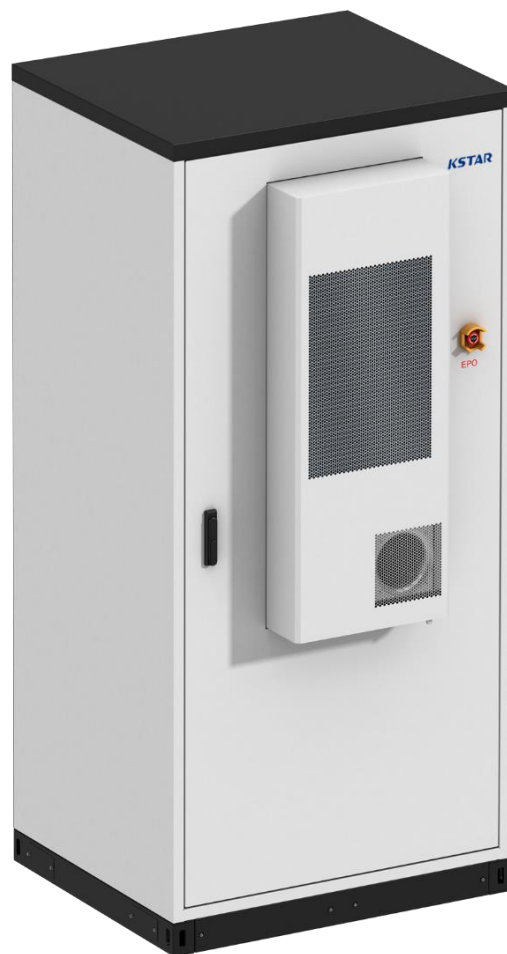


KSTAR

BC100DE Series Industrial Battery Cabinet User Manual and Commercial



Version V01 Release Date

Overview

This Manual introduces the main features, performance indicators, system principles, appearance and structure of the BC100DE industrial and commercial battery cabinet, and also provides instructions for installation, use and operation, maintenance management, etc.

Recipients

This document is primarily intended for the following engineers:

Sales Engineer

Technical Support Engineer

System Engineer





Hardware Installation Engineer

Commissioning Engineer

Maintenance Engineer

Meanings of symbols

The following symbols may appear in this document, and their meanings are as follows:

Symbol	Description
 DANGER	Indicates a hazard with a high level of risk which, if not avoided, will result in death or serious injury.
 WARNING	Indicates a hazard with a medium level of risk which, if not avoided, could result in death or serious injury.
 ATTENTION	Indicates a hazard with a low level of risk which, if not avoided, could result in minor or moderate injury.
I NOTIFY	Used to convey equipment or environmental safety warning information. If not avoided, it could result in equipment damage, data loss, equipment performance degradation, or other unpredictable outcomes. "NOTICE" does not cover personal injury.
 NOTE	Supplemental explanation of key information in the main text. "NOTE" is not a safety alert and does not address personal, equipment, or environmental hazards.

History of Revisions

Version	Revision date	Content	Number Document Internal
V00	February 16, 2023	First edition	/
V01	08/05/2023	Change parameter	/
V02	08/12/2023	Added average reload time and 2.1 EMS	/
V03	March 11, 2024	Edit figures 3-8, 3-10, 3-12	/

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1. General safety precautions

1.1 General safety

Declaration

Please read this manual before installing, operating, and maintaining the equipment and follow the directions on the equipment and all safety precautions in the manual.

The "Caution," "Warning," and "Danger" elements in this manual do not represent all safety regulations, but are merely supplements to all safety precautions. KSTAR assumes no liability arising from violations of general operational safety requirements or violations of safety standards for the design, manufacture, and use of equipment. This equipment must be used in an environment that meets the design specifications. Failure to do so may result in equipment failure, resulting in abnormal equipment operation or component damage, personal safety incidents, and property loss, which are beyond the scope of equipment quality assurance.

Comply with local laws, regulations, and standards when installing, operating, and maintaining this equipment. The safety precautions in this manual are only a supplement to local laws, regulations, and standards.

KSTAR is not responsible for any of the following situations.

- Failure to operate under the conditions of use described in this manual.
- The installation and use environment does not comply with the regulations in the relevant international or national standards.
- Unauthorized disassembly, modification of the product, or alteration of the software code.
- Failure to follow the operating instructions and safety warnings in the product and documentation.
- Equipment damage caused by abnormal natural environments (force majeure, such as earthquakes, fires, storms, etc.).
- Damage caused by transport carried out by the customer.
- Damage caused by storage conditions not in accordance with the documentation requirements.

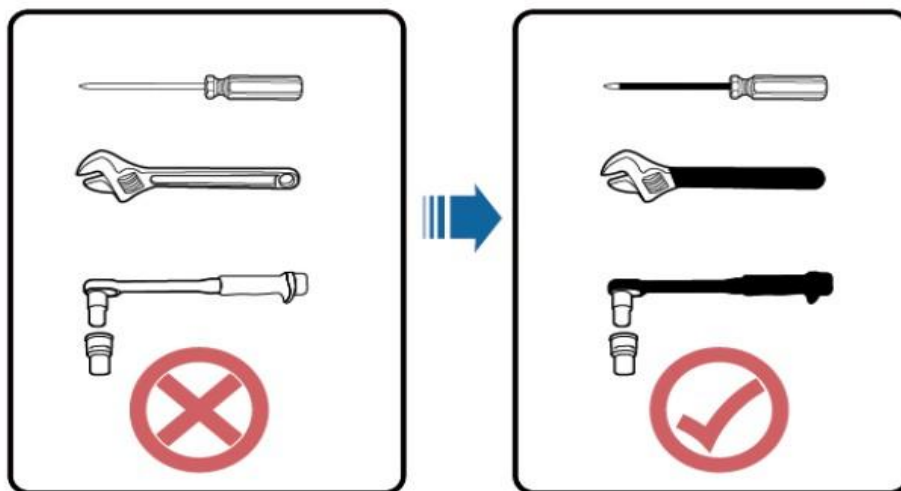
General Requirements

- It is strictly prohibited to install, use and operate external equipment and cables (including but not limited to moving equipment, operating equipment and cables, connecting/disconnecting externally connected signal interfaces, working at heights, outdoor installation, etc.) in adverse weather conditions such as lightning, rain, snow and wind of scale 6.
- Do not wear watches, bracelets, rings, necklaces or other conductive objects during installation, use and maintenance, to avoid electric shock.
- During installation, use and maintenance, protective equipment must be used. special, such as insulating gloves, protective glasses, safety clothing, helmet, safety shoes, etc., as shown in the following figure.

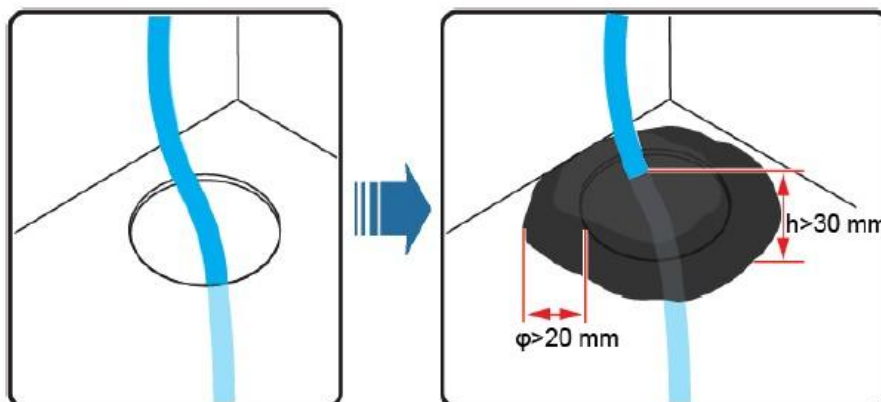


- Installation, operation and maintenance must be performed according to the sequence of steps in the instruction manual.
- Before touching any conductive surface or terminal, measure the voltage at the contact point to confirm that there is no risk of electric shock.

- After installing the equipment, remove any empty packaging materials in the equipment area, such as cardboard, foam, plastic, and cable ties.
- In case of fire, evacuate the building or equipment area and press the bell fire alarm or call the fire department. It is strictly forbidden to re-enter a burning building under any circumstances.
- Do not disable protective devices or ignore warnings, cautions, or precautions in manual and on the equipment. Promptly replace any warning signs that have become illegible due to prolonged use.
- With the exception of personnel operating the equipment, no one is permitted near the equipment.
- The handle of the tool used must be insulated and protected, or use an insulated tool, as shown in the following figure.



- Wiring holes with routed cables must be sealed with flame retardant mastic, and the wiring holes Non-routed wiring must be sealed with the cover provided with the cabinet. The correct construction standard for sealing with flame retardant mastic is shown in the following figure.



- It is strictly prohibited to alter, damage or cover the identification and nameplate on the equipment.

- Use tools to tighten the screws when installing the equipment.
- It is strictly prohibited to operate under current conditions during the installation process.
- Paint scratches that occur during transportation and installation of the equipment must be repaired promptly; it is strictly forbidden to expose the scratched parts to the external environment for a long period of time.
- Before operation, securely fix the equipment to the floor or other stable object, such as a wall or mounting bracket.
- Do not wash the electrical components inside and outside the cabinet with water.
- Do not change the structure and installation sequence of the equipment without authorization.

Personal safety

- If a fault is detected during operation of the equipment which could cause personal injury or equipment damage occurs, stop operation immediately, report to the person in charge and take effective protective measures.
- To avoid the risk of electric shock, it is prohibited to connect the safety extra low voltage (SELV) circuit to the telecommunications network voltage (TNV) circuit.
- Do not power the equipment until it is installed or confirmed by a professional.

1.2 Staff requirements

- Personnel responsible for the installation and maintenance of KSTAR equipment must first undergo rigorous training to understand safety precautions and master correct operating methods.
- Only qualified professionals or trained personnel are authorized to install, operate and maintain the equipment.
- Only qualified professionals are authorized to remove safety devices and repair the equipment.
- Personnel operating the equipment, including operators, trained personnel and professionals, Must possess special operating qualifications required by local government, such as high-voltage operation, climbing, and special equipment operation qualifications.
- Professionals: People who have experience in the formation or operation of equipment and who can clearly understand the potential sources and levels of hazards during the installation, operation and maintenance process of the equipment.
- Trained Personnel: A person who has received adequate technical training and has the necessary experience, may be aware of the dangers that may arise when performing a certain operation and can take measures to minimize the danger to himself or to other people.
- Operators: Operators who may come into contact with the equipment, except trained personnel and professionals.
- Replacement of equipment or components (including software) must be done by

1.3 Electrical safety

Grounding requirements

- When installing equipment that needs to be grounded, the ground wire
The protective earth wire must be installed first; when removing the equipment, the protective earth wire must be removed last.
- Do not damage the grounding conductor.
- Do not operate the equipment without an earth conductor installed.
- The equipment must be permanently connected to protective earth. Before using the equipment, check the electrical connection of the equipment to ensure that it is securely grounded.

General Requirements

- When performing high voltage operations, use special insulated tools.

Operating requirements for AC and DC



DANGER

It is prohibited to install or remove the power cord while it is energized. When the core of the power cord touches the conductor, an electric arc or spark is generated, which can cause fire or personal injury.

- If the equipment is marked "High Leakage Current", the ground terminal
The protective earth of the equipment case must be grounded before connecting the AC input power to prevent the equipment leakage current from causing electric shock to the human body.
- Before installing or removing the power cord, you must turn off the power switch.
- Before connecting the power cord, make sure the label on the power cord is correct.
- If the equipment has multiple inputs, all inputs must be disconnected and the equipment can only be used after it has been completely switched off.
- It is not recommended to configure an overhead switch with a leakage protection function.
- If the power cord is damaged, it must be replaced by the manufacturer, its service agent or similarly qualified persons in order to avoid a hazard.
- Personnel performing high-voltage operations and installing AC equipment must have qualifications in high-voltage and AC work.

Wiring requirements

- Using the cable in a high temperature environment may cause aging and Damage to the insulation layer. The distance between the cable and the outer edge of the heating device or heat source area must be at least 30 mm.

- It is not permitted to pass cables through the air inlet and outlet of the equipment.

- Cables must meet VW-1 flame retardancy requirements.

- Cables of the same type must be grouped together, and cables of different types must be laid at least 30 mm apart. Twisting or crossing cables is prohibited.

- When the temperature is too low, severe shock and vibration can cause brittleness and Breakage of the cable's plastic sheath. To ensure safety during construction, the following requirements must be met:
 - All cables must be laid and installed above 0°C. When moving cables, especially in low-temperature environments, they must be handled with care.

 - If the temperature of the cable storage environment is below 0°C, Cables must be stored at room temperature for more than 24 hours.

 - It is prohibited to push cables directly from the truck or perform other non-standard operations.

 - Cable selection, installation and routing must comply with local laws, regulations and specifications.

Static protection requirements

I NOTIFY

Static electricity generated by the human body will damage static-sensitive components on the board, such as large integrated circuits (LSIs).

- Static electricity generated by the human body will damage static-sensitive components on the board, such as large integrated circuits (LSIs). Before touching the equipment while holding a board or an ASIC (application-specific integrated circuit), you should wear ESD gloves or an ESD strap. The other end of the ESD strap must be properly grounded.

- When holding the board, you should grasp the edge of the board that does not contain components and do not touch the components with your hands.

- The disassembled board must be packaged in ESD packaging materials before storage or transportation.

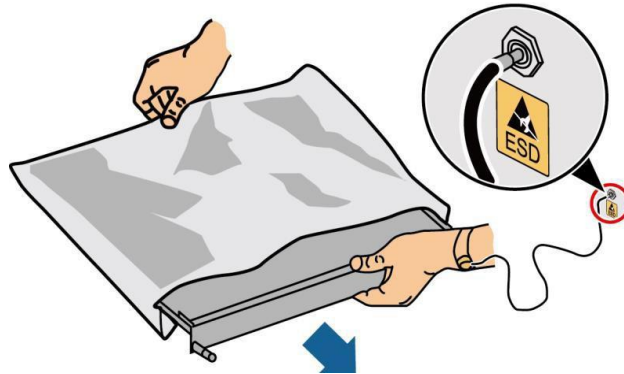


Fig. 1-1 ESD strap wearing diagram

Neutral-to-earth voltage

- It is recommended that the user balance the three-phase load so that the neutral-to-ground voltage is less than 2V and meets the power distribution requirements.

1.4 Installation environment requirements

- When the equipment is in operation, do not cover the air vents or heat dissipation system to prevent fire due to high temperature.
- The equipment must be installed in an area away from liquids; it is forbidden to install it under pipes water, air vents and other places prone to condensation, or under places prone to water leakage, such as air conditioning vents, air vents and outlet windows in the engine room, to prevent liquids from entering the equipment and causing malfunctions or short circuits.
- If liquid enters the equipment, turn off the power immediately and inform the administrator.
- Do not place the equipment in an environment with flammable or explosive gas or smoke, and do not perform operations in such an environment.
- The equipment must be installed away from desert or sandy environments.

High altitude installation

- Operations performed more than 2 meters above the ground are considered high-altitude operations.
- High altitude operations must be terminated in the event of any of the following situations: Rainwater on steel pipes is not drying, and other potentially hazardous situations. Once the above situation is resolved, the company's safety director and relevant technical personnel must inspect the operating equipment, and the operation can only be performed after confirmation and approval.
- High altitude operations must meet the requirements of local laws and regulations on high altitude operations.
- Personnel must receive relevant training and obtain relevant certificates before starting to work and perform operations at high altitude.
- Before high altitude operations, carefully check climbing tools and

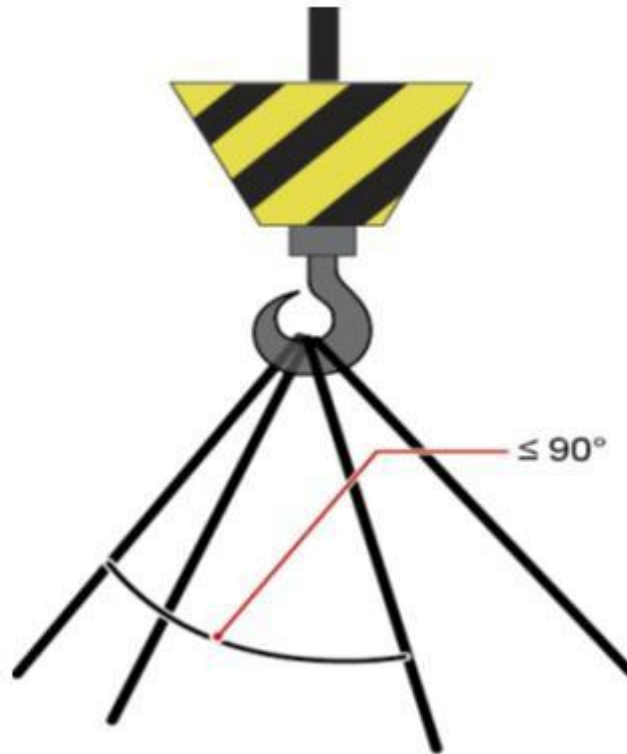
Safety equipment, such as safety helmets, safety belts, ladders, deck boards, scaffolding, lifting equipment, etc., must be used. Any non-compliance must be corrected immediately or high-altitude operations must be stopped. Take appropriate protective measures, wear a safety helmet, safety belt, or safety rope, and secure it to a solid structural element. Hanging from unstable objects or metals with sharp edges and corners is strictly prohibited to prevent the hook from slipping and causing a fall.

- At the high-altitude operation site, a danger area must be cordoned off and visible signs must be installed to prohibit access by unauthorized personnel.
- Carry equipment and operating tools properly to prevent them from falling and injuring others.
- Dropping objects from high altitudes to the ground or vice versa is strictly prohibited. Sturdy cables, suspended baskets, elevated vehicles, or cranes must be used to transport objects.
- Guardrails and signs must be installed at the edges and in the holes of high-altitude operations to prevent accidental falls.
- On the ground below the high altitude operations area, it is strictly forbidden to accumulate scaffolding, Deck boards and other miscellaneous materials. Personnel are strictly prohibited from standing or passing directly beneath the high-altitude operations area.
- Scaffolding, deck boards and workbenches for high altitude operations must be inspected and safety assessed in advance to ensure that the structure is sound and that the scaffolding is not overloaded.
- If the site manager and safety officer find that construction personnel who
If someone working at height does not follow the rules, they must immediately ask for a correction; otherwise, their operations must be stopped.

1.5 Machine safety

Safety when lifting

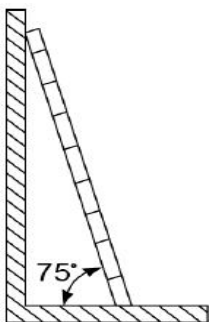
- When lifting heavy objects, it is strictly forbidden to walk under the crane arm and the lifted objects.
- Personnel performing lifting operations must receive relevant training and may only work after passing the qualification.
- Lifting tools must be inspected and may only be used if complete.
- Before lifting, make sure that the lifting tools are securely attached to the load-bearing brackets or walls.
- When lifting, make sure that the angle between the two cables does not exceed 90°, as shown in the figure below.



- When lifting, it is forbidden to drag the steel rope and lifting equipment or hit them with hard objects.

Safety when using stairs

- Use wooden or fiberglass ladders when climbing operations are involved.
- When using a scissor ladder, the rope must be secure and the ladder must be held by dedicated personnel during operation.
- Before using the ladder, confirm that it is intact and that its load capacity meets the requirements. Use exceeding the maximum weight is strictly prohibited.
- The ladder must be placed in a stable place. The inclination of the ladder is preferably 75°, which can be measured with a set square, as shown in the figure below. The ladder should be used with wide legs facing downward or with protective pads at the base to prevent slipping.



- When climbing a ladder, pay attention to the following actions to reduce danger and ensure safety.

- Keep your body stable.
- The maximum height at which workers can stand must not exceed the fourth step from the bottom to the top of the ladder.
- Make sure your body's center of gravity does not deviate from the edge of the ladder.

Safety when drilling

- When drilling holes in walls and floors, consider the following safety precautions:
-

I NOTIFY

Drilling holes into the equipment is strictly prohibited. Drilling will damage the electromagnetic shielding performance of the equipment, internal components, and cables, and metal shavings generated by drilling may enter the equipment and cause a short circuit on the board.

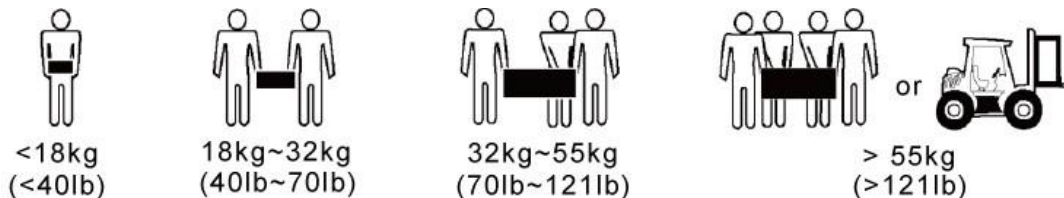
- Before drilling, obtain consent from the customer, the contractor and KSTAR.
- Wear protective glasses and gloves when drilling.
- During the drilling process, the equipment must be covered to prevent debris from fall inside the equipment, and the debris must be cleaned up promptly after drilling.

Safety in handling heavy loads



When removing equipment from the cabinet, be careful of any unstable or heavy equipment on the cabinet to avoid being crushed.

- When handling heavy objects, be prepared to support the weight to avoid being crushed or dislocated.



When carrying the equipment by hand, wear protective gloves to avoid injury.

- When moving or lifting the equipment, hold the handle or bottom edge of the equipment instead of the handle of the module installed in the equipment.
- Avoid scratching the cabinet surface or damaging the cabinet components and cables when moving the equipment.
- When using a forklift for transport, the fork must be in the center position to prevent tipping. Before moving, use ropes to secure the equipment to the

forklift; special attention is required when moving it.

- During transportation, try to choose rail, sea, or road routes in good condition to ensure the safety of the equipment. Impacts and tilts should be minimized during transportation.
- Move the cabinet with care to avoid damage to the equipment caused by impacts or falls.

1.6 Battery safety

Basic requirements

Before working on the battery, you must carefully read the safety precautions for the operation and master the correct method of connecting the battery.

DANGER

- Do not expose the battery to high temperature environments or heat-generating devices, such as sun, fire, transformers, heaters, etc. Batteries can explode if overheated.
 - Do not incinerate the battery, it may cause an explosion.
 - It is strictly prohibited to disassemble, modify or destroy the battery (for example by inserting foreign objects, immersing it in water or other liquids), to avoid electrolyte leakage, overheating, fire or explosion.
-
- Wear safety glasses, rubber gloves and protective clothing to prevent damage caused by Electrolyte leaks. If electrolyte leaks, avoid contact with skin or eyes. If it comes into contact with skin or eyes, rinse immediately with clean water and seek medical attention.
 - Please use special insulation tools.
 - When moving the battery, carry it in the direction required by the battery; it is strictly prohibited to turn it upside down or tilt it.
 - During installation and maintenance operations, the battery circuit must remain disconnected.
 - Please use the specified battery type, otherwise it may cause damage to the battery.
 - Please dispose of used batteries according to local laws and regulations, and do not dispose of them as household waste. Improper disposal of batteries could cause them to explode.
 - Fire-fighting equipment that meets the requirements, such as fire-fighting sand and dry powder extinguishers, must be available on site.
-

I NOTIFY

To ensure battery safety and accurate battery management, please use the battery supplied with the PCS host by KSTAR. KSTAR will not be responsible for any battery failures caused by using batteries not supplied by KSTAR.

Battery Installation Specifications

- Before installing and using the battery, the following basic precautions must be observed to ensure safety:
- The battery must be installed in a ventilated, dry and cool environment, away from sources of Heat, flammable materials, humidity, infrared radiation, organic solvents, and corrosive gases. Fire prevention measures must be taken. The battery must be positioned and secured horizontally.
- When installing, pay attention to the polarity of the battery. It is strictly forbidden to create a short circuit between the positive and negative poles of the same battery or the same string of batteries, as this would cause a short circuit.
- Check the battery connection terminal screws regularly to ensure they are tight and not loose.
- It is strictly prohibited to place installation tools on the battery during installation.

Battery short circuit protection



DANGER

A battery short circuit will generate a high instantaneous current and release a large amount of energy, which can cause personal injury and property damage.

To avoid battery short circuits, online battery maintenance is not permitted.

Special precautions for lithium batteries

Refer to lead-acid batteries for safety precautions when working with lithium batteries. Additionally, the following guidelines should be observed:



WARNING

There is a risk of explosion if the battery is replaced by an incorrect type.

- Replace only with the same or similar type of battery recommended by the manufacturer.
- It is prohibited to overturn, tilt or hit lithium batteries during handling.
- During installation, maintenance and other operations, the lithium battery module circuit must remain disconnected.
- Charging is prohibited when the lithium battery is below the lower limit of the operating temperature. exercise (charging is prohibited at 0°C),to avoid internal battery short circuits due to crystallization from low temperature charging.
- Do not exceed the temperature range, as this will affect the performance and safety of the battery.
- Do not throw the lithium battery module into a fire source.

- After maintenance, return the used lithium battery module to the maintenance site.

1.7 Others

Transport, storage and maintenance

- For long-term storage, charge and discharge every 6 months according to the method specified in the manual.
- Be careful not to drop the battery when loading and unloading during transportation.
- Don't turn it upside down.

Warnings and precautions

Please carefully read the specifications and warnings on the battery case before using the battery. Improper use of the battery may cause overheating and damage to the battery. KSTAR will not be liable for any accidents resulting from failure to observe the specifications. To ensure the safe use and disposal of the battery, please read the operating instructions carefully before use.

2. Overview

2.1 Product Introduction

The industrial and commercial battery cabinet includes a high-voltage box, battery module, EMS, MBMU (optional), and other modules, which can store and release electrical energy according to the EMS energy management system requirements. The battery cabinet's input and output ports use high-voltage DC.

- **Battery charging:** The output of the battery cabinet is connected to the storage terminals of energy (BAT+, BAT-) of the energy storage inverter. Under the control of the energy storage inverter, it charges the battery and transfers energy from the photovoltaic system or the grid to the battery.
- **Battery discharge:** When the photovoltaic energy is not enough to power the load, the system must control the battery to power the load and transfer the energy stored in the battery to the load via the energy storage inverter.

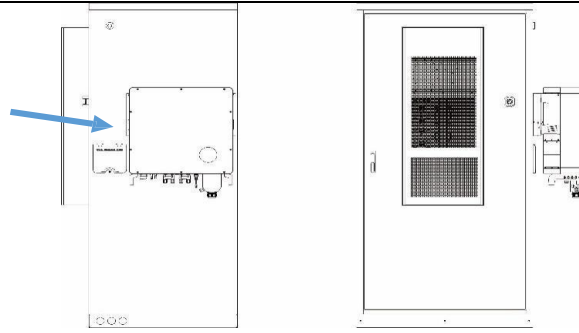
Depending on the functional configuration, industrial and commercial battery cabinets can be divided into main cabinets and secondary cabinets. Each battery cabinet contains two battery clusters with independent outputs. Specifically:

The main cabinet includes 2 battery clusters, the EMS module and the MBMU battery array management module.

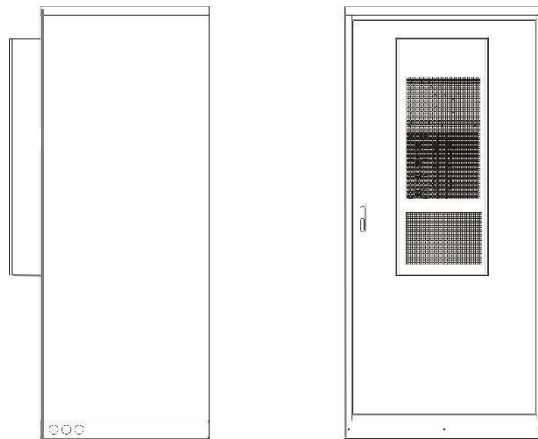
The secondary cabinet includes 2 battery clusters and the MBMU battery array management module (optional).

2.1.1 Product appearance

PCS display and
MS



Main drum cabinet



Secondary cluster

Fig. 2-1 Battery cabinet

Main battery cabinet functions: battery cluster management, communication with the PCS, display and save all system data, EMS management, system parameter modification, etc. There is an EMS display on the side panel of the main battery cabinet.

Slave cluster functions: accept the power management of the main battery cabinet, evaluate fault information and report it to the main battery cabinet, perform protection actions, obtain the current and voltage information of the battery cluster and perform fault assessment, etc. The slave cluster cabinet does not contain a screen.

2.1.2 Product structure

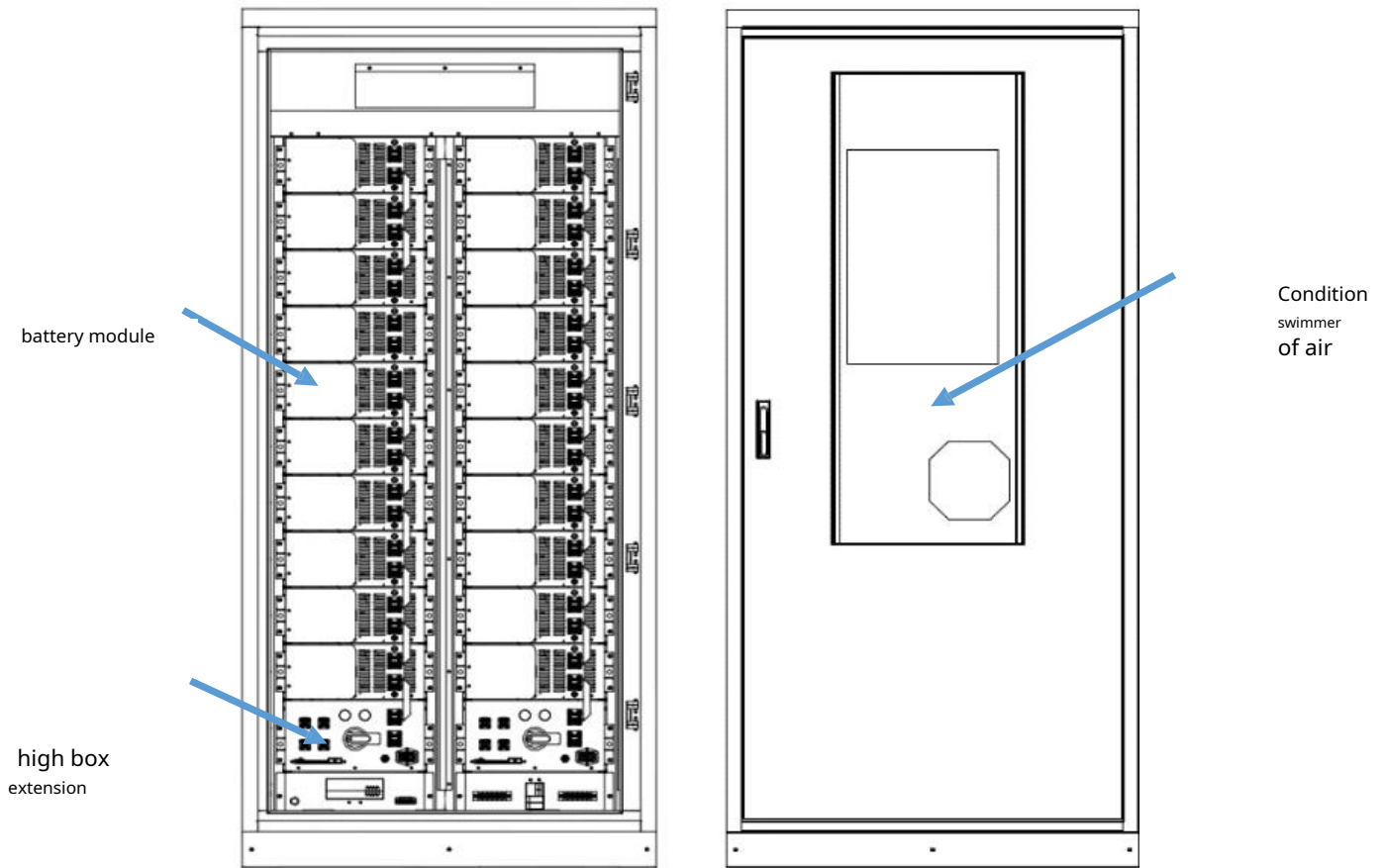


Fig. 2-2 Product structure

2.1.2.1 High voltage box

The high voltage box contains the protection components of the entire system, such as relays, MCCB (molded case circuit breaker), fuses, SPD (surge protective device), etc.

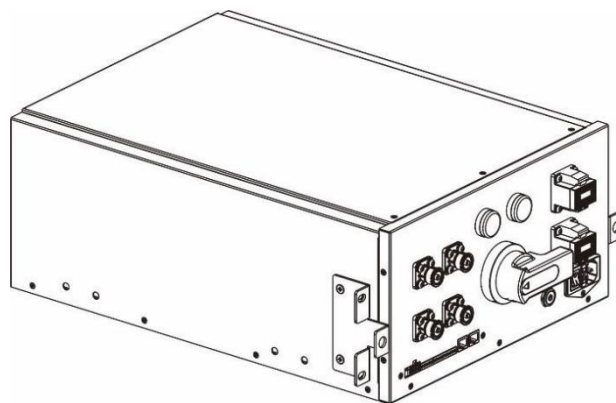


Fig. 2-3 High voltage box

Characteristics

The high-voltage box collects information such as cluster voltage, current, temperature, and external digital input signals, and works with the BMS to implement system operating strategies. The dimensions of the high-voltage box are as follows:

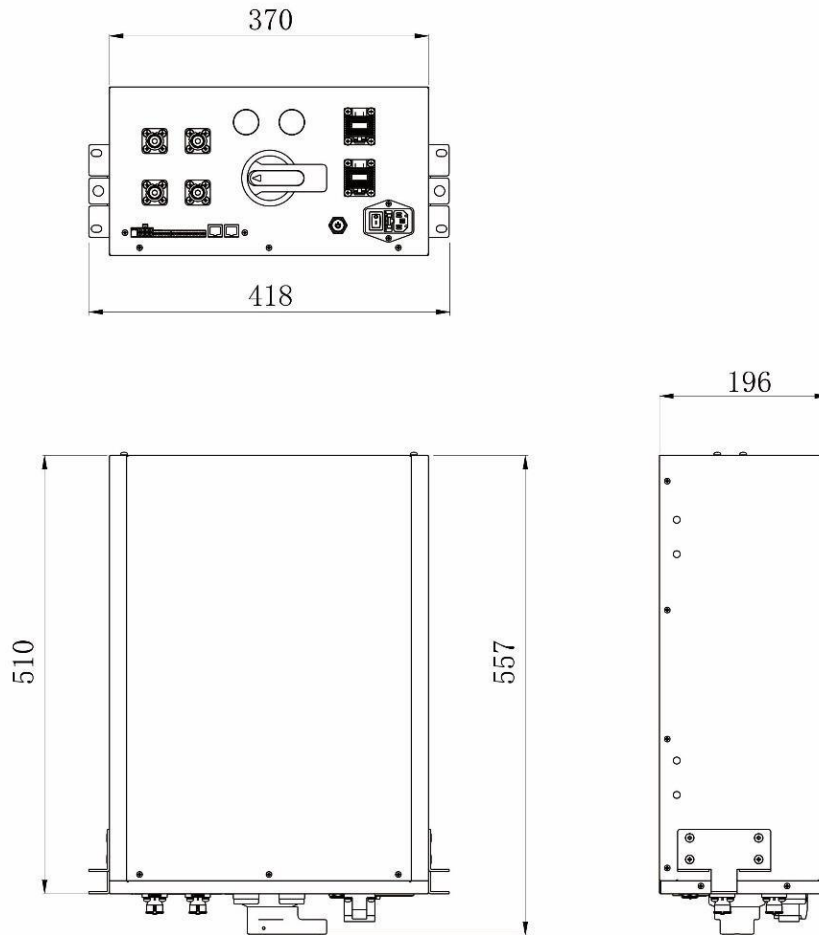


Fig. 2-4 Dimensions of high voltage box (mm)

2.1.2.2 Battery module

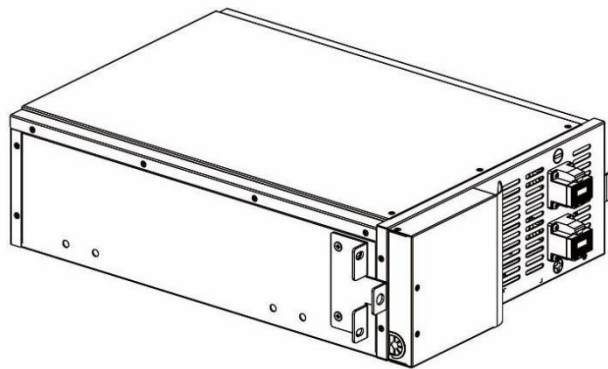


Fig. 2-5 Battery module

Characteristics

The battery module is composed of cells and is the power source for the entire system. The BMU collects information such as the voltage and temperature of the lithium battery and uploads the data to the SBMU control unit. The battery module also contains a fire suppression unit for automatic fire suppression. The battery module dimensions are as follows:

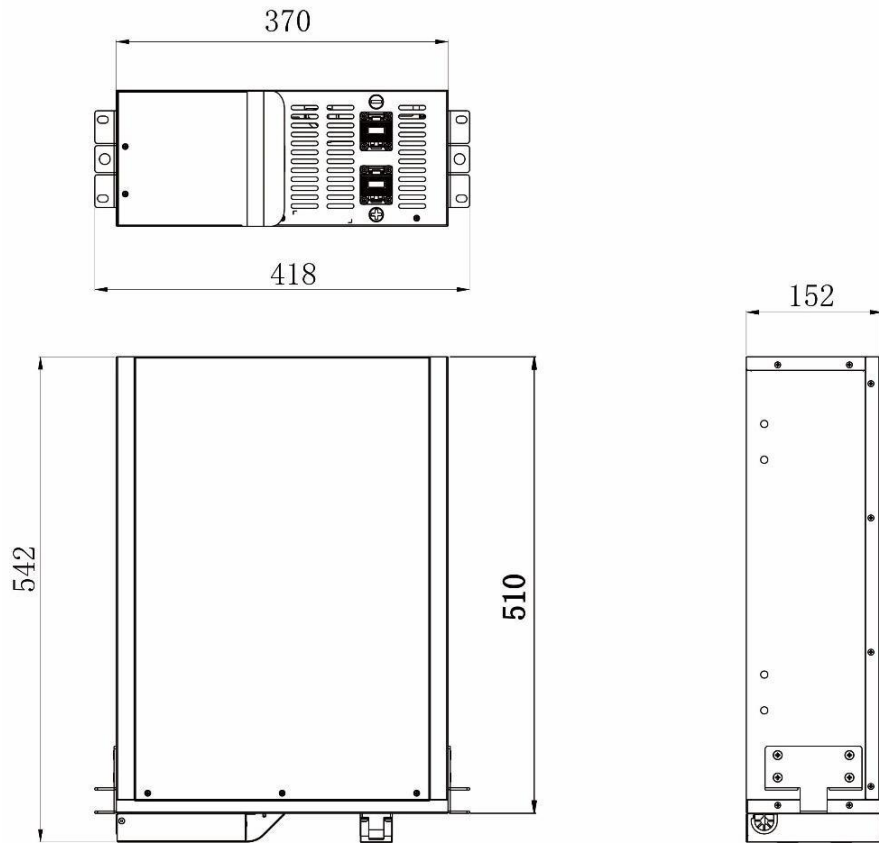


Fig. 2-6 Battery module dimensions (mm)

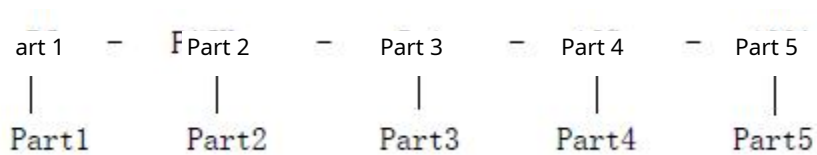
2.1.3 Product model and nomenclature scheme

2.1.3.1 Battery cabinet naming scheme



Part 1	Part 2	Part 3	Part 4
BC: Cabinet drums	Energy 100: 100 KWH 090:90KWH 080:80KWH	D: External	E: EMS Unit Empty: None EMS unit

2.1.3.2 Battery module naming scheme:



Part 1	Part 2	Part 3	Part 4	Part 5
BC: Cabinet of the drums	Battery pack	Energy 5.1: 5.1 KWH	16S: 16 cells in series	100A: Current maximum from the cell

2.2 Battery system parameters

2.2.1 Cell parameters

N.	Voice	Characteristics
1	Cell type	LFP (LiFePO4)
2	Rated voltage	3.2 V
3	Nominal capacity	100 AH
4	Nominal energy	320 WH
5	Maximum continuous charging current	1 C
6	Recommended charging current	≤0.5 C
7	Maximum continuous discharge current	1 C
8	Recommended discharge current	≤0.5 C

2.2.2 Battery module parameters

N.	Voice	Characteristics
1	Connecting cells	16S1P
2	Rated voltage	51.2 V
3	Nominal capacity	100 AH
4	Nominal energy	5.1 kWh
5	Nominal charging voltage	57.6 V
6	Recommended charging and discharging current	≤50 A @25±5°C
7	Weight	Approximately 44 kg

Charging instructions for the battery module:

If the user wants to charge a separate battery module, the charger parameters must be set in strict accordance with the above battery module parameters, otherwise the battery module may be damaged.

2.2.3 Battery cluster parameters

N.	Voice	Characteristics
1	Connecting cells	160S1P
2	Rated voltage	512 V
3	Nominal capacity	100 AH
4	Nominal energy	51.2 kWh
5	Nominal charging voltage	576 V
6	Recommended charging and discharging current	≤50 A @25±5°C

2.2.4 Battery cabinet parameters

N.	Voice	Characteristics
1	Total energy	102.4 kWh
2	Rated voltage	512 VDC
3	Depth of Discharge (DOD)	90%
4	Operating voltage range	456 VDC-576 VDC
5	Quantity of battery packs per cabinet	2
6	Maximum charging current	50A DC+50A DC(0.5C)
7	Maximum discharge current	50A DC+50A DC(0.5C)
8	Monitoring parameters	Battery cluster voltage, current, cell voltage, cell temperature, temperature environment, etc.

9	Communication	CAN/Ethernet
10	Operating temperature range	- 30°C - +50°C
11	Storage temperature range	- 30°C - +55°C (Temperature recommended 25°C for long-term storage).
12	Relative humidity	5%~95%, non-condensing
13	Type of ventilation	Air conditioner
14	Net weight	Approximately 1,400 kg
15	Size	1,100 mm*1,100 mm*2,380 mm
16	IP Rating	IP54

Charging instructions for the battery cabinet

Nominal charging voltage: 576 V

Charging current: The charging current limit for each cluster in the battery cabinet is calculated and defined by the BMS based on voltage and temperature. When the cell voltage is below 3.5 V, the system recommends a charging current of 50 A; when the cell voltage is above 3.5 V, the battery enters trickle charging mode, and the recommended charging current is 0.1 C to 0.5 C. In this case, the specific charging current is calculated and defined by the BMS based on the system's operating state.

2.2.5 High voltage box interfaces

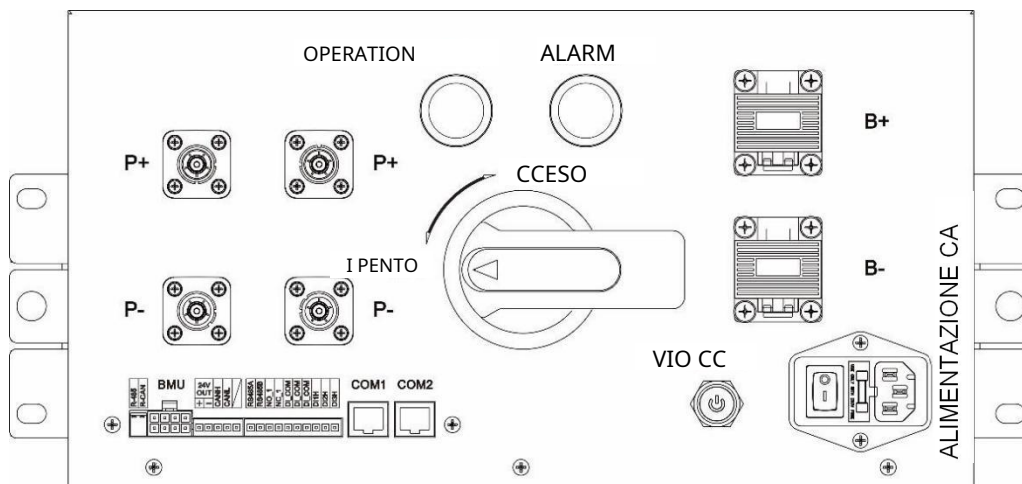


Fig. 2-7 High voltage box panel

Definition of components on the panel:

Brings	Description
--------	-------------

P+	DC output positive terminal
P-	DC output negative terminal
B+	Positive terminal of battery modules in series
B-	Negative terminal of battery modules in series
CC START	DC start button/black start button
AC POWER	220 VDC input
OPERATION	Operation indicator
ALARM	Warning indicator
MCCB circuit breaker	DC output switch

Definition of communication ports/weak current

Brings	Description
R-485	RS485 communication terminal DIP resistor
R-CAN	CAN communication terminal DIP resistor
BMU	Battery module communication port
24V OUTPUT	24V power output port
CANH/L	CAN communication interface
RS485A/RS485B	Air conditioner communication interface
NO_1/NC_1	Switch output port 1
DI1H	Digital input port 1
DI2H	Digital input port 2
DI3H	Digital input port 3
DI_COM	Digital input negative common terminal
COM1/COM2	Communication ports between high voltage boxes inside or outside the cabinet

2.2.6 Charging interval for the battery cabinet

Charging range for KSTAR battery cabinet: BC100DE	
6 months	- 10°C~+40°C,0~95%, non-condensing

* All dates are calculated from the date of shipment to the Warranty Start Date;

Kstar will provide the impact of permanent degradation over time and a complete charging procedure (including the specification of a commercially available charging device) no later than 1 month after the execution of this contract.

3. Installation

3.1 Site planning

3.1.1 Battery cabinet dimensions

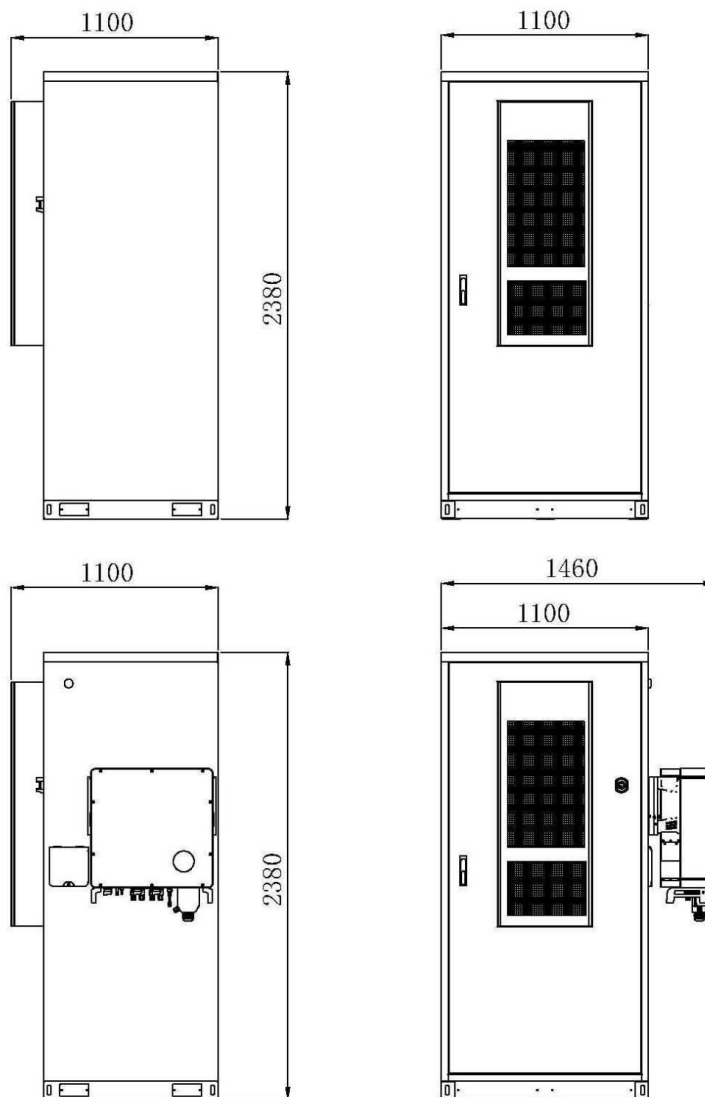


Fig. 3-1 Cabinet dimensions (mm)

3.1.2 Installation Precautions

Please place the battery cabinet on level ground and make sure it is stable without wobbling or tilting.

When installing the battery cabinet, the load and bearing capacity of the ground and floor must be considered (according to the requirements of the architectural drawings).

Do not cover the ventilation holes with objects, as this will hinder the heat dissipation of the battery cabinet, which will cause the internal temperature of the system to rise and compromise the safety and lifespan of the battery.

Please keep the battery cabinet installation area well ventilated. Avoid installing it in locations with high or low temperatures and high humidity. Keep away from water, flammable gases, corrosive agents, heat sources, and direct sunlight. Keep the air inlet and outlet free of dust.

Please avoid using in environments with dust, volatile gases, corrosive gases or high salt content, and do not place flammable and explosive objects around the battery cabinet.

To reduce the possibility of fire and consequent damage, the walls, ceilings and floors of the room in which the battery cabinet is located should be made of fire-retardant materials as much as possible and should be equipped with portable dry powder fire extinguishers.

During the installation process, refer to the applicable safety regulations for installation.

3.1.3 Space reserve

It is necessary to reserve some space for operation and ventilation around the cabinet:

- At least 1,200 mm of space must be reserved in front of the cabinet for ventilation and operation.
- At least 1,200 mm of operating space must be reserved at the rear.
- At least 600 mm of operating space must be provided on each side.





3.2 Preparation of tools and instruments

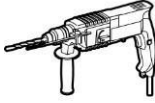

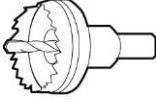

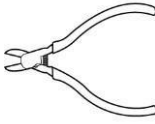
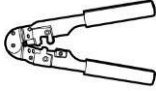
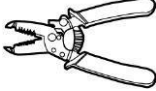

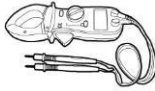




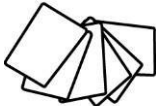
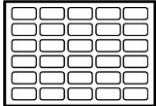
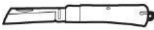
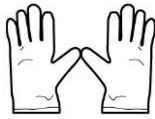




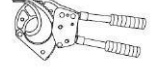



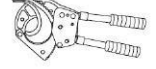
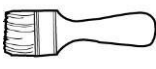



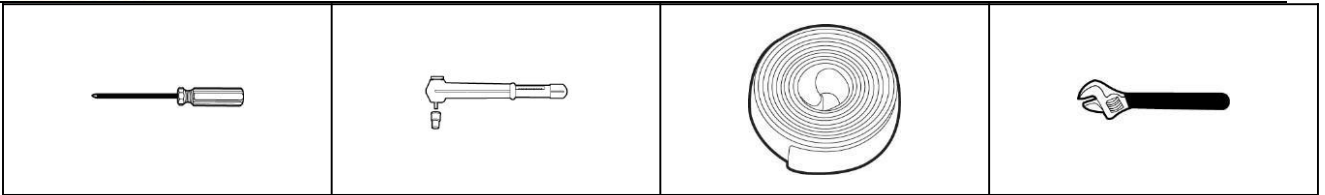
DANGER

Use insulated tools to avoid electric shock.

Table 3-1 Preparation of tools and utensils

Tools and instruments			
Forklift electric	Forklift manual	Stairs	Rubber hammer
			

Hammer drill	Hammer drill manual	Alloy hole saw	Heat gun
			
Wire cutters	Crimping pliers	Wire stripper	Electro-hydraulic press
			
Clamp ammeter	Multimeter	Cable ties	Level
			
Insulating tape	Cotton cloth	Label	Electrician's knife
			
ESD gloves	Rubber gloves of lead	Thermal insulating gloves	Protective shoes insulators
			
Torque screwdriver	Cable cutter	Brush	Flathead screwdriver (2-5mm)
			
Phillips screwdriver (M3/M4/M5/M6/M8)	Torque wrench isolated (M6/M8/M12/M16)	Heat shrink tubing	Insulated adjustable wrench
			



3.3 Preparing the power cables

Cables between cabinets should be 25 mm², low-smoke, halogen-free and flame-retardant.

3.4 Unpacking

Passages

Step 1: Transport the battery cabinet to the designated location with a forklift.

Step 2: Remove the outer packaging from the battery cabinet.

Step 3: After confirming that the equipment is in good condition, remove the bolts securing the battery cabinet and the pallet and remove the battery cabinet from the pallet.

3.5 Single cabinet installation

3.5.1 Installation environment

- Do not install the battery cabinet in a location with high, low temperatures or humidity beyond the technical specifications.
- Keep the battery cabinet away from water sources, heat sources, and flammable and explosive objects.
- Avoid installing the battery cabinet in the desert or surrounding desert environment.
- Avoid installing the battery cabinet in an environment with direct sunlight, dust, volatile gases, corrosive substances and high salt content.
- Avoid installing the battery cabinet on unstable or vibrating foundations.
- Do not install the battery cabinet in a working environment with conductive metal dust.
- The optimum temperature for battery operation is 20°C~30°C. Working in an environment with a temperature above 30°C will reduce battery life, and working in an environment below 20°C will reduce battery backup time.

3.5.2 Cabinet installation

Step 1: According to the design requirements, determine the installation position of the cabinet on a flat ground and draw a marking line.

Step 2: Transport the battery cabinet to the designated location with a forklift and install it in the marked position.

Step 3: After installation, check whether the cabinet body is tilted and whether the space between the cabinets meets the requirements.

Secure the battery cabinet to the foundation with mounting bolts. After installation, the U-shaped angle steel should be treated with an anti-rust treatment, such as anti-rust paint.

3.5.3 Instructions for installing copper bars between battery modules

3.5.3.1 Battery module

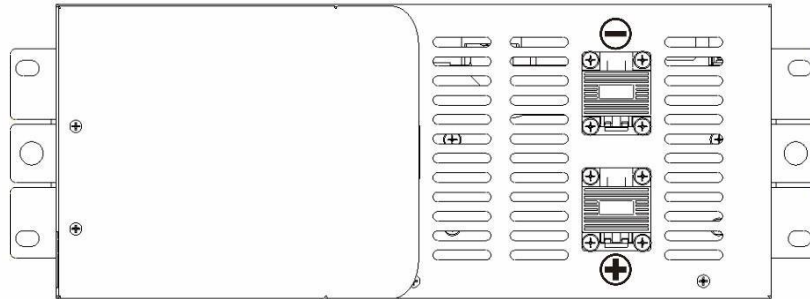




Fig. 3-2 Battery module

NOTE:

: Negative terminal of the battery module;

: Positive terminal of the battery module;

3.5.3.2 Instructions for connecting the battery module power supply

The connection between the battery modules was completed before the battery cabinet was shipped. If the customer still needs to maintain the connection between the battery modules, please refer to the following:

Parts Specifications:

Name	Description
Soft copper bar -1	Soft copper bar connecting the battery modules
power cable "B-	Connecting cables of module 01 "B-" and high voltage box "B-".
M8*12 combination bolts	Used to secure copper bars and "B-" power cables.
Cable tie	Used to secure the power cable "B-".

Connecting the copper bar between the battery modules:

Wear insulating gloves and secure the copper bars from the upper battery module to the lower battery module. Place the soft copper bars on the "+" of the upper battery module 01 and the "-" of the battery module 02, and secure the copper bars (M8*12 combination bolts, torque 5.5~6.0 NM). Secure battery modules 02, 03...10 in this order until the "B+" connection of the high-voltage box is complete.

Note: Do not open the covers of all DC connection terminals at the same time to avoid short circuits caused by improper use. It is recommended to open only the terminals on both sides of the copper bar (or power cable) to be secured, and close the terminal cover after securing the copper bar (or power cable).

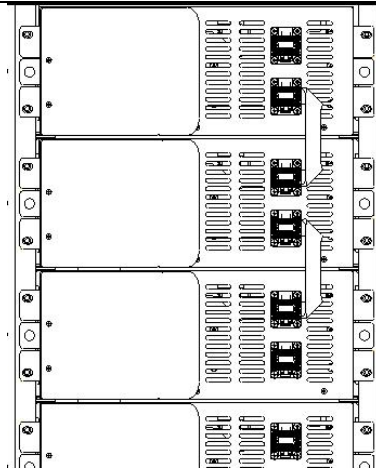


Fig. 3-3 Copper bars connected in series

Step 3: Install the power cord "B-". One end of the "B-" power cable is connected to the "-" position of the battery module 01 on the top, the other end is connected to the "B-" terminal position of the high-voltage box, and fixed with bolts (M8*12 combination bolts, torque 5.5~6.0 NM). Fix the "B-" power cable with the cable tie from the accessory bag.

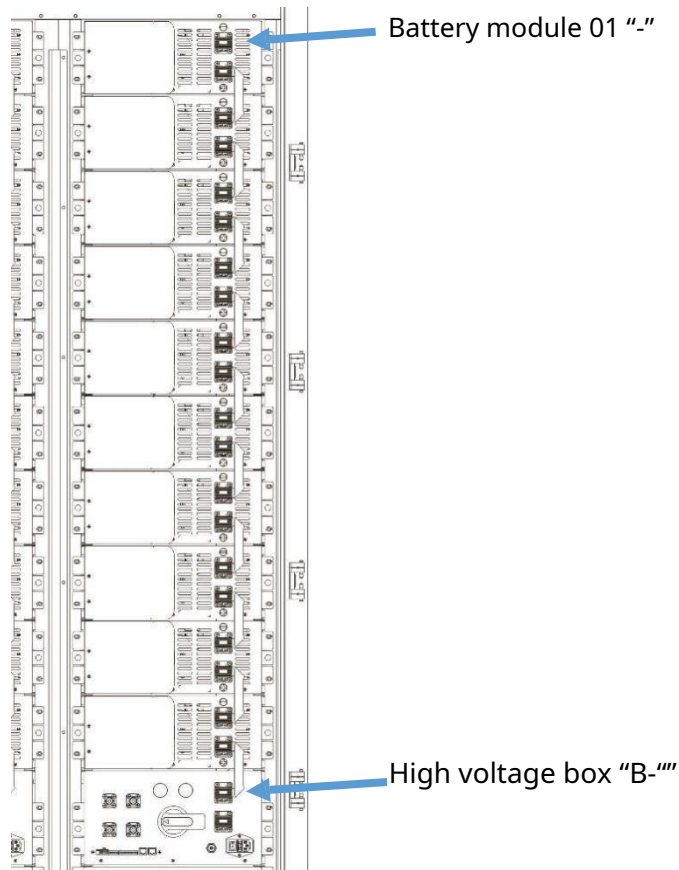


Fig. 3-4 Battery module slot diagram

Step 4: Install another battery module cluster. Repeat steps 1~3 to complete the connection and fixing of the power cables and soft copper bars of another battery module cluster in the battery cabinet, as shown in Fig. 3-5.

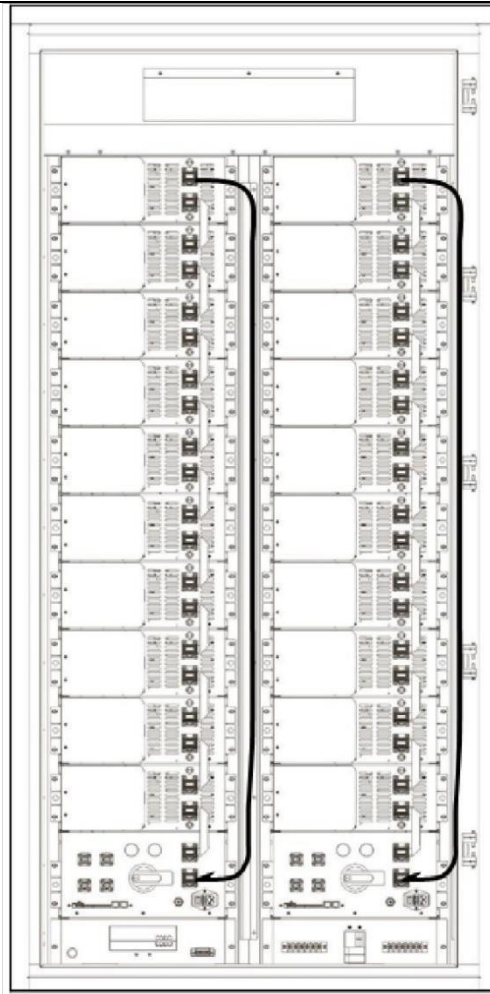


Fig. 3-5 Connecting the power cable "B".

3.6 Electrical connection



Before installation, make sure the MCCB on the high voltage box is turned off.

3.6.1 AC input connection

Step 1: Make sure the AC switch is in the OFF position.

Note: The AC input is single-phase 220 VAC. Please confirm whether it is powered before wiring.

The 220 VAC power supply will be used to power the air conditioner and the AC/DC power module.

Step 2: Connect the L/N/PE wires of the 220 VAC power cable to the corresponding terminals as shown in the following figure and fasten them with bolts (torque ≤ 2 NM).

Note: The 3 terminals (L/N/PE) on the right side of the "INPUT" side are reserved AC input terminals that can be used as an AC power source when connected to another battery cabinet. The two sets of terminals on the "OUTPUT" side are used for internal wiring to power the high-voltage box and the air conditioner.

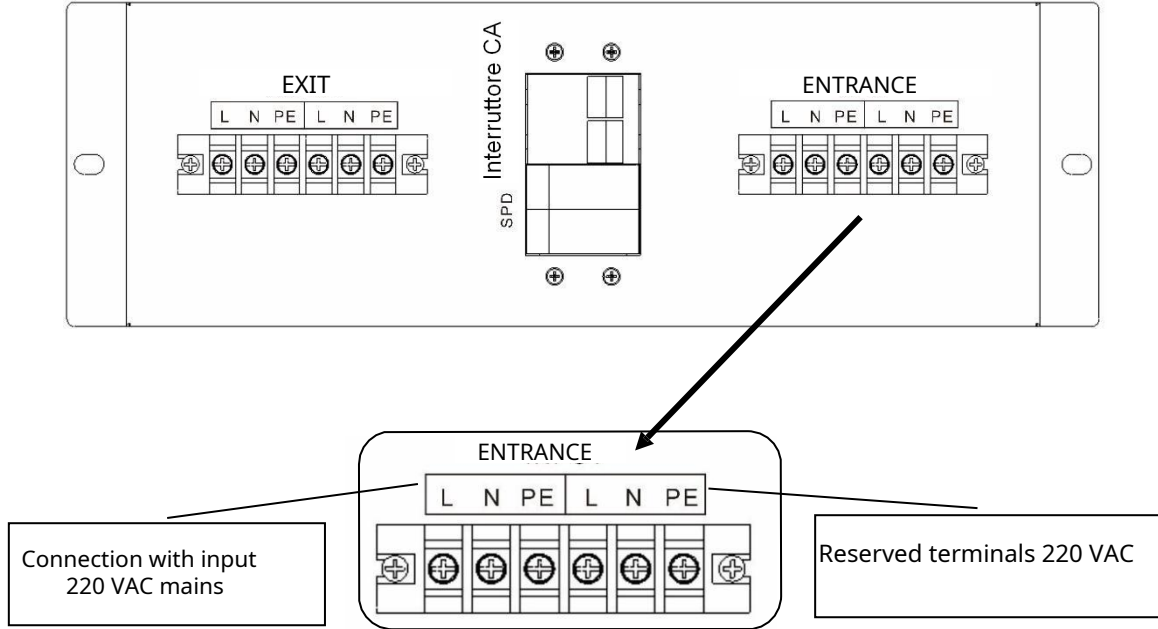


Fig. 3-6 AC input connection

3.7 Cabinet installation

3.7.1 Parallel connection of battery clusters in the cabinet

Step 1: Connect the P+/P- ports of the high-voltage box 01 and the high-voltage box 02 with the parallel power cable (accessory 5), and connect the P+/P- power cable connected to the PCS to the P+/P- port of the high-voltage box 01 or 02. The connection method is shown in the following figure.

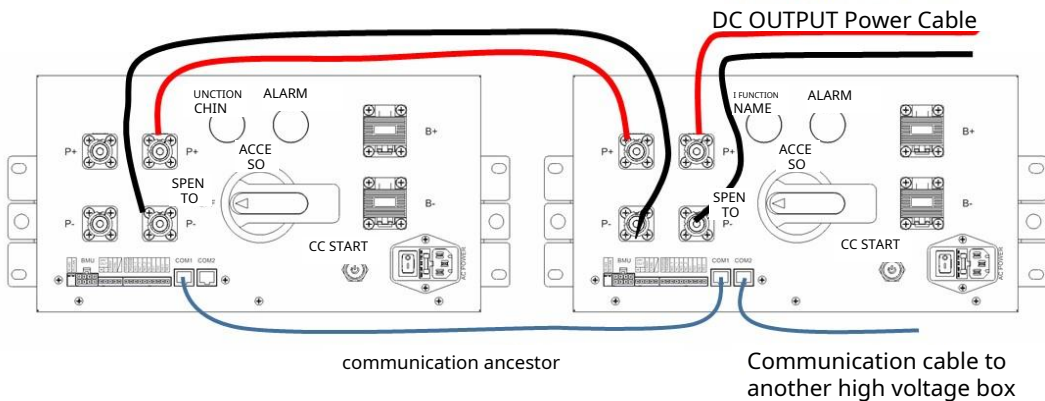


Fig. 3-7 Connecting the power cable in parallel

Step 2: When the number of battery cabinets in the energy storage system is greater than or equal to 2, connect one end of the parallel CAN/power communication cable (accessory 04) to the COM2 port of the high-voltage box shown above (both high-voltage box 01 and 02 are acceptable), and connect the other end to the COM2 port of the high-voltage box.

voltage in other battery cabinets.

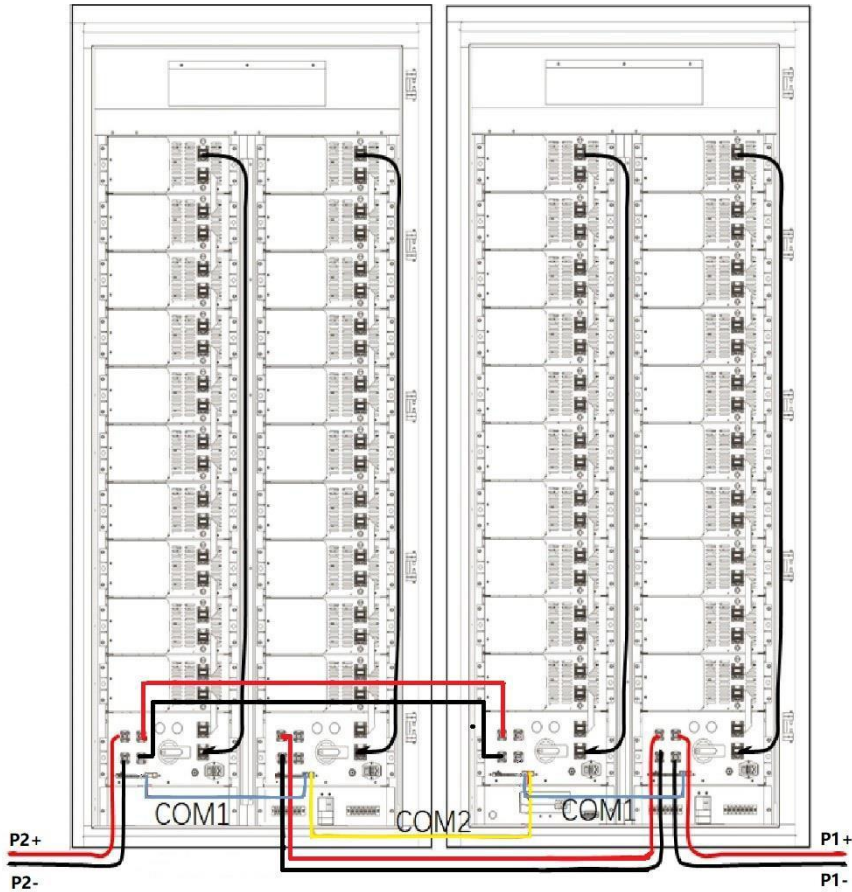


Fig. 3-8 Parallel wiring cable connection when the number of battery cabinets ≥ 2

3.7.2 Parallel connection of battery cabinets

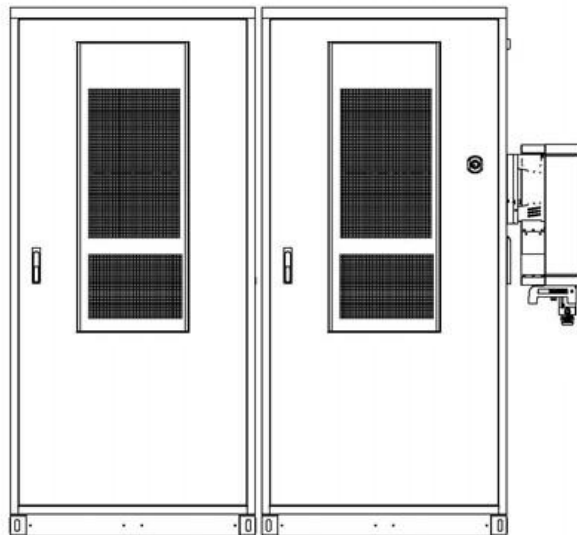


Fig. 3-9 Location of the main/secondary battery cabinets

Step 1: Connect the P+/P- ports of the high-voltage box 01 and the high-voltage box 02 with the parallel power cable (accessory 5), and connect the power cable (accessory 5) connected to P+/P- of the other cabinet to the P+/P- port of the high-voltage box 01 or 02. The method

connection is shown in the following figure.

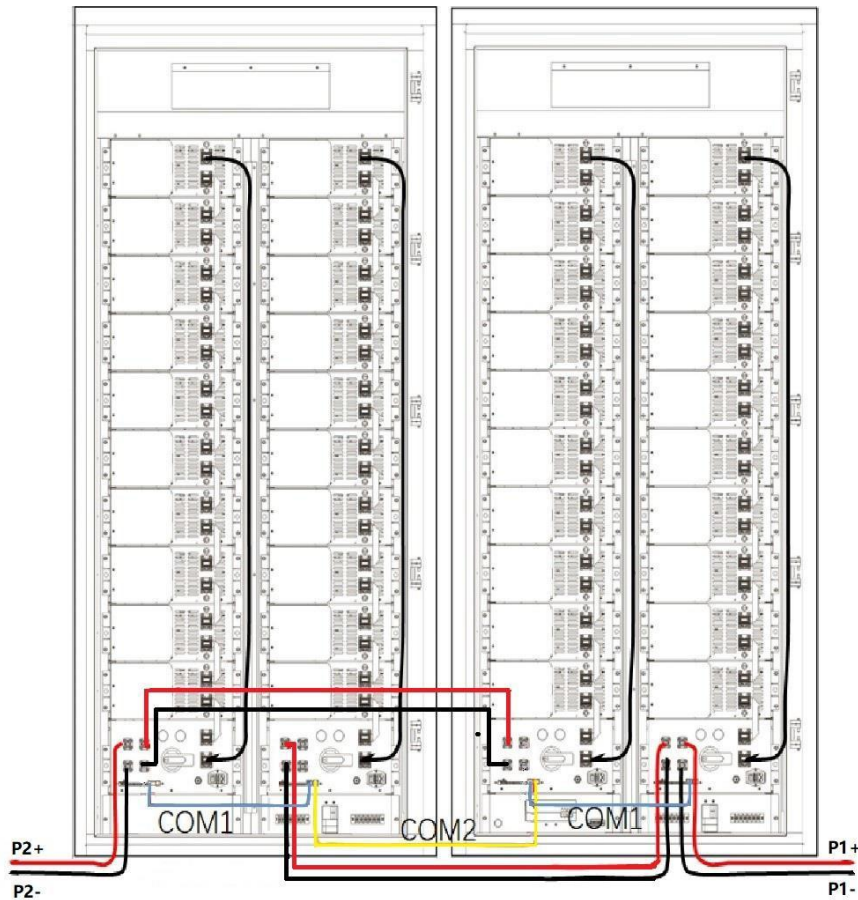


Fig. 3-10 Connection diagram of two battery cabinets in parallel

Step 2: Connect one end of the parallel CAN/power communication cable (accessory 4) to the COM2 port of the high voltage box in the figure above (both high voltage box 01 and 02 are acceptable), and connect the other end to the COM2 port of the high voltage box in other battery cabinets.

3.8 Communication Wiring Instructions

1) Wiring the network communication interface

The battery cabinet has a built-in network switch, which is connected to the EMS controller's network port. The user must connect it to the cloud platform or higher-level monitoring system and connect directly to the switch via a standard network cable.

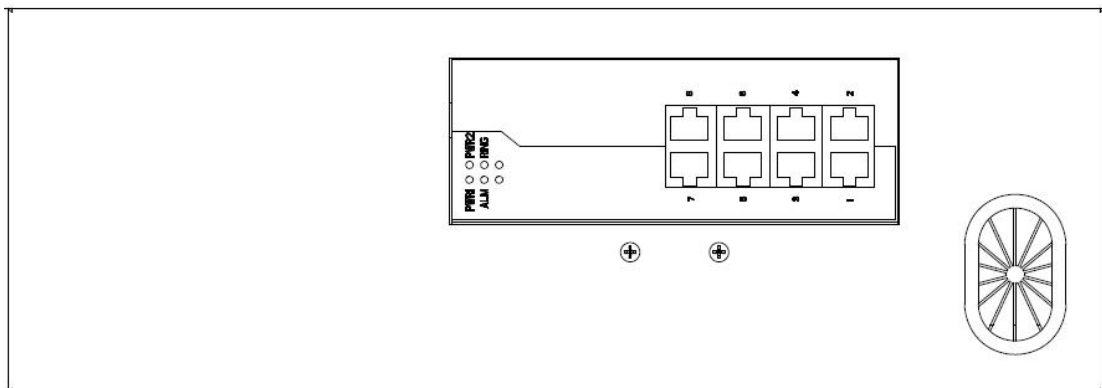


Fig. 3-11 Network switch ports on the panel

2) PCS communication wiring

The four-core communication cable is connected via the position shown in the following figure, and the cable is connected to the PCS communication interface.

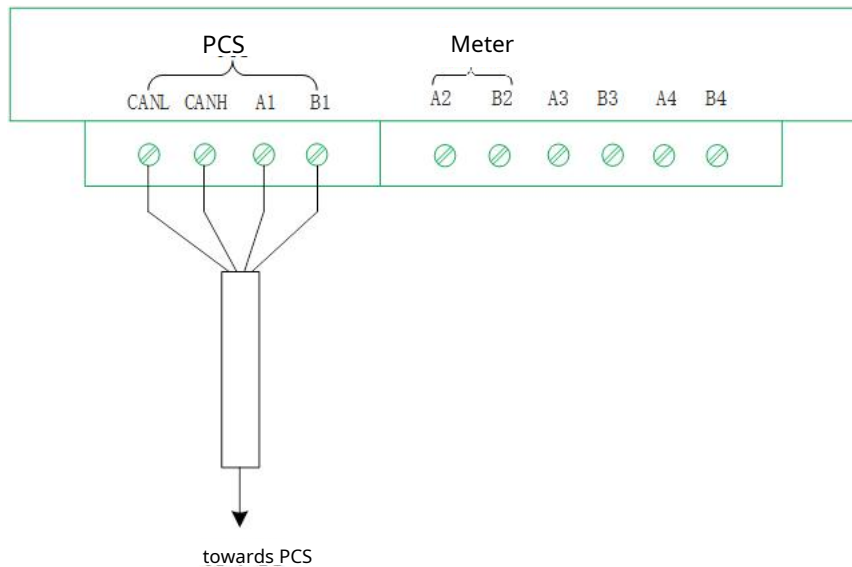


Fig. 3-12 Connecting the PCS communication cable

4. Operation Guide

4.1 Inspection after installation

DANGER

- Personnel responsible for the installation and maintenance of the equipment must first accept rigorous training to understand various safety precautions and correct operating methods.
- Only qualified professionals or trained personnel are authorized to install, operate and maintain the equipment.

Verification steps:

Step 1: Check the fixation of the module box

- Check that the battery module, high voltage box and battery cabinet are secured:

Step 2: Check the power cord

- Check that the copper bars between the battery modules and between the battery modules and the high voltage box tension or power cable fixing bolts are not missing, loose or not tightened with the recommended torque;
- Check that the P+/P- quick-connect power cord is not reversed and that the plug and socket are fully locked;
- Check that the 220 VAC input cable is not reversed and that the fixing bolts are not missing, loose or not tightened to the recommended torque;

Step 3: Check the communication cable

- Check that the communication cable between the battery modules, the high voltage box, the MBMU module and the EMS unit is not loose or missing;
- Check that the communication cable between the PCS and the MBMU module is not loose or missing;
- Check that the CAN communication cable between two battery cabinets is properly connected and is not loose or missing;

Step 4: Check the power supply, guide and communication cable of the fire starter

- Check the fire starter's power supply and the power indicator light or flash. If the power indicator light does not come on, contact KSTAR personnel.
- Check that the fire starter, power, feedback and other wiring cables are not loose or missing;

If any abnormalities are found and cannot be recovered, please contact KSTAR staff.

4.2 Checking the operating environment

Check the room temperature: -20°C~55°C

Check the humidity of the environment: 10%~95%, non-condensing

4.3 Power-on operation**4.3.1 Prerequisites**

- Before turning on, make sure that all items to be checked after installation have been checked.
- Before power on, measure the total battery and it should be within the range of 400~576V.
- Before turning on, make sure all switches are off.

4.3.2 Operational steps**● If there is a 220VAC input**

Step 1: Supply 220 VAC mains to the battery cabinet;

Step 2: Turn on the AC switch in the cabinet and close the "AC POWER" switch on the high voltage box panel;

Step 3: Turn the handle of the high voltage box switch to the "ON" position and check whether the indicator light turns green;

Step 4: Confirm whether the air conditioner is on;

Step 5: Check whether the EMS screen on the right side of the battery cabinet is on and whether there are any faults;

Step 6: Repeat steps 2~3 to power up another set of batteries in the battery cabinet;

---- The End

● **If there is no 220VAC input**

Step 1: Turn the high voltage box switch handle to the "ON" position;

Step 2: Press the "DC START" button on the high-voltage box for 3-6 seconds. After the indicator light is on, release the button to perform DC black start;

Step 3: Confirm if the operation light turns green;

Step 4: Turn on the "AC POWER" switch of the high voltage box;

Step 5: Check whether the EMS screen on the right side of the battery cabinet is on and whether there are any faults;

Step 6: Close the AC switch inside the cabinet;

Step 7: Repeat steps 2~4 to power up another battery cluster in the cabinet;

---- The End

After the battery clusters in the battery cabinet have successfully completed the self-test, set up the EMS unit and send the control command to close the relays in the battery cabinet. Check for any faults during the process; if all the relays close successfully, the system power-up operation is complete.

4.4 Shutdown operation

4.4.1 Shutdown steps

Step 1: Set the EMS unit and turn off the relays in the battery cabinet by the control command.

Step 2: Turn the switch handle on the high voltage box to the "OFF" position.

Step 3: Turn off the "AC POWER" switch on the high voltage box.

Step 4: Repeat steps 2~3 to disconnect the DC output and AC input of another group in the cabinet.

Step 5: Turn off the AC breaker in the cabinet.

---- The End

4.4.2 Emergency shutdown

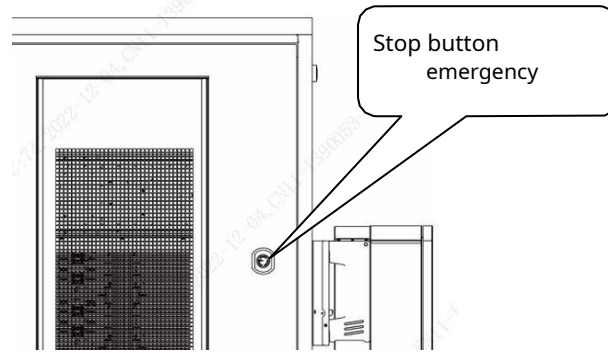


Fig. 4-1 Emergency stop button

Step 1: Press the emergency stop button.

Step 2: Turn the switch handle on the high voltage box to the "OFF" position.

Step 3: Turn off the "AC POWER" switch on the high voltage box;

Step 4: Repeat steps 2~3 to disconnect the DC output and AC input of another cluster in the cabinet.

Step 5: Turn off the AC breaker in the cabinet.

---- The End

Note: The emergency stop button can only be configured on the main battery cabinet.

4.5 Battery Cabinet Operation Test

The battery cabinet exchanges energy with the outside through the PCS.

Precautions during the function test are as follows:

Capacity calibration: To ensure that the battery can complete a full and normal charge and discharge cycle. By default, the nominal capacity will be corrected in the first ten times of initial system operation, so deep charging and discharging should be performed during the function test and joint commissioning. It is recommended to perform a capacity calibration during the function test with a DOD = 100% charge and discharge depth, and test according to the product's nominal power. The default process is "discharge + soak (2h) + full charge". The specific description is as follows:

- Discharge: Battery discharged to SOC=0%.
- Parking: Leave the battery parked for more than 2 hours (for SOC correction). During parking, there must be no charging or discharging current; auxiliary power is permitted during parking.
- Full charge: After the rest time, charge the battery up to SOC=100%.

After the battery is discharged, if it is not used for a long time, it should be recharged in time (within 6 months) to >50% SOC.

Operational stabilityAll components in power circuits, communication circuits, and sampling circuits must be validated during the functional test, if conditions permit. It is used to determine whether there are any abnormalities in each connection of the system installation, especially overtemperature, overcurrent, overvoltage, overdischarge, and other abnormal conditions, which must be addressed promptly to avoid potential safety hazards.

5. Routine maintenance

I NOTIFY

- All maintenance work inside the battery cabinet must be performed using insulated tools and by specially trained personnel. Components behind protective covers that require tools to open are not user-serviceable. If maintenance is required, consult KSTAR for details.
- The battery cabinet must be regularly maintained according to the following requirements, otherwise the normal operation of the battery cabinet will be affected and the normal service life of the battery cabinet will be shortened.

5.1 Monthly maintenance

The battery system should be checked at least once a month to ensure cell voltage and temperature are normal. Check the battery history to see if any serious faults have occurred.

Table 5-1 Monthly maintenance

Content of the control	Basic requirements	Management method
Cell voltage	The cell voltage is between 2.55V~3.60V	Contact KSTAR staff
Cell temperature	The temperature is between -20~65°C	Contact KSTAR staff
Voltage difference within a single cluster	The voltage difference is less than 500 mV	Contact KSTAR staff
During the charging process of the battery system, the voltage fluctuation range of the cells is small.	The fluctuation of the voltage is less than 10mV during the stationing process	Contact KSTAR staff
System fault data, if there is a fault cell overvoltage	No level 4 faults	Contact KSTAR staff
System fault data, if a cell undervoltage fault is present	No level 4 faults	Check the cause of the level 3 fault; Report level 4 fault
System error data, if there is a system failure overtemperature	No level 4 faults	Check the cause of the level 3 fault; Report level 4 fault
System error data, if there is an error undertemperature	No level 4 faults	Check the cause of the level 3 fault; Report level 4 fault

System fault data, if there is a discharge overcurrent fault	No level 3 faults	Check the cause of the level 2 fault; Report level 3 fault
System error data, if there is a charging overcurrent error	No level 3 faults	Check the cause of the level 2 fault; Report level 3 fault
System fault data, if a low insulation fault is present	No level 3 faults	Check the cause of the level 2 fault; Report level 3 fault
System error data, if there is a cluster voltage too high error	No level 4 faults	Check the cause of the level 3 fault; Report level 4 fault
System error data, if there is a cluster voltage too low error	No level 4 faults	Check the cause of the level 3 fault; Report level 4 fault
System error data, if there is an excessive temperature difference error	No level 3 faults	Check the cause of the level 2 fault; Report level 3 fault
System error data, if there is an error charging overtemperature	No level 3 faults	Check the cause of the level 2 fault; Report level 3 fault
System error data, if there is an error charging undertemperature	No level 3 faults	Check the cause of the level 2 fault; Report level 3 fault
If the fault light is normal	The fault light may be on	Contact KSTAR staff
If the operation light is normal	The operation light can always be on	Contact KSTAR staff

5.2 Quarterly maintenance

Table 5-2 Quarterly maintenance

Content of the control	Basic requirements	Management method
Cell voltage	The cell voltage is between 2.55V~3.60V	Contact KSTAR staff
Cell temperature	The temperature is between -20~65°C	Contact KSTAR staff

Content of faults <small>historians</small>	Check the cause of level 1/2 error; Report level 3/4 fault	Contact KSTAR staff
If the fault light is normal	The fault light may be on	Contact KSTAR staff
If the light of operation is normal	The operation light is always on	Contact KSTAR staff
The system can perform a complete charge-discharge cycle	The system can perform a complete charge-discharge cycle	Contact KSTAR staff
Cabinet status	The cabinet shows no obvious signs of rust, traces of water infiltration or abnormal bends	Contact KSTAR staff
Starter box cabinet fire prevention	The power light can be turned on	Contact KSTAR staff

5.3 Annual maintenance

Table 5-3 Annual maintenance

Content of the control	Basic requirements	Management method
Cell voltage	The cell voltage is between 2.55V~3.60V	Contact KSTAR staff
Cell temperature	The temperature is between -20~65°C	Contact KSTAR staff
Content of faults <small>historians</small>	Check the cause of level 1/2 error; Report level 3/4 fault	Contact KSTAR staff
If the power cord is normal	The power cord is normal	Replace the power cord
If the cable of communication is normal	The communication cable is normal	Replace the power cord
If the fault light is normal	The fault light may be on	Contact KSTAR staff
If the light of operation is normal	The operation light is always on	Contact KSTAR staff

State of the fixed screw of the copper bar of diet	No rust, no obvious oxidation, no loosening.	Replace or tighten the screw
Cabinet status	The cabinet shows no obvious signs of rust, traces of water infiltration or abnormal bends	Contact KSTAR staff
Starter box cabinet fire prevention	The power indicator can be turned on	Contact KSTAR staff
Accuracy of battery system current collection	Error < 2%	Contact KSTAR staff
Accuracy of battery system voltage collection	Error < 2%	Contact KSTAR staff

6. Troubleshooting and maintenance

For common faults, refer to Table 6-1 for troubleshooting methods. If you encounter other problems during troubleshooting, you can consult the alarm list or contact KSTAR.

Table 6-1 Troubleshooting

Type of fault	Symptom	Analysis of the cause	Management method
Pre-timeout load	The product it does not work	The external load is too large, affecting the pre-charging process	Restart the battery system
Overvoltage of the cell	Level 1	Abnormal charge, abnormal communication with PCS	Download or check the communication cable
	Level 2	Abnormal charge, abnormal communication with PCS	Download or check the communication cable
	Level 3	Abnormal charge, abnormal communication with PCS	Download or check the communication cable
	Level 4	Abnormal charge, abnormal communication with PCS	Contact KSTAR staff
Undervoltage of the cell	Level 1	Abnormal discharge, Abnormal communication with the PCS	Charge or check the communication cable

	Level 2	Abnormal discharge, Abnormal communication with the PCS	Charge or check the communication cable
	Level 3	Abnormal discharge, Abnormal communication with the PCS	Charge or check the communication cable
	Level 4	Abnormal discharge, Abnormal communication with the PCS	Contact KSTAR staff
Cluster Difference of tension - <small>broken down</small>	Level 3	Abnormal sampling circuit	Contact KSTAR staff
Overvoltage of the cluster	Level 1	Abnormal charge, abnormal communication with PCS	Download or check the communication cable
	Level 2	Abnormal charge, abnormal communication with PCS	Download or check the communication cable
	Level 3	Abnormal charge, abnormal communication with PCS	Download or check the communication cable
	Level 4	Abnormal charge, abnormal communication with PCS	Contact KSTAR staff
Undervoltage of the cluster	Level 1	Abnormal discharge, Abnormal communication with the PCS	Charge or check the communication cable
	Level 2	Abnormal discharge, Abnormal communication with the PCS	Charge or check the communication cable
	Level 3	Abnormal discharge, Abnormal communication with the PCS	Charge or check the communication cable
	Level 4	Abnormal discharge, Abnormal communication with the PCS	Contact KSTAR staff
Overtemperature of the cell during <small>the discharge</small>	Level 1	Abnormal operation of the air conditioner or air temperature too high.	Clean the air conditioner or lower the temperature

	Level 2	Abnormal operation of the air conditioner or air temperature too high.	Clean the air conditioner or lower the temperature
	Level 3	Abnormal operation of the air conditioner or air temperature too high to.	Clean the air conditioner or lower the temperature
	Level 4	Ambient temperature too high or battery end of life. Risk of thermal runaway.	Contact KSTAR staff
Overtemperature of the cell during the charge	Level 1	Abnormal operation of the air conditioner or air temperature too high.	Clean the air conditioner or lower the temperature
	Level 2	Abnormal operation of the air conditioner or air temperature too high.	Clean the air conditioner or lower the temperature
	Level 3	Abnormal operation of the air conditioner or air temperature too high.	Clean the air conditioner or lower the temperature
	Level 4	Ambient temperature too high or battery end of life. Risk of thermal runaway.	Contact KSTAR staff
Undertemperature of the cell during the charge	Level 1	Abnormal operation of the air conditioner or air temperature too low.	Clean the air conditioner, increase the temperature
	Level 2	Abnormal operation of the air conditioner or air temperature too low.	Clean the air conditioner, increase the temperature
	Level 3	Abnormal operation of the air conditioner or air temperature too low.	Clean the air conditioner, increase the temperature
Undertemperature of the cell during the discharge	Level 1	Abnormal operation of the air conditioner or air temperature too low.	Clean the air conditioner, increase the temperature

	Level 2	Abnormal operation of the air conditioner or air temperature too low.	Clean the air conditioner, increase the temperature
	Level 3	Abnormal operation of the air conditioner or air temperature too low.	Clean the air conditioner, increase the temperature
Failure of the difference of temperature of the cells	Level 1	Abnormal resistance of the cooling channel, abnormal sampling circuit.	Clean the air conditioner or contact KSTAR staff.
Overcurrent of battery cluster charging	Level 1	Abnormal charge, abnormal communication with PCS	Check if the communication cable between the PCS and the battery cabinet is missing or unstable and PCS setting.
	Level 2	Abnormal charge, abnormal communication with PCS	Check if the communication cable between the PCS and the battery cabinet is missing or unstable and PCS setting.
	Level 3	Abnormal charge, abnormal communication with PCS	Check if the communication cable between the PCS and the battery cabinet is missing or unstable and PCS setting.
Overcurrent of cluster download of batteries	Level 1	Abnormal discharge, Abnormal communication with the PCS	Check if the communication cable between the PCS and the battery cabinet is missing or unstable and PCS setting.
	Level 2	Abnormal discharge, Abnormal communication with the PCS	Check if the communication cable between the PCS and the battery cabinet is missing or unstable and PCS setting.
	Level 3	Abnormal discharge, Abnormal communication with the PCS	Check if the communication cable between the PCS and the battery cabinet is missing or unstable and PCS setting.
Failure of insulation	Level 1	Water in the cabinet, faulty grounding	Check if the grounding is loose and if there is water in the cabinet.

	Level 2	Water in the cabinet, faulty grounding	Check if the grounding is loose and if there is water in the cabinet.
	Level 3	Water in the cabinet, faulty grounding	Check if the grounding is loose and if there is water in the
Failure of communication with PCS	Level 2	Abnormal communication with PCS	Check whether the communication cable between the PCS and the battery cabinet is missing or unstable.
Failure of communication internal	Level 2	The communication cables in the cabinet are missing or unstable.	Check whether the communication cable between the high voltage box and the battery cabinet is missing or unstable.
Relay failure positive	Level 4	Damaged relay	Contact KSTAR staff
Relay failure negative	Level 4	Damaged relay	Contact KSTAR staff
Breakdown at cell voltage	Level 2	Abnormal cell sampling circuit	Check the connection of the battery module sampling cables
Failure of the temperature of the cells	Level 2	Abnormal cell sampling circuit	Check the connection of the battery module sampling cables
Circuit failure integrated AFE	Level 3	Damaged BMU unit	Contact KSTAR staff
Breakdown at balancing the cell voltage	Level 3	Damaged BMU unit	Contact KSTAR staff
Sensor failure of current	Level 3	Abnormal current sampling circuit in high voltage box	Contact KSTAR staff
System failure of the battery	Level 3	High voltage box malfunction	Contact KSTAR staff
Failure of the cluster voltage	Level 2	The power cables in the cabinet are missing or unstable.	Check whether the communication cable between the high voltage box and the battery cabinet is missing or unstable.
Overtemperature of the B+/B- terminal	Level 1	Abnormal discharge, Abnormal communication with the PCS	Stop operation and lower the cell temperature

	Level 2	Abnormal discharge, Abnormal communication with the PCS	Stop operation and lower the cell temperature
	Level 3	Abnormal discharge, Abnormal communication with the PCS	Stop operation and lower the cell temperature
Failure of the temperature environment	Level 1	Temperature sampling failure in high voltage box	Contact KSTAR staff
Overtemperature environment	Level 1	The ambient temperature is too high	Move the battery cabinet
Undertemperature environment	Level 1	The ambient temperature is too low	Move the battery cabinet
Fire alarm	Level 4	Battery thermal runaway	Contact KSTAR staff
Broken down waterproof	Level 4	Waterproof failure	Contact KSTAR staff
Control failure access	Level 2	The cabinet door is open	Check the cabinet door and lock it
Failure of the difference of cluster voltage	Level 2	Abnormal connection between the battery module and the high voltage box	Check whether the communication cable between the high voltage box and the battery cabinet is missing or unstable.
Anomaly of the temperature of the B+ terminal	Level 1	High voltage box abnormal sampling circuit	Contact KSTAR staff
Failure of the temperature of the terminal B-	Level 1	High voltage box abnormal sampling circuit	Contact KSTAR staff
SPD failure	Level 3	Surge protection device fault	Contact KSTAR staff

Observation:

A clogged air conditioner condenser is the main cause of decreased cooling capacity. To ensure optimal air conditioning performance, it is recommended to clean the condenser every six months.

7. List of accessories

A single battery cabinet contains the following accessories (placed in the accessory box):

N.	Name	Amount	Scope
Accessory 1	Fireproof stucco	1 SET	Fill the wiring holes for the battery cabinet input and output.
Accessory 2	Basic deflector	1 SET	Battery cabinet base deflector
Accessory 3	Power cord PCS	1 SET	Power cable connecting the PCS and the battery cabinet.
Accessory 4	Communication cable between battery cabinets	Reserved	CAN communication cable for main battery cabinet and secondary battery cabinet
Accessory 5	Cable assembly of parallel power supply	Reserved	Cluster parallel and cabinet parallel power cable

8. Terms

1. Cell

A battery cell

2. Battery module

A combination of multiple cells connected in series, parallel, or series-parallel, with a single pair of positive and negative output terminals, used as a power source.

3. Battery cluster

Multiple battery modules, a high-voltage box, and connecting cables form a complete battery cluster, which can independently complete the functions of energy transfer and self-protection.

4. Drum array

Multiple battery clusters form a battery array, and the energy transfer of subsequent clusters is managed by the BMS with the three-tier architecture.

5. Battery Management System (BMS)

An electronic device that controls or manages the electrical or thermal performance of a battery system.

Battery Management Unit (BMU)

Secondary Battery Management Unit (SBMU)

Main Battery Management Unit (MBMU)

Energy Management System (EMS)

6. Battery system

Energy storage devices, including the integration of battery modules or packs, battery management systems, high-voltage circuits, low-voltage circuits.

7. Battery capacity

The size of the battery storage capacity.

8. State of Charge (SOC)

The percentage of capacity that can be released from the cell, battery pack, or system under the conditions specified by the manufacturer compared to the actual capacity, also known as residual capacity.

9. State of Battery (SOH)

The deviation ratio between the actual battery performance and the normal design index.

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※Product dimensions and parameters are subject to change without notice.