Version: EN-UM-1.6

USER MANUAL

PV 44.0C-614.4 ESS Battery System

HISTORY

VERSION	ISSUED	COMMENTS
1.0	December 24	First release
1.1	March 6	Second release
1.2	April 10	Update accessories list, Add installation requirements
1.3	May 12	Update the interface definition description
1.4	July 11	Update the list description
1.5	August 07	Update product labels and notes
1.6	September 15	Tag Updates

Preface

About This Manual

This manual provides instructions for the installation, electrical connection, and commissioning of the PV 44.0C-614.4 ESS Battery System. It is strongly recommended that installation, operation, and maintenance personnel read this manual and all related documents carefully before using the product. The illustrations in this user manual are for reference only. This user manual is subject to revision without prior notice. (Specific please in kind prevail.)

Target Group

PV 44.0C-614.4 ESS Battery System must be installed by professional electrical engineers who have obtained relevant qualifications.

Scope

This manual is applicable to the following Energy storage system:

- PV 44.0C-614.4

Conventions

The following safety instructions and general information are used within this user manual.

DANGER	Indicates an imminently hazardous situation which, if not correctly followed, will result in serious injury or death.
WARNING	Indicates a potentially hazardous situation which, if not correctly followed, will result in serious injury or death.
CAUTION	Indicates a potentially hazardous situation which, if not correctly followed, could result in moderate or minor injury.
NOTICE	Indicates a potentially hazardous situation which, if not correctly followed, could result in equipment failure to run, or property damage.
NOTE	Call attention to important information, best practices and tips: supplement additional safety instructions for your better use of the PV 44.0C-614.4 to reduce the waste of you resource.

CONTENTS

1. Introduction

1.1 Brief Introduction

PV 44.0C-614.4 is a high voltage battery storage system based on lithium iron phosphate battery, and it's one of the new energy storage products, it can be used to support reliable power for various types of equipments and systems. PLHS HV is especially suitable for application scene of high power, limited installation space, restricted load-bearing and long cycle life.

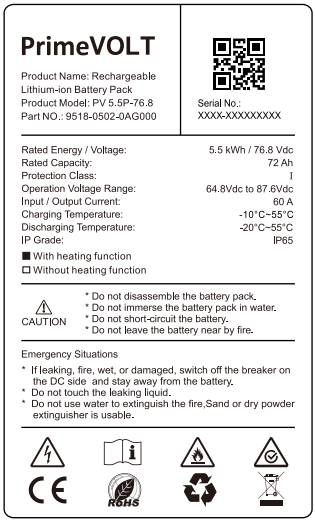
1.2 Product Features

- The whole module is non-toxic, non-polluting and environmentally friendly;
- Anode material is made from LiFePO4 with safety performance and long cycle life;
- Battery management system (BMS) has protection functions including over-discharge, over-charge, over-current and high/low temperature;
- The system can automatically manage charge and discharge state and balance current and voltage of each cell;
- Flexible configuration, multiple battery modules can be in serial for expanding voltage and Capacity.
- Adopted natural cooling reduced system entire noise;
- The module has less self-consumption, up to 6 months without charging; no memory effect, excellent performance of shallow charge and discharge;
- Working temperature range is from -20 to 55℃, with excellent discharge performance and cycle life;
- Small size and light weight, standard module is comfortable for installation and maintenance;

1.3 Product Identity Definition

Figure 1-1 Rechargeable Lithium-ion Battery Pack Label

■ With heating function



■ Without heating function

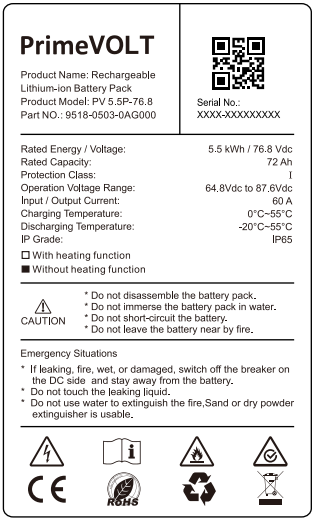
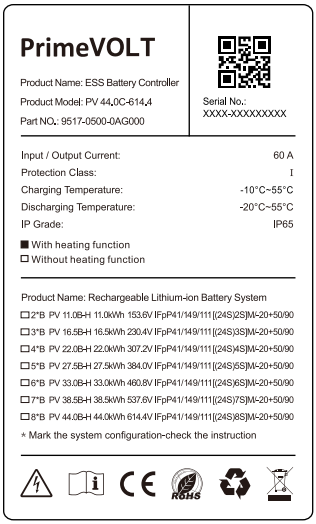
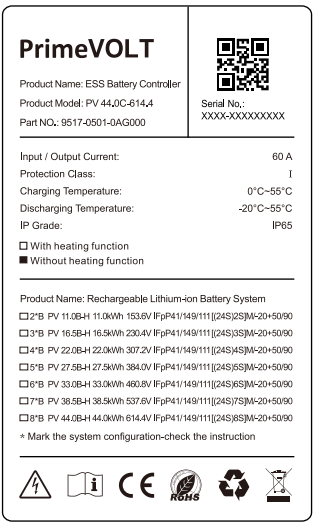


Figure 1-2 ESS Battery Controller Label

■ With heating function



■ Without heating function



2 Specification

2.1 System Performance Parameter

Table 2-1 The parameter of Rechargeable Lithium-ion Battery System

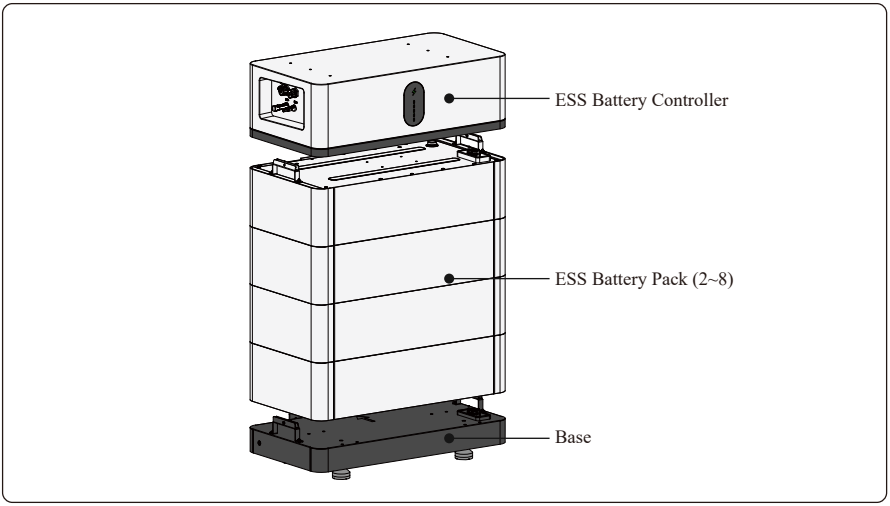
Model Name	PV 11.0B-H	PV 16.5B-H	PV 22.0B-H	PV 27.5B-H	PV 33.0B-H	PV 38.5B-H	PV 44.0B-H
Cell Type	LiFePO4, Prismatic Cell						
Nominal Capacity	72						
Module Number	2	3	4	5	6	7	8
Norminal Energy [kWh]	11.05	16.58	22.11	27.64	33.17	38.70	44.23
Nominal Voltage [V]	153.6	230.4	307.2	384.0	460.8	537.6	614.4
Voltage Range [V]	129.6V~175.2	194.4V~262.8	259.2V~350.4	324.0V~438.0	388.8V~525.6	441.6V~624.0	518.4V~700.8
Max. Continuous Charge / Discharge Current (A)	60						
Rated Charge / Discharge Current	36A (0.5C)						
Rated Charge / Discharge Power(KW)	5.5	8.3	11.1	13.8	16.6	19.4	22.1
Max Charge / Discharge Power(KW)	9.2	13.8	18.4	23.0	27.6	32.3	36.9
Size (W*D*H) mm	675*360*643	675*360*813	675*360*983	675*360*1153	675*360*1323	675*360*1493	675*360*1663
Weight (kg)	127	176.5	226	275.5	325	374.5	424
Protection Degree	IP65						
Altitude (m)	3000						
Warranty [1]	10 years						
Cycle Life [2]	6000						
Operating Temperature (℃) [3]	-20~55						
Noise Emission	<35dB						
Humidity	5%~95%RH (non-condensing)						
Cooling	Natural Cooling						
Heating	CAN						
Communication Interface	Low temperature charging heating (option)						
Transmit Certification	UN38.3						
Certification	ROHS						
Safety	EN 62619, EN62477						
EMC	EN 61000-6-1/2/3/4						

1 0.5 C @ 25 ℃, 90% DoD, 1 cycle per day

2 0.5C@ 25 ℃, 90% DOD

3 Charging Temperature: -10-55°C (With heating function)
0-55°C (Without heating function)
Discharging Temperature: -20-55°C

The following uses four battery modules as an example:



2.2 Battery Pack

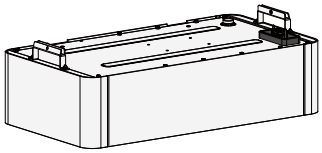
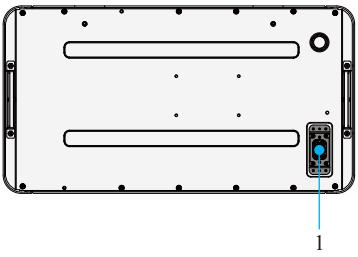


Table 2-2 Product Parameters

Module Name	PV 5.5P-76.8
Cell Technology	72AH-LFP (Prismatic)
Battery Module Energy (kWh)	5.5
Battery Nominal Voltage (Vdc)	76.8
Nominal Capacity (Ah)	72
Battery Module Cell Quantity (pcs)	24
Working Voltage Range (Vdc)	60-87.6
Charge Current (Standard) [A]	60
Discharge Current (Standard) [A]	60
Dimensions (W*D*H, mm)	675*360*170
Communication Mode	CAN
Ambient Temperature (°C)	-20~55
IP Grade	IP65 (In stacked up state)
Weight (kg)	49.8

Battery Pack top interface

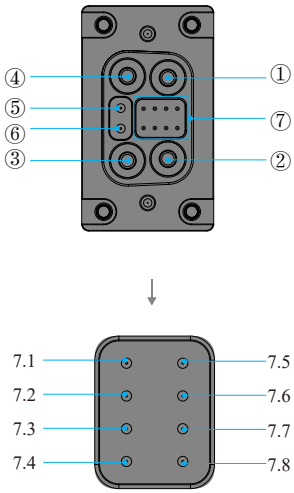


Battery Pack bottom interface

Table 2-3 Interface Definition

Item	Name	Definition
1	Socket interface definition	Battery module output and communication interface
2	Plug interface definition	Battery module output and communication interface

Socket interface definition



Plug interface definition

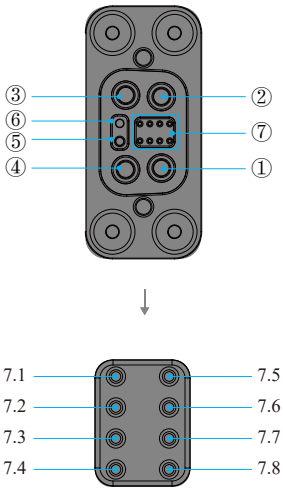


Table 2-4 Port Definition

Pin No.	Socket interface definition	Plug interface definition
1	-	-
2	PE	PE
3	- (Negative)	- (Negative)
4	+ (Positive)	+ (Positive)
5	Heating film+	Heating film+
6	Heating film-	Heating film-
7	-	
7.1	CAN-H	CAN-H
7.2	CAN-L	CAN-L
7.3	DI 1	DO 1
7.4	VCC+	VCC+
7.5	VCC-	VCC-
7.6	-	-
7.7	-	-
7.8	-	-

2.3 Controller

Controller front interface

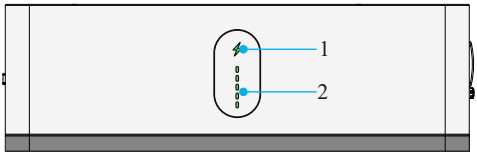


Table 2-5 Display Area Definition

Item	Name	Definition
1	Status LED	Alarm: yellow light, Protection (Fault): red light Charging/Discharging: green light
2	SOC LED	State Of Capacity, green light

There are 6 LED indicator, 5 LED gives status of SOC, 1 LED Running Status LED (indicating charging, discharging etc.)

Status		
Power Off		no
Stand by		Continuous
Charging		Continuous
Discharging		Twinkle 2s
Warning		Continuous
Protection (Fault)		Continuous

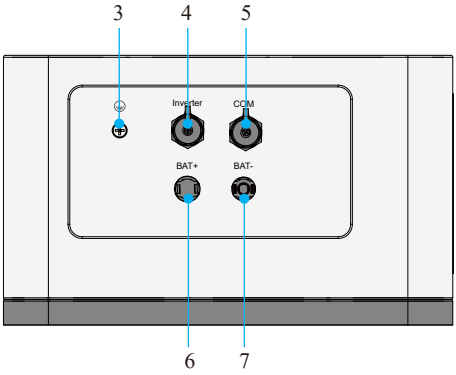
SOC					
-	Real SOC	Real SOC	Real SOC	Real SOC	Real SOC
(0~0]	(1~20]	(21~40]	(41~60]	(61~80]	(81~100]

System Self-test: LED1~LED5 Green Running Horse Light (1s)

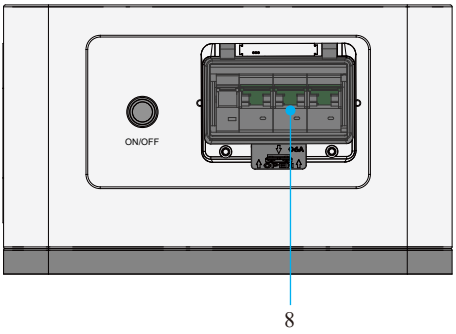
System Upgrade: LED1~LED5 Blue Running Horse Lamp (1s)

Charging: The highest lit LED flashes for seconds

Controller HV-BOX left interface



Controller HV-BOX right interface



Controller HV-BOX bottom interface

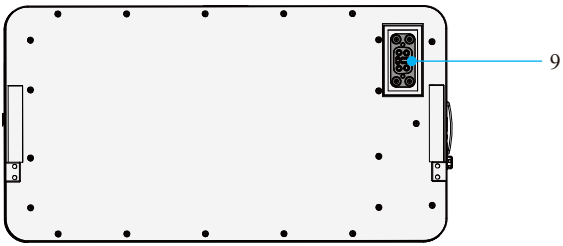
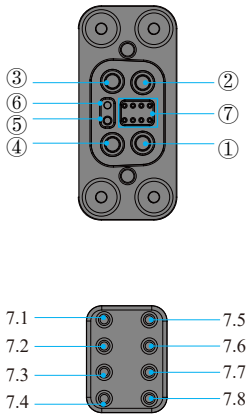


Table 2-7 Interface Definition

Item	Name	Definition
3	Ground Point	PE connecting point
4	Inverter Communication Port	Connect to inverter communication
5	COM Communication Port	COM: Connect to upper computer communication
6	P+ Output Terminal	DC+ to inverter
7	P- Output Terminal	DC- to inverter
8	DC Breaker	DC Breacker 100A
9	Connector-Plug	Battery module output and communication interface

Table 2-8 Controller Connector-Plug Definition

Pin No.	Module Input Connector
1	-
2	PE
3	- (Negative)
4	+ (Positive)
5	Heating Film +
6	Heating Film -
7	
7.1	CAN-H
7.2	CAN-L
7.3	DI 1
7.4	VCC+
7.5	VCC-
7.6	-
7.7	-
7.8	-



Connector-Plug

2.4 Base

Base top interface

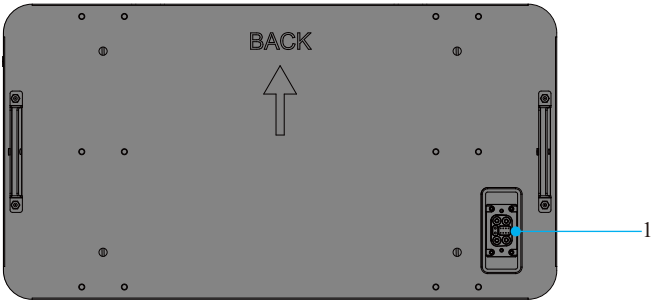
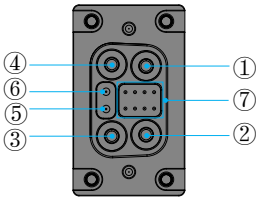
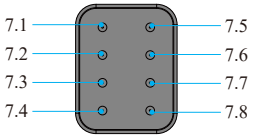


Table 2-9 Interface Definition

Pin No.	Definition
1	NA
2	PE
3	4 Short Circuit
4	3 Short Circuit
5	6 Short Circuit
6	5 Short Circuit
7	
7.1	120Ω
7.2	120Ω
7.3	-
7.4	-
7.5	-
7.6	-
7.7	-
7.8	-





CAUTION	When the DC breaker is tripped off because of over current or short circuit, must wait after 30mins to turn on it again, otherwise may cause the breaker damage.

Power Switch: Generally when it is at ON state, you can't turn off it during normal running ondition.

DANGER	Ensure Power Switch is turned on before waking up the battery. Otherwise it will affect automatic checking process and cause danger. DO NOT turn off the "Power Switch" during normal running condition, only in emergency case it could be turned off directly.

Communication Connector

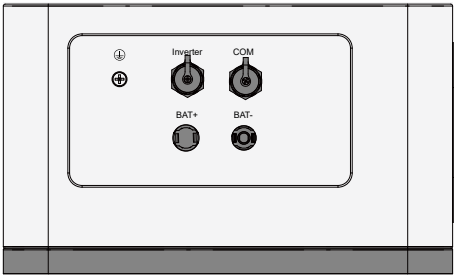
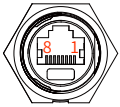
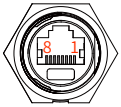


Table 2-9 Interface Definition

Inverter Communication Port		COM Communication Port	
			
PIN 1	PCS-485-B	PIN 1	TX_P
PIN 2	PCS-485-A	PIN 2	TX_N
PIN 3	GND	PIN 3	RX_P
PIN 4	PCS-CAN-H	PIN 4	DI+
PIN 5	PCS-CAN-L	PIN 5	DI-
PIN 6	VCC-	PIN 6	RX_N
PIN 7	N/A	PIN 7	N/A
PIN 8	N/A	PIN 8	N/A

3 Installation

3.1 Environmental Requirement

3.1.1 Cleaning

The battery system has high-voltage connectors, and environmental conditions can affect the isolation performance of the system. Before installation and system power on, the dust and iron scurf must be removed to keep a clean environment. And the environment must have certain anti-dust ability. Dust and humidity condition shall be periodic checked during the system continuous operation.

3.1.2 Temperature

ESS battery system working temperature range: -20°C~55°C. Optimum temperature: 15°C~30°C;
Caution: Out of the working temperature range will cause the battery system over / low temperature alarm or protection which may lead to the cycle life reduction.

3.1.3 Cooling System

It is essential to equip a cooling system to keep the battery system in a relevant temperature range.
Caution: Out of the working temperature range will cause the battery system over / low temperature alarm or protection which may lead to the cycle life reduction.

3.1.4 Heating System

Danger: The module is equipped with a heating system. When the temperature is below 0°C and needs to be charged, to start the battery system, first start the heating system, until the battery module temperature exceeds 0°C to allow charging. The heating system will continue to heat until the battery module temperature reaches 15°C and stops.
Caution: Out of the working temperature range will cause the battery system over / low temperature alarm or protection which may lead to the cycle life reduction.

3.1.5 Fire-extinguisher System

The room must be equipped with fire-extinguisher system for safety purpose. The fire system needs to be regularly checked to be in normal condition. Refer to the using and maintenance requirements, please follow local fire equipment guidance.

3.1.6 Grounding System

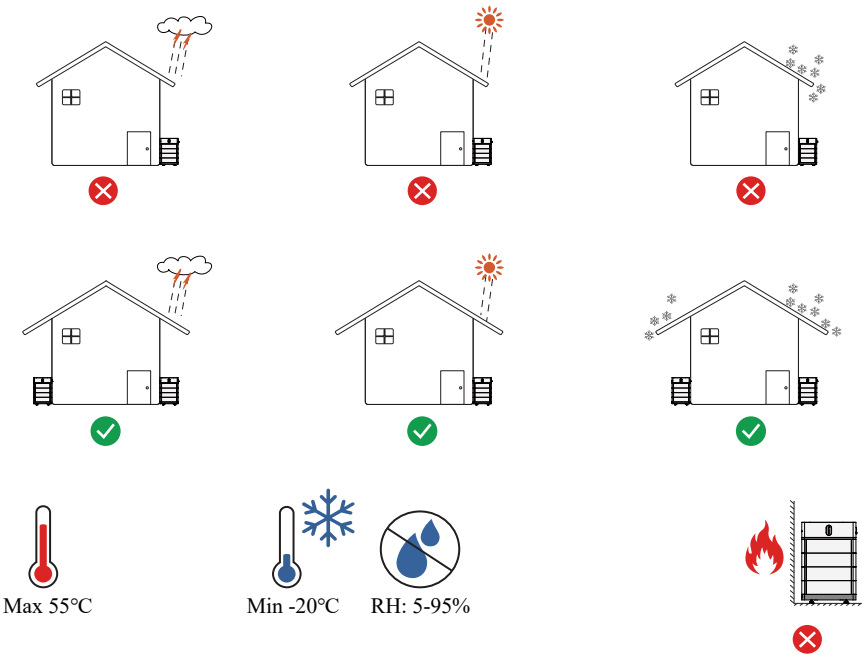
Make sure the grounding point for battery system is stable and reliable before the battery installation. If the battery system is installed in an independent equipment cabin (e.g. container), must make sure the grounding of the cabin is stable and reliable.

3.1.7 Requirements for Installation Location

- A solid support surface must be available (e.g., concrete or masonry).
- The installation location must be inaccessible to children.
- The installation location must be suitable for the weight and dimensions of the PLHS HV.
- The installation location must not be exposed to direct solar irradiation.
- Keep away from metal conductive dust.
- Keep away from water source, heat source and inflammable and explosive articles.
- The installation location must not be close to the fire.
- The operating temperature should be between -20°C ~ +55°C.
- The ambient humidity should be between 5-95%.

3.1.8 Low Battery Voltage Warning

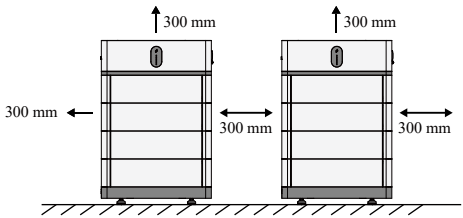
When the battery is used up, turn off the main battery switch. If the battery is not used for a long time, turn off the main switch of the battery. If not, the battery voltage will be too low, and the machine cannot be started.



3.2 Recommended Installation Clearance

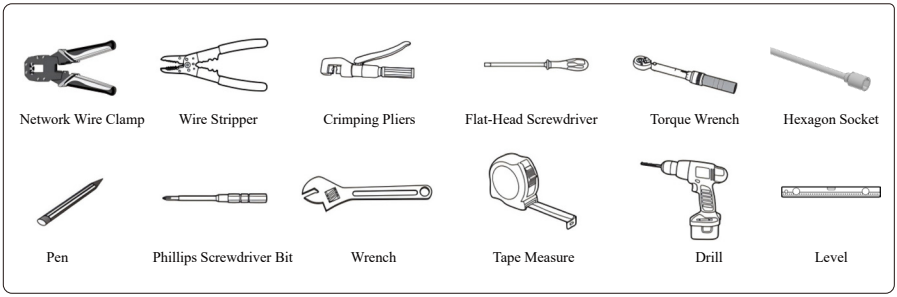
Please note that the battery should be installed with a minimum safe clearance from the surrounding equipment or battery. Please refer to the minimum clearance diagram below.

Space Requirements	
Min. clearance from left side	300 mm
Min. clearance from right side	300 mm
Min. clearance above ESS Battery Syetem	300 mm
Min. clearance between side-by-side ESS Battery Syetem	300 mm
Min. clearance from back	36~50 mm



3.3 Tools

The tools in the following table could be needed during the installation.

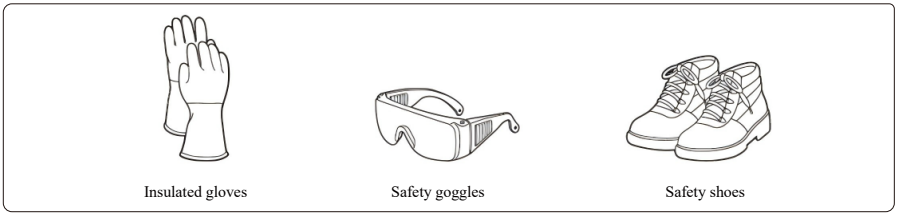


Note:
Use properly insulated tools to prevent accidental electric shock or short circuits.
If insulated tools are not available, cover the entire exposed metal surfaces with available insulated alternatives, except their tip, with electrical tape.

M6x60 expansion bolts delivered with the battery are used to install the floor support and power control module. If the length and quantity of the bolts do not meet installation requirements, prepare M6 stainless steel expansion bolts by yourself. The expansion bolts delivered with the battery are mainly used for solid concrete walls and concrete floors. If other types of walls and floors are used, ensure that the walls and floors meet the loadbearing requirements (one battery expansion module weighs 50 kg) and select the bolts by yourself.

3.4 Safety Gear

It is recommended to wear the following safety gear when dealing with the battery system.



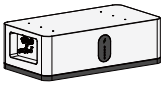
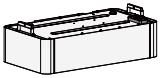
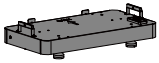
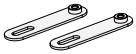
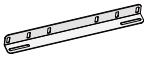
3.5 Unpacking Inspection

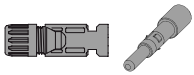
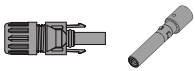
When the equipment arrives at the installation site, loading and unloading should be performed according to the rules and regulations, to prevent from being exposed under sunlight. Battery should not be installed in direct sunlight. Please refer to Section 3.3.

- Before unpacking, the total number of packages shall be indicated according to the shipping list attached to each package, and the case shall be checked for good condition.
- In the process of unpacking, handle with care and protect the surface coating of the object.
- Open the package, the installation personnel should read the technical documents, verify the list, according to the configuration table and packing list, ensure objects are complete and intact, if the internal packing is damaged, should be examined and recorded in detail.

Packing list is as follows:

Note: The four battery modules are used as reference, and the shipment is subject to actual conditions.

Type	Item name	Quantity	Picture	Remarks
/	Battery Controller	1 PCS		
/	Battery Pack	N PCS		According to customer selection of electricity configuration
/	Base	1 PCS		
/	Wall-mounted component adapter	2 PCS		
/	Wall mounting brackets	1 PCS		
Accessory	Communication cable	1 PCS		
	GND cable	1 PCS		
	PV connector wrench	1 PCS		

Accessory	Output cable connector " - "	1 PCS		
	Output cable connector " + "	1 PCS		
	M6 expansion screw	2 PCS		The hole diameter is 8mm and the depth is 60mm
	Screw M6*16mm	4 PCS		
	User manual, Packing list, Outgoing inspection report	3 PCS		

3.6 Installation

Installation steps

Step1	Installation preparation	1. The environment is meeting all environmental requirements: "3.1.1~3.1.6"
Step2	Mechanical installation	1. Determine ESS battery system placement
		2. Place the base
		3. Install battery module
		4. Install controller
		5. Install hangers
		6. Mark the system configuration
Step3	Battery system self-test	1. Switch on the DC breaker of the controller
		2. Switch on the "POWER" switch
		3. Press the "POWER" button for about 3S
		4. Check the system output voltage
		5. Shut down the battery system
Step4	Connecting inverter	1. Connect output power cable to the inverter
		2. Connect the output communication cable to the inverter
		3. Connect dry contact communication cable

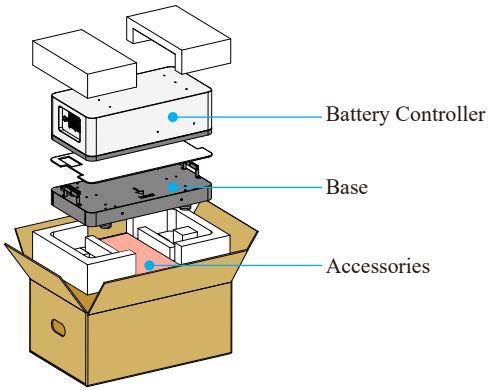
3.6.1 Installation Preparation

- Make sure the environment is meeting all technical requirements: "3.1.1~3.1.6".
- Prepare equipment and tools for installation.
- Confirm that the DC breaker is in the OFF state to ensure that it is no live operation.

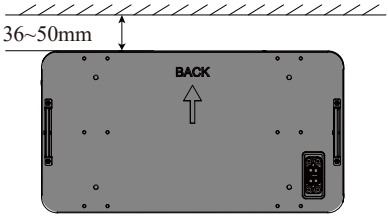
3.6.2 Mechanical Installation

3.6.2.1 Place the base

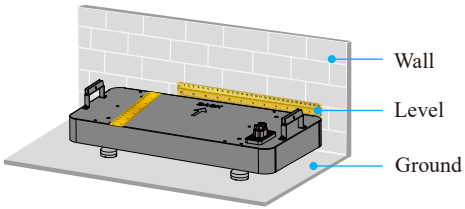
- Choose an appropriate place to set base.
- Take the Controller and base from the package out.



- Put the installed base and feet along the wall, and keep the distance of 36~50mm between the wall and the base.



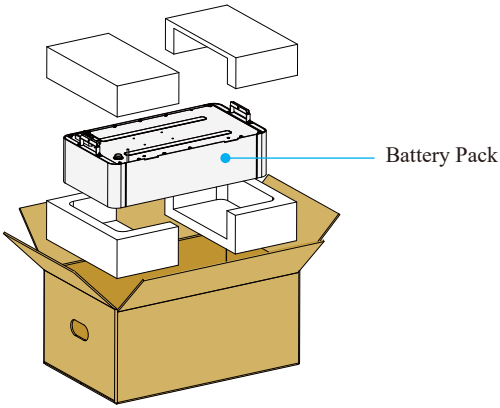
*Make the base level



*Use a level to ensure the base is level in the X and Y directions

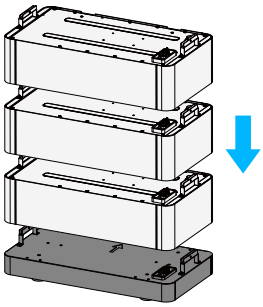
3.6.2.2 Battery module installation

- Take the battery from the package.



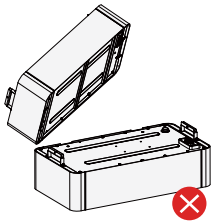
- Install all the ESS Battery Pack modules and controller on the base from bottom to up, follow the sequence B8~B1. Referring to the following figure.

Warning: Single battery module is 50kg. It's necessary to arrange more than 1 person to install battery module if without lifting equipment, more than 2 person when install battery module in higher position.

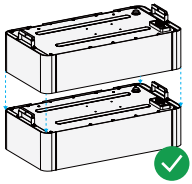


Place the Battery Packs on the base one by one from bottom to top

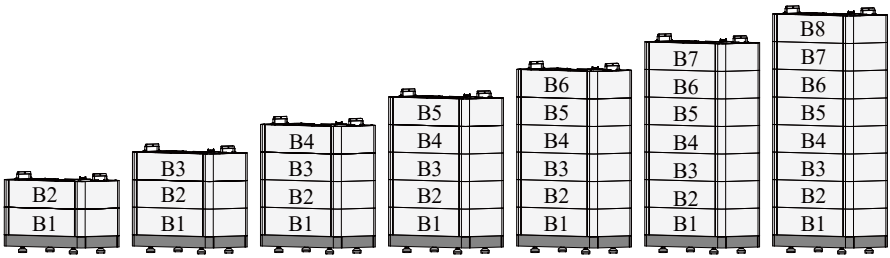
Do not tip the PACK on one side during installation.



(Prohibit)

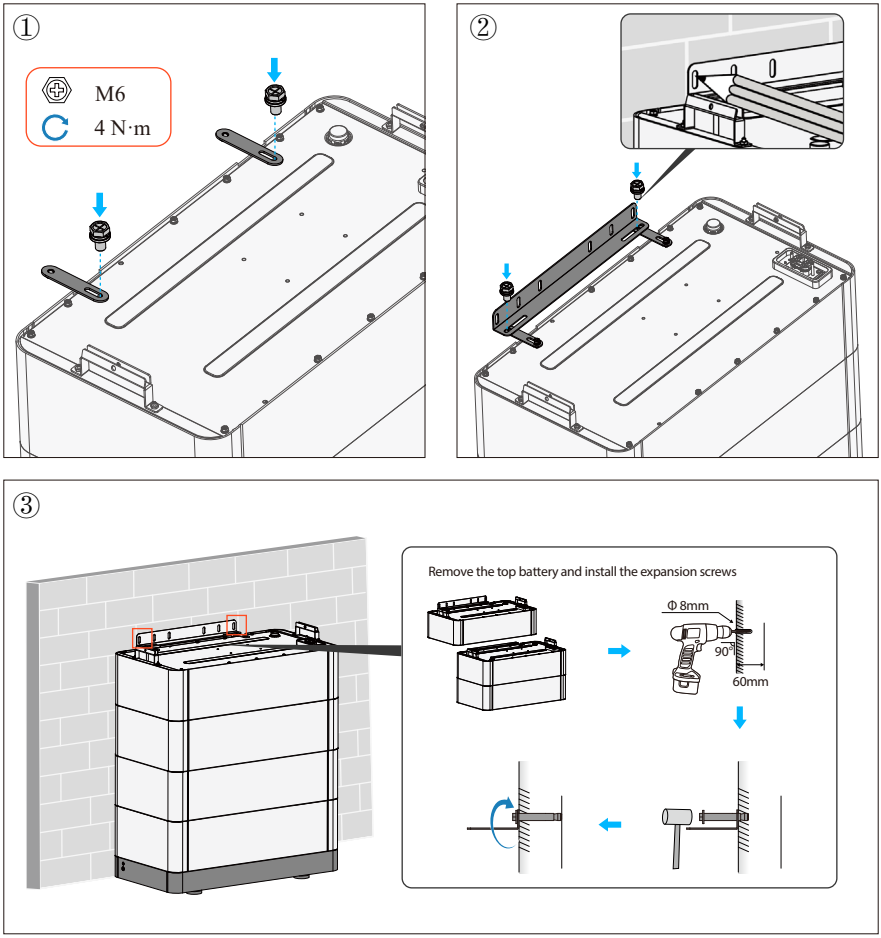


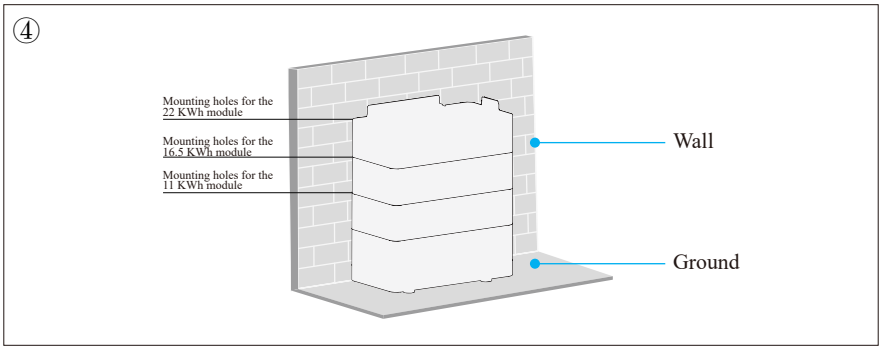
(Recommend)



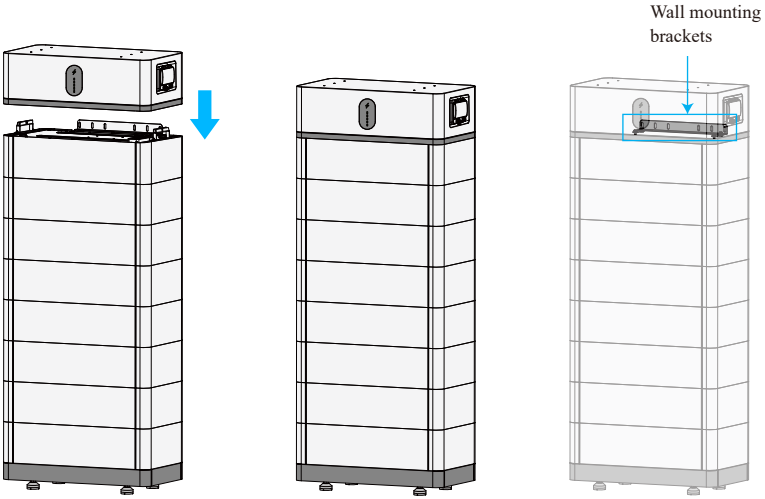
Warning: Battery module ΔV of single cluster should be less than 0.15V at first installation.

- Install the fixed wall bracket onto the battery pack.



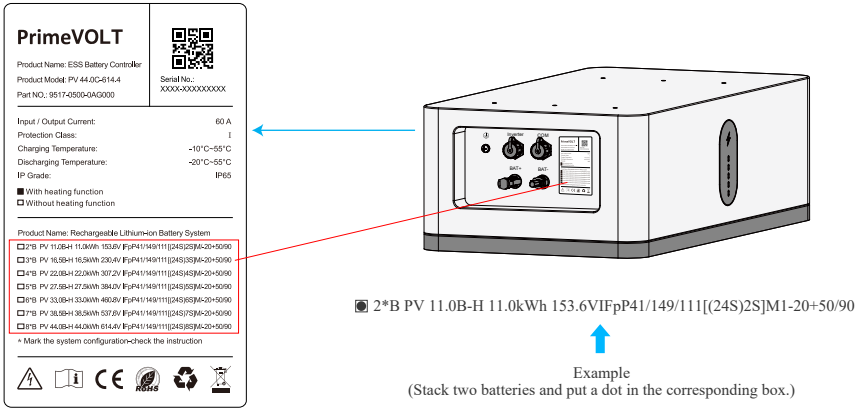


3.6.2.3 Controller installation



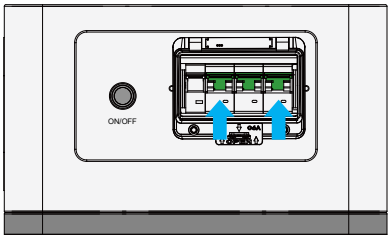
- Hold the hanger (wall part) where it intends to be mounted on the wall and mark the position of the drill holes. Please pay attention that there may be power cables or other supply lines (e.g., gas or water) routed in the wall. Ensure that no lines are laid in the wall, which could be damaged when drilling holes.
- Set the hanger aside and drill the marked holes.
- Insert screw anchors into the drill holes if the support surface requires them.
  Secure the hanger using screws (recommended M6x16).
- Fix the four hangers (wall parts and controller parts) with M6X12 bolts and nuts, using a cylinder screwdriver to tighten it.

- Mark the System configuration.

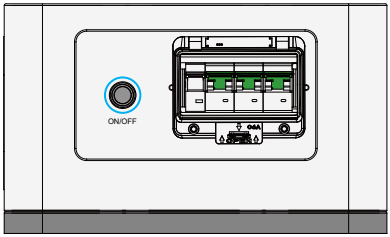


3.6.3 Battery System Self-Test

3.6.3.1 Switch the controller "DC BREAKER" to the "ON" state.



3.6.3.2 Press and hold the "ON/OFF" button for approximately 3 seconds. The SOC indicator lights LED1-LED5 on the panel will illuminate in blue sequentially, each for 1 second. When the operational indicator changes to "Standby", it indicates the completion of the system's self-check.



3.6.3.3 Use a multimeter to measure the output voltage on the positive and negative ports of the controller.

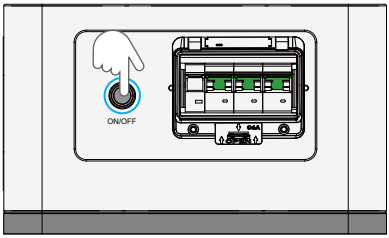
3.6.3.4 The output voltage should conform to the voltage range in the table "Table 2-1 The parameter of PV 44.0C-614.4 ESS Battery system". Otherwise, the system will be not working properly.

Use a multimeter to check the output voltage is within the normal range.

- **Danger:** The voltage of the battery is too high, please pay attention to do self-protection during the measurement.

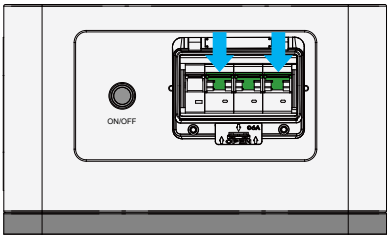
3.6.4 Shut Down the System.

- Switch off the "ON/OFF" switch.



Press and hold on 3S

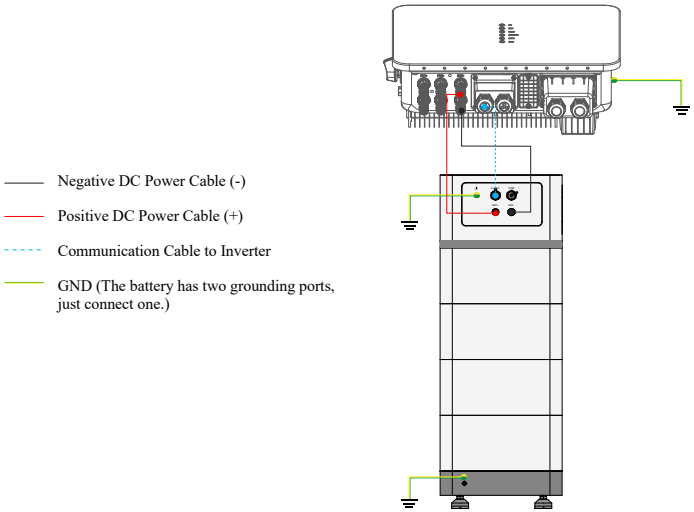
- Switch the controller "DC Breaker" to the "OFF" state .

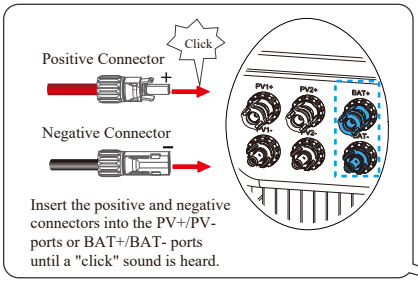


3.6.5 Connecting Inverter

Taking 4 battery modules as an example for a single cluster

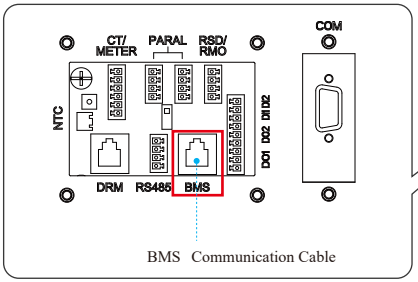
Single-phase ESS Inverter (3K/3K6/4K6/5K/6K)

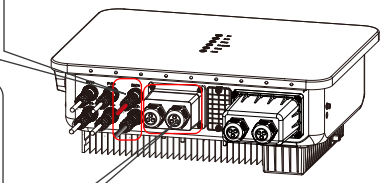




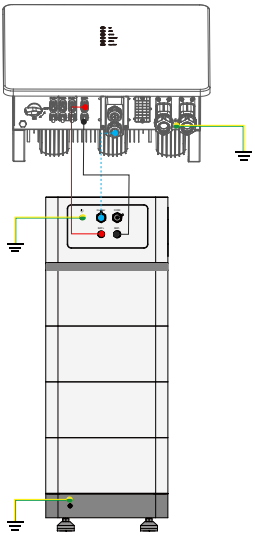
Note:

For detailed inverter wiring information, please refer to the inverter user manual.





Three-phase ESS Inverter (5K/6K/8K/10K)

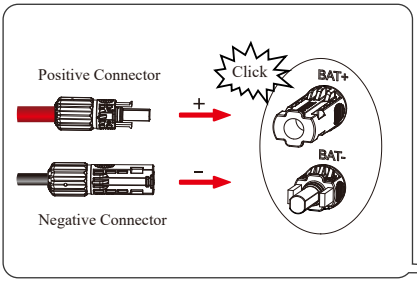


Negative DC Power Cable (-)

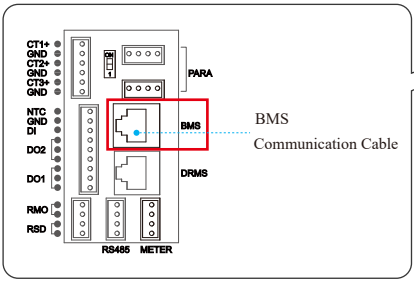
Positive DC Power Cable (+)

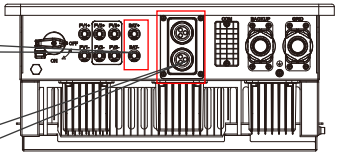
Communication Cable to Inverter

GND (The battery has two grounding ports, just connect one.)

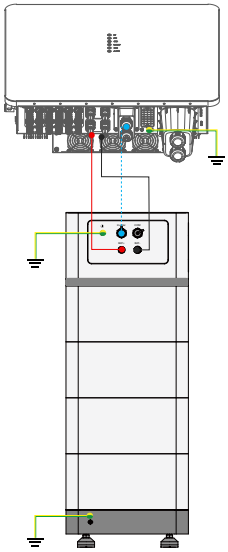


Note:
For detailed inverter wiring information, please refer to the inverter user manual.





Three-phase ESS Inverter (12K/15K/20K/25K/30K)

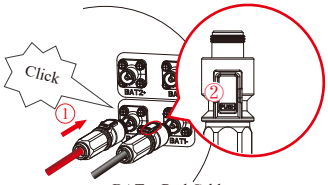


Negative DC Power Cable (-)

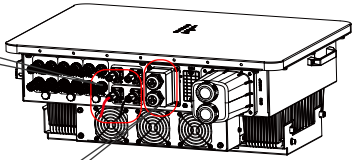
Positive DC Power Cable (+)

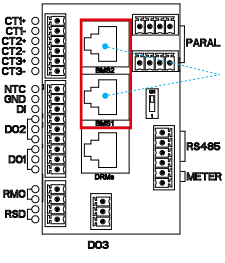
Communication Cable to Inverter

GND (The battery has two grounding ports, just connect one.)



BAT+ Red Cable
BAT- Black Cable



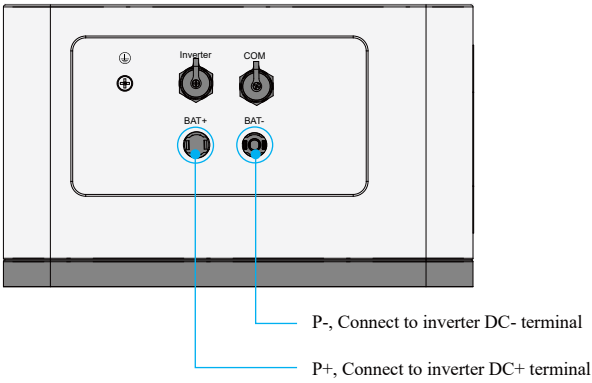


BMS1/BMS2
Communication Cable

Note:
For detailed inverter wiring information, please refer to the inverter user manual.

DANGER	Please confirm that the battery system is in the off state before connecting. It maybe cause electric shock to personnel and damage to the inverter if connect the battery directly without power off.

Connect output Power Cable to the inverter



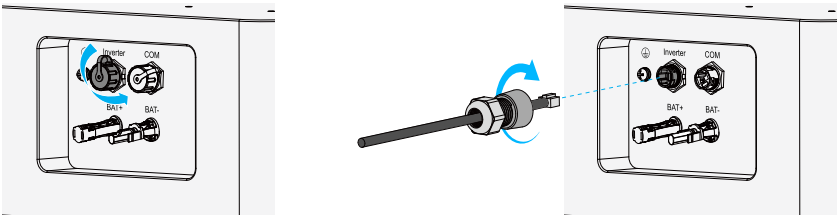
Connect the output communication cable to the inverter RJ45 CAN port.

(1) Take off the RJ45 waterproof cover.

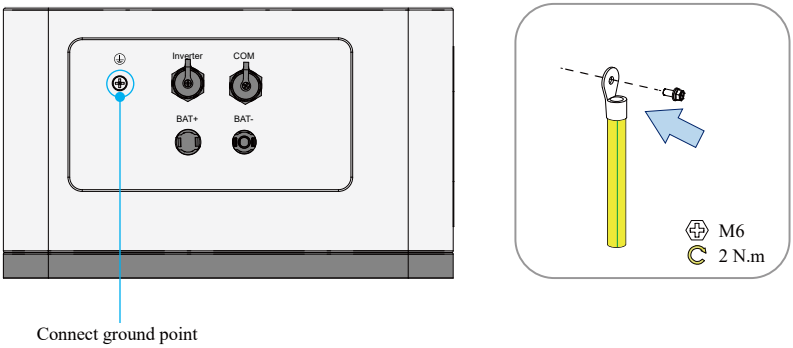
(2) Pass the communication cable through the RJ45 wiring cover.

(3) Plug the communication cable to the corresponding RJ45 port.

(4) Tighten RJ45 wiring cover.



Connect external grounding cable



WARNING	Double check all the power cables and communication cable. Make sure the voltage of the Inverter is in the same level with the battery system.

(1) Switch on the inverter, to make sure all the power equipments can work normally.

(2) Start the battery system.

4 Maintenance

4.1 Trouble Shooting

DANGER	The ESS battery system is a high voltage DC system, operated by professional and authorized person only. Before check the failure, must check all the cables connection. Switches are right or not, and if the battery system can be woken up normally.

No	Problem	Possible Reason	Solution
1	The battery has no voltage output, and "POWER"Light is off.	The DC breaker of the controller didn't be turned on	Turn on the DC breaker of Controller
2		The "POWER" switch of the controller box was not switched on	Switch on the "POWER" button
3		Battery is in sleep state	Long press the "POWER" button for about 3s
4		The fuse in the controller is faulty	Replace fuse
5		Battery gets into over-discharged protection	Charge the battery to relieve the protection state
6	The battery has no voltage output, but "POWER" is on	The relay in controller is faulty	Replace a new controller directly
7	When the battery is connected to the inverter, the DC breaker trips automatically	The circuit between the battery and the inverter has a short circuit point	Check for short circuits between the battery and the inverter. Also, check whether the inverter is faulty.
8	Communication failure between battery and inverter	The wrong battery model type is selected on the inverter	Select correct battery model type on the inverter
9		Communication cable interruption	Replace communication cable
10		PIN error in communication cable between inverter and battery	Replace with the cable corresponding to the CAN signal (the battery side CAN is 4H5L)
11		Error dialing code on the control box	On the dialing board, use the normal protocol to dial the code

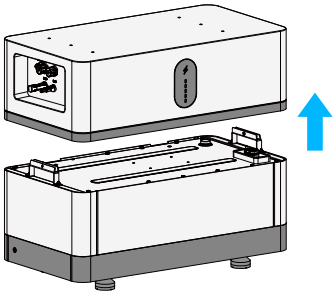
4.2 Replacement of Main Component

DANGER	The ESS battery system is a high voltage DC system, only can be operated by professional and authorized person.

4.2.1 Replacement of Controller

4.2.1.1 Turn off the whole battery system. Ensure the negative terminal and positive terminal have no power.

4.2.1.2 Remove the four screws on the controller, then remove the controller from the system.



4.2.1.3 Change a new controller. Then fix four screws.

4.3 Battery Maintenance

DANGER	The maintenance of battery only can be operated by professional and authorized person. you need turn off the battery system firstly when you do some maintenance items.

4.3.1 Voltage Inspection

[Periodical Maintenance] Check the voltage of battery system through the monitor software. Check whether the system voltage is normal or not. For example: Check Single cell's voltage is out of rated range or not.

4.3.2 SOC Inspection

[Periodical Maintenance] Check the SOC of battery system through the monitor software. Check the SOC of battery string is normal or not.

4.3.3 Cables Inspection

[Periodical Maintenance] Visual inspect all the cables of battery system. Check the cables have broken, aging, getting loose or not.

4.3.4 Balancing

[Periodical Maintenance] The battery system will become unbalanced if have not be charged fully for a long time. Solution: Preform the balancing maintenance (fully charged) every 3 month. Generally this maintenance progress needs to be completed when external devices such as the monitor software and battery and inverter are in good communication.

4.3.5 Output Relay Inspection:

[Periodical Maintenance] Under low load condition (low current), control the output relay OFF and ON to hear the relay has click voice, that's mean this relay can off and on normally.

5 Storage Recommendations

- It is recommended that batteries not be stored for a long period. They should be used soon after being deployed onsite. The batteries should be handled according to the following requirements.

Required Storage Temperature	Actual Storage Temperature	Recharge Interval	Remarks
–15°C < T ≤ 55°C	T ≤ –15°C	Not allowed	Not reaching the time for recharge: Use the batteries as soon as possible. Reaching the time for recharge: Recharge the batteries.
	–15°C < T ≤ -10°C	6 months	
	–10°C < T ≤ +25°C	12 months	
	25°C < T ≤ 35°C	9 months	
	35°C < T ≤ 55°C	6 months	
	55°C < T	Not allowed	

CAUTION	The cycle life of the battery will have relative heavily reduction if not follow the above instructions to store the battery for a long term.

6 Shipment

Battery module will pre-charged to 50% SOC or according to customer requirement before shipment. The remaining capacity of battery cell is determined by the storage time and condition after shipment.

- The battery modules meet the UN38.3 certificate standard.
- In particular, special rules for the carriage of goods on the road and the current dangerous goods law, specifically ADR (European Convention on the International Carriage of Dangerous Goods by Road), as amended, must be observed.