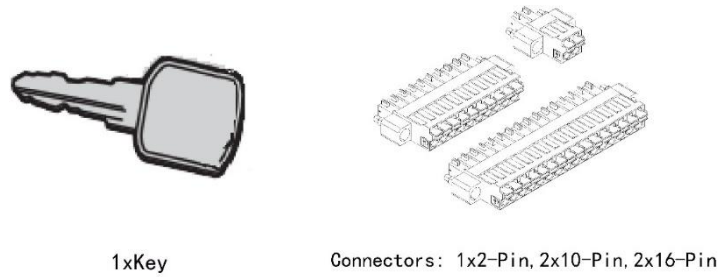
#### (about setting power quality response modes)

The PCS have the capability of operating in modes which will contribute to maintaining the power quality at the point of connection with the customer installation; or provide characteristics which are outside the typical operation of an inverter for the purpose of providing support to a grid. These various operating modes may be enabled or disabled in an inverter and may include the following: Volt response modes, Fixed power factor or reactive power mode, Power response mode and Power rate limit.

User can refer to chapter 6.2, 6.7, 6.8, 6.9 and 6.10 of Operation Manual <PCS100HV\_OM> respectively for each power quality response mode settings.

## Accessories

Check that the following items are included. Contact your vendor if any item is missing or appear damaged.



**Figure 3. Accessories**

The key is tied to the hoisting ring. The connectors are connected to the corresponding terminals. All of the accessories are transported with the PCS100HV.

# Installation

This chapter describes how to mount and install the PCS, including the information about recommended tools, groundwork preparation, location and ventilation considerations, unpacking, moving, and mounting. Read this chapter and plan your PCS layout and installation accordingly.

## Before You Begin

### Recommended Tools

The following tools are recommended for a successful installation:

- 1 x PH2\*100 mm Phillips screwdriver
- 1 x PH3\*100 mm Phillips screwdriver
- 1 x M8 hex bolt socket wrench
- 1 x M12 hex bolt socket wrench
- 1 x M5 hex bolt socket wrench
- 1 x M4 Allen wrench
- 1 x M4 Torx(T15) L-type wrench
- Concrete drill
- Hydraulic crimping tools (capable to crimp cable lugs)
- Wirecutter
- Wire stripper
- Diagonal pliers

### Grounding Instructions



#### **WARNING!**

**Grounding:** All input and output circuits are isolated from the enclosure. System grounding, when required by IEC/EN 62477-1, is the responsibility of the installer.

An equipment grounding conductor or a grounded, metal, and permanent wiring system is required for the PCS connection. This should run with circuit conductors and connected to the equipment grounding bar on the PCS.

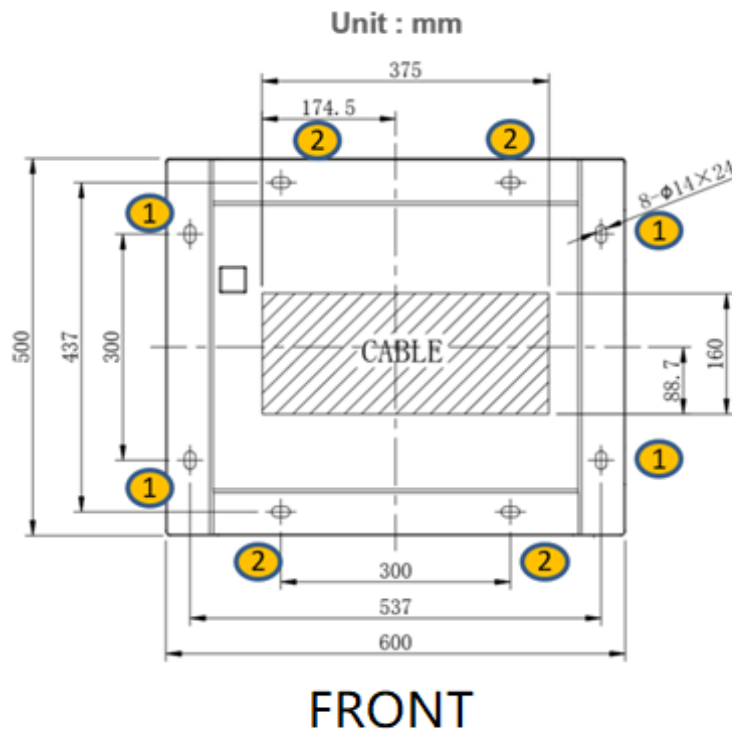
## Foundation

The PCS cabinet is recommended to be mounted on a concrete floor. Follow the illustration below to prepare the groundwork.

Before installing a PCS cabinet, it is recommended to have a solid foundation established. The following information is provided to serve as a guide for the setup of a recommended foundation.

The footprint boundary area of the PCS is 600 x 500 mm, and there are two ways for mounting:

1. Mounting by the left and right sides of the unit base: Drill four holes for M12 expansion bolts (not provided with PCS100HV) at the 4 corners of an area of 537 x 300 mm as marked in number 1.
2. Mounting by the front and rear sides of the unit base: Drill four holes for M12 expansion bolts (not provided with PCS100HV) at the 4 corners of an area of 437 x 300mm as marked in number 2.



**Figure 4. Mounting Layout and Anchoring Holes Placement Variations (Top View)**

Once the anchoring holes are completed, insert the expansion sleeves (not provided with PCS100HV) into the anchoring holes:

- Remove four M12 expansion bolts from the accessory kit.
- Separate the nuts and washers from the bolts.
- Once the expansion sleeves are individually separated, insert each one into the anchoring holes.

## Location and Ventilation Requirements

### Dimensions



**Figure 5. Front and Side Views of a Delta PCS100HV**

### Location Considerations

To fully experience the benefits and reliability of the PCS design, follow the provided guidelines:

- The PCS unit is rated IP55 and configured for outdoor installations.
- Install the PCS in an accessible location by following local requirements or Australian Standard for enclosures, door clearances, and proximity to other equipment.
- For optimal PCS life and performance, it is suggested not to mount the PCS in direct sunlight, especially in hot climates. If the unit must be mounted in direct sunlight, a metal sun-shield is recommended but not required.
- The PCS is forced-air-cooled. The cabinet is separated into two compartments: front and rear compartments.

In the case of the front compartment, the fan circulates internally and transmits heat to the external environment through the case for heat dissipation, as shown in figure 6.

From the rear compartment, the air is drawn in through vents at the lower part of the rear side, and exhaust air is emitted from vents in the front of the roof. The air inlet and outlet must not be blocked, and the installation location should be sufficiently ventilated to prevent the PCS heat output from increasing the ambient temperature beyond the PCS's rating.



- Under certain operating conditions, the PCS emits an audible noise. It is advisable to install away from living accommodations to protect against noise levels.
- The PCS should not be installed in an excessively dusty area, as this may decrease the performance of the air cooling system.
- The PCS must not be installed in areas in which dust containing conductive particles (e.g. iron filings) may form.

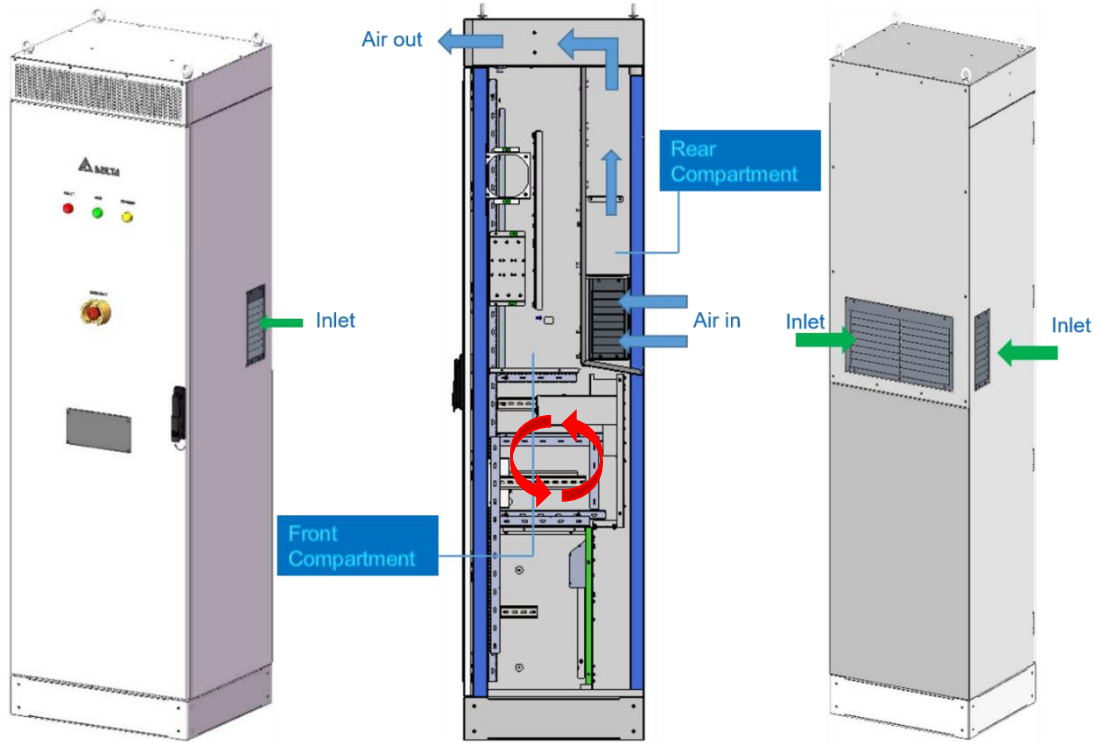


Figure 6. Diagram of PCS Airflow Design (Side View)

## Maintenance distance requirements

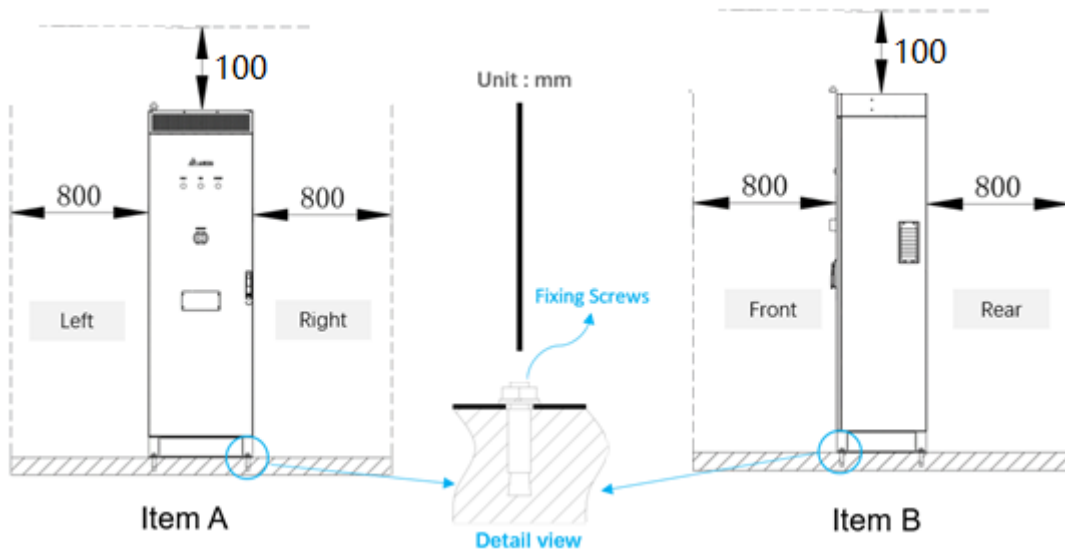
A minimum distance behind the PCS is required for maintenance from the rear side as shown in figure 7.

Item A: When the PCS fixing screws are installed in left and right, the left and right of PCS need at least 800mm installation space.

Item B: When the PCS fixing screws are installed in front and rear, the front and rear of PCS need at least 800mm installation space.

When the PCS fixing screws are installed in left and right, at least 800mm net maintenance space is required at the rear of PCS.

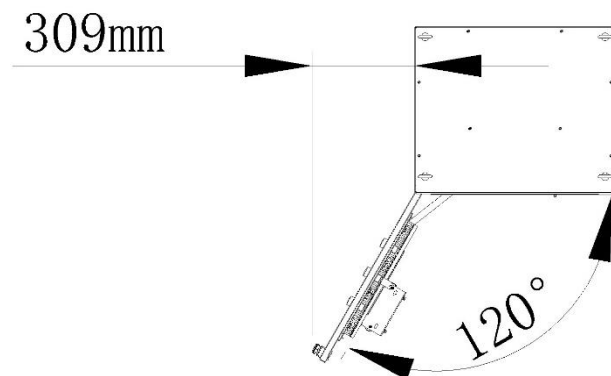
Above the PCS maintenance space need at least 100mm installation and maintenance space.



**Figure 7. Front and Rear Maintenance Clearance Distance**

## Opening the door space

When installing the PCS, consider the necessary ventilation space as well as the space requirements to allow access when opening the door. At the same time, 309mm space should be reserved for door opening as shown in the following figure.



**Figure 8. Top View of Door Clearance**

## Unpacking the 1-Unit PCS100HV

Use a forklift to move and place the crate containing the PCS and the wooden pallet in a designated location. Make sure the location is clean and prepared before moving the crate.



### WARNING!

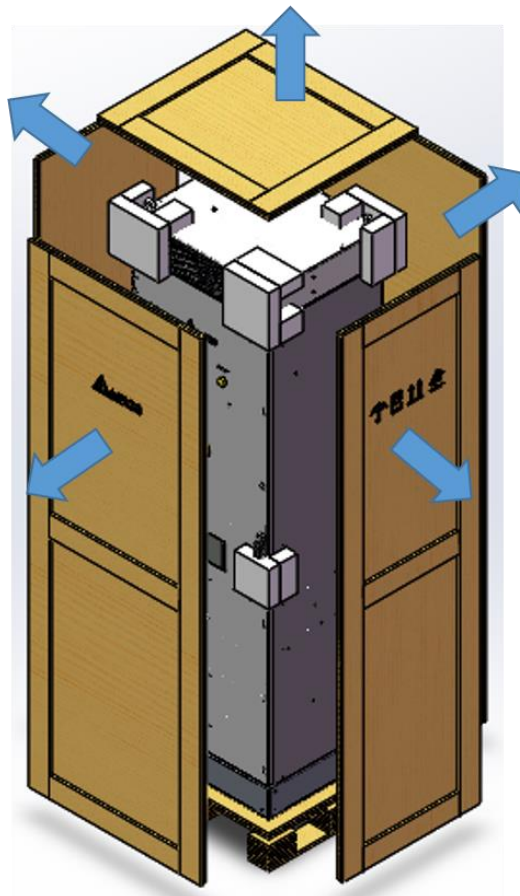
The PCS and crate have a combined weight of approximately 300 kg. DO NOT attempt to lift and/or move the package/unit by hand. The unit is extremely heavy. Attempting to move the unit by hand may lead to injury, damage, and even possibly death.



### WARNING!

Before opening the package, make sure the Tip Tell label is OK. If the Tip Tell label shows the PCS has toppled and fell, immediately contact Delta and the Shipping Company.

1. Use a ladder to reach the top of the PCS.
2. Remove the screws securing the top cover.
3. Remove the top cover.
4. Remove the screws securing the left and right sidewalls from the shipping package.
5. Remove the right and left sidewalls
6. Remove the screws securing the front and rear walls from the shipping package.
7. Remove the front and rear walls.



**Figure 9. Removing All Walls of 1-Unit PCS100HV**

Upon unpacking the unit, inspect the unit for signs of damages that may have been caused during shipping. If any sign of damage is found, immediately contact Delta and the shipping company.

## Unpacking the 2-Unit PCS100HV

Use a forklift to move and place the crate containing the PCS and the wooden pallet in a designated location. Make sure the location is clean and prepared before moving the crate.



### WARNING!

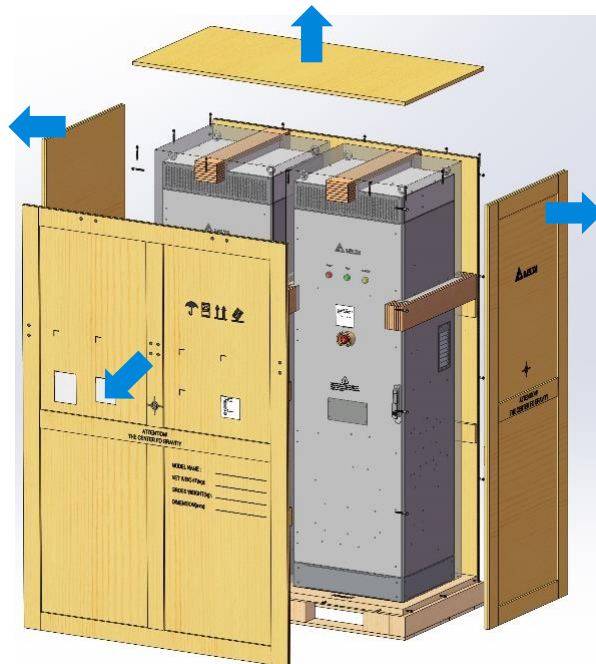
The PCS and crate have a combined weight of approximately 600 kg. DO NOT attempt to lift and/or move the package/unit by hand. The unit is extremely heavy. Attempting to move the unit by hand may lead to injury, damage, and even possibly death.



### WARNING!

Before opening the package, make sure the Tip Tell label is OK. If the Tip Tell label shows the PCS has toppled and fell, immediately contact Delta and the Shipping Company.

1. Use a ladder to reach the top of the PCS.
2. Remove the screws securing the top cover.
3. Remove the top cover.
4. Remove the screws securing the left and right sidewalls from the shipping package.
5. Remove the right and left sidewalls
6. Remove the screws securing the front and rear walls from the shipping package.
7. Remove the front and rear walls.



**Figure 10. Removing All Walls 2-Unit PCS100HV**

Upon unpacking the unit, inspect the unit for any signs of damages that may have been caused during shipping. If any sign of damage is found, immediately contact Delta and the shipping company.

## Installing the PCS Onsite

### Safety Considerations

The following safety information is intended to reduce the risk of accidents:

- Keep the floor around the PCS clean to prevent metallic dust, iron, or other metal fillings from being drawn inside the device, consequently causing short circuits.

Closed area installations:

- The floor and surrounding area around the PCS must use non-flammable material.
- A portable powder fire extinguisher must be installed within easy reach of the PCS.
- An automatic fire extinguishing system should be installed and enabled for the site.
- Access to the installation site should be restricted to qualified service personnel.

### Surge Arrester Safety

The function of the lightning and surge protection system is to protect the devices, functional isolations, and over voltage-sensitive consumer equipment of the PCS. The PCS is equipped with a Class II SPD to cover the system when not placed in a direct lightning strike area.

Due to the wide surge energy, voltage, and frequency range of overvoltage in lightning strike areas, it is recommended:

1. Where the system is equipped with an external lightning protection system(LPS) or protection against effects of direct lightning is otherwise specified, Class I SPDs shall be used.
2. Where the system is not equipped with an external lightning protection system(LPS) and where the occurrence of a direct lightning strike to the overhead lines between the last pole and the entrance of the installation is to be taken into consideration, Class I SPDs at or near the origin of the electrical installation shall be used.
3. Class II SPDs shall be installed as close as possible to the origin of the installation in the system, for example in the upstream distribution board for PCS.

### Battery Ground Fault Concerns

The following are concerns surrounding the potential risks of DC ground faults and the possible causes.



#### **WARNING!**

To prevent possible escalation into serious or catastrophic ground faults, make sure to equip the corresponding Ground Fault Detection (GFD) equipment and follow strict maintenance guidelines.

The primary concerns with any Battery Ground Fault include three principle areas:

1. Fire due to ground fault.
2. Risk to personnel due to ground or battery fault.
3. Risk to system reliability due to ground fault.

To prevent possible ground fault risks, equip the corresponding GFD equipment. The battery warranty may be null and void if the GFD equipment is not equipped.

Please be noted there is DC Insulation Detection circuits equipped inside this PCS, but if PCS is installed in a grounded system, a Residual Current Monitoring (RCM) Device is necessary to do GFD function. A type B (universal current sensitive) RCM device is recommended. It can be installed at either DC or AC side, it is recommended to install RCM on the AC side

## AC and DC Disconnect Switch Concerns

There are two disconnect switches inside the PCS100HV, one for AC side and another for DC side.

1. AC disconnect switch has a load-breaking capacity and can break under normal voltage and current.
2. DC disconnect switch does not have load-breaking capacity for voltage above 1000Vdc. If the battery system operating voltage is higher than 1000Vdc, this DC disconnect switch shall not break under load. To break the DC side between the battery system and PCS under load, an external DC disconnect switch with load breaking capacity complying with the local standard is recommended to install in the energy storage system. The recommended DC switch rating is 1500Vdc / 200A.

## Acoustic Noise Concerns

This PCS is designed to produce less noise by fan speed control. When the PCS is operating at full load in an environment with ambient temperature below 25°C, the measured acoustic noise at 1m distance is below 70dB. But if the ambient temperature is higher than 25°C, the maximum acoustic noise at 1m may be up to 75dB. So we will recommend people who will work near the PCS, to wear earplugs or earmuffs for protection from the noise.



### **WARNING!**

The weight of the PCS is distributed on a small surface of the floor. It is necessary to verify the floor load-bearing capacity.

All service and maintenance personnel must be trained in normal as well as emergency procedures.

## Chain Hoist Installation

The dimensions and weights specified must be taken into consideration when mounting the PCS. All lifting equipment and lifting components (hooks, bolts, lifts, slings, chains, etc.) must be properly sized and rated to safely lift and hold the weight of the PCS during the mounting process.



### **CAUTION!**

TO MOVE THE PCS, USE LIFTING EQUIPMENT THAT HAS AN APPROPRIATE RATED LIFT CAPACITY.



### **CAUTION!**

IF USING LIFTING LUGS, BE SURE THE SPREADER BAR IS SUFFICIENTLY LONG TO PREVENT DAMAGE TO THE HOOD AND BE SURE TO USE A MINIMUM OF FOUR STRAPS OF SUFFICIENT LENGTH.



### **CAUTION!**

THE UNIT WEIGHS APPROXIMATELY 250 KG/ 550 LBS. TO PREVENT POSSIBLE DAMAGE OR INJURY ANY LIFTING DEVICE MUST BE RATED TO WITHSTAND THE MAXIMUM REQUIRED WEIGHT.



### **CAUTION!**

THE UNIT SHOULD NOT BE INSTALLED WITH THE CABINET DOORS OPEN.

1. Locate the eye bolts on each corner of the PCS.
2. Check the eye bolts are properly tightened to the frame.



**Figure 11. Eye Bolts Locations**



### **WARNING!**

Before proceeding with the normal operation of the hoist, the operator(s) must be trained in accordance with the hoist manufacturer's operation manual. Failure to read and comply with any of the instructions and limitations noted in this manual and the hoist manufacturer's manual can result in product failure, serious bodily injury or death, and/or property damage.

Follow the initial start-up procedures for the hoist as described in the manufacturer's operation manual. Do not attempt operation until all start-up procedures have been fulfilled.

The load attachment may differ from the following figure depending on the type of chain hoist used. The following is a depiction to illustrate a possible scenario.



### **WARNING!**

Keep hoist lines plumb. The working load limits of hoisting equipment apply only to freely suspended loads on plumb hoist lines. If the hoist line is not plumb during load handling, side loads are created which can destabilize the load and cause structural failure or tip-over, with little warning.

3. Connect the hoist to the eye bolts on the cabinet. Make sure the load is secured before making any attempt to move it. The recommended diagonal length of the sling is 2 to 2.5 m (6.56 to 8.2 ft.).
4. Follow the hoist manufacturer's guidelines on moving the load as described in the manufacturer's operation manual.



### **WARNING!**

Check on Sling Angle. Ensure that the sling angle is always greater than  $45^\circ$  and preferably greater than  $60^\circ$ . When the horizontal distance between the attachment points on the load is less than the length of the shortest sling leg, then the angle is greater than  $60^\circ$  and generally safe.



**Figure 12. Eye Bolts Lifting**

5. Once the PCS is placed in its final installation site, secure the PCS to the site as described in “Securing a Cabinet in a Final Location” on page 28.
6. Remove the hoist.
7. Once the cabinet is secured to the location, install the top cover, see “Securing a Cabinet in a Final Location” on page 28.



## Forklift Installation



### CAUTION!

TO MOVE THE PCS, USE A FORKLIFT THAT HAS AN APPROPRIATELY RATED LIFT CAPACITY AND A 915 CM (36-INCH) FORK SPAN.



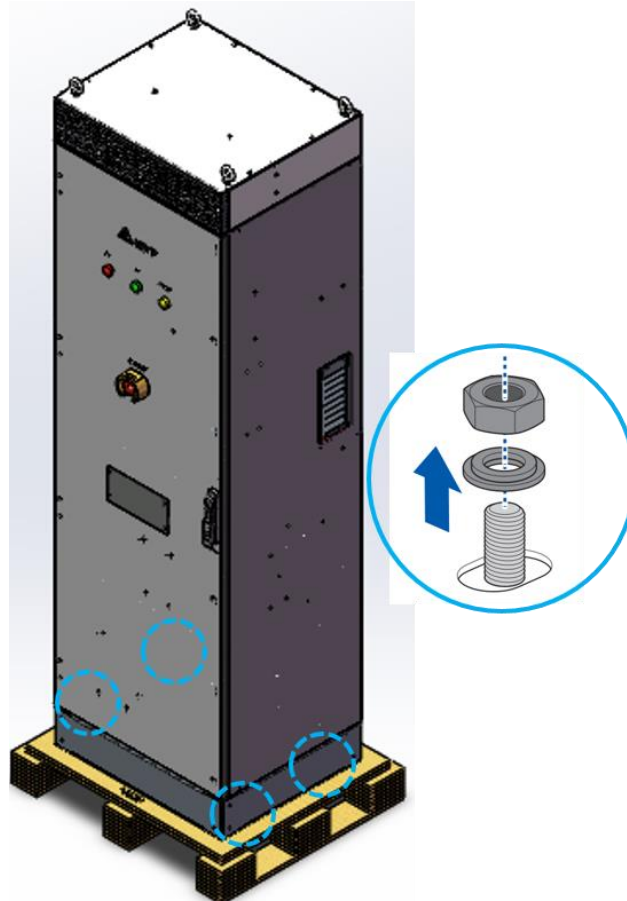
### CAUTION!

THE ENCLOSURE MUST BE LIFTED FROM THE BOTTOM. THE ENCLOSURE MUST BE SUPPORTED ON ALL FOUR SIDES WHEN LIFTING. PRECAUTIONS MUST BE TAKEN TO AVOID TIPPING OF THE ENCLOSURE FRONT TO BACK AND SIDE TO SIDE DURING LIFTING BECAUSE THE CENTER OF GRAVITY OF THE ENCLOSURE IS NOT THE CENTER OF THE ENCLOSURE.

1. Unpack the PCS, see “Unpacking the Unit” on page 12.
2. Using the forklift to move the PCS.

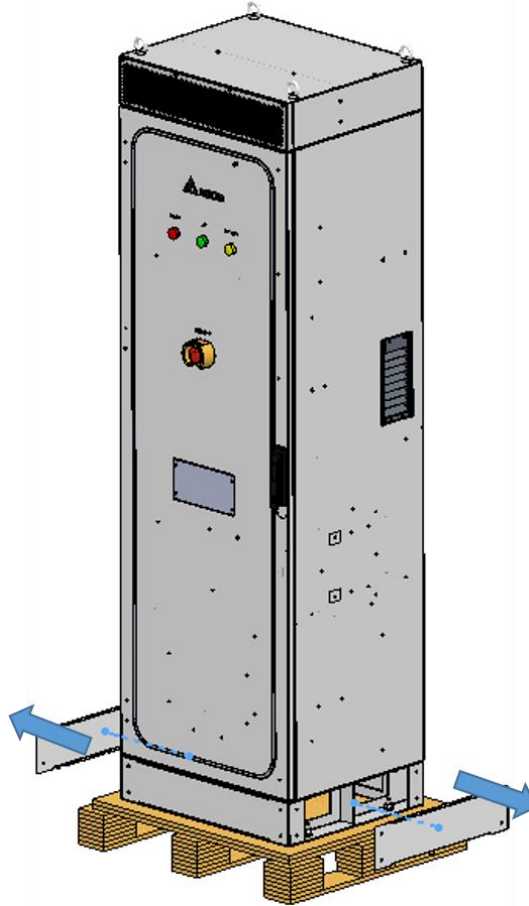
Removing the PCS100HV from the left/right side:

- a. Remove the hexagonal nuts and washers securing the cabinet to the pallet.



**Figure 13. Releasing a PCS from a Pallet**

- b. Remove the screws securing the side base covers.
- c. Remove the base covers. Place them on a clean work surface for later use. The covers must be replaced after the completion of cabinet installation and cable routing



**Figure 14. Removing Left and Right Base Covers**

- d. Align the forklift with the bottom channels on the cabinet, see the following image.
- e. Once aligned, insert the forks into the channels until they are completely through the opposite side of the insertion channels.



**WARNING!**

Take care the unit is balanced and no risk to prevent it fall.

- f. Carefully lift the cabinet.

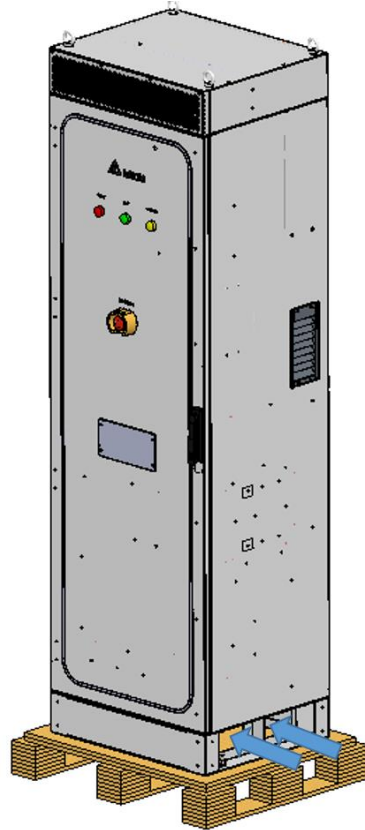


Figure 15. Lateral Handling of PCS

#### Front/Rear Handling

- a. Remove the hexagonal nuts and washers.

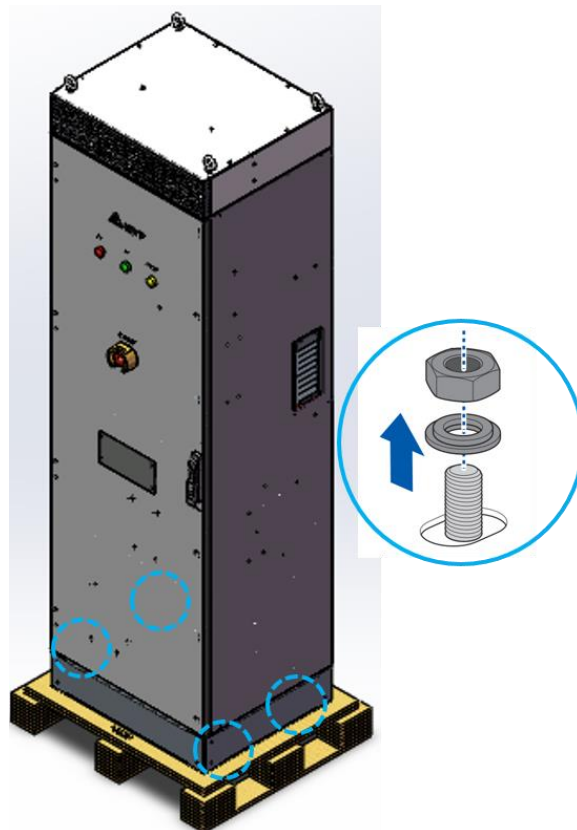


Figure 16. Releasing a PCS from a Pallet

- b. Remove the screws securing the front/rear base covers.
- c. Remove the front and rear side panels.



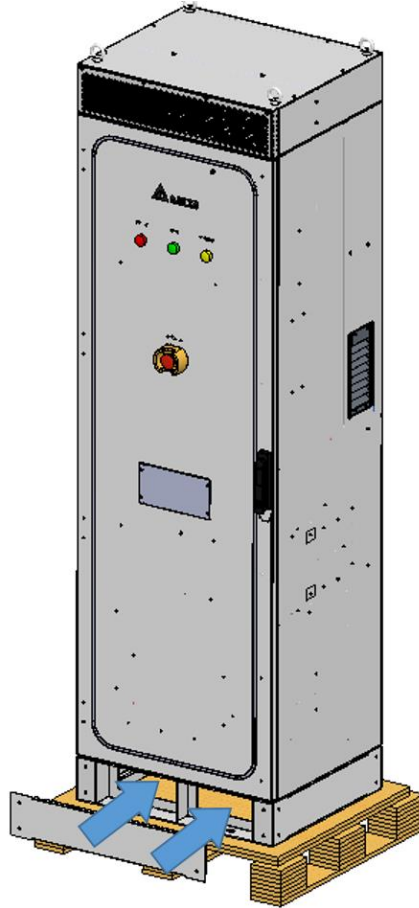
**Figure 17. Removing Front/Rear Base Covers**

- d. Align the forklift with the bottom channels on the cabinet, see the following image.
- e. Once aligned, insert the forks into the channels until they are completely through the opposite side of the insertion channels.

**WARNING!**

Take care the unit is balanced and no risk to prevent it fall.

- f. Carefully lift the cabinet.

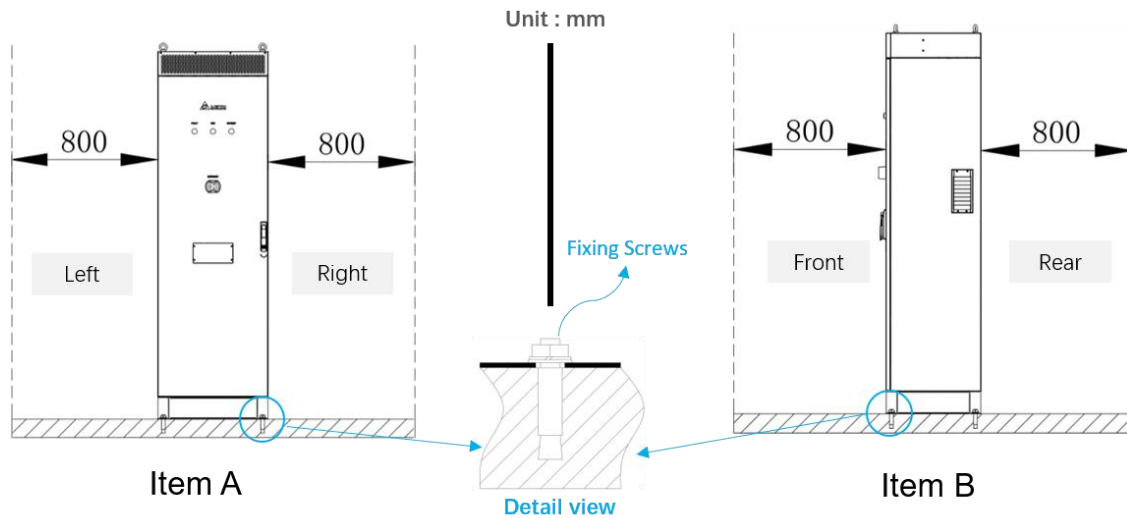


**Figure 18. Front/rear Side Handling**

3. Once the cabinet is secured to the location, install the top cover, see “Securing a Cabinet in a Final Location” on page 30.

## Securing a Cabinet in a Final Location

1. First, insert a washer in the anchoring bolt followed by a nut.
2. Turn the nut until it is lowered in the bolt. Do not tighten at this time. All nuts must be inserted in their respective anchoring bolts.
3. Repeat for the remaining anchoring bolts.
4. Once all nuts are inserted, tighten the anchoring bolts in ascending order. See the following figure.
5. Move on to the opposite side of the bolt and tighten the bolt.
6. Repeat in the same manner for the remaining anchoring bolts.



**Figure 19. Securing a Cabinet with Anchoring Bolts**

## Wiring Instructions

This chapter describes how to perform the system wiring and cabling procedures.

Read the Safety section first and follow the rules carefully before doing any wiring and cabling works to ensure personal safety.

### Safety



**Shock Hazard:** Ensure that no DC voltage is being supplied to the PCS and that no AC voltage is present on the AC wiring. Failure to do so could cause serious injury or death. A warning label is provided to inform all personnel that multiple sources of power are available inside. This label is installed on the outside of the door and should remain clearly visible. Ensure all sources of power are OFF or disconnected before servicing.

The Delta PCS100HV contains electrical components carrying potentially lethal voltages and currents. Extreme caution should be exercised around the system, especially when the cabinet door is open once it's installed. Before opening the cabinet, all supply power should be disconnected using a standard physical lock-out procedure and the service personnel should wait 5 minutes prior to opening the enclosure door.



#### **WARNING!**

**Grounding:** All input and output circuits are isolated from the enclosure. System grounding, when required by IEC/EN 62477-1, is the responsibility of the installer.

## Wire Sizing and Ratings

### AC Wire Sizing and Ratings

Prepare all the AC power cables as per the following wiring specifications:

**Table 2: AC Wire Sizing and Ratings**

Cable Type	Solid Copper Conductor
Voltage Rating	600 Volts or greater
Temperature	90°C or greater
Gauge	35 ~ 50 mm <sup>2</sup> (2 AWG ~ 1/0 AWG)
Insulation	PVC
According to	IEC standard
Flame Test	V-1
Quantity	8 (2 for L1, 2 for L2, 2 for L3, 2 for N)

### DC Wire Sizing and Ratings

Prepare all the DC power cables as per the following wiring specifications:

**Table 3: DC Wire Sizing and Ratings**

Cable Type	Solid Copper Conductor
Voltage Rating	1500 Volts or greater
Temperature	90°C or greater
Gauge	50 mm <sup>2</sup> (1/0 AWG)
Insulation	PVC
According to	IEC standard
Flame Test	V-1
Quantity	2 per battery set (1 for positive, 1 for negative up to 2 sets)

### Grounding Wire Sizing and Ratings

All ground wiring must meet the following specifications:

1. The grounding wire sizing must be larger than half of the AC or DC wire sizing.
2. Wire sizing and ratings are recommended in the previous tables by the manufacturer.

If wiring other than posted is used, the wiring must comply with the local regulations.

**Table 4: Grounding Wire Sizing and Ratings**

Cable Type	Solid Copper Conductor
Voltage Rating	600 Volts or greater
Temperature	90°C or greater
Gauge	35~ 50 mm <sup>2</sup>



**Table 4: Grounding Wire Sizing and Ratings (Continued)**

Cable Type	Solid Copper Conductor
Quantity	1

## Communication and I/O Wire Sizing and Ratings

Here are the requirements for the communication and I/O wires:

**Table 5: Communication and I/O Wire Sizing and Ratings**

Cable Type	Solid Copper Conductor
Voltage Rating	600 Volts or greater
Temperature	90°C or greater
Gauge	1.32 mm <sup>2</sup> (16 AWG)
Quantity	Depending on customer needs

## Preparation of Cables

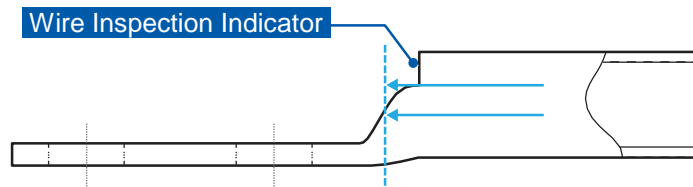
This section describes how to prepare the corresponding cables and wires to meet the specified requirements, see section “Wire Sizing and Ratings” on page 24.

- 2 x 1500V, 1/0 AWG cables for DC (battery) connection
- 6 x 600V or greater, 1/0 AWG ~ 2 AWG cables for AC connection
- 1 x 600V or greater, 1/0 AWG ~ 3 AWG cables for grounding
- 300V or greater, 16 AWG wires for communication or I/O connection.

## Preparing AC/DC Cables

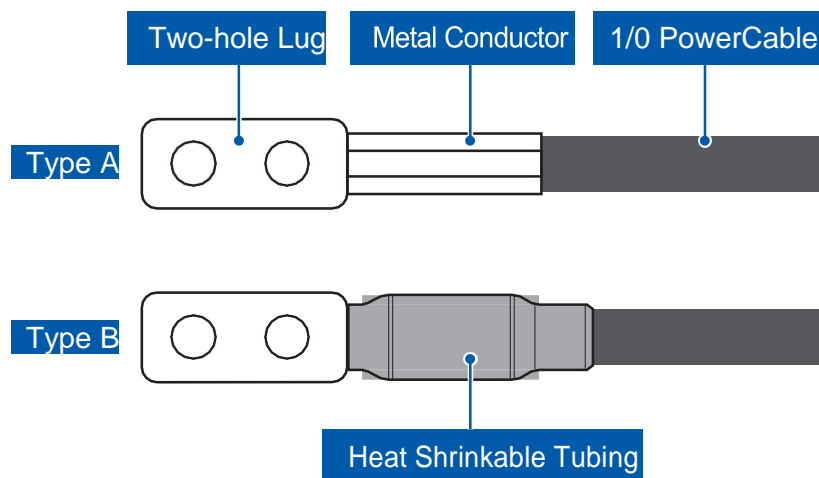
The following guidelines describe how to prepare the AC/DC cables for a grid or battery connection. When crimping a cable, a hexagonal crimping method is recommended.

1. Strip the head of the insulator of the AC and DC power cables. Insert the exposed part of the power cable into the junction hole of the corresponding cable lug.
2. Continue inserting the cable until its head reaches the wire inspection indicator, as shown in the following figure:



**Figure 20. Inserting a Power Cable into a Cable Lug, Depth Reference Diagram**

3. For safety purposes, use heat shrinkable tubing on the junction between the cables and lugs. The voltage rating of the heat shrinkable tubing should be at least 1500 V for DC power cable or 600 V for AC power cable. Make sure the exposed part of the junction between the cables and lugs is fully covered by the tubing, as shown in the following figures.
4. Prepare the cables as follows:



**Figure 21. Preparation of AC/DC Cables**



**Note:**

We recommend two-hole lugs for cable connection, but in some cases if customer want to use single-hole lugs, the lug type and connection way should meet local standard and regulation.

## Communication and I/O Wiring and terminal resistor setting

Get the wires with connectors or terminals prepared for communication and I/O connection through the front square hole of the unit base

Plug these connectors into the relevant connector bases built-in at the inner left side wall of the cabinet adjacent to the DC terminals as the following figure:

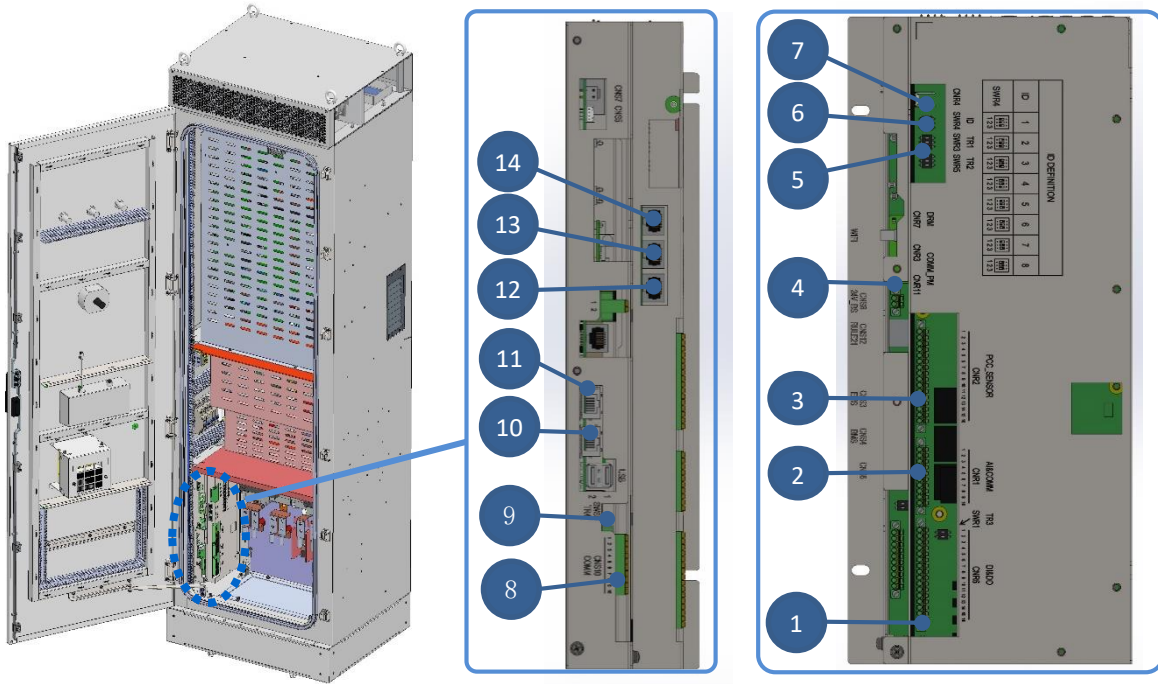


Figure 22. Communication and I/O Connection Location

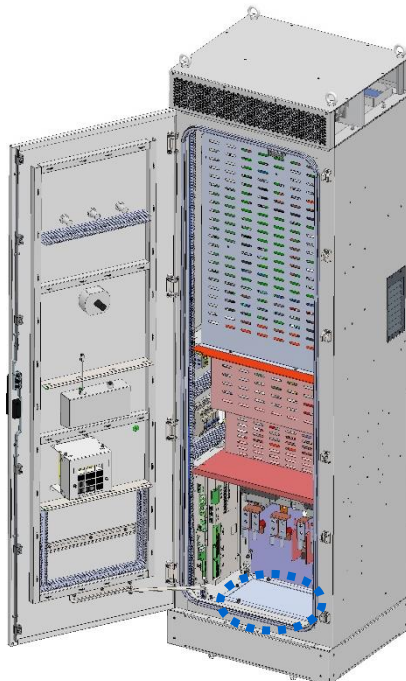


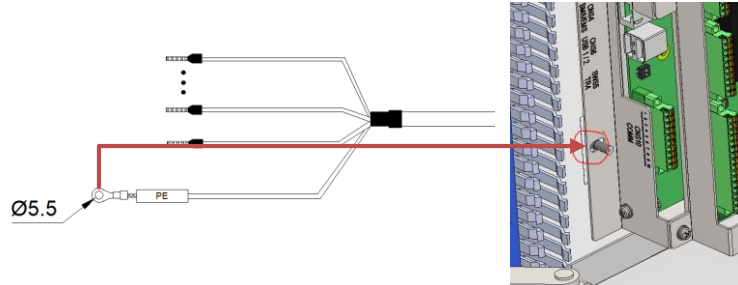
Figure 23. Communication wiring through the front square hole

**Table 6: Communication and I/O Connection**

No.	Connector	Description
1	CNR6	I/O terminal 16-pin connector
2	CNR1	Reserved for temperature sensor to MCU 10-pin connector
3	CNR2	For external grid or load current sensing 16-pin connector
4	CNS8	Black Start auxiliary power (24V) 2-pin connector
5	SWR5	Terminal resistor switches for RS485 and CAN For CNR11
6	SWR3	Terminal resistor switches for RS485 and CAN For CNR3
7	SWR4	ID setting resistor switches
8	CNS10	CAN communication for BMS 10-pin connector
9	SWS5	Terminal resistor switches for RS485 and CAN For CNS10
10	CNS4	Ethernet interface for ESS/BMS
11	CNS3	Debug interface for FAE
12	CNR11	PCS parallel RS485 & CAN communications RJ45 connector
13	CNR3	PCS parallel RS485 & CAN communications RJ45 connector
14	CNR7	Interface for DRM function RJ45 connector

## I/O Connector (CNR6)

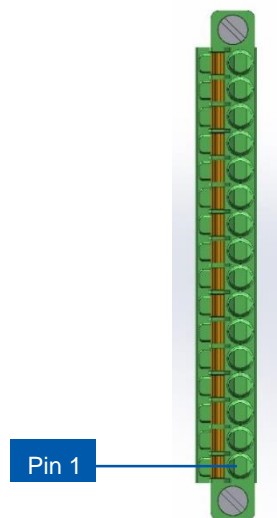
The CNR6 connector is for digital I/O connection. Take out the green 16-pin connector (CNR6) from the accessory kit, and connect prepared AWG 16 wires to pin 1~16 of this connector as shown in figure 25. It's recommended to substitute the wires with a multi-core shield cable. The shielding layer should be crimped with ring terminal whose diameter  $D=5.5$ . And the ring terminal need be connected to a grounding screw as shown in figure 24



**Figure 24. Ring terminal connection**

The 4 dry contact outputs are programmable. They are reserved functions. The state of contact outputs (short or open) can be configured according to the customer's requirements. Similarly, the wet inputs detect the state of contacts from the customer. They are also programmable according to the requirements. A customized FW revision is needed to realize both the dry outputs and wet inputs function.

The Remote EPO connector is also a wet input from custom. Only normal close EPO is supported. When the function is reserved, the shorting stub between CNR6-15 and CNR6-16 should be retained.



**Figure 25. CNR6 Pin Assignment**

**Table 7: CNR6 Pin Assignment**

Item	Pin Assignment	Notes
CNR6	1. Digital Output 1-2	Dry Contact 1 (Max 24Vdc/10mA)
	2. Digital Output 1-1	
	3. Digital Output 2-2	Dry Contact 2 (Max 24Vdc/10mA)
	4. Digital Output 2-1	
	5. Digital Output 3-2	Dry Contact 3 (Max 24Vdc/10mA)
	6. Digital Output 3-1	

7. Digital Output 4-2	Dry Contact 4 (Max 24Vdc/10mA)
8. Digital Output 4-1	
9. Digital Input 1-2	Wet Contact 1 (24Vdc/20mA)
10. Digital Input 1-1	
11. Digital Input 2-2	Wet Contact 2 (24Vdc/20mA)
12. Digital Input 2-1	
13. Digital Input 3-2	Wet Contact 3 (24Vdc/20mA)
14. Digital Input 3-1	
15. REPO_2	Remote EPO, Wet Contact for customer, Normal Close.
16. REPO_1	

## AD sample connector (CNR2)

The CNR2 connector is for the AD sampling connection. Take out the green 16-pin connector (CNR2) from the accessory kit, and connect three prepared AWG 16 wires to pin 11~16 of this connector as shown in the following figure.

The PIN1~PIN10 are reserved. And the PIN11~PIN16 are used for sensing the grid current for the reverse power detection.

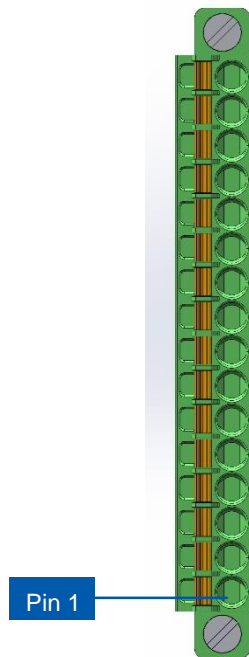


Figure 26. CNR2 Pin Assignment

Table 8: CNR2 Pin Assignment

Item	Pin Assignment	Notes
CNR2	1~10: NA	Reserved
	11: IGR_2	From external current measurement
	12: IGR_1	

13: IGS_2
14: IGS_1
15: IGT_2
16: IGT_1

### Auxiliary Power Interface Connector (CNS8)

The CNS8 connector is used for optional auxiliary power input with 24Vdc 0.5A.

When the grid side and battery side are both disconnected, the controller of PCS can be supplied by this terminal.

When the grid side or battery side are connected, the controller of PCS will be supplied by internal auxiliary power.

Connect two AWG 16 wires to the 2 pin connector as per the pin assignment table below.

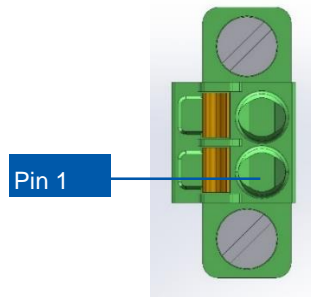


Figure 27. CNS8 Pin Assignment

Table 9: Auxiliary Power Interface Connector

Item	Pin Assignment	Notes
CNS8	1: Vdc-1	24Vdc, 0.5A;
	2: GND	

### DRM Connector (CNR7)

PCS100HV supports all the demand response modes (DRMs) defined in the standard AS/NZS 4777.2. The CNR7 connector is an RJ45 socket that can be connected to a demand response enabling device (DRED).

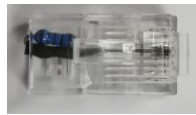
**Table 10: DRM mode definition**

Mode	Requirement
DRM 0	Operate the disconnection device
DRM 1	Do not consume power
DRM 2	Do not consume at more than 50 % of rated power
DRM 3	Do not consume at more than 75 % of rated power AND supply reactive power if capable
DRM 4	Increase power consumption (subject to constraints from other active DRMs)
DRM 5	Do not generate power
DRM 6	Do not generate at more than 50 % of rated power
DRM 7	Do not generate at more than 75 % of rated power AND absorb reactive power if capable
DRM 8	Increase power generation (subject to constraints from other active DRMs)

NOTE Demand response modes of [Table 3.1](#) are as described in AS/NZS 4755.3 series of Standards.

The DRM function can be used or reserved.

If the DRM function is not used, keep the RJ45 terminal which has a settled resistor as shown in the following figure connected to CNR7. If the DRM function is used, an RJ45 terminal which is complied with the standard should be connected to CNR7.



**Figure 28. CNR7 connector with Terminal resistor**

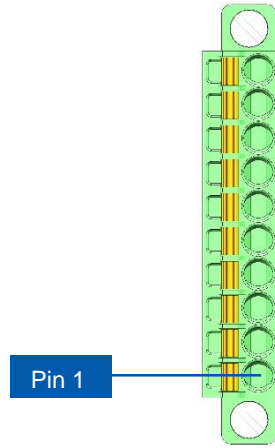
**Table 11: CNR7 Pin Assignment**

Item	Pin Assignment	Notes
CNR7	1: DRM1/5	FOR DRM function
	2: DRM2/6	
	3: DRM3/7	
	4: DRM4/8	
	5: REF GEN/0	
	6: COM LOAD/0	
	7: Shorted to PIN 8	
	8: Shorted to PIN 7	

### Battery temperature sensor connector(CNR1)

The CNR1 connector is reserved for battery temperature sensor. When the lead-acid batteries are connected to PCS100HV, the PIN1 and PIN2 of CNR1 can be connected to the battery temperature sensor. Take out the green 10-pin connector (CNR1 from the accessory kit, and connect two prepared AWG 16 wires to pin 1~2 of this connector as shown in the following figure.





**Figure 29. CNR1 Pin Assignment**

**Table 12: CNR1 Pin Assignment**

Item	Pin Assignment	Notes
CNR1	1: Battery Temperature 1	Temperature sensor of lead-acid battery
	2: Battery Temperature 2	
	3~10: NA	Reserved

## Ethernet Communication Connector (CNS4)

The CNS4 connector is used for Ethernet communication. Use a common Ethernet cable to connect to a site controller, EMS or BMS.

Please be noted if one uses PC to connect with a PCS Ethernet port, there may be a connection issue due to the Ethernet Card compatibility in some PCs. In this case, we can suggest an Ethernet-USB converter to connect with PCS.

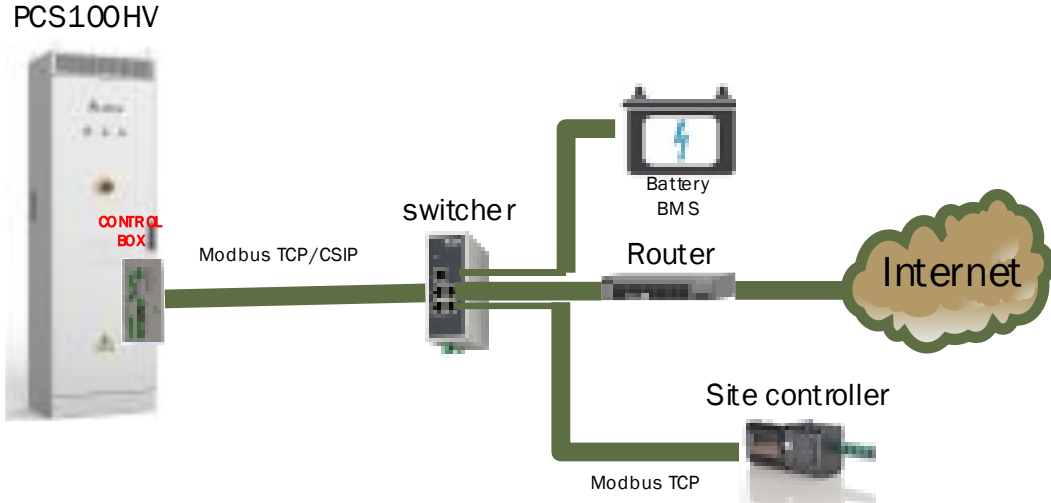


Figure 30. Communication connection diagram

## Communication Connector for BMS(CNS10)

The CNS10 connector is used for CAN communication with BMS. Take out the green 10-pin connector (CNS10 from the accessory kit, and connect two prepared AWG 16 wires to pin 1~2 of this connector as shown in the following figure.

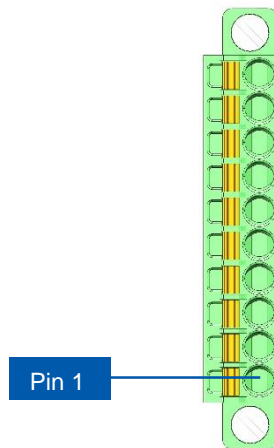


Figure 31. CNS10 Pin Assignment

Table 13: CNS10 Pin Assignment

Item	Pin Assignment	Notes
CNS10	1: CANH_BCC	CAN communcation for BMS
	2: CANL_BCC	
	3~10: NA	Reserved

### Communication Connector (CNR3, CNR11)

The CNR3 and CNR11 connectors are for communication with other PCS in parallel operation. Prepare two RJ45 connectors with shielded Ethernet cables, and the wires to the pin 1~8 of the RJ45 connector, and it should be connected as the graphic and pin assignment below:

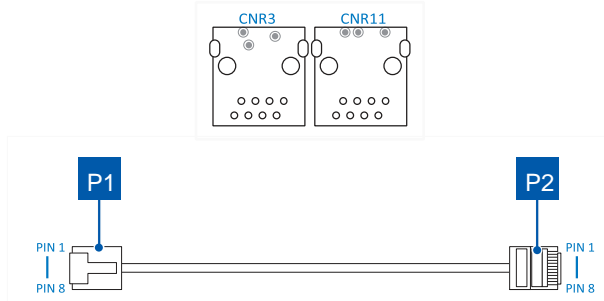


Figure 32. CNR3, CNR11 Pin Assignment

Table 14: CNR3, CNR11 Pin Assignment

Item	Pin Assignment	Notes
CNR3, CNR11	1: RS485A_P	PCS parallel RS485 communications
	2: RS485B_P	
	3: #SYSDISABLE	PCS parallel I/O
	4: CANH_P	PCS parallel CAN communications
	5: CANL_P	
	6: PGD	
	7: RS485A_M	Monitor RS485 communications
	8: RS485B_M	

### ID setting switches (SWR4)

The SWR4 switches are used to set the ID of PCS.

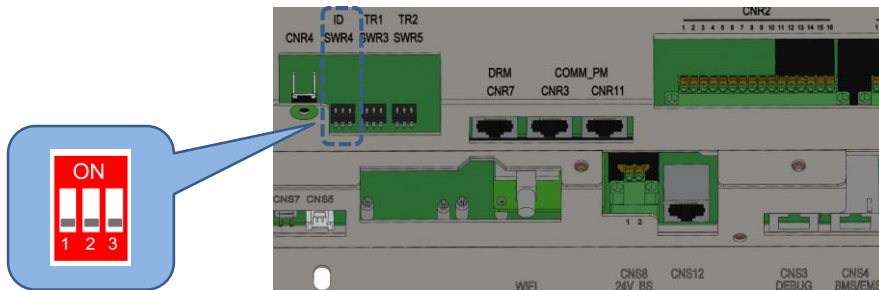


Figure 33. SWR4 Assignment

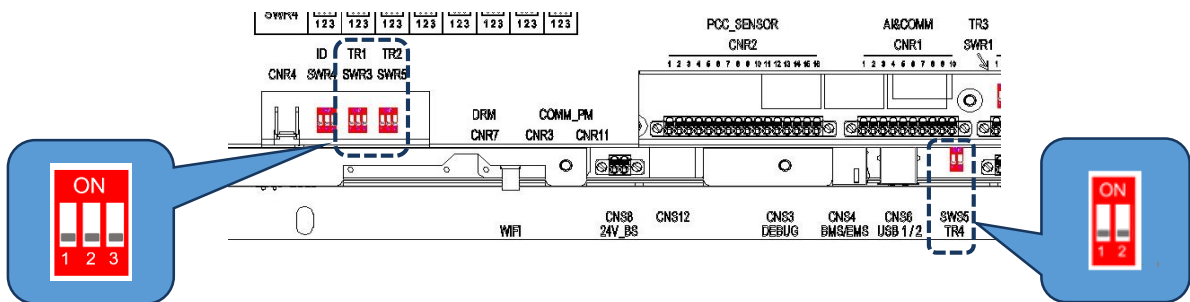
The ID of PCS should be set according to the following table.

**Table 15: ID setting of SWR4**

ID DEFINITION								
ID	1	2	3	4	5	6	7	8
SWR4								

### Terminal resistor setting switches (SWR3, SWR5, SWS5)

The SWR3 and SWR5 switches are used to set the terminal resistors of RS485 and CAN for PCS parallel communication. The SWS5 switches are used to set the terminal resistors of CAN for BMS communication. When the switch is placed at the upper side (ON Marking), the corresponding terminal resistor is connected.



**Figure 34. SWR3, SWR5, SWS5 Assignment**

### EMS Communication wiring

The PCS100HV supports Ethernet for communication. Ethernet can be used for a site controller or EMS or remote server.

A 120ohm terminal resistor must be set in the site controller before it's connected.

The connection diagram of communication is shown in the following figure.

## Connected by Ethernet

When a single PCS#1 is used, make sure the connector CNR11 is not connected.

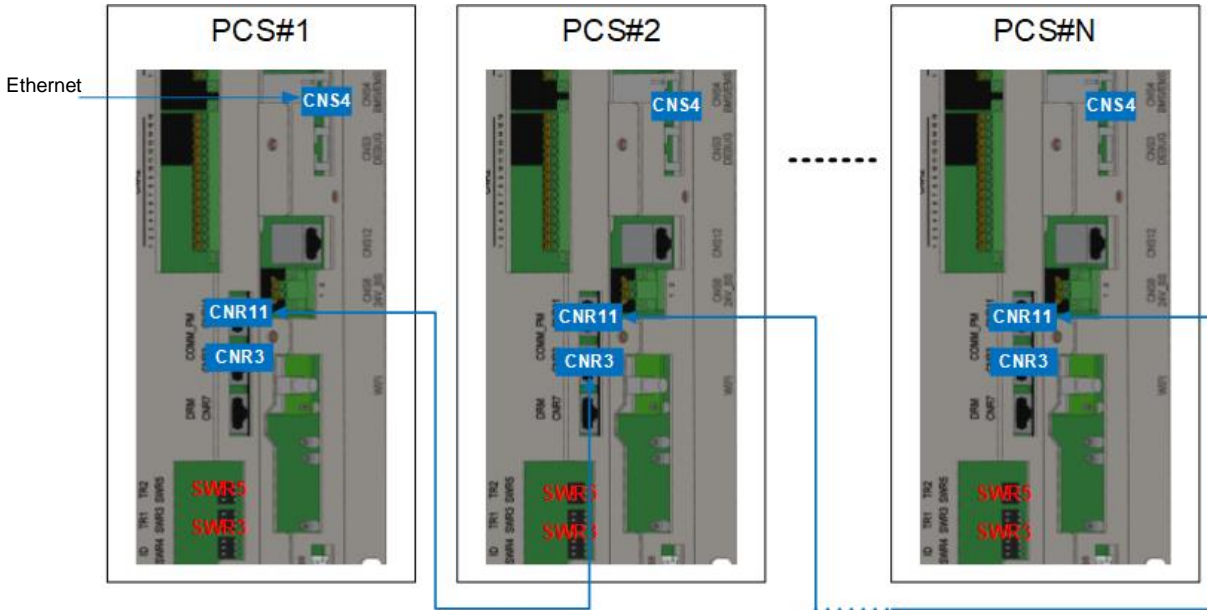


Figure 35. Connected by Ethernet

## Terminal resistors setting

The terminal resistor switches SWR3 and SWR5 must be set according to the following two tables.

Table 16: Terminal resistors switches setting of single PCS for Ethernet communication

Mode	Switches	1# PCS
Single	SWR3-1	√
	SWR3-2	√
	SWR3-3	√
	SWR5-1	√
	SWR5-2	√
	SWR5-3	√
		 SWR3 SWR5

Table 17: Terminal resistors switches setting of parallel PCS for Ethernet communication

	Switches	1# PCS	2# PCS	n# PCS
Parallel	SWR3-1	√	×	×
	SWR3-2	√	×	×
	SWR3-3	√	×	×
	SWR5-1	×	×	√
	SWR5-2	×	×	√
	SWR5-3	×	×	√
		 SWR3 SWR5	 SWR3 SWR5	 SWR3 SWR5

## BMS Communication wiring

The PCS100HV can be connected to BMS by Ethernet or CAN.

1. If the PCS100HV is connected to BMS by Ethernet, a switcher should be used as shown in Fig.29. and the BMS communication wire, PCS communication wire and EMS communication wire should be connected to the same Ethernet switcher.
2. If the PCS100HV is connected to BMS by CAN, the connector CNS10 should be connected as shown in Fig. 30 and Table 12. And the terminal resistors SWS5 should be settled to the "ON" site.

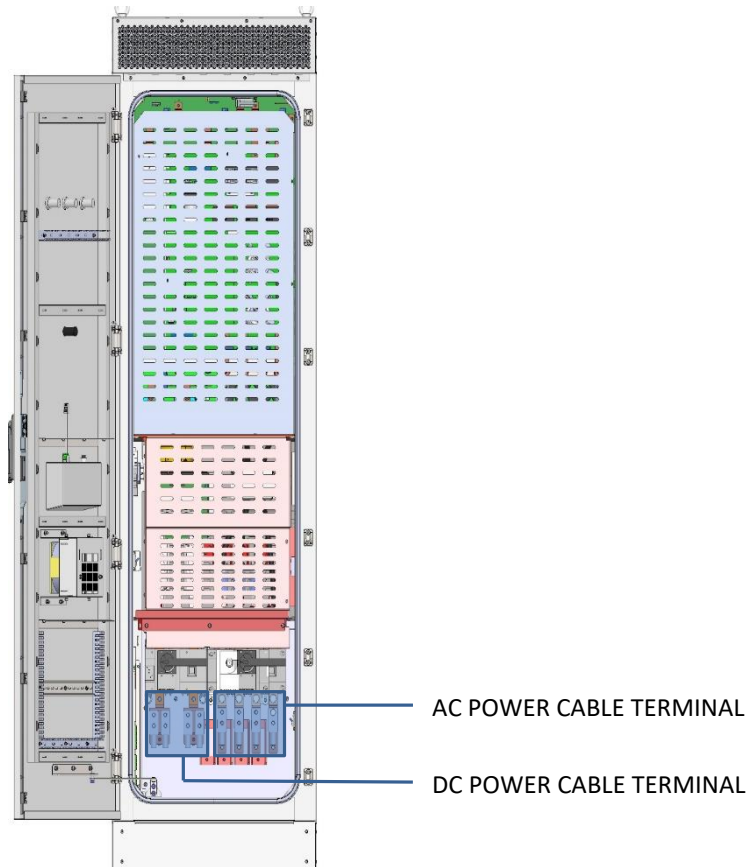
## Wiring

### General Introduction

For wiring convenience, you can make the cables and wires go from the left, right, front, or rear bottom side of the unit into the cabinet.

The following sections will be described in the case of wiring from the front bottom side of the unit as an example. As for the other cases, please remove the relevant side cover of the unit base to lead the cables and wires into the cabinet.

To do the wiring works from the front bottom side of the PCS, first, remove the front cover of the unit base and the protective cover in the middle of the cabinet and with a Phillips screwdriver.



**Figure 36. Remove the Front Cover of the Unit Base and the Protective Cover**

After removing the protective cover, you can also see several labels marked as “DC+”, “DC-”, “L1”, “L2”, “L3”, and “N” along with relevant terminals.

## DC Wiring

1. **Prepare DC cables:** Prepare several 1/0 sizes, 1500V cables for DC wiring. The PCS supports up to 2 sets of battery connection, and each set of battery connection requires two cables (one for positive, the other for negative). Connect the DC cables to the two-hole lugs which are available, and use heat shrinkable tubing on the junction between the cables and lugs to prevent the exposure of the conductive part.
2. **Remove the protective cover of DC terminals:** Remove the protective cover in front of the DC terminals as shown in the following figure. There are two labels indicating the polarity of the terminals: "DC+" for positive, and "DC-" for negative.

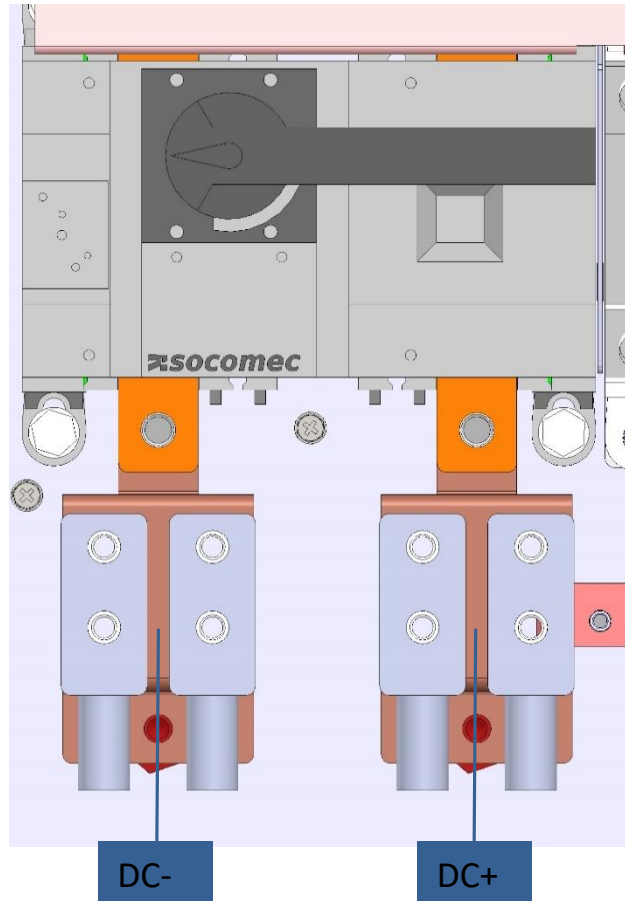


Figure 37. DC Terminal



## AC Wiring

1. **Prepare AC cables:** Prepare six 35 ~ 50 mm<sup>2</sup> 600V cables for AC wiring. The PCS supports 3-phase/4-wire connection type AC wiring with L1, L2, and L3 phase and Neutral terminals, and each phase terminal requires two cables to connect. Attach the AC cables to the two-hole lugs, and use a thermal casing to prevent the exposure of the naked part.
2. **Remove the protective cover of AC terminals:** Remove the protective cover in front of the AC terminals as the figure shown below. There are three labels indicating the phase of the terminals: "L1" for L1 phase, "L2" for L2 phase, "L3" for L3 phase, and "N" for Neutral phase. Each phase terminal provides a back-to-back connection way for connecting two AC cables.

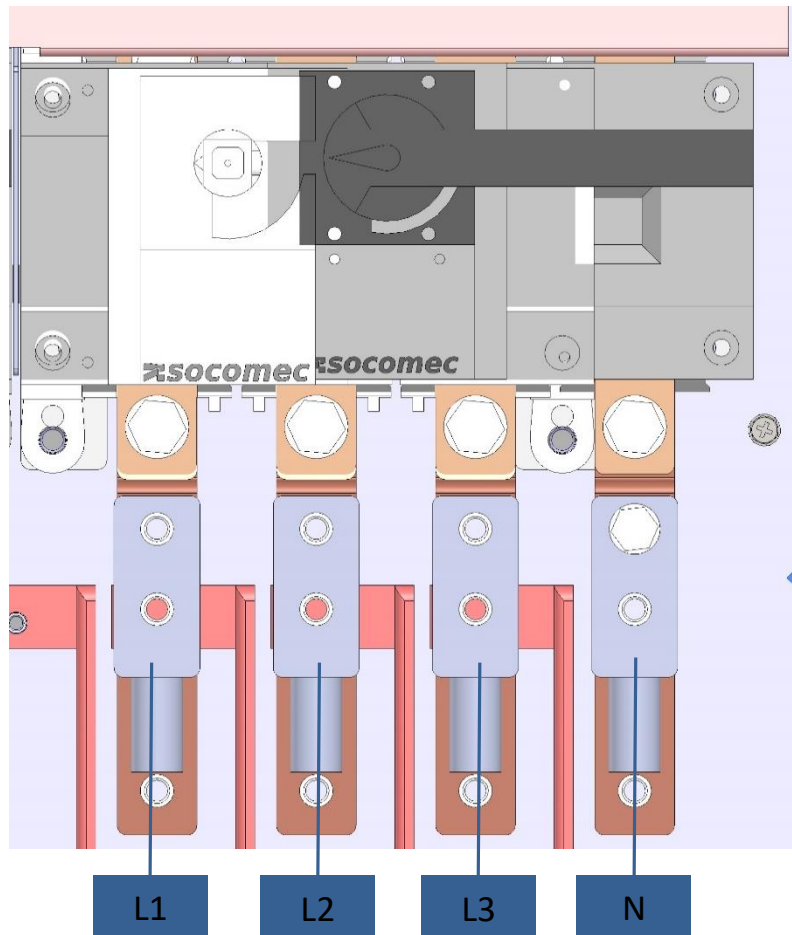


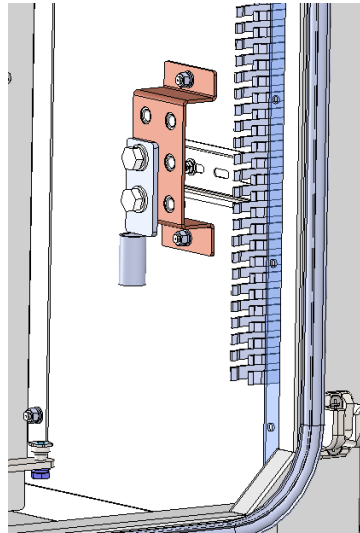
Figure 38. AC Terminal

3. **Connect AC cables to AC terminals:** Loosen the hex socket screws of the AC terminals by Allen wrench, then lead the AC cables with two-hole lugs through the AC cable glands into the PCS, connect and secure these cables to the relevant "L1", "L2", "L3" and "N" terminals.
4. Reinstall and secure the AC protective cover.

## Grounding

Lead the grounding cable through the front square hole of the unit base or through the grounding cable glands into the PCS cabinet.

Then use a socket or adjustable wrench to connect and secure the grounding cable lugs to the grounding copper plate at the inner sidewall of the cabinet adjacent to the AC terminals as shown below:



**Figure 39. Grounding Cable Connection with Grounding Copper Bar**



**Note:**

The grounding cable only needs a 35 ~ 50 mm<sup>2</sup> cable.

It's recommended to connect the protection grounding wires of PCS100HV and battery cabinet to one bonding point and then grounding to the earth.



**Note:**

The grounding wire sizing must be larger than half of AC or DC wire sizing.

The wire sizing and ratings are recommended by the manufacturer. If non-recommended wiring is used, it should comply with local regulations.

As suggested by the device vendor, adhesive tape is used to fix the SPD module to SPD base support before shipping out of the factory. One needs to remove the adhesive tape on both SPDs.

Be careful not to be scratched by the cover plate.

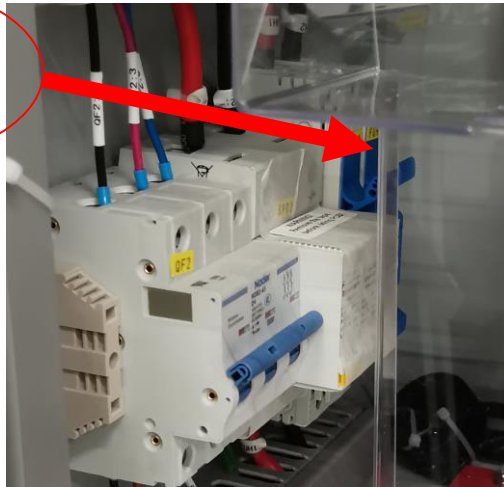


Figure 40. Remove the adhesive tape on DC SPD



Figure 41. Remove the adhesive tape on AC SPD

## Warranty

The warranty may be void and invalid when the product has been exposed to the following conditions:

1. used in a manner inconsistent with any instructions provided hereby or the given specifications;
2. damaged by water, earthquake, lightning, or typhoons;
3. operated in unusual circumstances such as strikes, riots, wars, or nuclear disasters;
4. repaired, modified, moved, or installed by any party without Delta's prior written authorization;
5. damage due to accidents such as fire, inundation, unusual electric shock, power failure, or shipping;
6. damaged by rodents, improper temperature, humidity, or any unmet environmental requirement;
7. deliberately damaged;
8. corresponding GFD equipment is not equipped.

Additional charges and costs may apply when maintenance services are required due to the improper maintenance of the product.

# Appendix

## Specifications

**Table 18: Technical Specifications of the Delta PCS100HV**

Item	Description
<b>Grid-tied Operation</b>	
Rated Grid Voltage	400 Vac (3P,N,PE) or (3P,PE)
Grid Voltage Range	310 ~ 450 Vac
Rated Grid Frequency	50 Hz
Frequency Range	45~55 Hz
Rated AC Power	100 kVA / kW
Rated AC Current	145 A
Max. Continuous AC Current	167 Arms
Current THD	< 3%
Power Factor	-1 to 1, continuously adjustable
<b>Battery Input Performance</b>	
DC Voltage Range	650 ~ 1,350 Vdc for 3P3W 1)
	700 ~ 1,350 Vdc for 3P4W in Off-grid mode 1), 2)
Rated DC Voltage	900 Vdc
Rated Discharge Power	102 kW
Rated Charge Power	98 kW
Max. Discharge DC Current	157A
Max. Charge DC Current	151A
<b>Standalone Mode Performance</b>	
Rated Output Voltage	400 Vac (3P,N,PE)
Rated Output Power	100 kVA/kW with linear load; 80 kVA with RCD load ( $I_{pk} \leq 240A$ ) 3)
Rated Output Current	145A
Rated Output Frequency	50 Hz $\pm$ 1%
Power Factor	0.8 to 1
Output Voltage Accuracy	1%
Voltage Symmetry	$\pm$ 1%, @ 100% linear balanced load
Output Voltage THD	< 3% @ liner load
<b>Environment</b>	
Max Altitude	4,000 m, de-rating >3000m
Operating Temperature	-30 °C to +60 °C, de-rating >45°C
Storage Temperature	-30 ~ 70°C
Humidity	0 to 95% RH, no-condensing
Cooling	Forced air with speed control
Pollution Degree	III
Acoustic Noise	< 70 dB @ 1 m @25°C @ rated condition

IP Degree	IP55
<b>Interface &amp; Communication</b>	
Digital I/O	4 x Input, 3 x Output relays, 1 x REPO
User Interface	LED, EPO
Emergency Stop	Local EPO button & remote control
Communication	Ethernet/ Modbus TCP
<b>System Characteristic</b>	
Peak Efficiency	98%
Standby Loss	<25W @ sleep mode
Dimensions (W x D x H)	600mm x 500 mm x 2000mm
Net Weight	<250 kg
<b>Standard Compliance</b>	
Certificate	Safety: IEC/EN 62477-1, Grid Code: AS/NZS 4777.2, EMC: IEC/EN 61000-6-2, IEC/EN 61000-6-4 (class A)
Product Conformity	RCM
Applicable Battery Chemistry	Lithium-ion, lead-acid battery, flow battery
1) Output power will be de-rating if DC voltage is higher than 1250V. 2) The minimum DC voltage should be larger than 750V if the load is 100% unbalanced load. 3) Transformer or motor load or rectifier load, which has a large inrush current (I <sub>pk</sub> >240A) is not included.	
*Specifications are subject to change without prior notice.	

**Table 19: Icc declaration (r.m.s. value, Icp,mr, device)**

Characteristics of SCPD					
Ports	Icc	Icp,mr	Type	Location	Specification
AC	10kA	5kA	L50QS250.V, LITTELFUSE	FU1, FU2, FU3	Rated current: 250A; rated voltage:500V; Interrupt rating: 200kA.
DC	20kA	5kA	PV312-2XL- T250A1500V SINOFUSE	FU4,FU5	Rated current: 250A; rated voltage:1500V; breaking capacity: 50kA.

## Glossary

- AC  
Abbreviation for “Alternating Current”.
- AHJ  
Abbreviation for “Authority Having Jurisdiction” (electrical inspector).
- AWG  
American Wire Gauge.
- Basic Insulation  
Insulation to provide basic protection against electric shock.
- BMS  
Battery management system.
- DC  
Abbreviation for “Direct Current”.
- EMC  
The Electro-Magnetic Compatibility (EMC) concerns the technical of the mutual influencing of electrical devices through electromagnetic fields caused by them.
- EPO  
Emergency power off.
- ESS  
Energy storage system.
- Galvanic isolation  
Non conductive connection between two component parts.
- GEC  
Grounding Electrode Conductor
- GET  
Grounding Electrode Terminal
- IEEE  
The Institute of Electrical and Electronics Engineers or IEEE is an international non-profit, professional organization for the advancement of technology related to electricity.
- IMI  
Isolation Monitor Interrupter
- ISC  
Short Circuit Current
- Local utility company

A local utility company is a company that distributes electricity over the grid.

- PCS

Power Conditioning System, an electrical device that converts DC direct voltage into AC voltage and/or direct current into alternating current.

- Power dissipation

Power dissipation is designated as the difference between absorbed power and power of a device or process yielded. Power dissipation is released mainly as heat.

- PVC

Polyvinyl chloride.

- RJ-45

Abbreviation for standardized eight-pole electrical connector connection. RJ stands for Registered Jack (standardized socket).

- RS-485 (EIA485)

Differential voltage interface on which the genuine signal is transmitted on one core and the negated (or negative) signal on the other core.

- SPD

Surge protection device.

- THD

Total harmonic distribution.

- Icc

Conditional short-circuit current.

- SCPD

Short-circuit current protective device.

- Icp,mr

Minimum required prospective short-circuit current.



## Screw Torque Table

- The torque level for M3~M5 screws is 4.8, refer to the following torque standard table to make sure the washers are in close contact with the screws.

**Table 20: Screw Torque Table for M3~M5 Screws**

		Screw Assembly Torque Standard			Unit: N·m
Screw Type		M3	M4	M5	
Screw Thread		Standard	Standard	Standard	
Material		N/A			
Securing	Secured				
Steel Plate	Steel Plate	$0.8 \pm 0.15$	$1.4 \pm 0.2$	$3.0 \pm 0.2$	
Steel Plate	Aluminum Plate	$0.7 \pm 0.1$	$1.4 \pm 0.15$	$3.0 \pm 0.2$	
Aluminum Plate	Aluminum Plate				
Plastic	Aluminum Plate	$0.6 \pm 0.1$	$0.8 \pm 0.15$	$1.2 \pm 0.2$	
Plastic	Steel Plate	$0.6 \pm 0.1$	$0.8 \pm 0.15$	$1.2 \pm 0.2$	
PWB	Steel Plate	$0.6 \pm 0.2$	$1.0 \pm 0.2$	N/A	
Insulator	Copper Plate	$0.6 \pm 0.2$	$1.2 \pm 0.2$	$1.6 \pm 0.2$	

- The torque level for M6 or bigger screws is 8.8, refer to the following torque standard table to make sure the washers are in close contact with the screws.

**Table 21: Screw Torque Table for M6~M16 Screws**

		Screw Assembly Torque Standard					Unit: N·m	
Screw Type		M6	M8	M10	M12	M14	M16	ST5.5
Screw Thread		Standard	Standard	Standard	Standard	Standard	Standard	Customized
Material		N/A						
Securing	Secured							
Steel Plate	Steel Plate	$5 \pm 1$	$12.5 \pm 1$	$25 \pm 2$	$42 \pm 3$	N/A	$100 \pm 10$	$5.5 \pm 1$
Copper Plate	Copper Plate	$5 \pm 1$	$12.5 \pm 1$	$25 \pm 2$	$42 \pm 3$	N/A	$100 \pm 10$	N/A
Insulator	Copper Plate	$5 \pm 1$	$10 \pm 1$	$12.5 \pm 2$	N/A	N/A	N/A	N/A