# PCS ECS105-LB-F-SK



# **User Manual**

Version V2.6.3

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# 1 Foreword

#### 1.1 Overview

Dear customer, thank you very much for using our Power Conversion System (PCS) product developed and produced by our company. We sincerely hope that this product can meet your needs, and look forward to your more valuable comments on the performance and function of the product. We will continue to improve, and constantly improve the quality of product.

The main function of the PCS (ECS105-LB-F-SK) is to realize the energy exchange between the battery and the grid, and to control and manage the charge and discharge of the battery. In the grid-connected system, the converter mainly operates in the current source (P/Q) mode to achieve peak shaving and valley filling, frequency modulation and peak regulation, active power reserve and reactive power support for the grid. The converter also supports a variety of charge and discharge modes of constant voltage, constant current and constant power. Under no circumstances does this converter allow operation in off-grid/island mode. It can only operate in "on-grid" mode with "Anti Islanding" function.

This manual describes the functions and features of PCS and the use methods, including product installation, parameter setting, fault diagnosis, daily maintenance and other related instructions and precautions. Before use, be sure to read this manual carefully, and understand the safety precautions before use of the product.

# 1.2 Product Confirmation

The following confirmation is required before installation:

- Verify that the appearance is free from damage, scratches, dents and other phenomena.
- Verify that the product order options are complete.
- Verify that the nameplate information is consistent with the ordered product model.
- Verify that the warning label is free of damage, scratches, and blurring.

If anything out of the ordinary occurs, please contact the company.

# 2 Security

### 2.1 Safety statement

Before installing, operating and maintaining the product, please read and follow these safety precautions.

- For personal and equipment safety, follow all the safety precautions described on the label and manual when installing, operating, and maintaining the product.
- The words "Caution", "Warning" and "Danger" in this manual do not represent all safety precautions to be followed. They are only supplements to all safety precautions.
- This product should be used in an environment that meets the requirements of the design specifications, otherwise it may cause failure, and the abnormal function or component damage caused by failure to comply with the relevant regulations are not within the scope of product quality assurance.
- Due to illegal operation of the product caused by personal safety accidents, property losses, etc., our company will not assume any legal responsibility.

# **2.2** Definition of safety level

The following is a list of identifiers used in this manual. Please read carefully and understand the meaning of each identifier.

Table2-1 Symbol Description

Symbols	Instructions
<b>▲</b> DANGER	Indicates a hazard during operation and that failure to comply with such warning messages can lead directly to serious personal injury or death.

<b>≜</b> WARNING	Indicates a potential hazard during operation that could result in personal injury or death if such warning message is not observed.		
Indicates a potential hazard during operation that result in equipment of if such warning message is not observed.			
★NOTICE	It is used to communicate equipment details or environmental safety warning messages. Failure to avoid them may result in equipment damage, loss of data, reduced equipment performance, or other unforeseen consequences.  The "NOTICE" does not relate to personal injury.		
<b>□</b> NOTE	A supplementary note to the key information in the text.  "NOTE" is not a safety warning message and does not relate to personal, equipment or environmental injury information.		

# 2.3 Installation Safety

#### **A** DANGER

High voltage is present in the live parts of the device, and touching the live parts may result in death or serious electric shock injury. Touching DC cables may cause electric shock. The DC cable that connects the battery is live, and contact with the live cable may result in death or serious injury by electrocution. Before connecting the DC cable, ensure that the DC cable has no voltage.

- Do not touch any live parts.
- To avoid personal injury and product damage, do not install or remove cables (including power and signal cables) with power on.
- Follow all warning messages that appear in the device and documentation.
- Follow all safety information provided by the battery manufacturer.
- Wear the appropriate personal protective equipment for the job.

#### **WARNING**

Entering the storage system is a risk of electric shock. Damage to insulation in a storage system can lead to a deadly ground current that can cause an electric shock. Ensure that the insulation resistance of the storage system exceeds the minimum insulation resistance:  $14 \text{ k}\Omega$ .

- The PCS must be installed in a closed electrical operating area.
- Fire caused by failure to follow torque specifications when bolted.

- Failure to comply with the specified torque will reduce the load carrying capacity of the bolted connection, thus reducing the contact resistance value.
- May cause components to overheat and catch fire.
- Make sure to use the torque specified in this document to always tighten the bolt connection.
- Only use the correct tools when working on the equipment.
- Avoid repeatedly tightening bolts, as this can lead to unacceptably high torque.

#### **ACAUTION**

Pay attention to waterproof, ventilation.

- Waterproof: The IP rating of the PCS module is IP20, which is only suitable for installation in a dry and clean carrier. At the same time, attention should be paid to avoid the carrier water leakage damage to the PCS.
- Ventilation: When a module is integrated in a cabinet, a heat dissipation and ventilation device must be
  installed behind the module to ensure that the heat emitted by the bidirectional energy storage converter
  can be smoothly discharged outside the cabinet.

# 2.4 Electrical installation safety

#### 2.4.1 Pre-installation inspection

In order to ensure the life safety of the installation personnel, there must be necessary safety protection measures in the electrical installation of this product. During electrical installation, the following procedures must be followed:

#### **A** DANGER

- Before installation, all switches of the converter and the external front stage must be disconnected, and all cables and converters must be in a state of no power inside.
- Do not allow the installation in a live state, otherwise there is a risk of electric shock.
- After powering off the converter for 10 minutes, ensure that there is no power inside the converter before operating.
- All power supplies connected to the converter must be disconnected to ensure that the converter is in a no-power state.
- A warning sign must be placed on the disconnected position in case it is re-powered during installation.
- Necessary ground and short circuit connections should be made.

- Live parts should be treated as necessary and isolated with insulation materials to avoid injury to personnel.
- Only professional personnel can install the converter. During the installation, strictly follow the instructions in the user manual.
- The installation personnel must comply with the relevant electrical operation regulations of the country or region where they are located.
- The installation personnel must know the voltage level of the power supply area and determine the voltage adaptation.

#### 2.4.2 Use safety

#### **A** DANGER

- In the case of AC circuit breaker tripping during use, the converter is not allowed to be powered on again.
- In the case of DC high voltage box tripping during use, the converter is not allowed to be powered on again.

In case of the above crisis situation, please contact the after-sales engineer of the company immediately to solve it. It is not allowed to power on twice, otherwise the corresponding loss will not be borne by the company.

# 2.4.3 Cable protection

#### NOTICE

Communication cables are thin and need to be protected to avoid being torn by force.

Cables should meet the voltage insulation level, and necessary protection should be added to avoid scratches on the cable insulation skin.

# **3** Product Introduction

PCS (Power Conversion System) can control the charging and discharging process of the battery.

PCS is composed of bidirectional AC/DC converter, control unit, etc. receives control instructions through communication interface, sends the instructions to the power part to realize charge/discharge control of the battery, and then realizes the adjustment of active power and reactive power of the grid.

# **3.1** Product positioning and features

#### 3.1.1 Product Positioning

This PCS module is mainly suitable for industrial and commercial energy storage: from the scale, it is suitable for industrial plants, commercial buildings, small communities and other relatively small scenes, usually in kilowatt-hour (kWh) as the unit; Can be applied to energy storage, standby power supply, load smoothing, peak shaving and valley filling, and other scenarios; In terms of economic benefits, it is more suitable for meeting local electricity demand, managing energy costs, and has direct economic benefits for independent industrial plants or commercial buildings.

Overall, industrial and commercial energy storage is an important tool to provide energy reliability, reduce costs, and promote clean energy applications.

#### **3.1.2** Product Features

#### **Efficient conversion**

• Standby battery zero power consumption;

- Charge and discharge conversion time ≤100ms;
- The highest conversion efficiency is 98.5%.

#### Flexible application

 Compatible with three-phase three-wire/four-wire system, customized communication bus can monitor all module data.

#### **Battery friendly**

- Different battery clusters can work completely independently, avoiding circulation between battery clusters and improving service life;
- Support 30+BMS protocol.

#### **Fully featured**

- Only operate in "on-grid" mode with "Anti Islanding" function.
- Support reactive power compensation, harmonic governance, three-phase unbalance compensation.

#### **Easy maintenance**

- Group series scheme, the fault branch does not affect the operation of other branches;
- Can support PCS module hot swap, fast maintenance;

#### Safe and stable

- Perfect fault protection function;
- Low battery circulation, multi-parallel automatic current sharing;
- Support stable operation in the grid environment with 20% THDu.

# 3.2 Application Scenarios

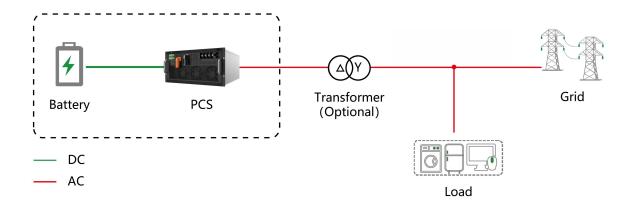
Load smoothing: PCS is used to release the electrical energy stored in the period of low electricity
prices in the period of high electricity prices to smooth the load curve and help users reduce energy
costs.

- **Peak Shaving:** PCS helps users avoid peak electricity prices and reduces stress on the grid by storing energy during off-peak hours and releasing power during peak hours.
- Renewable Integration: In conjunction with renewable energy systems such as solar panels and wind turbines, PCS coordinates the storage and release of energy, improving the predictability and stability of renewable energy.
- **Power Quality Optimization:** PCS can improve the quality of power supply, reduce harmonics and ensure the stable operation of the power system by adjusting parameters such as voltage, frequency and phase.
- Battery Energy Storage Systems: In the battery energy storage system, PCS is responsible for controlling the charging and discharging process of the battery, coordinating the flow of electric energy, and improving the efficiency and life of the energy storage system.
- Grid Scheduling Support: PCS can respond to grid scheduling instructions, provide flexible energy scheduling, and support the balanced and stable operation of the power system.
  - Distributed Energy Systems: In a distributed energy system, PCS coordinates the output of various
- distributed energy sources to ensure the coordinated operation of the system.

# **3.3** Product System Architecture

As shown in the following figure, the energy storage system built by PCS module can be composed of battery pack, PCS, transformer, grid and load. When the battery pack is connected to PCS, and then connected to the load and grid, the DC power output of the energy storage battery pack can be converted into AC power, which can be used by the grid or AC load. At the same time the AC power provided by the grid can also be rectified to direct current for charging the battery pack.

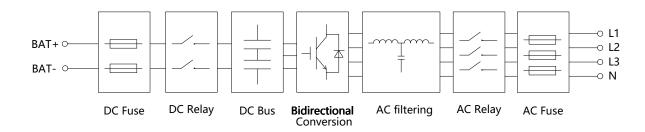
Figure 3-2 Components of energy storage system



# **3.4** Product principle

# 3.4.1 Principle of Main loop

Figure3-3 Electrical topology of the PCS



# 3.4.2 Operating mode

PCS support one operating mode: on-grid.

• In on-grid operation, the AC side of the PCS is connected to the grid, and the DC side is connected to the battery. Cooperate with the grid dispatching system, participate in the voltage and frequency regulation of the power grid, and realize the peak shaving and valley filling of the grid load. According to the selected operating mode, thebattery can be charged and discharged at constant voltage, constant current and constant power.

# 3.5 Product Structure

# **3.5.1** Product structure style

Product	Dimensions (W × D × H, mm)	Remarks	Dissipation wind direction
105kW (ECS105-LB-F-SK)	500 × 670 × 270	Front-maintenance (air terminal on DC side)	Front air in and rear air out

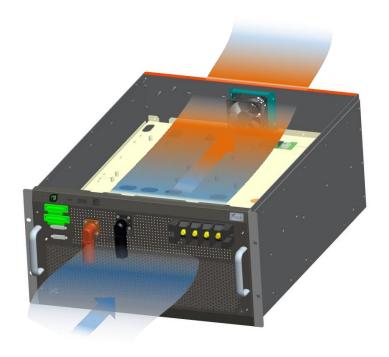
#### **NOTE**

The structural dimensions figure in this section is listed in the order of "Dimensions" in the table. The above dimensions are the minimum cabinet dimensions of the module, that is, the inner dimensions, excluding external structural parts and terminals.

For the conventional DB26 terminal model, the dimensions of the front maintenance (conventional terminal, front air outlet) design (formerly known as "C model") are 440 x 620 x 270 mm.

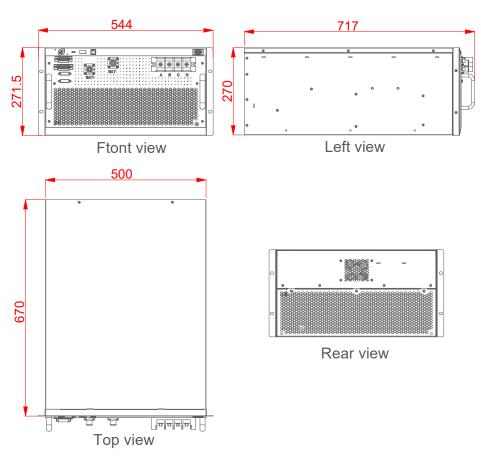
In addition, we have other customized versions (e.g. Phoenix terminal model: the communication method is Phoenix terminal), please contact us for details.

Figure 3-4 Heat dissipation air direction



# **3.5.2** Structural dimensions

Figure3-5 Dimensions of E C S 1 0 5 - L B - F - S K

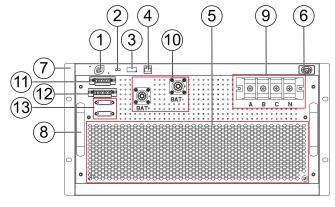


# **3.6** Product appearance

# 3.6.1 Structural layout

Figure 3-6 shows the front view of the front-maintenance model (terminal on front). Table 3-3 shows the appearance.

Figure 3-6 Structure layout of the front-maintenance model (the DC side is the aviation terminal)



Front view

Table 3-3 Component description

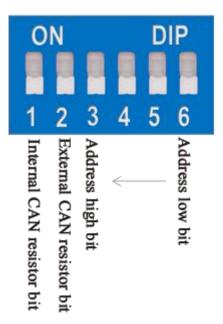
Serial number	Identity/name	Instructions
1	Indicator light	<ul> <li>Operating output power is green for a long time;</li> <li>In standby (0kW operation), the green light blinks 0.5s quickly;</li> </ul>
1	indicator right	<ul> <li>When the system is not powered on and no fault occurs, the green light blinks slowly for 1s.</li> <li>If the device is faulty, the indicator blinks red.</li> </ul>
2	ETH/LOCAL	Ethernet/local debug switch; Right dial LOCAL for local debugging; Dial ETH Ethernet (reserved) on the left
3	(IO) 6-bit dip switch	Bits 1-2 are for CAN communication matching resistor access; Bits 3-6 are module address settings (binary) - bit 6 is the lowest bit (right to left).
4	TEST Debugging network port	Factory back-end debugging communication port (internal dedicated).
5	Vents	Air duct vent hole for forward air and out air
6	220V power interface	220Vac input (internal dedicated)
7	Mounting ears	Installed on both sides of the module to secure it to the rack.
8	Handle	Rack-mount module handle, not for load-bearing.
9	AC interface	AC side wiring
10	DC interface	DC side wiring
11	Grid current sampling interface	A/B/C three-phase current inlet and outlet interface (reserved)
12	Grid voltage sampling interface	A/B/C/N Grid voltage sampling input interface (reserved)
13	Communication port	COM (26pin signal terminal) signal port

#### 3.6.2 Dip switch description

The dip switch for the PCS is a 6-bit dip switch used to manually assign the PCS's communication address. The down position is OFF for "0" and the up position is ON for "1".

From left to right, the first bit is the internal CAN parallel signal resistance (when multiple modules are combined, the first and last units need to be dialed up to "1"), the second bit is the external BMS-CAN communication resistance (factory default is "0"), the third to the sixth bit is used to set the address communication dip (using binary), the third bit is the high bit and the sixth bit is the low bit. Set the address bit from right to left (refer to the figure below). After the dip switch is set and debugged, it is recommended that the dip switch no longer change.

Figure 3-17 PCS 6-bit dip switch schematic



When we need to use multiple parallel machines, we can set the communication address of the module according to the 6-bit dip switch. For example, address 1, the address dip of our 6-bit dip switch can be dialed up the low-6th dip, then 0001 is the address 1, according to the binary and so on to set the address.

Table3-4 Addr DIP switch Description

Communication Addr	DIP switch setting
1	0001
2	0010
3	0011

4	0100
5	0101
6	0110
7	0111
8	1000
15	1111

#### **M** NOTE

- When a single module is used, it is not recommended to change the first two communication matching resistance dip switches.
- When multiple module are paralleled, the DIP switch first bit of the first module and the last
  module must be dialed up and leave this DIP switch bit of the intermediate modules dialed down. If
  PCS and BMS need to do direct communication (match the BMS-CAN communication protocol),
  you should dial up the second resistor dial bit of the host PCS for communication.
- When multiple module are paralleled, there is a group distinction in the default settings of the module host.

Table3-5 Parallel group description

Number of parallel modules per group	Address group	Host serial number
2	(12), (34), (56), (78)	1,3,5,7
3	(123), (456), (789)	1,5,7
4	(1234), (5678)	1,5
5 or more	1+ any address bits	The default is 1 for all

When multiple module are paralleled, please set the dip switch of the modules according to above default address group, otherwise, the parallel modules will not be able to communicate.

	M NOTE	

# 4 Transportation, Storage, and Handling

# **4.1** Transportation and storage

Pay attention to the marks on the carton when transporting and storing the converter. The transportation and storage process should meet the following requirements:

- Do not remove the converter's outer package;
- There is no corrosive gas around;
- The storage temperature is maintained at -45°C~70°C, and the relative humidity is maintained at 0%RH~95%RH;
- Non-dusty environment;
- Maximum yard pile 3 layers;
- Regular inspections are required during storage, and packaging materials need to be replaced in a timely
  manner if insect and rodent bites are found;
- Meet fire protection requirements;
- If the storage time is more than half a year, the converter needs to be checked and tested by professionals before it can be put into use.

#### **ACAUTION**

- Please avoid transporting the PCS in rain or bad weather. If it cannot be avoided, please take necessary protective measures.
- After long-term storage, it must be guaranteed to be powered on once within half a year for at least

6 hours. The input voltage must be slowly raised to the rated value with a voltage regulator.

The graphic description of the packaging label is shown in the following table.

Table4-1 Package identification

Icons	Descriptions		
+	Center of gravity identifier, indicating where the center of gravity of the PCS is located		
ф ģ	Hoisting identifier, indicating the chain or rope position when hoisting the PCS		
<u>11</u>	The upward identifier indicates the way of placing the PCS when transporting and placing it. It is strictly prohibited to place it upside down, sideways or tilted.		
I	Lightly place identifier, indicates that transportation and placement should be done in such a way as to avoid severe friction or impact.		
T	Moisture resistant identifier, the PCS should be protected from rain or moisture during transportation and storage.		

# 4.2 Unpack

Table4-2 Conventional lists of accompanying materials

Name	Instructions	Quantity	Pictures
PCS module	105kW (or corresponding specification)	N	

Factory test report	List of factory test items	1	### 10.00 #### 10.00 ###################
Certificate of conformity	Certificate of conformity of the product	1	### ### ### ### ### ### ### ### #######
DB26 Communication cable	The default length is 1.5m	N	
Debugging tools	Blue cable + Yellow cable + communication board +220V power cable	1	101

Table4-3 Non-conventional lists of accompanying materials

Names	Instructions	Quantity	Pictures
Parallel cable	For parallel communication of PCS modules	According to the quantity of parallel modules	
N-wire screw	3P3W, N wire is nylon screw, prepare 1 power screw	According to the number of modules shipped	Qi-
Aviation terminal connectors	One PCS with a pair of yellow and black connectors		

#### **4.2.2** Unpacking Procedure

Unpacking steps:

- 1. Remove all ties and uncover the box.
- 2. Remove all filler material.
- 3. Remove the module and accessories.
- 4. Cut the plastic wrap around the module.
- 5. Ensure there is no evidence of damage.
- 6. Dispose of or recycle packaging according to local regulations.

#### **CAUTION**

Check whether the dustproof film on the air duct is damaged. If it is not damaged, tear the film off the air duct. If it is damaged, check whether there is foreign matter entering the module.

#### NOTICE

For orders requiring three-phase three-wire system, our company will replace the N wire with white nylon screw (metal screw delivered with the attachment) when shipping. If you need to change to the three-phase four-wire system, please contact our company.

#### **4.2.3** Open box inspection

Each module has undergone strict factory inspection and testing. In order to prevent damage during transportation, an unpacking inspection is required before the PCS is ready for installation. The main inspection contents are as follows:

- Check whether the quantity of each item in the packing list is consistent with the physical object;
- Check whether the product nameplate data is consistent with the order contract, such as product model, rated capacity, voltage level, etc.;
- Check whether the factory documents and accessories are complete;
- Check whether the PCS is deformed, paint off;

Check each received item against the supply sheet. If the goods are missing or damaged, notify the shipping company as soon as they are found.

# 4.3 Handling

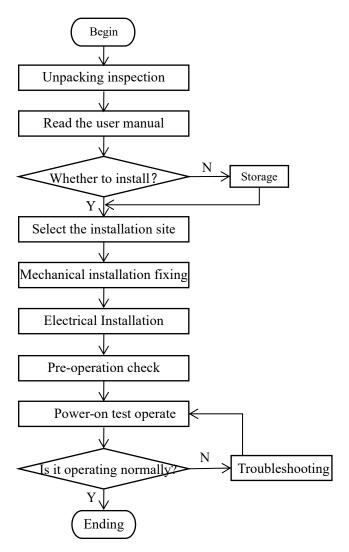
#### **ACAUTION**

- Test fork, if not fit to adjust the foot of the forklift. After the test fork is suitable, the fork will start the PCS and move it to the appropriate position.
- In the process of transporting the converter fluctuation height as low as possible.
- Do not carry the forklift for a long distance or walk on a slope, otherwise it may damage the forklift.
- Handle the forklift gently to avoid impact or vibration. When the forklift is descending, it is necessary to take care not to press the foot.
- When moving, pay attention to the level of the ground.

Adjust the width of the forklift foot so that the center of gravity is in the center of the forklift foot. If the package has been removed, it is necessary to fork into the same position of the converter.

# Mechanical installation

Figure 5-1 Installation flowchart



# **5.1** Installation tool requirements

Table5-1 Install required tools

Tools				
Forklift	Torque wrench	Screwdriver		
	<b>7</b>			
Indoor and outdoor handling equipment	Fix screws	Phillips screwdriver M6 screws, used to secure the module in the cabinet		



The above table only lists the general tools, the field technician please add or subtract according to the situation.

# **5.2** Requirements for Installation Environment

#### **DANGER**

- The PCS must be installed in a place that is shielded from sunlight.
- The PCS should be installed in a place with good ventilation to prevent poor heat dissipation from affecting its working performance.
- When the PCS is operating, the temperature on the surface of the machine is high. Please be sure to install it in a position that is not easy to touch.
- The PCS must be kept away from children and special people.
- The PCS should be installed away from flammable and explosive materials and free from strong electric interference devices.

- The installation frame or wall of the PCS should have certain fire resistance.
- The PCS should be avoided in the vicinity of office areas or living places that are relatively sensitive to noise.

In order to ensure the life safety of the installation personnel, necessary safety protection measures must be taken during the electrical installation of this product. During electrical installation, the following procedures must be followed:

- All power supplies connected to the PCS must be disconnected to ensure that the PCS is in a no-power state.
- A warning sign must be placed on the disconnected position in case it is re-powered during installation.
- Make the necessary ground connections.
- Live parts need to be treated as necessary and isolated with insulation materials to avoid injury to personnel.
- Only professional personnel can install the PCS. Strictly follow the instructions in the manual during installation.
- The installation personnel must comply with the relevant electrical operation regulations of the country or region where they are located.
- The installation personnel must know the voltage level of the power supply area and determine the voltage adaptation.

Table 5-2 Environmental Requirements

Items	Environmental requirements		
Installation site requirements	This product is a cabinet installation product that needs to be installed in the final system		
Altitude	4000m, if more than 2000m need to drop capacity to use		
Temperature	-30 °C ~ +55 °C, > 45°C derated use		
Humidity	0%RH to 95%RH, non-condensing		
Dust conditions	In a high dust environment, it is necessary to add a dust filter device according to the site situation		
Corrosion conditions	Strong acid, strong alkali and strong salt areas need to make special remarks according to the site situation		

# **5.3** Installation steps

#### **Background Information**

#### NOTICE

The converter module is designed for rack mounting, it is fixed on the cabinet mounting columns through the front mounting ears on both sides (see Figure 5-2). During installation, two people should work together to hold up the converter, push the converter into the cabinet guide rail for smooth placement, and strengthen the connection stability between the cabinet and the module through the back fastener.

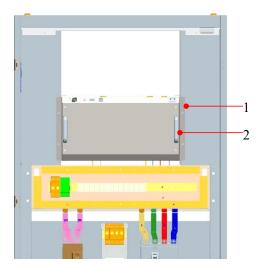
#### **Procedure**

 Hole the cabinet (Front left and right fixed lugs with φ8\*11mm mounting holes, upper and lower mounting hole spacing: 125mm).

#### **ACAUTION**

- The fixing screws do not exceed the specifications of the mounting holes. Pay attention to the hole spacing when drilling holes in the cabinet, as shown in point 1 in the following figure.
- Note that this handle is only used for pulling and dragging the module during installation, and is not used for bearing weight, as shown in point 2 in the following figure

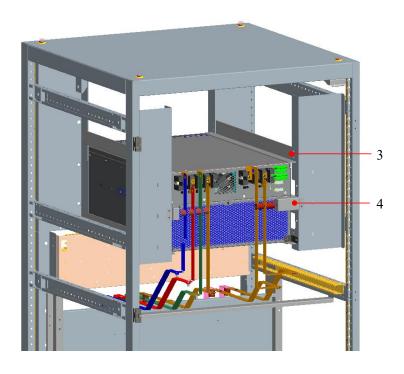
Figure 5-2 Drill holes for installation



- 2. Install a fixed guide rail: it is easy to push and pull the PCS module, so that the module is placed smoothly, as shown in point 3 of Figure 5-3. (Provided by the cabinet factory)
- 3. Install the back fastener: It is used for the connection and fixing of the back cabinet and the module to ensure that the module will not shake up and down in the cabinet (install one on the left and right side).

The recommended aperture of the fastener is 7.5\*10.5mm, as shown in point 4 in the following figure. (Provided by the cabinet factory)

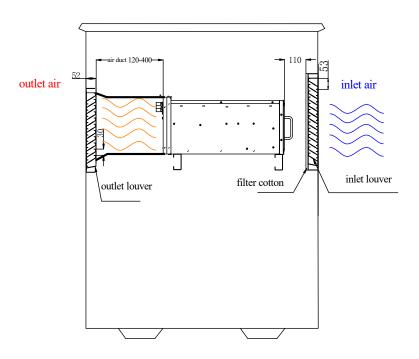
Figure 5-3 Drill holes for installation



# **5.4** Ventilation requirements

The cooling method of PCS module adopts forced air-cooling, and the module heat dissipation method is front air in and rear air out. In the integrated system, the inlet and outlet air of the cabinet must face the module, and the module air inlet distance from cabinet air inlet  $\ge 110$ mm. An air duct must be added to the outlet air of the module to directly send hot air to the outlet air of the cabinet to prevent hot air from backflowing in the cabinet.

Figure 5-4 Heat dissipation diagram



#### M NOTE

It is recommended that the filter cotton of the inlet and outlet louver be 40PPI dense-polyurethane mesh foam and flame retardant, and the louver of the outlet louver be 10-mesh insect-proof steel mesh.

If you do not add air ducts out of the air outlet, you can install a fan in the outlet exhaust, corresponding to the fan selection should be based on the actual effective air volume of 2 times the choice of fan (fan specifications on the nominal maximum air volume can not be achieved, the actual efficiency point is probably in the 0.5 times the maximum air volume).

Table 5-3 Ventilation parameters of PCS in cabinet

Model number	Actual effective airvolume of the module		Actual effective airintake area of	Actual effective airoutlet area of	
	(CFM)	(m³/min)	thecabinet (m²)	thecabinet (m²)	
ECS105-LB-F-SK	556	15.75	0.06	0.072	

#### **M** NOTE

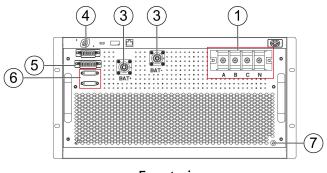
- The Actual effective air intake area of the cabinet and Actual effective air outlet area of the cabinet in the table above refers to the area of the cabinet through holes;
- The parameters in the table above apply only to a single PCS module, and the heat dissipation of other components in the cabinet is not taken into account.

# 6 Electrical installation

# **6.1** Wiring port instructions

# **6.1.1** Port definition

Figure6-1Front-maintenance module terminal (DC side aviation terminal)



Front view

Table6-1 Wiring terminal Description

Number	Description	Instructions
1	AC wiring terminal, M8 crimping terminal is recommended.	The pitch between each terminal is 23mm
2	DC wiring terminal: BAT- connects to the negative terminal of the battery, BAT+ connects to the positive terminal of the battery. M8*12 is recommended.	The pitch between each terminal is 23mm
3	DC aviation terminal: BAT- connects to the negative terminal of the battery, BAT+ connects to the positive terminal of the battery. BAT-, BAT+ support conductor cross-section: 50mm²-70mm²	Rated voltage: 1500V, rated current: 250A
4	Grid current sampling interface	Reserve interface, refer to Figure 6-3
5	Grid voltage sampling interface	Reserve interface, refer to Figure 6-3
6	26pin COM Signal port	
7	Protective earth terminal. M6 crimping terminal is recommended.	

# **6.1.2** Sampling interface

The sampling ports are reserved. It is not enabled and does not need to be connected.

Figure6-2 Grid voltage and current sampling interface

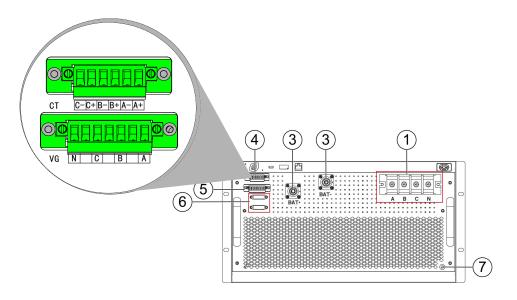


Table6-2 Terminal description

Name	Terminal symbol	Terminal function Description
	A +	Connect to the S1 terminal of the A-phase CT
	A -	Connect to the S2 terminal of the A-phase CT
Grid current sampling interface	B +	Connect to the S1 terminal of the B-phase CT
(CT)	В-	Connect to the S2 terminal of the B-phase CT
	C +	Connect to the S1 terminal of the C-phase CT
	C -	Connect to the S2 terminal of the C-phase CT
	A	A-phase grid voltage sampling input
	NA	Do not connect
Grid voltage	В	B-phase grid voltage sampling input
sampling interface	NB	Do not connect
(VG)	С	C-phase grid voltage sampling input
	NC	Do not connect
	N	N-phase grid voltage sampling input

# **6.1.3** Signal port

Figure6-3 COM interface pins

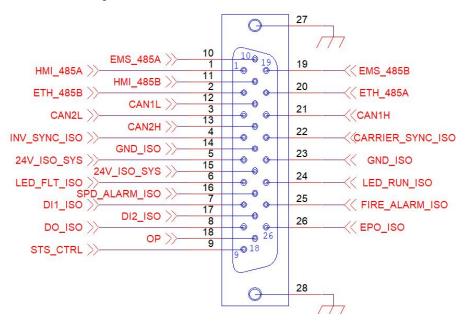


Table6-3 COM interface - RS485 & CAN pin definition

Signal name	Name	Pin number	Function Description
EMS 495 signal	EMS_485A	10	This 485 signal is used for external signal interface
EMS_485 signal	EMS_485B	19	- EMS, host computer, etc
HMI_485A 1	Hard Comment ID March and a		
HMI_485 signal	HMI_485B	11	Used for external HMI touch screen
Reserved 485	ETH_485A	20	
bits	ETH_485B	2	Reserved 485 Communication (no signal yet)
Parallel -CAN	CAN1L	12	Parallel CAN communication (for CAN
signal	CAN1H	21	communication with devices such as STS/PCS)
BMS-CAN signal	CAN2L	3	BMS-CAN communication (for external BMS
	CAN2H	13	communication)

Table6-4 COM interface- Digital signal pins definition

Signal name	Wire post	Pin number
Internal power frequency synchronization signal	INV_SYNC_ISO	4
Internal carrier synchronization signal	CARRIER_SYNC_ISO	22
Common signal terminal 1	GND_ISO1	14
Common signal terminal 2	GND_ISO2	23
DC24V+ output signal 1	24V_ISO_SYS1	5
DC24V+ output signal 2	24V_ISO_SYS2	15
LED fault signal	LED_FLT_ISO	6
LED running signal	LED_RUN_ISO	24
Lightning protection input signal	SPD_ALARM_ISO	16
Fire alarm input signal	FIRE_ALARM_ISO	25
DI1 digital input signal (BMS to PCS failure shutdown alarm)	DI1_ISO	7
DI2 Digital input signal (reserved)	DI2_ISO	17
DO1 Digital output (reserved)	DO_ISO	8
EPO (Emergency stop) input	EPO_ISO	26
24V+/GND type select signal	OP	18
DO Digital Output	GND_ISO4	9

# **6.2** Electrical wiring preparation tool

Table6-5 Wiring tool List

Tools and meters			
Multimeter	Torque wrench	Crimping pliers	
	<b>1</b>		
Measure the live status of the measuring equipment	Connect the power wire, torque 13N·m	For power cable crimping	
Screwdriver	Wire strippers	Heat gun (or heat outlet fan), heat shrink sleeve	
Phillips screwdriver ×2, for M6 and M8 screws	Used to make power cables	Wrap the conductive part of the power cable to avoid leakage	

# **M** NOTE

The above table only lists the general tools used for installation and wiring, other professional tools field technicians please add or subtract according to the situation.

# **6.3** Preparing Power Cables

When configuring cables, select and match them according to the following specifications.

Table6-6 Cable Configuration Specifications

Cablelocation	Max. voltage& current	Cablerecommended	Cableterminalselection	Remarks
DC side(positive andnegative)	Voltage: 1000VCurrent: 170A	Unipolar:50mm² x 1	GTNR50-8	The cable and terminalare provided
AC side(A, B, C, N)	Voltage: 440VCurrent: 167A	ingle phase:50mm² x 1	GTNR50-8	by theuser.

### **M** NOTE

- The above table is recommended for PVC insulated copper cables at 70°C. If other types of cables are used, refer to local cable wiring regulations, the specific application environment (such as temperature and physical support media), and IEC62109-1/IEC62477-1 requirements.
- The terminal selection must be compatible with the cable. The selection in the table corresponds to the recommended cable, if the recommended cable is not used, the user needs to choose another suitable terminal.

Table6-7 Screw configuration Specifications

Mounting position	Screw type	Torque (kgf·cm)
Power terminals	M8	130
Set screws	M6	60
Ground screws	M6	60

# **6.4** Requirements for wiring of DC aviation terminals

### **A** DANGER

- Cable terminals may fall off if they are not tightly crimped.
- There is a risk of falling off if the aviation terminal assembly is not properly assembled.
- Aviation terminal cables may fall off if they are not securely inserted into the cabinet.
- 1. Strip the cable insulation according to the specified length requirements.

Figure6-4 Strip the cable insulation

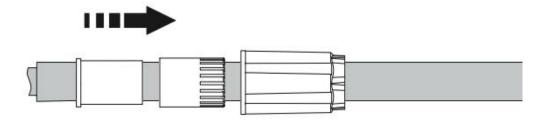


Table6-8 Stripping length requirements

mm <sup>2</sup>	a	AWG	a
35mm <sup>2</sup>	19mm~21mm	AWG 2	19mm~21mm
50mm <sup>2</sup>	19mm~21mm	AWG 1/0	19mm~21mm
70mm <sup>2</sup>	19mm~21mm	AWG 2/0	19mm~21mm

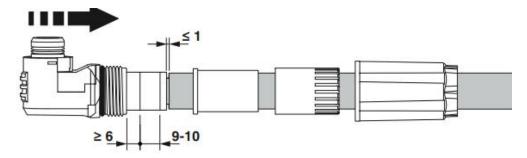
2. Prepare the aviation terminal, disassemble it and put it into the cable layer by layer.

Figure 6-5 Put the aviation terminals into the cable



3. Insert the copper core part of the cable into the aviation jack and press tightly;

Figure 6-6 Insert the copper part of the cable into the aviation jack



### **M** NOTE

- A distance of at least 6mm or more should be left between the edge of the crimping position and the plastic wall of the plug after stripping;
- The recommended width of the crimping area is about 9~10mm;
- The distance between the outer jacket of the cable and the edge of the copper tube of the plug should be less than or equal to 1mm;
- It is recommended to use a hexagonal internal retractable fixture with a hexagonal crimp, and the corresponding crimp height **b** of the relevant cable is shown in the figure below;
- In the case that the pulling force, temperature rise and contact resistance meet the requirements and the section metallurgy has no broken wire, you can also evaluate the relevant crimping parameters by yourself if there is a mature crimping process.

Figure6-7 Crimp height schematic

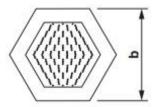


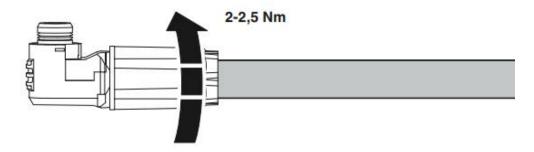
Table6-8 Crimp height requirement

mm <sup>2</sup>	b	AWG	b
35mm <sup>2</sup>	$8 \mathrm{mm}^{\pm 0.2}$	AWG 2	$8 \mathrm{mm}^{\pm 0.2}$
50mm <sup>2</sup>	$9.2 \text{mm}^{\pm 0.25}$	AWG 1/0	10mm <sup>±0.25</sup>
70mm <sup>2</sup>	10.8mm <sup>±0.25</sup>	AWG 2/0	10.65mm <sup>±0.25</sup>

#### 4. Reassemble the aviation terminals;

The plug shell mounting torque is recommended to be  $2\sim2.5$ N·m;

Figure 6-8 Assemble the aviation terminals



5. Insert the fabricated cable into the terminal sockets on the module chassis, with the positive aerial terminal (orange) connected to the positive connector "+" and the negative aerial terminal (black) connected to the negative connector "-", and make sure to lock it.

# **6.5** DC side wiring

### **A** DANGER

- The battery voltage must not be greater than the maximum DC voltage of the converter 950V. Otherwise, the device may be damaged.
- If a ground fault exists, rectify the fault before connecting cables.
- An incorrect wiring sequence may cause a fire.
- The cables should be securely secured, otherwise they may cause a fire.
- Wrong wiring can cause the converter to not work properly and may burn the device.
- 1. Measure the port voltage of the battery with a measuring tool to ensure that its voltage is within the input voltage range of the PCS;
- 2. Disconnect the previous level of DC switch;
- 3. Use a multimeter to measure and confirm that the connected terminal is not live;
- 4. Strip the DC cable to a suitable length with a tool, put the terminal over it and press it tightly with the tool;
- 5. Connect the positive and negative cables of the battery pack to BAT+ and BAT- on the DC terminal block. The DC connection is complete.

# **6.6** AC side wiring

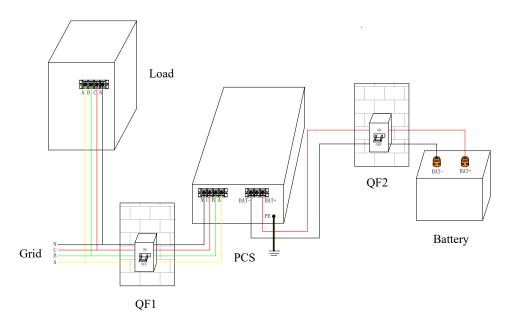
### **A** DANGER

- The wrong voltage has the potential to damage the PCS.
- Incorrect wiring sequence will cause poor contact and may cause a fire.
- The cables must be securely fastened; otherwise, a fire may occur.
- The wrong phase sequence can cause the PCS to work improperly.
- 1. Measure with a phase sequence table to ensure that the phase sequence of the connected cable is positive;
- 2. Disconnect the previous level of AC switch;
- 3. Use a multimeter to measure and confirm that the connected terminal is not live;
- 4. Use a tool to strip the AC cable to the appropriate length, cover the terminal and press it tightly;
- 5. The AC cable should be connected to the AC terminal block: "A", "B", "C", "N". The AC cable is connected to the AC side.

# **6.7** Power cable wiring

The following figure shows one connection method of PCS power cables. For reference only, the ground cable must be connected with yellow and green cables.

Figure6-10 Power cable connection for reference

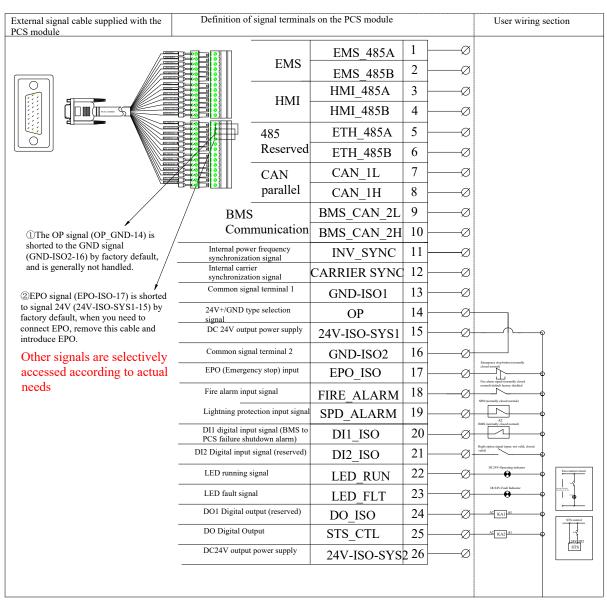


# **6.8** Communication cable wiring

# **6.8.1** Signal port wiring

The signal port on the back of ECS105-LB-F-SK module has multiple signals (see Table 6-3 and Table 6-4 for the description of signal ports). Our company provides a DB26 signal cable for the signal port as standard, which leads the required signal pins to one end of the XT terminal block, and the other end of the XT terminal block connects to the XT terminal according to the corresponding wire number, and then connects to the EMS, BMS and other devices.

Figure6-11 COM interface DB26 connection cable diagram



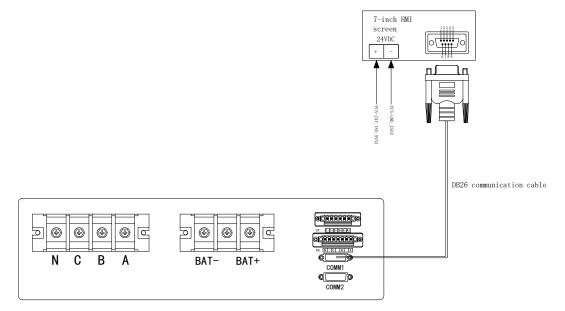
### NOTICE

Our factory equipment EPO function is enabled open state. If you need to shield the EPO function, please note it before ordering. The tester will turn off the EPO function when leaving the factory. If the EPO fault is reported because the EPO emergency stop circuit is not connected on site, refer to the above scheme to short-circuit and cancel the EPO fault alarm.

# **6.8.2** Single converter communication wiring

The converter signal port (COM) external signal cable (see Figure 6-11) can be led out to the terminal block (all signals do not need to be led out to the terminal block, connect corresponding signals as required, and refer to Table 6-4 for pin signals), and connect to the EMS/HMI controller through secondary cables.

Figure6-12 Single module communication wiring (DB26 to DB9)



| T inch IMI screen | T in

DB26 communication cable

Figure6-13 Single module communication wiring (DB26 to the secondary wire)

⊕ [⊆

BAT+

**(+)** 

BAT-

**(4)** 

9

**(b) (d)** 

# **6.8.3** Multiple converters communication wiring

Figure6-14 Multi-module communication wiring diagram (DB26 to DB9)

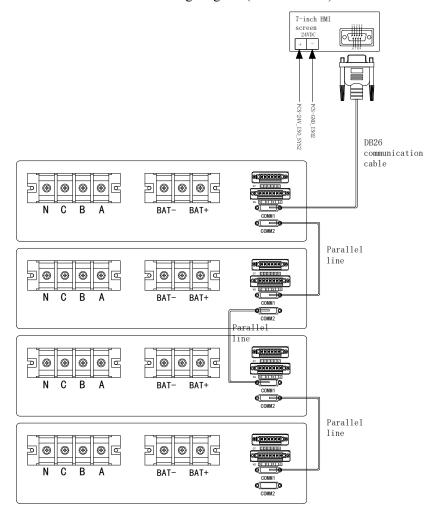
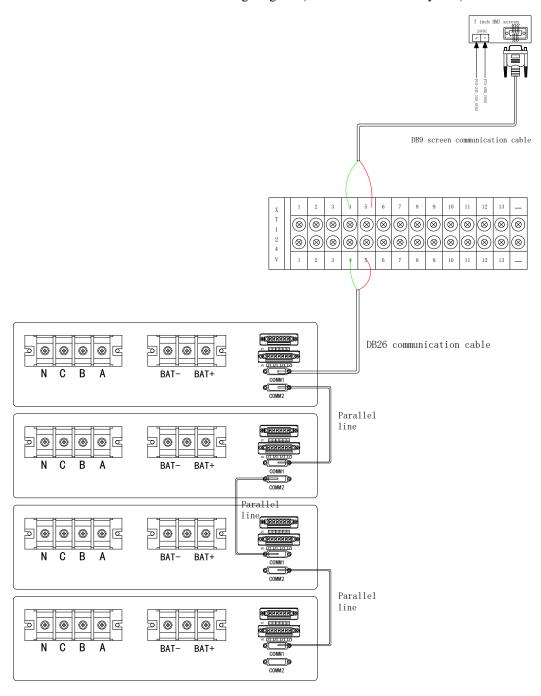


Figure6-15 Multi-module communication wiring diagram (DB26 to the secondary line)



### NOTICE

We provides DB26 terminal parallel line length 800mm, signal transfer line length 1500mm, if you need to customize other lengths, please note when ordering! When multiple converters paralleled at the same time, different communication addresses must be set in order to distinguish each machine. For the communication address settings, refer to Table 3-4.

# **6.9** Communications

This converter supports Modbus protocol and RS485/CAN communication mode, which is convenient for users to monitor the energy storage device system in the background, and realize the remote communication, telemetry and remote adjustment of the energy storage system.

### **6.9.1** Communication with EMS

The BMS-485 signal from the converter COM interface can be used for EMS communication. As the energy management dispatching unit of the energy storage system, EMS accepts the remote dispatch of the grid, and receives the battery information reported by the BMS. It completes the automatic charge and discharge control of the energy storage system by controlling PCS and realizes the corresponding protection measures.

### **6.9.2** Communicate with BMS

The converter can support communication with the BMS to obtain and detect the basic status and protection information of the battery pack reported by the BMS, and shut down the converter according to the fault protection status information of the battery. That is, another level of protection is added to the original safety logic to improve the safety of the battery pack.

Usually the converter does not communicate directly with the BMS.

### M NOTE

If PCS is required to communicate directly with BMS, customized CAN protocol and high voltage box of BMS are required.

# **6.10** Post-installation inspection

After installation, in order to avoid equipment damage and property loss, the following items must be inspected and measured again:

Table6-10 Equipment inspection items

Serial number	Check items	Condition
1	The equipment must be placed and installed in a proper position to meet load-bearing and environmental requirements.	o

2	The power line is correctly connected, the ground wire is well connected to the grounding network, and the construction unit is required to detect the grounding resistance value.	•
3	Check whether the main line is connected incorrectly/the line sequence is reversed, and determine whether the difference will affect the safe operation of the energy storage system.	•
4	Make sure that all communication lines are correctly connected and that there are no breaks or short circuits in the connection.	•

Table6-11 Check items before power-on

Items	Check the scheme	Situation
Check the AC side	Disconnect the DC circuit breaker QF2; Close AC circuit breaker QF1; Use a multimeter AC voltage mode to measure the voltage between AC terminal "A", "B", "C", "N", if it is a three-phase three-wire connection, the detected voltage between "AB", "BC", "CA" should be 400/380V; If it is a three-phase four-wire connection, the voltage between the detected "AN", "BN" and "CN" should be 230/220V; If the measurement deviation is large, please disconnect the AC circuit breaker QF1 and re-check the AC side wiring.	•
Check the DC side	Disconnect AC circuit breaker QF1; Close DC circuit breaker QF2; Use a multimeter in DC voltage mode to measure the voltage between the DC terminals "BAT+" and "BAT-" of the PCS. If the voltage is consistent with the battery voltage and within the correct voltage range, the cables are correctly connected. Otherwise, disconnect the DC circuit breaker QF2 and check the cables to the DC side.	•

# First power-on and operation

# **7.1** Power-on and off operation

# **7.1.1** Power on steps

After checking correctly before powering on, the converter can be powered on. The steps are as follows:

- 1. Provide power supply: close the AC (or DC) circuit breaker and the power indicator of the device lights up;
- 2. Set the power mode: set the converter working mode according to the need, and the device running indicator lights up.

### **A** DANGER

- If you need to turn off the system, turn off the PCS and then disconnect the AC/DC circuit breaker;
- Do not operate the device until the electrical lines to which the converter is connected have been disconnected for approx. 10 minutes (after the DC bus capacitance inside the module has been discharged);
- To prevent personal injury, if you want to maintain or open the chassis after powering off the
  module, use a multimeter to measure the voltage at the wiring terminals and ensure that all
  components inside the machine are not powered on before performing related operations.

# **7.1.2** Power off steps

The specific steps for normal shutdown are as follows:

- 1. The EMS issues the Stop command.
- 2. The converter stops running and automatically disconnects the internal AC and DC circuits.
- 3. If the converter is in external power supply mode, disconnect the external power supply.

### 7.1.3 The HMI controls the on and off of the PCS

The converter can be configured with an HMI controller to control the switching signal of the converter (HMI is optional - Recommended model: TPC-7032kx). For HMI instructions, refer to the PCS Man-machine Operation Interface Guide.

### 7.1.4 The EMS controls the on and off of the PCS

The PCS can be configured with EMS (energy management system) to match the communication protocol of our company's PCS to control the switching signal (our company provides external communication protocol text).

### **7.1.5** Emergency shutdown steps

In the event of an emergency, follow these steps:

- 1. Pressing the emergency stop button triggers the EPO alarm, the PCS shuts down, and automatically disconnects the AC and DC circuits inside the PCS.
- 2. If the PCS is in external power supply mode, disconnect the external power supply.

# 7.2 Fault diagnosis

PCS has perfect protection function and warning information, once the fault can be read through EMS related fault information. Before seeking service, users can self-check according to the prompts in the following table to analyze the cause of the fault and find out the solution. In the self-check, please do not disassemble the machine parts, if you can not solve the problem, please contact the agent or directly with our company.

### NOTICE

### Troubleshooting level Meaning:

- Fault: indicates that the PCS, grid, battery and other external conditions are abnormal, and automatically stops. Personnel need to troubleshoot the exception in time.
- Alarm: indicates that the PCS, grid, battery and other external conditions are abnormal, without stopping. Personnel need to troubleshoot the exception in time.

The fault reset mode is divided into automatic reset and manual reset.

- Automatic reset mode means that after a fault occurs, the system clears the fault at a certain interval. If the fault condition is eliminated, the system exits the fault state. If the fault condition still exists, the fault is reported again. The number of automatic reset times can be set by the function code. When the number of automatic reset times is used up, the fault will no longer be automatically reset until the user manually resets the system. The number of automatic reset times of the fault can be reloaded.
- Manual reset mode means that after the cause of the fault is eliminated, need to click reset, the PCS can resume work.

Table7-1 Equipment Check Items

ID	Fault name	Trigger mechanism	Troubleshooting
0	EPO signal	Detect Circuit Open	<ol> <li>Check the circuit</li> <li>Can be shielded if not used</li> </ol>
1	IGBT OCP fault	OCP overcurrent protection	The voltage value is set incorrectly and exceeds the maximum voltage of the predetermined value      The circuit in the power supply may fail, causing the output voltage to exceed a predetermined value
2	Overvoltage of the bus hardware	The bus voltage exceeds the protection point set by the system hardware	<ol> <li>Confirm whether there is a fault in the system causing the bus overvoltage</li> <li>Check whether the bus sampling line is correctly and reliably connected.</li> </ol>
3	Bus hardware overcurrent	The bus current exceeds the protection point set by the system hardware	<ol> <li>Confirm whether there is a fault in the system causing the bus overcurrent</li> <li>Check whether the bus sampling line is correctly and reliably connected.</li> </ol>
4	IGBT hardware	IGBT hardware Vce	Check to see if the red LED on the

	overcurrent	protection	corresponding driver board is lit. The solution of the red diode lighting is:  1. Check whether the polarity of the line between the detection board and the driver board is correct, and whether it is loose replace or secure the line tightly;  2. Check whether the drive line between the grid side power module driver board and IGBT is loose secure the drive line;  3. Check the appearance of the drive board to see if there are traces of damage, and confirm whether the drive board is damaged replace the drive board;  4. Check whether the IGBT module is damaged replace the damaged IGBT module.  The solution of the red light-emitting diode is not lit is:  it is caused by interference, check whether the system is well grounded;  Whether the connection between the
			control board and the detection board is well connected.
			Confirm whether there is a fault in the system causing the system to overcurrent;
5	Balance module hardware overcurrent	The balance module hardware exceeds the protection point set by the system hardware	2. Check whether the polarity of the current sampling line on the grid side is correct and reliably connected replace or secure the sampling line tightly;
			3. Check whether the detection board is working normally replace the detection board.
17	24V power fault	The DSP24V power	Check for power failure

		supply is abnormal	
18	Fan fault	The fan is abnormal	Check for blocked or non-rotating fans
19	Board connection failure	The cable between the internal driver board and the control board is abnormal	Check the connection cable
23	Lightning fault protector	Detect Circuit Open	<ol> <li>Check the circuit</li> <li>Can be shielded if not used</li> </ol>
25	The IGBT module is overheated	The IGBT module temperature is detected to exceed the system set point	<ol> <li>Confirm that the IGBT module is indeed overheating check that the fan is working properly;</li> <li>Check whether the grid side drive line is connected reliably - secure the drive line tightly;</li> <li>Check whether the grid side detection board is working properly replace the gird side detection board</li> </ol>
27	Positive and negative 15V power supply failure	The +15V of the auxiliary power supply is lower than +12V or the -15V of the auxiliary power supply is higher than -12V	<ol> <li>Check that the power supply to the signal processing board is out of range repair the power supply</li> <li>Check that the power cable between the auxiliary power supply board and the detection board is connected correctly and reliably</li> <li>Check that the cables from the control board to the detection board are loose secure the cables tightly</li> <li>Check that the detection board is working properly Replace the detection board</li> </ol>
28	Fire alarm failure	Detect Circuit Open	Check the circuit     Can be shielded if not used
29	The BMS dry contact is faulty	Detect Circuit Open	Check the circuit     Can be shielded if not used

33	Grid phase A voltage overvoltage (AB line voltage)	The grid AB line voltage exceeds the overvoltage point set by the system	<ol> <li>Determine if the grid is overvoltage - the system needs to shut down for protection when the grid is overvoltage;</li> <li>Determine if the grid overvoltage protection point is appropriate;</li> <li>Check whether the grid voltage detection line is loose or abnormal secure the detection line tightly.</li> </ol>
34	Grid phase B voltage overvoltage (BC line voltage)	The grid BC line voltage exceeds the overvoltage point set by the system	<ol> <li>Determine if the grid is overvoltage -         the system needs to shut down for         protection when the grid is         overvoltage;</li> <li>Determine if the grid overvoltage         protection point is appropriate;</li> <li>Check whether the grid voltage         detection line is loose or abnormal         secure the detection line tightly.</li> </ol>
35	Grid phase C voltage overvoltage (CA line voltage)	The grid CA line voltage exceeds the overvoltage point set by the system	<ol> <li>Determine if the grid is overvoltage - the system needs to shut down for protection when the grid is overvoltage;</li> <li>Determine if the grid overvoltage protection point is appropriate;</li> <li>Check whether the grid voltage detection line is loose or abnormal secure the detection line tightly.</li> </ol>
36	Grid phase A voltage undervoltage (AB line voltage)	The grid AB line voltage is below the undervoltage point set by the system	<ol> <li>Determine if the grid is undervoltage - the system needs to shut down for protection when the grid is undervoltage;</li> <li>Determine if the grid undervoltage protection point is appropriate;</li> <li>Check whether the grid voltage detection line is loose or abnormal secure the detection line tightly.</li> </ol>
37	Grid phase B	The grid BC line	Determine if the grid is undervoltage -

	voltage undervoltage (BC line voltage)	voltage is below the undervoltage point set by the system	the system needs to shut down for protection when the grid is undervoltage;  2. Determine if the grid undervoltage protection point is appropriate;  3. Check whether the grid voltage detection line is loose or abnormal secure the detection line tightly.
38	Grid phase C voltage undervoltage (CA line voltage)	The grid CA line voltage is below the undervoltage point set by the system	<ol> <li>Determine if the grid is undervoltage - the system needs to shut down for protection when the grid is undervoltage;</li> <li>Determine if the grid undervoltage protection point is appropriate;</li> <li>Check whether the grid voltage detection line is loose or abnormal secure the detection line tightly.</li> </ol>
39	Grid overfrequency	The grid frequency exceeds the overfrequency set by the system	<ol> <li>Determine whether the grid frequency is too high when the grid frequency is too high, the system stops and protects;</li> <li>Determine if the grid overfrequency protection point is appropriate.</li> </ol>
40	Grid underfrequency	The grid frequency is below the underfrequency set by the system	<ol> <li>Determine if the grid frequency is too low the system stops and protect when the grid frequency is too low;</li> <li>Determine if the grid underfrequency protection point is appropriate.</li> </ol>
41	Grid phase sequence error	The grid phase sequence is incorrect	<ol> <li>Determine whether the grid phase sequence is connected incorrectly adjust the grid input phase sequence to ABC after power failure;</li> <li>Check whether the grid voltage sampling line is connected incorrectly adjust the grid sampling line phase sequence to ABC after power failure.</li> </ol>
42	Grid phase A	Phase A overcurrent	Determine whether the grid phase A

	software overcurrent	occurs in the module when the system is operating	overcurrent occurs when the module overcurrent, the system needs to stop for maintenance;  2. Determine whether the overcurrent protection point is appropriate.	
43	Grid phase B software overcurrent	Phase B overcurrent occurs in the module when the system is operating	Determine whether the grid phase B overcurrent occurs when the module overcurrent, the system needs to stop for maintenance;      Determine whether the overcurrent protection point is appropriate.	
44	Grid phase C software overcurrent	Phase C overcurrent occurs in the module when the system is operating	Determine whether the grid phase C overcurrent occurs when the module overcurrent, the system needs to stop for maintenance;      Determine whether the overcurrent protection point is appropriate.	
45	The grid voltage is unbalanced	The three phases of the grid voltage are inconsistent		
46	Grid current imbalance	The grid current imbalance exceeds the protection point	Check that the grid current is normal     Check the protection point Settings	
47	Grid phase loss	No voltage on one phase of the grid	Check that the grid voltage is normal	
48	N-wire overcurrent	The N-wire current exceeds the protection value	Check that the wire system is correct	
49	Precharge bus overvoltage	When the bus is charging, the bus voltage is too high	<ol> <li>Determine if the bus voltage is detected correctly see if the detected value is consistent with the real bus voltage;</li> <li>Determine if the pre-charging contactor is working normally the pre-charging action can be tested in the single step debugging mode;</li> </ol>	

			3. Check that the precharge bus overvoltage point is set properly.
50	Precharge bus undervoltage	When the bus is charging, the bus voltage is too low	<ol> <li>Determine if the bus voltage is detected correctly see if the detected value is consistent with the real bus voltage;</li> <li>Determine if the pre-charging contactor is working normally the pre-charging action can be tested in the single step debugging mode;</li> <li>Check that the precharge bus undervoltage point is set properly.</li> </ol>
51	Uncontrolled rectifier bus overvoltage	During uncontrolled rectification, the bus voltage is too high	Determine whether the bus voltage detection is correct check whether the detection value is consistent with the real bus voltage;      Check whether the overvoltage point setting of the uncontrolled rectifier bus is appropriate
52	Uncontrolled rectifier bus undervoltage	During uncontrolled rectification, the bus voltage is too low	<ol> <li>Determine whether the bus voltage detection is correct check whether the detection value is consistent with the real bus voltage;</li> <li>Check whether the undervoltage point setting of the uncontrolled rectifier bus is appropriate</li> <li>Determine if the main contactor is working properly</li> </ol>
53	Modulation operation bus overvoltage	The bus voltage is too high during normal operation	Determine whether the bus voltage detection is correct - check whether the detection value is consistent with the real bus voltage;      Check that the bus overvoltage point setting is appropriate for normal operation
54	Modulation operation bus	The bus voltage is too low during normal	Determine whether the bus voltage detection is correct - check whether

	undervoltage	operation	the detection value is consistent with the real bus voltage;
			2. Check whether the undervoltage point setting of the uncontrolled rectifier bus is appropriate
			3. Determine if the main contactor is working properly
55	Positive and negative bus unbalanced fault	The difference between positive and negative busbars exceeds the protection value	Check that the protection value is correct
56	Battery voltage	No battery voltage was	1. Check the wiring
36	undervoltage	detected	2. Check BMS
57	Current mode bus undervoltage	The current mode bus voltage is below the protection value	Check that the configured parameter is correct
58	Battery voltage overvoltage	The battery voltage is detected to exceed the set maximum battery voltage	Check that the configured parameter is correct
59	DC pre-charge overcurrent	The DC precharge overcurrent exceeds the set value	Check that the configured parameter is correct
60	DC overcurrent	DC overcurrent exceeds the set value	Check that the configured parameter is correct
61	Balance module software overcurrent	Balance module software current exceeds the protection value	Check that the configured parameter is correct
64	Battery reverse connection	The positive and negative battery terminals are wrong	Check whether the positive and negative terminals are connected in reverse
65	Pre-charge timeout	When charging, the predetermined value is	Determine if the bus voltage detection is correct

		not reached in the specified time	2. Check that the pre-charge end voltage and timeout settings are appropriate
66	Pre-charge phase A overcurrent	The module overcurrent in the pre-charging phase	<ol> <li>Check that the pre-charge loop is properly wired</li> <li>Check that the current sampling loop is working properly</li> </ol>
67	Pre-charge phase B overcurrent	The module overcurrent in the pre-charging phase	<ol> <li>Check that the pre-charge loop is properly wired</li> <li>Check that the current sampling loop is working properly</li> </ol>
68	Pre-charge phase C overcurrent	The module overcurrent in the pre-charging phase	<ol> <li>Check that the pre-charge loop is properly wired</li> <li>Check that the current sampling loop is working properly</li> </ol>
69	AC capacitor overcurrent	Module overcurrent occurs when the system is operating	Verify that the overcurrent protection point is appropriate
70	AC capacitor overvoltage	Module overvoltage occurs when the system is operating	Verify that the overvoltage protection point is appropriate
81	Control board RAM failure	The control board RAM chip read/write error occurs	Replace the grid-side control board after confirming the problem.
82	Control board EEPROM failure	The control board EEPROM chip read/write error occurs	Restore the parameter to the default setting by curing the default parameter, and then clear the fault, if the fault can be cleared, then the EEPROM chip itself has no problem, the user only needs to set the parameter to a specific value again, otherwise the control board needs to be replaced.
83	Excessive AD Zero Drift	ADC analog sampling channel zero drift is too large	<ol> <li>Check whether the current sampling or voltage sampling line is loose secure the current and voltage detection line tightly;</li> <li>If the fault still cannot be eliminated -</li> </ol>

			replace the network side detection board
84	The background communication protocol fault	The communication protocol between DSPs does not match	Upgrade DSP firmware synchronously.
85	The CAN communication protocol fault	The communication protocol between CAN does not match	
86	The CPLD communication protocol fault	The version of the CPLD and DSP does not match	Upgrade the firmware of the CPLD and DSP synchronously.
92	BMS battery failure	BMS status	Check the BMS status
93	STS communication failure	STS signal is not monitored by the system	Check settings     Check the STS signal cable
94	BMS communication failure	BMS signal is not monitored by the system	Check settings     Check the BMS wiring
95	Slave CAN communication failure during parallel operation	No parallel signal detected by the system	<ol> <li>Check the parallel line signal</li> <li>It can be shielded when there is no parallel</li> </ol>
96	EMS communication failure	No EMS signal detected by the system	Check settings     Check EMS wiring
109	Thyristor short circuit failure	1. The SCR has received a shutdown command, and the PCS is shut down, however, the voltage difference between the input and output of the STS is small, and the phase voltage exceeds	Check the PCS on-grid parameters

		120V; 2. The SCR has received a shutdown command, but the STS detected large current;	
110	Thyristor open circuit failure	The SCR is on, but there is a large voltage difference between the input voltage and the output voltage of the STS	Check the PCS on-grid parameters.
111	Thyristor quick current check short circuit fault	Reserved	Reserved
113	Inverter voltage phase A overvoltage fault	Inverter voltage phase A voltage exceeds the set value	Check that the configured parameters are correct
114	Inverter voltage phase B overvoltage fault	Inverter voltage phase B voltage exceeds the set value	Check that the configured parameters are correct
115	Inverter voltage phase C overvoltage fault	Inverter voltage phase C voltage exceeds the set value	Check that the configured parameters are correct
118	System resonance failure	Filter capacitor current is greater than 35 A	Check the power quality of the grid, whether the harmonic content is too large, if the problem still cannot be located, please contact the after-sales service.
122	Inverter voltage phase A undervoltage fault	Inverter voltage phase A voltage is lower than the set value	Check that the configured parameters are correct
123	Inverter voltage phase B undervoltage fault	Inverter voltage phase B voltage is lower than the set value	Check that the configured parameters are correct

124	Inverter voltage phase C undervoltage fault	Inverter voltage phase C voltage is lower than the set value	Check that the configured parameters are correct

# 8 Maintenance and upkeep

### **8.1** Routine maintenance

Due to the influence of ambient temperature, humidity, dust and vibration, it will lead to the aging of the components inside the PCS, which may cause potential faults of the PCS or reduce the service life of the PCS. Therefore, it is necessary to carry out daily and regular maintenance work on the PCS.

### **A** DANGER

- The input and output of the PCS are strong electricity, and necessary safety precautions must be taken before maintenance begins.
- Before maintenance, ensure that both the DC and AC power supplies have been disconnected.
- The PCS has an energy storage capacitor inside. After powering off the PCS, wait for more than 10 minutes to ensure that the PCS is in no power state before performing maintenance.
- To avoid unexpected dangers, in the process of maintenance, the maintenance personnel should wear insulating protective equipment.
- Before performing maintenance, you must strictly follow the correct operating procedures.
- Only qualified personnel are allowed to maintain the PCS.
- After the power supply is disconnected, hang a warning sign at the disconnected place to prevent anyone from powering on the PCS during maintenance.

### **ACAUTION**

Pay attention to cleaning and corrosion prevention, in harsh environmental conditions should shorten the maintenance interval.

• More frequent maintenance may be required, depending on site conditions.

- If DC distribution components are susceptible to harsh environmental conditions, shorter maintenance intervals are recommended.
- Regular visual inspections are recommended to determine if maintenance is required.
- If the product is not used for a long time (more than 6 months), please contact our after-sales engineer if you need to use it.

# **8.2** Daily inspection items

Routine inspection items shall be carried out according to the following points:

Table8-1 Routine inspection items

Serial number	Daily inspection items	Confirmation
1	It is necessary to monitor the input, output voltage and current and operating status of the PCS in real time. Observe the PCS at a fixed point by a fixed number of people, and carry out maintenance in time when abnormal converter operation or abnormal voltage and current are found.	•
2	There is no abnormal sound in the PCS.	•
3	There is no odor in the PCS.	•
4	Read the internal temperature of the PCS and observe that the temperature is within the normal range.	0

# **8.3** Regular check items

Regular three-monthly inspections focus on daily inspections and areas that are difficult to inspect during daily operation.

Table8-2 Regular inspection items

Serial number	Routine check items	Confirmation
1	Check that the PCS is not damaged or rusty in appearance.	•
2	Use the temperature measuring instrument to detect the internal temperature of the PCS without abnormality.	•

3	Check that the ventilation, ambient temperature, humidity, dust and other environment around the PCS meet the requirements.	•
4	Check whether the cables are aged or damaged without layers. If the cables are damaged, add insulation measures or replace the cables.	0
5	Check that there are no signs of aging and burning on the wiring bolts, and shake them with your hand to confirm that they are tightened.	•

# 9 Addendum

### **Contract Statement**

The products, services or features you purchase shall be subject to the commercial contracts and terms of the company, and all or part of the products and service features described in this document may not be within the scope of your purchase. Unless otherwise agreed in the contract, the Company does not make any express or implied representations or warranties in the content of this manual.

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Use And Warranty Coverage Only Applicable To Mainland China.

# **Quality assurance**

If the product fails during the warranty period, our company will repair or replace it with a new product free of charge.

Evidence: During the warranty period, the company requires the customer to show the invoice and date of purchase of the product. At the same time, the trademark on the product should be clearly visible, otherwise the company has the right to deny the quality guarantee.

Replacement agreement: The unqualified products after replacement shall be dealt with by the company; The customer shall reserve a reasonable time for the company to repair the faulty products.

Liability exemption: The company reserves the right to void the warranty under the following conditions:

• The whole machine and parts have exceeded the free warranty period.

- Shipping damage.
- Incorrect installation, modification, or use.
- Operating in very harsh environments beyond those described in this manual.
- Failure or damage to equipment caused by installation, repair, alteration or disassembly not by our service personnel.
- Failure or damage to the equipment caused by the use of non-standard or non-purchased parts or software from our company.
- Any installation and use beyond the scope specified in the relevant international standards.
- Damage caused by abnormal natural environment.

Product failure caused by the above circumstances, the customer request for maintenance services, after the company's service department to determine, can provide paid maintenance services.

In order to continuously improve customer satisfaction, the company's products and user manuals are under continuous improvement and upgrading. If there is a difference between the user manual and the product in your hand, it may be due to the version. Please refer to the specific product. If you still have questions, please contact the company.