USER MANUAL

Z BOX-P 5000-2H

Battery Container

P5015L2H-A-EU

Version: V1.0

Table of Contents

Safety Precautions

Cybersecurity Statement

- This chapter explains the safety precautions required for the correct use of this product. Before using this product, please read the product manual and correctly understand the relevant safety precautions. Failure to comply with the safety precautions may result in death, serious injury, or equipment damage.
- The "Danger", "Warning" and "Caution" items in this manual do not represent all the safety precautions that shall be observed, but are only supplementary to all safety precautions.
- This product shall be used in an environment that meets the design specifications, otherwise it may cause malfunctions. Functional exceptions or component damage caused by failure to comply with relevant regulations are not covered by the product quality guarantee.
- ZOE Energy Storage Co., Ltd. will not bear any legal responsibility for personal safety accidents, property losses, etc. caused by failure to comply with the contents of this manual or illegal operation of the product.

Definition of safety level

⚠ **DANGER**	indicates that death or serious injury will result if instructions are not followed.
⚠ **WARNING**	indicates that death or serious injury may result if instructions are not followed.
⚠ **CAUTION**	indicates that minor injury or equipment damage may result if instructions are not followed.

Settings of safety warning signs

⚠ **DANGER**

When performing installation, daily maintenance, inspection and other operations on the BESS, in order to prevent unauthorized personnel from approaching and causing misoperation or accidents, please comply with the following items:

- Set up obvious signs at the front and rear stage switches of the BESS to prevent accidents caused by misclosing.
- Set up warning signs or safety warning tapes near the operating area.
- After maintenance and inspection operations are completed, be sure to remove the container key and keep it properly.

Escape route requirements

⚠ **DANGER**

- During the entire process of maintenance, inspection and other operations on the BESS, ensure that the escape route is completely unobstructed.
- Do not pile debris in the escape route or occupy the escape route in any form.

Protection of energy storage battery

DANGER

- The voltage between the positive and negative poles of the energy storage battery pack is extremely high; if accidentally touched, there may be an electric shock or even life-threatening danger.
- There is fatal HV between the positive and negative poles of the energy storage battery. When maintaining the equipment, ensure that the energy storage converter (ESC) is completely disconnected from the energy storage battery.
- There is fatal HV between the positive and negative poles of the energy storage battery. Place warning signs at disconnect points to ensure they are not accidentally reconnected.

Safety Precautions

- The illustrations of the product in this manual sometimes show the product with its cover or safety cover removed in order to show product details. When using this product, be sure to install the outer cover or housing as specified and operate it in accordance with the instructions in the manual.
- The product illustrations in this manual are only examples and may be slightly different from the product you ordered. Please refer to the actual product ordered.

Unpacking and acceptance

WARNING

- If you find that the product and product accessories are damaged, rusted, or show signs of use when unpacking, please do not install it!
- If you find that water has entered the product, parts are missing or parts are damaged when unpacking, please do not install it!
- Please check the packing list carefully. If you find that the packing list does not match the product name, please do not install it!

CAUTION

- Before unpacking, please check whether the outer packaging of the device is intact and whether it is damaged, soaked, damp, deformed, etc.
- Please open the package in the order of the layers, and violent knocking is strictly prohibited!
- When unpacking, please check whether the surface of the equipment and accessories is damaged, rusted, or bruised.
- After unpacking, please carefully check the packing list to check whether the quantity and information of the equipment and accessories are complete.

Transportation and storage

WARNING

- Be sure to use professional lifting equipment and have large or heavy products handled by qualified professionals. Otherwise, there is a risk of injury or product damage!
- Before lifting the product vertically, please make sure that the front cover, terminal strip and other

product components are firmly fixed with screws. Otherwise, there is a risk of personal injury or product damage if the components fall off!

- When the product is lifted by lifting equipment, no one is allowed to stand or stay under the product.
- When lifting the product with a wire rope, please lift it steadily and at a constant speed. Do not subject the product to vibration or impact, do not overturn the product, and do not leave the product in a hoisted state for a long time. Otherwise, there is a risk of personal injury or product damage!

⚠ CAUTION

- When handling the product, be sure to lift it with care and pay attention to objects under your feet at all times to prevent tripping or falling. Otherwise, there is a risk of injury or product damage!
- When handling the product with bare hands, be sure to hold the product case firmly to avoid product components falling, otherwise there is a risk of injury!
- Please strictly follow the storage and transportation conditions required by the product for storage and transportation, otherwise there is a risk of product damage.
- Avoid storage and transportation in places with water splash, rain, direct sunlight, strong electric field, strong magnetic field, strong vibration, etc.
- Avoid product storage for more than 3 months. If the storage period is too long, please protect it more strictly and take necessary inspection procedures.
- Please package the product strictly before transporting it by vehicle. Closed boxes must be used for long-distance transportation.
- Do not transport this product together with equipment or items that may affect or damage the product.

During installation

⚠ DANGER

- Only professionals who have received relevant training on electrical equipment and have electrical knowledge can operate it. Operation by non-professionals is strictly prohibited!

⚠ WARNING

- Please be sure to read the product manual and safety precautions carefully before installation!
- Do not install this product in places with strong electric fields or strong electromagnetic wave interference!
- Before installation, please ensure that the mechanical strength of the installation location is sufficient to support the weight of the equipment, otherwise it may cause mechanical hazards.
- During installation, please do not wear loose clothes or accessories, otherwise there may be a risk of electric shock!
- When installing the product into a closed environment (such as a container or a chassis), please use a cooling device (such as a cooling fan or cooling A/C) to fully cool it to meet the installation environment requirements. Otherwise, the product may overheat or fire.
- Modification of this product is strictly prohibited!
- Do not twist the fixing bolts and red-marked bolts of product parts and components!
- When this product is installed in a container or terminal equipment, the container or terminal equipment shall have protection devices such as fireproof enclosures, electrical protection enclosures, and mechanical protection enclosures. The protection class shall comply with relevant IEC standards and local laws and regulations.

- When installing equipment with strong electromagnetic wave interference such as transformers, please install a shielding protection device to avoid malfunction of this product!
- Please install the product on flame-retardant objects such as metal, and do not allow flammable materials to come into contact with the product or attach flammable materials to the product, otherwise there is a risk of fire.

⚠ CAUTION

- When installing the product, please use cloth or paper to cover the air inlet and outlet of the product to prevent metal shavings, oil, water and other foreign matter from entering the product during drilling, causing product failure. After the installation, please remove the cover to prevent the cover from blocking the ventilation holes and affecting heat dissipation, causing the product to become abnormally hot.

When wiring

⚠ DANGER

- Non-professionals are prohibited from equipment installation, wiring, maintenance, inspection or component replacement!
- Before wiring, turn off the power supply to all equipment. After cutting off the power supply, there is residual voltage in the internal capacitor of the equipment. Please wait at least for the time specified on the warning label on the product before performing wiring and other operations. Measure the DC voltage of the main circuit and make sure it is below the safe voltage, otherwise there is a risk of electric shock.
- Please cut off the power supply before wiring, removing the product cover or touching the circuit board, otherwise there is a risk of electric shock.
- Please ensure that the equipment and the product are well grounded, otherwise there is a risk of electric shock.

⚠ WARNING

- Do not connect the input power to the output of the equipment or product, otherwise it may cause damage to the equipment or even cause a fire.
- The cables used during wiring must meet the requirements on wire diameter and shielding. The shielding layer of shielded cables must be reliably grounded at one end!
- Please tighten the terminal screws according to the tightening torque specified in the manual. Insufficient or excessive tightening torque may cause the connection part to overheat and be damaged, resulting in a fire hazard.
- After the wiring is completed, please make sure that all cables are connected correctly and there are no fallen screws, washers or exposed cables inside the product, otherwise there may be a risk of electric shock or damage to the product.

⚠ CAUTION

- Please follow the steps specified in the prevention measures for electrostatic discharge (ESD) and wear an electrostatic bracelet when performing wiring and other operations to avoid damaging the equipment or circuits inside the product.
- When wiring the control circuit, please use a shielded twisted pair (STP) wire and connect the

shielding layer to the ground terminal of the product for grounding. Otherwise, the product may operate abnormally.

During power-on

DANGER

- Before powering on, please confirm that the product is installed well and the wiring is secure.
- Before powering on, please confirm that the power supply meets the product requirements to avoid product damage or fire!
- Do not open the container door or protective cover of the product, touch any terminals of the product, or disassemble any device or component of the product while the power is on, otherwise there is a risk of electric shock!

WARNING

- After the wiring work and parameter settings are completed, please conduct a test run of the product to confirm that the product can operate safely, otherwise it may cause personal injury or equipment damage.
- Before powering on, please ensure that the rated voltage of the product is consistent with the mains voltage. If the mains voltage is used incorrectly, there is a risk of fire.
- Before powering on, make sure there are no people around the product or machinery, otherwise personal injury or death may result.

While running

DANGER

- Non-professionals are prohibited from operating the product, otherwise there will be a risk of personal injury or death!
- Do not touch any terminals of the equipment or disassemble any devices or parts of the equipment and product during operation, otherwise there is a risk of electric shock!

WARNING

- Do not touch the equipment housing, fan or resistor to test the temperature, otherwise it may cause burns!
- During operation, avoid other objects or metal objects falling into the equipment, otherwise it may cause fire or product damage!

During maintenance

DANGER

- Non-professionals are prohibited from equipment installation, wiring, maintenance, inspection or component replacement!
- No maintenance on the equipment is allowed when the power is on, otherwise there is a risk of electric shock!
- After cutting off the power to all equipment, please wait at least the time specified on the warning label on the product before performing equipment maintenance and other operations.

WARNING

- Please carry out daily and regular inspection and maintenance of the equipment and product in accordance with equipment maintenance and servicing requirements, and keep maintenance records.

During maintenance

DANGER

- Non-professionals are prohibited from equipment installation, wiring, maintenance, inspection or component replacement!
- No maintenance on the equipment is allowed while the power is on, otherwise there is a risk of electric shock!
- During maintenance, be sure to shut down the equipment and confirm that the ESS has stopped running before performing maintenance or inspection operations on the equipment.
- After cutting off the power supply to all equipment, please wait at least the time specified on the warning label on the product before performing equipment inspection, maintenance, etc.
- Even if all external circuits are disconnected, HV still exists between the positive and negative poles of the energy storage battery pack. Some parameters need to be measured with special instruments by professionals while the product is powered on.
- Do not modify the internal equipment of the battery system to avoid danger.

WARNING

- Please report equipment for repair in accordance with the product warranty agreement.
- When the fuse blows, the circuit breaker trips, or the earth leakage circuit breaker (ELCB) trips, please wait at least for the time specified on the warning label on the product before turning on the power or operating the product. Otherwise, personal injury or death and equipment damage may result.
- When the equipment malfunctions or is damaged, professionals must follow the maintenance instructions to troubleshoot and repair the equipment and product, and keep maintenance records.
- Please follow the replacement instructions to replace the product wearing parts.
- Do not continue to use a damaged product, otherwise personal injury or greater damage to the product may result.
- After replacing the equipment, be sure to re-check the equipment wiring and parameter settings.

When scrapped

WARNING

- Please scrap the equipment and product in accordance with relevant national regulations and standards to avoid property losses or casualties!
- Scrapped equipment and product shall be processed and recycled according to industrial waste treatment standards to avoid environmental pollution.

Safety signs

In order to ensure safe operation, please be sure to abide by the safety signs affixed to the equipment, and do not damage or peel off the safety signs. The safety signs are explained as follows:

Safety signs	Content description

	There is HV in the container. Be sure to cut off all power supplies before maintenance. After waiting for 35 min, professionals can only operate after confirming that the capacitors and other energy storage devices in the equipment have no power.

1 Terms and abbreviations

Table1 Terms and abbreviations

No.	Terms and abbreviations	Descriptions
1	ZOE	ZOE Corporation Limited
2	ZESS	ZOE Energy Storage System
3	BMS	Battery Management System
4	BAMS	Battery Array Management System
5	BCMU	Battery Cluster Management Unit
6	BMU	Battery Management Unit
7	MSD	Manual Service Disconnector
8	CAN	Controller Area Network
9	BOL	Begin of Life
10	EOL	End of Life
11	SOC	State of Charge
12	SOE	State of Energy
13	SOH	State of Health
14	SOP	State of Power

2 Product information

2.1 Product appearance and size

The name of the system and ZOE's LOGO are screen-printed on the front of the liquid-cooled Battery Energy Storage System (BESS). Nameplates and safety signs are set on the housings of the system and its internal electrical devices. The nameplates and signs meet the requirements of the technical specifications. (The final effect is subject to proprietor confirmation)

Fig.1 Diagram of the BESS Structure Scheme

The container layout is shown below. The electrical room mainly includes the isolated switch (disconnected during maintenance, and an obvious disconnect point can be seen), fuse (provides short circuit protection to prevent further damage to the equipment), liquid cooling unit (keeps the equipment and components working at the appropriate temperature), and fire control panel (gives early warning and takes corresponding measures when detecting combustible gas). The specific location is marked in the figure.

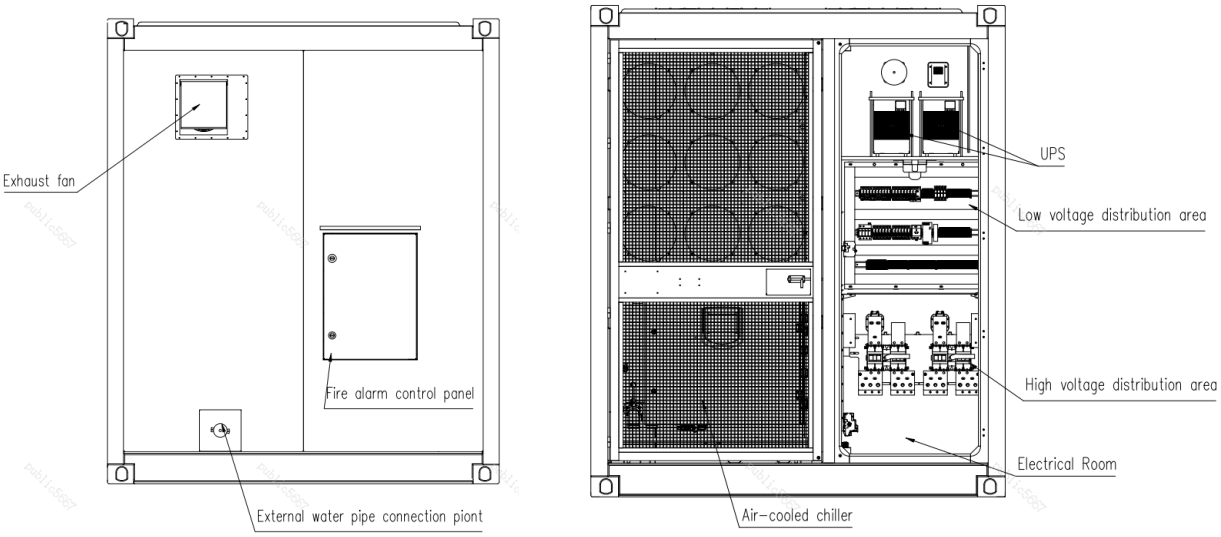
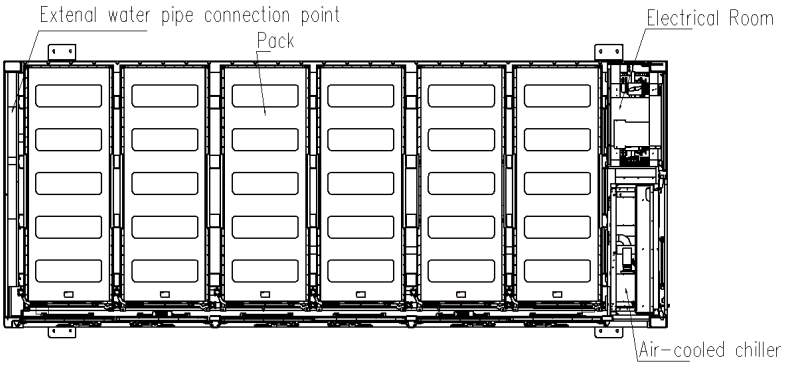


Fig.2 Layout of electrical room and fire suppression system

The container layout is shown below:

Each 1P416S is composed of 4 PACK by series and each 2P416S cluster shares a high voltage box, each PACK is composed of 104 cells in series. 2P416S as a cluster, 3 clusters in the electrical room are connected into a stack,two battery stacks in total ， rated voltage 1331.2V. The specific position is shown in Figure 3.



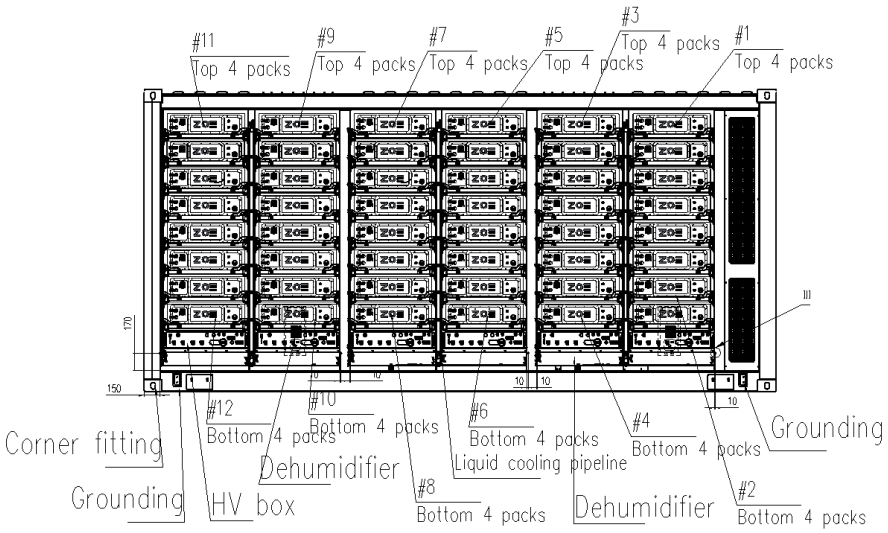


Fig.3 Container Layout

The 3D view of the BESS is as follows:

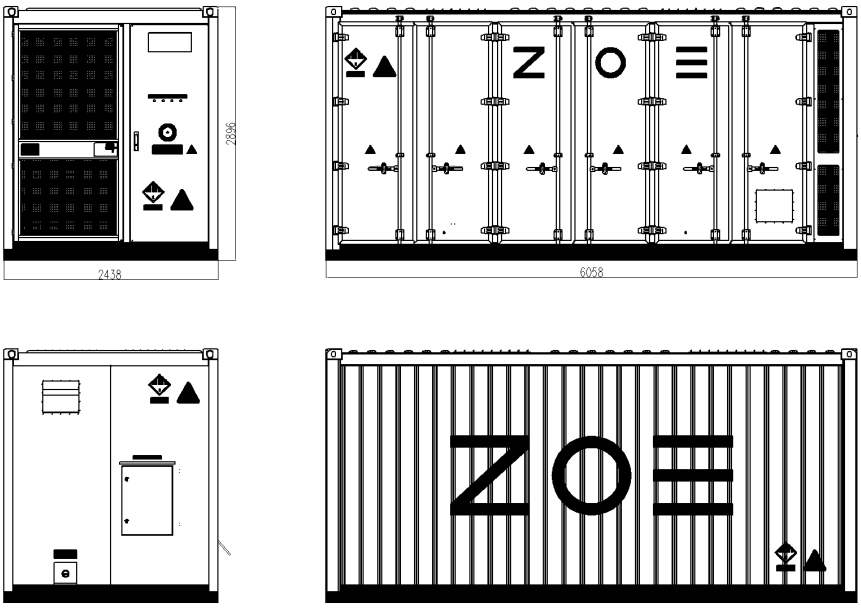


Fig.4 Appearance and Installation Dimensions

2.2 Nameplate description

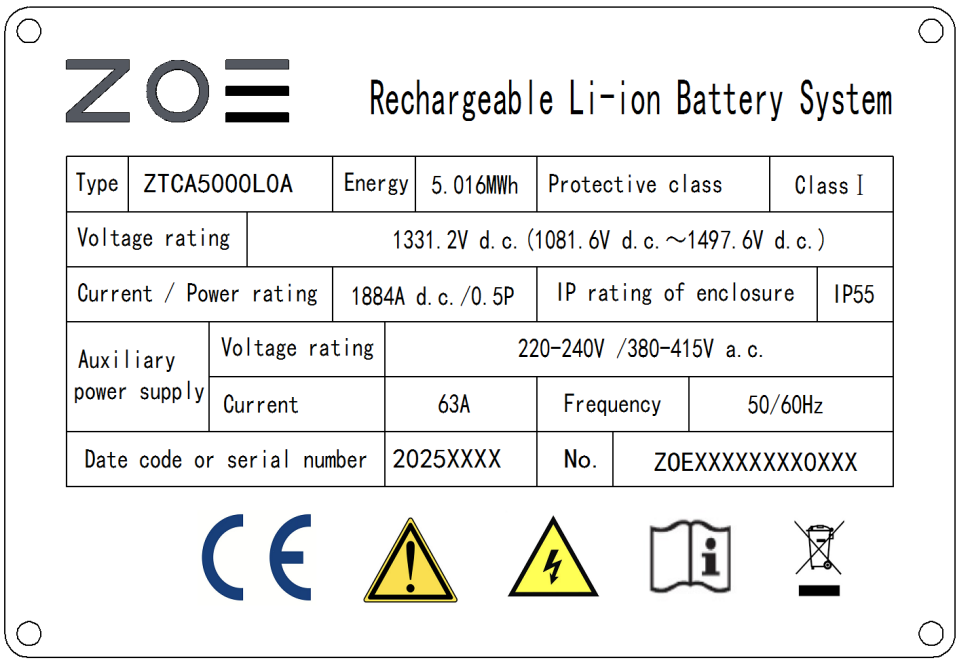


Fig.5 Nameplate Description Diagram

2.3 Product specifications

Table2 System Configuration

	Series connection and parallel connection	Energy	Remarks
Battery pack	1P104S	104.4992KWh	Cell 314Ah/3.2V
Battery cluster	1P416S2P	835.992KWh	
Battery stack	3 clusters are connected in parallel	5015.9616kWh	2 stacks

The equipment composition of the BESS system is shown in the table below

Table3 System configuration

SN	Item	Model Specification	Qty.	Remarks
1	Battery cluster	1P416S2P/314Ah/1331.2V	6 sets	Contains HV box
2	（BMS） Battery management system (BMS)	Slave control BMU, master control BCMU, central control (including display screen)	1 set	
3	Electrical room	DC1500V	1 set	The main circuit is equipped with fuses+disconnecting switch, and the auxiliary power circuit includes BESS power distribution, UPS, etc.
4	TMS	60kW Liquid-cooled unit, pipeline and dehumidifier	1 set	
5	Automatic fire suppression system (including automatic early warning system)	Fully submerged aerosol fire extinguishing system, automatic detection, alarm, fire extinguishing, explosion venting, exhaust, equipped with water immersion	1 set	
6	Lighting device	Explosion-proof lamp	1 set	
7	Connecting cable, control cable	Flame retardant cable	1 set	
8	Video monitoring	Semi-spherical explosion-proof camera	1 set	
9	BESS	BESS 20 feet	1 set	

2.4 BESS

The BESS consists of 6 clusters. 3 clusters form a stack.BESS has 2 stack，Each battery cluster consists of 8 PACK, with 1 HV box shared by every 2P416S cluster. Each PACK consists of 104 cells connected in series, 2P416S is a cluster, 6 clusters are connected in parallel in the bus area, and the rated voltage is 1331.2V.

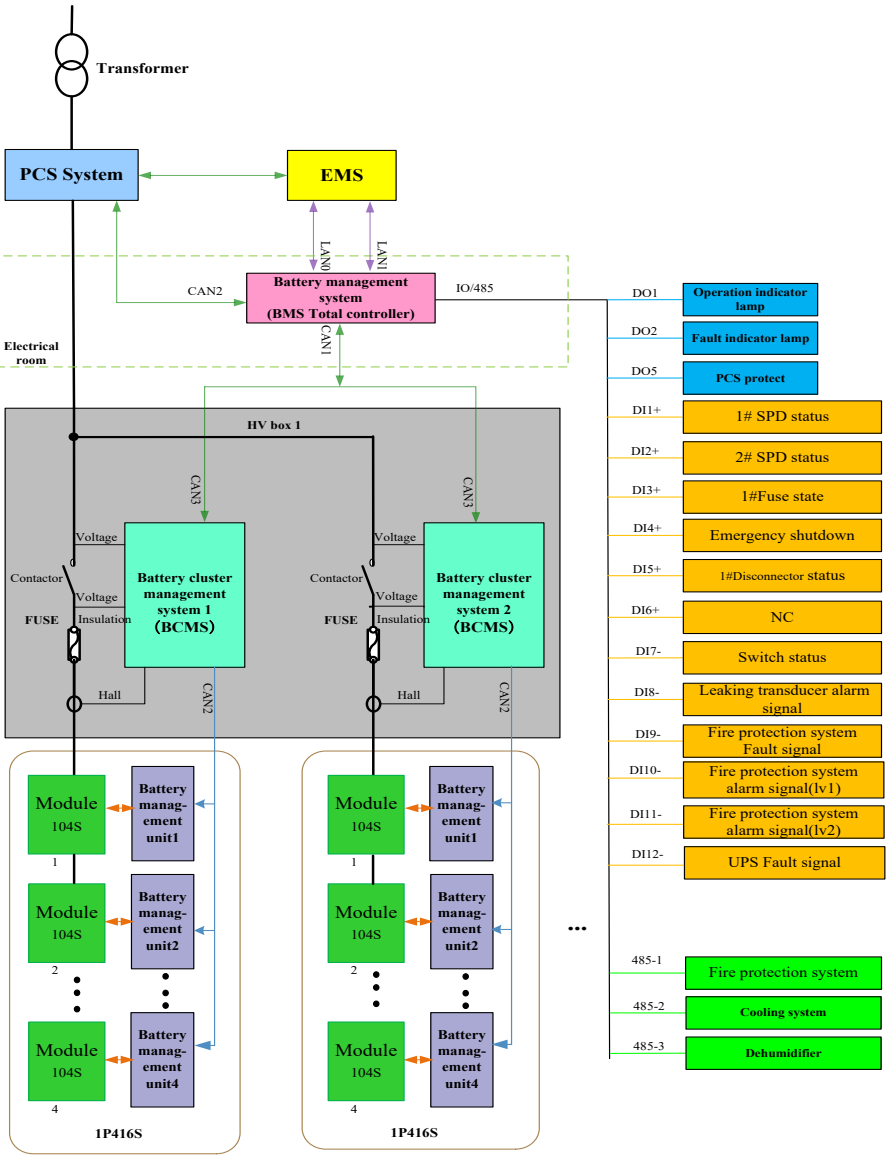


Fig.6 Circuit frame diagram 1

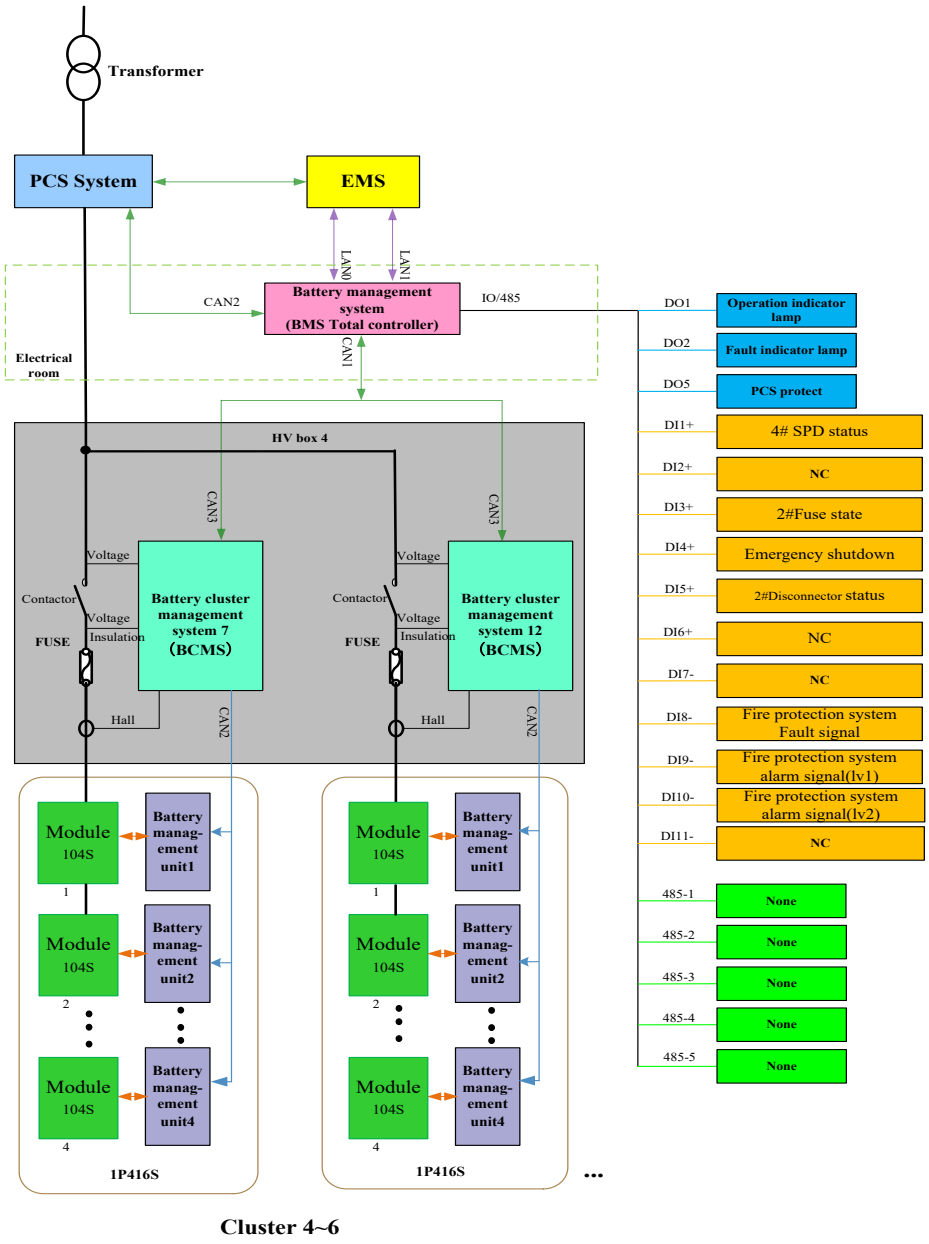


Fig.7 Circuit frame diagram 2

Table4 BESS Cluster Parameters

Item	Parameter	Remarks
Cell type	Lithium iron phosphate battery	
Cell specifications	314Ah/3.2V	
Rated voltage	DC1331.2V	
System capacity	628Ah	
Rated discharge ratio	0.5P	

Nominal capacity	417.996kWh*2	Rated discharge ratio
Energy efficiency	≥92%	Rated rate (discharge energy/discharge Ah)/(charge energy/charge Ah)

2.4.1 Battery Pack

This Battery Pack is a liquid-cooled PACK, with compact structure and high energy density, and its protection class is IP67.

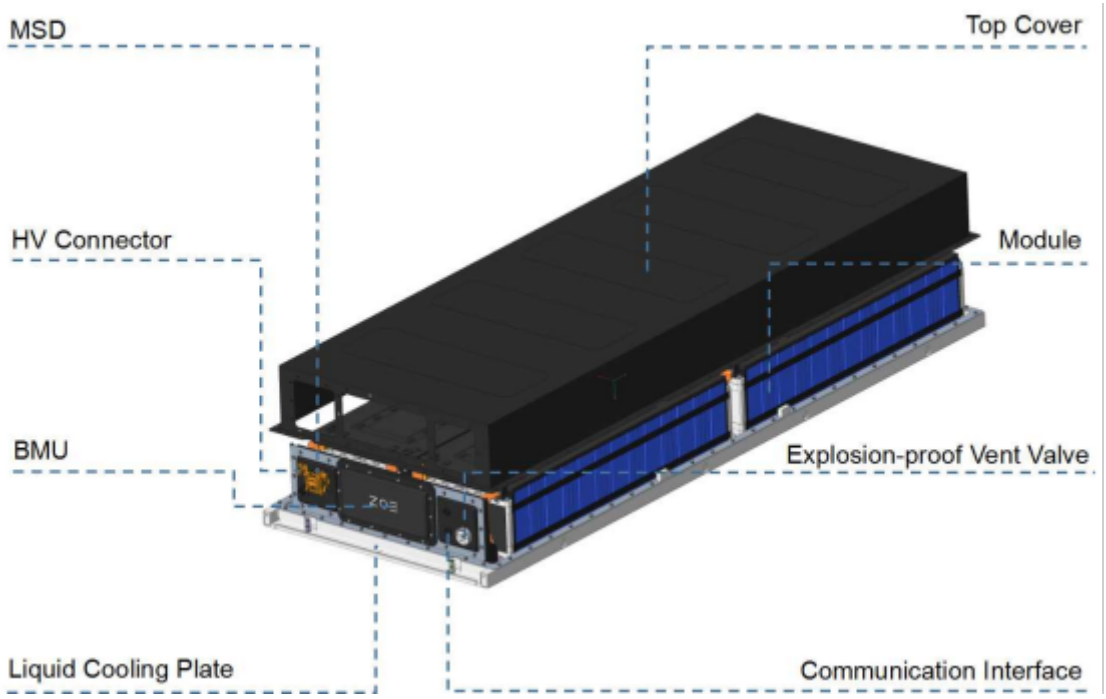


Fig.8 3D Diagram of Battery Pack

Configuration: The liquid-cooled battery pack consists of the combination of 3.2V/314Ah cells through 1P104S. The rated specifications are 332.8/314Ah. The battery pack is configured with components such as a liquid-cooled plate, battery module, a slave control module, a positive and negative pole connector, and a top cover.

Table5 Battery Pack Technical Parameters

No.	Item		Specifications	Remarks
1	Cell Parameters	Rated capacity	314Ah	
2	Battery Module	Configuration	1P104S	
		Rated capacity	314Ah	
		Nominal energy capacity	104.499kWh	
		Rated voltage	332.8V	
		Rated charge/discharge rate	0.5P	

No.	Item		Specifications	Remarks
		Operating voltage range	270.4V~374.4V	Cell operating voltage: 2.6~3.6V
		Weight	Approx. 670±15kg	
		Size	794±2*2210±2*240±3	W*D*H(mm)

2.4.2 HV box

The energy storage HV box is an intermediate unit that connects the battery pack and the bus control area to control cluster-level units. The energy storage HV box is installed a switch disconnector with a manual operating handle. It is also equipped with a main positive contactor, a main negative contactor, a circulation control circuit, a fuse, a master control unit BCMU, a switching power supply, etc. The energy storage HV box fully considers the electrical characteristics, heat dissipation performance, waterproof performance, safety performance and operability and maintenance of each component. The space layout is reasonable, and it has the characteristics of compact structure, flexible configuration, safety and reliability. The energy storage HV box has a DC24V power supply interface, CAN communication interface, etc. to realize data communication, control and protection of the BMS.

- AC230V power supply;
- Supporting CAN communication;
- Monitoring status of switch disconnectors, fuses and main positive and main negative contactors, and reliable breakpoint maintenance;
- Power indicator and system fault indicator for product status visualization;
- Collecting the total voltage and current of the battery cluster;
- Controlling circulation current of battery cluster;
- Judging whether the main circuit contactor is disconnected or closed;
- HV quick plug-in for fast, safe and reliable connection;
- High protection with protection class of IP55.

Definitions of HV box external interfaces:

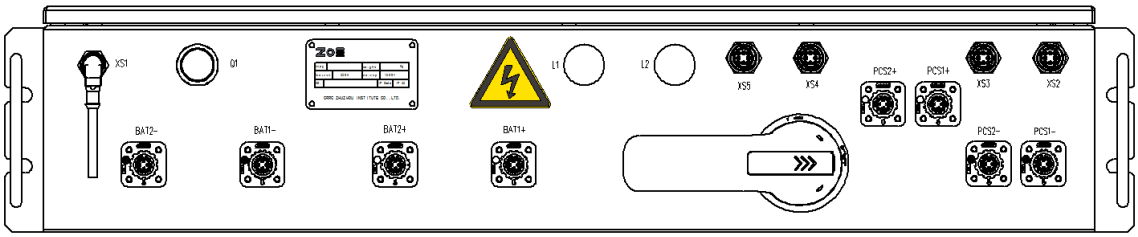


Fig.9 Panel Diagram of HV Box

The main interfaces on the HV box panel are illustrated as follows:

Table6 Main Interface Functions of HV Box Panel

SN	Interface Name (Printed)	Main Function	Remarks
1	BAT1+	Positive terminal for 1# battery PACK	
2	BAT1-	Negative terminal for 1# battery PACK	
3	BAT2+	Positive terminal for 2# battery PACK	
4	BAT2-	Negative terminal for 2# battery PACK	
5	PCS1+	Positive terminal for 1# external output	
6	PCS1-	Negative terminal for 1# external output	
7	PCS2+	Positive terminal for 2# external output	
8	PCS2-	Negative terminal for 2# external output	
9	QS1	Switch on/off the main circuit	
10	Q1	Power button	
11	L1	Error indicator	Red
12	XS1	Power supply interface	
13	XS2	HV box - 1# PACK communication power interface	
14	XS3	Debugging interface	
15	XS4	HV box - 2# PACK communication power interface	
16	XS5	Inter-cluster communication power interface	

3 Storage and handling

3.2 Inspection after receipt

Inspect the following items after receiving the product:

Table7 Inspection after receipt

SN	Inspection item	Completion status
1	Check whether the outer packaging of the product is intact and whether it is damaged, soaked, damp, deformed, etc.	☐
2	When receiving goods from the transportation company, be sure to carefully inspect the product, check each piece of received goods against the supply list, and confirm that the ordered product options are complete. If the goods are missing or damaged, inform the transportation company immediately upon discovery.	☐
3	The nameplate information is consistent with the product model ordered.	☐
4	Please check the surface of the product and product accessories for damage, scratches, dents, etc.	☐
5	The warning labels are not damaged, scratched, or blurred.	☐

⚠ CAUTION

When removing the packaging, please open the packaging in the order of the layers, and violent knocking is strictly prohibited!

3.2 Storage

- The equipment must be placed in a clean and dry space and avoid being exposed to water splash, rain, humidity, high temperature or outdoor environment.
- There are no harmful gases, flammable and explosive products and corrosive chemicals in the storage space.
- When stored for a long time, the module must be covered or corresponding measures must be taken to ensure that the module is not affected by contamination and the environment.
- Avoid mechanical impact, heavy pressure, strong electric fields and strong magnetic fields.
- Avoid direct sunlight, keep the distance ≥2m from heat sources, and the packaging box shall be placed ≥20cm high off the ground, and ≥50cm away from walls, windows or air inlets.
- The BESS is considered to be in storage state when it has not been charged or discharged for more than 10 days, you are advised to recharge it to 30% to 50% SOC.

⚠ CAUTION

- Under the above specified conditions, products stored for more than 3 months must be recharged once.
- Under the above-mentioned conditions, products stored for more than 6 months must undergo capacity verification tests.

- Under the above-mentioned conditions, products stored for more than one year must be re-inspected and can only be used after qualified.

3.3 Handling

CAUTION

- Please package the product strictly before transporting it by vehicle. Closed boxes must be used for long-distance transportation.
- Do not transport this product together with equipment or items that may affect or damage the product.

CAUTION

Operators handling the product must be trained and qualified to handle it.
Please use flexible slings or straps. A single strap must be able to withstand a weight greater than 50t.

CAUTION

- Perform a test lifting to confirm that the straps can bear the weight of the BESS and there is no tilt when lifting.
- The hook position needs to be at the center of gravity.
- After lifting, the swing angle must be less than 10°.
- Before handling, make sure the door lock is locked to avoid injuries caused by sudden opening during handling.
- Lifting and landing shall be handled with care to avoid shock or vibration.

CAUTION

- When handled with equipment, wooden pallets must be used. Modules can only be laid flat and cannot be handled upside down or sideways.
- When lifting with a crane, the hanging rope must not touch the container.

Description

- Flexible slings or straps are used as hanging ropes, and the hook shall be at least 3m away from the top of the container.
- Confirm that a single strap can withstand a weight of not less than 50t, and the inclination of the container does not exceed 10°.

4 External cable

See cable inventory

5 Water fire suppression system installation

The water fire suppression system uses water immersion and consists of DN65 pipe and DN65 quick connector. The thread specifications of the quick connector are 2.5" NH external thread (US version) and 2.5" BSP external thread (European version). The water flow at the inlet must meet the requirements of certain pressure and flow.

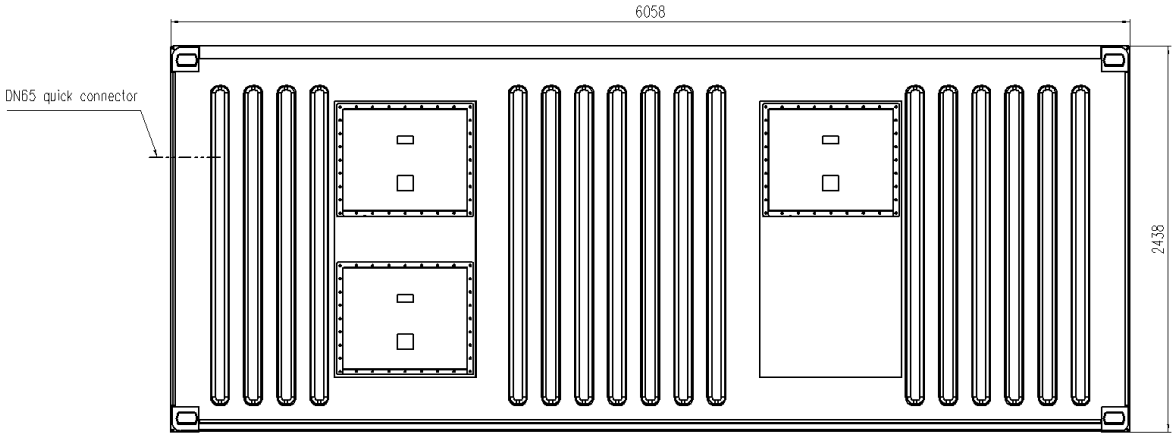


Fig.10 Water fire interface diagram

6 Machinery installation

6.1 Safety tips

During installation, ignoring the following safety tips may result in equipment damage, personal injury or serious casualties. Please strictly abide by the following safety tips.

⚠ DANGER

- Installation must be performed correctly by professionals who follow all warnings.
- Before installation, please ensure that the mechanical strength of the installation location is sufficient to support the weight of the equipment, otherwise it may cause mechanical hazards.
- During installation, please do not wear loose clothes or accessories, otherwise there may be a risk of electric shock!

⚠ CAUTION

- To facilitate installation and maintenance, you are recommended to leave sufficient space around the equipment: Adequate cooling airflow, necessary clearances, space for cables and cable support structures.
- Please ensure that any spanning components or racks in which components are installed are properly grounded and that the connecting surfaces are not painted.
- Nickel plated copper is recommended, but aluminum can also be used.
- Before connecting the aluminum busbars, remove the oxide layer and apply a suitable antioxidant caulking compound.

6.2 Preparation before installation

6.2.1 Requirements for Installation Environment

Table8 Requirements for Installation Environment

Item	Environment requirements
Installation site requirements	● Good ventilation must be maintained. ● The air inlet and outlet must be professionally protected against rain, wind, sand and dust. ● There must be no trees around the installation location to prevent strong winds from blowing down branches or leaving leaves blocking the product door or air inlet. ● There must be necessary fireproofing, waterproofing and rodent-proofing. ● Stay away from areas where toxic and harmful gases are concentrated. ● Keep away from flammable, explosive and corrosive items.
Foundation requirements	● The installation surface must be flat and dry, and water accumulation

	on the ground is strictly prohibited. ● The ground level does not shake and can bear the weight of the BESS.
Space requirements	Sufficient space must be left on the front, rear, left, right and top of the BESS for heat dissipation, maintenance and escape.
Altitude	2000m, non-standard processing for high-altitude（>2000m ）models
Relative humidity	0%~95%。 0%~95%.

CAUTION

The intrusion of moisture can easily cause damage to the energy storage terminal! To ensure the normal use of energy storage terminals:

- Do not open the container door when the air humidity is 95%.
- Avoid opening the container door, performing maintenance or inspection in rainy or humid weather conditions.

6.2.2 Installation site requirements

Foundation requirements

The BESS must be installed on concrete or other non-combustible surfaces. The installation surface must be level, firm, flat, and have sufficient bearing capacity. No dents or inclinations are allowed.

When building the foundation, consider the outlet of the BESS and reserve trenches, entrance and exit holes and maintenance channels. For mounting hole positions, see the following figure.

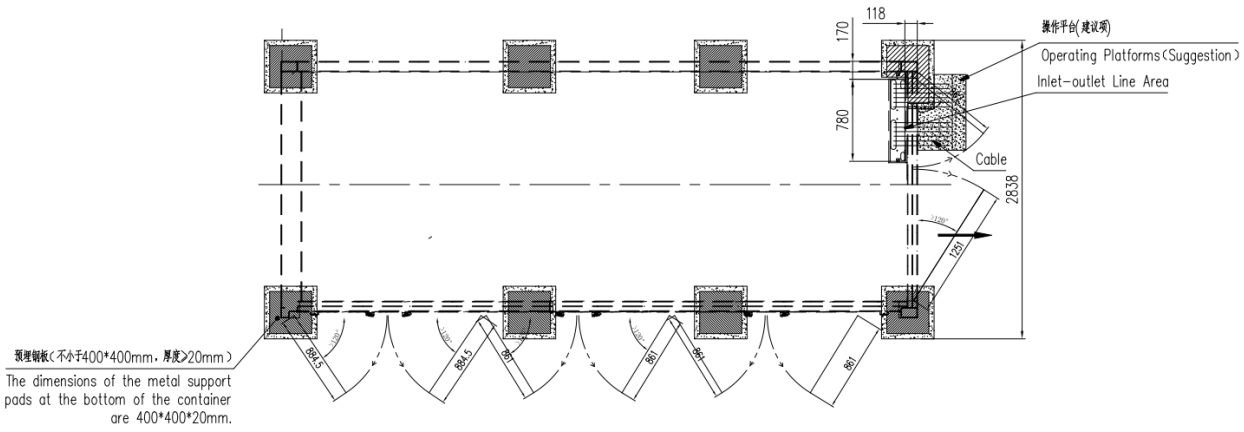


Fig.11 Mounting Hole Positions in Columns (Unit: mm)

Description

- The following foundation drawings cannot be used as final construction drawings and are for reference only.
- During construction, ensure that the bottom of the equipment is higher than the local historical highest water level.
- The equipment (including height, embedded parts, wiring pipes, etc.) is adjusted in combination with processes and on-site status.

- The top elevation of the equipment foundation can be adjusted according to the actual needs of the equipment and site.

Trench requirements

The BESS adopts cable entry from bottom. In order to prevent foreign objects from entering, there is no cable entry hole on the side of the BESS, and the cable must be entered through the trench. Therefore, trenches need to be preset on site. Trenches must meet the following requirements:

- Since the BESS adopts cable entry from bottom, the trench must have the necessary dust-proof and rodent-proof design to prevent foreign objects from entering.
- Necessary waterproof and moisture-proof design is required in the trench to prevent cable aging and short circuit, which will affect the normal operation of the BESS.
- Since the BESS has a large power and requires thick cables, the trench design shall fully consider the cross-sectional area of the cables.

6.2.3 Installation space requirements

Installation of a single BESS

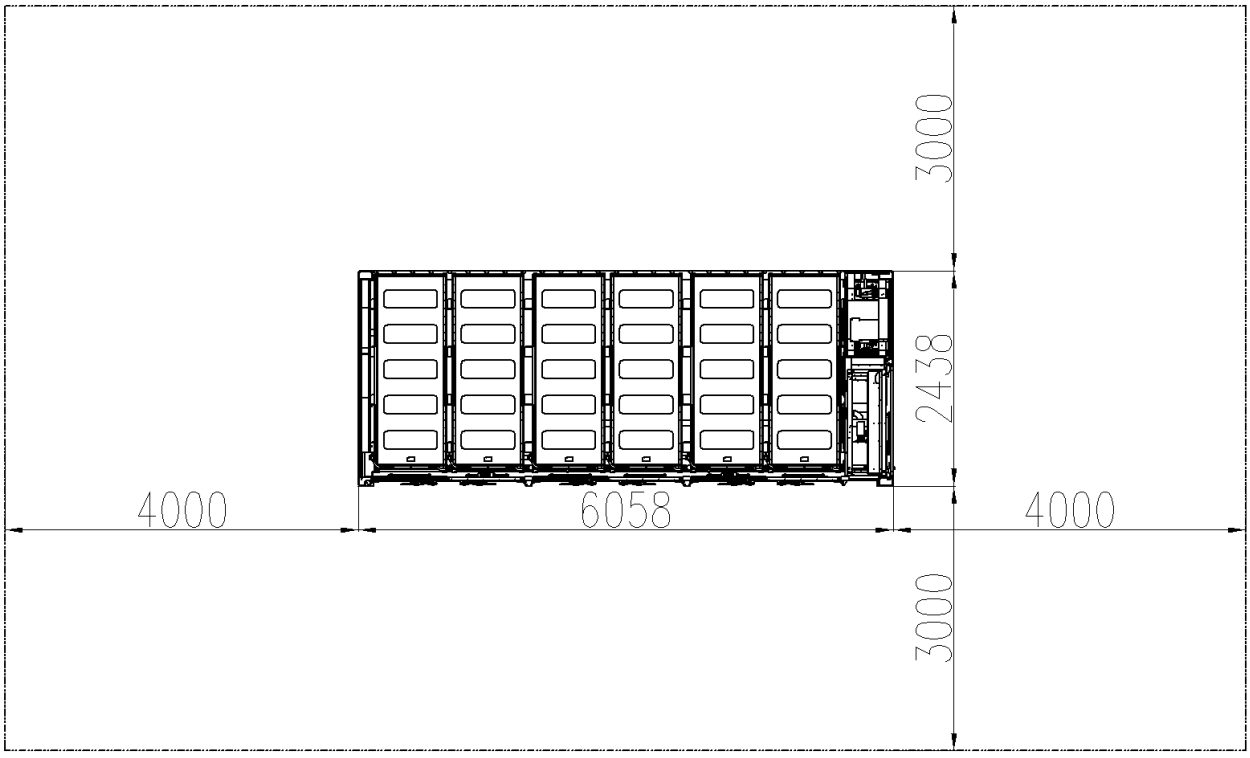


Fig.12 Schematic Diagram of Installation Space Requirements for a Single BESS (Unit: mm)

6.2.4 Preparation of installation tools

Table9 List of Mechanical Installation Tools

Tools	Qty.	Instructions for Use (IFU)
Crane (Tonnage not less than 80 tons)	1	For indoor and outdoor handling

6.3 Installation of BESS

1. Prepare a grinding machine and a welding machine, prepare a level and stainless steel pads.

2. Use a level to confirm whether the flatness deviation of the upper end of the concrete foundation meets the requirements, and use pads to level the out-of-tolerance areas.

3. Handle the energy storage module to the installation location.

4. Continuously weld and fix the bottom of the container and the embedded steel parts on the concrete foundation, and take anti-rust measures after welding.

CAUTION

- Handle the BESS with care.
- When placing the BESS, confirm that there is no dent in the installation plane and that there are no signs that the foundation cannot bear the weight of the BESS.

6.3.1 Hoisting

(1) When hoisting, a crane is used to hoist the battery compartment to the designated position by a single crane. The hoisting diagram is shown in Figure 13.

(2) The lifting spreader shall use the special lifting spreader for the 20-foot container and connect it with the corner piece of the cabin body through the locking pin mechanism (each locking pin mechanism corresponds to one corner piece, as shown in the following hoisting diagram). Before lifting, test lifting shall be carried out and the hook position shall be adjusted to ensure the vertical lifting of the top four corner pieces.

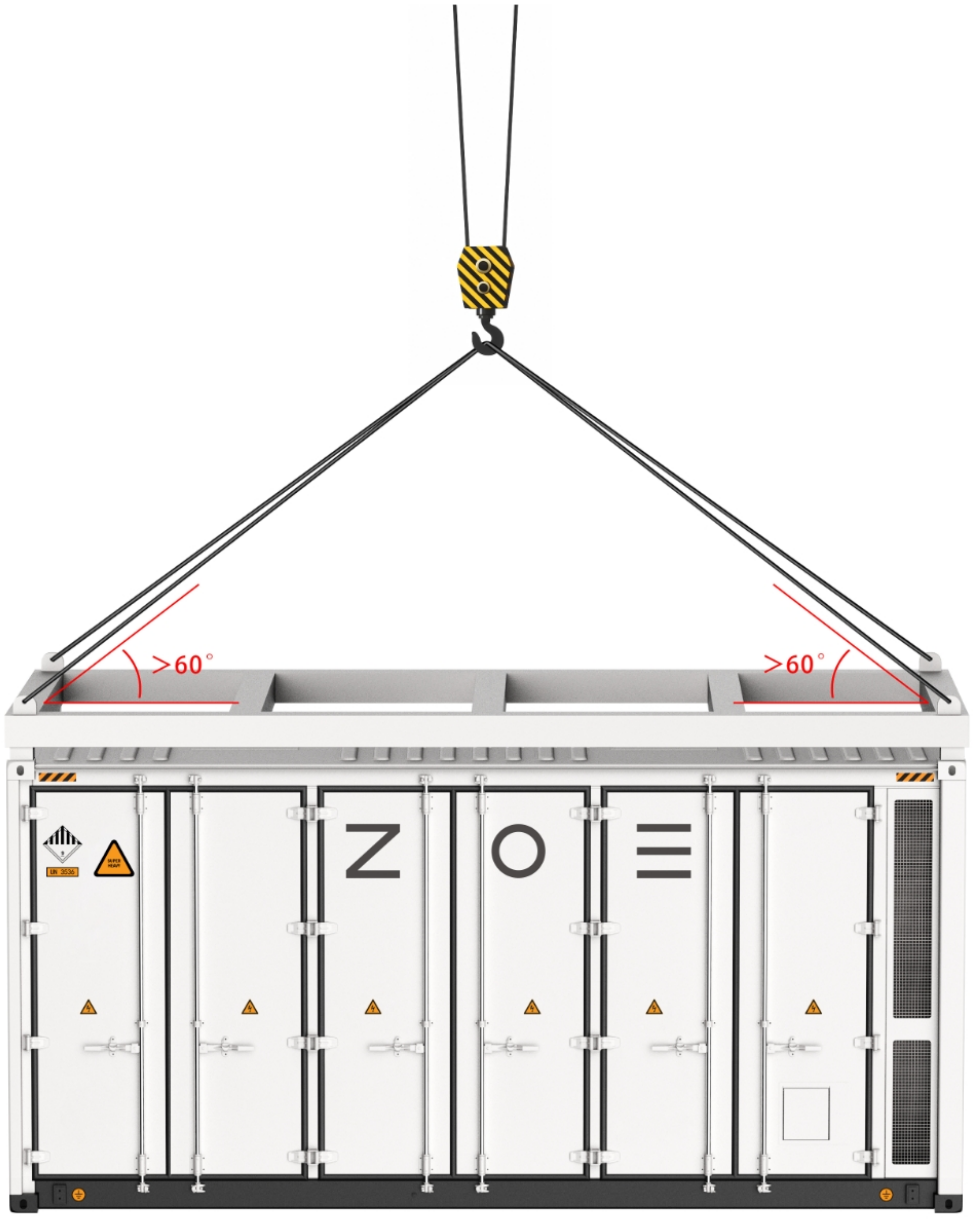


Fig.13 Hoisting diagram

6.3.2 Post-installation inspection

After the installation is completed, please check item by item according to the table below and tick the items that meet the requirements.

Table10 Checklist after Installation of BESS

No.	Items to be confirmed	Disposal measures	Confirmation
1	The BESS is installed in a pre-designed position according to regulations.	If there is a deviation in the position, make adjustments.	☐
2	The flatness deviation of the bottom of the BESS meets the requirements	If the flatness deviation is large, use pads to level it.	☐
3	The space around the BESS meets the	If there is insufficient space, the	☐

	requirements	position of surrounding obstructions needs to be adjusted.	

7 Electrical installation

Table11 Main External Electrical Interfaces

No.	Interface Definition	Wire connection point	Description
1	DC1500V+	Positive copper bar in the bus area	XT2- (fixed with M16 bolt)
2	DC1500V-	Negative copper bar in the bus area	XT2- (fixed with M16 bolt)
3	DC1500V+	Positive copper bar in the bus area	XT4+ (fixed with M16 bolt)
4	DC1500V-	Negative copper bar in the bus area	XT4- (fixed with M16 bolt)
5	1500V armored cable grounding	Grounding bar in the bus area	PE bar (fixed with M8 bolt)
6	AC400V	Terminal strip in the bus area	Terminal strip XT1:1-XT1:4, XT1:PE (C45 blade terminal can be used)
7	AC230V	Terminal strip in the bus area	Terminal strip XT1:5-XT1:6,XT1:PE (C45 blade terminal can be used)
8	Video network output	camera in the bus area	RJ45
9	BMS data network	BMS central control in the bus area	RJ45
10	BMS and PCS -CAN	Terminal strip in the bus area	XT7:4, 5, 6 uses tubular terminals to access the terminal strip

11	BMS and PCS2 -CAN	Terminal strip in the bus area	XT8:32, 33, 34 uses tubular terminals to access the terminal strip
12	Emergency stop dry contact	Terminal strip in the bus area	XT6:27, 28 uses tubular terminals to access the terminal strip
13	Emergency stop dry contact	Terminal strip in the bus area	XT8:27, 28 uses tubular terminals to access the terminal strip

The locations of external wiring and ground points in the electrical room are shown in Figure 14.

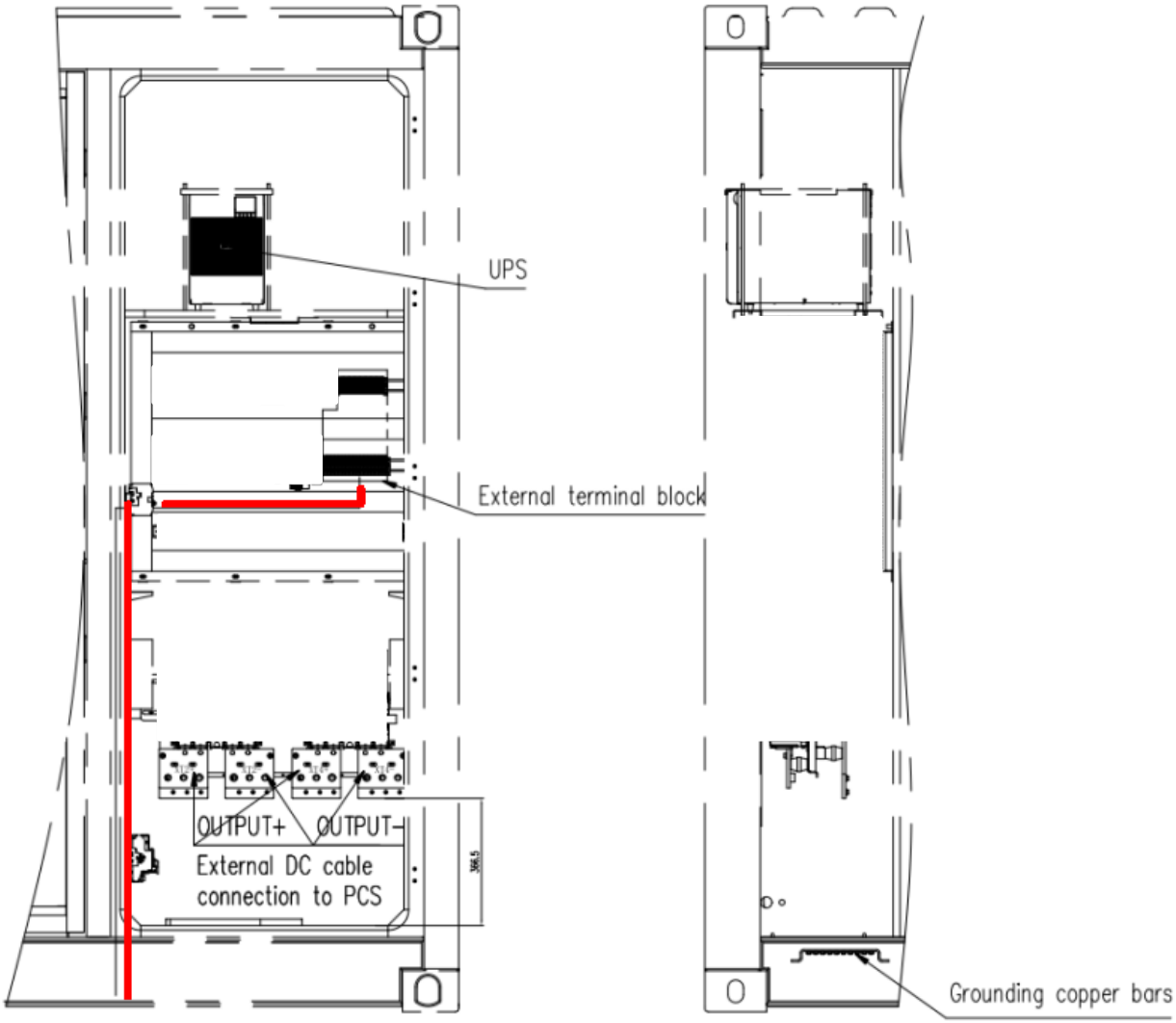


Fig.14 Schematic diagram of external cable connections in the electrical

Wiring steps for main circuit DC cable:

Step 1 Confirm that all output switches in the front and rear stages of the bus control area are in the off state.

Step 2 Peel off the insulation at the end of the cable. The length of the insulation at the end of the cable shall be the depth of the crimping hole of the wiring copper nose plus about 5mm.

Step 3 Crimp the wiring copper nose. Equip a suitable wiring copper nose according to the selected cable specifications.

(1) Place the exposed copper core of the stripped wire into the crimping hole of the wiring copper nose.

(2) Use a terminal crimping machine to crimp the wiring copper nose. The number of crimps shall be more than two.

Step 4 Heat shrink tubing.

(1) Select a heat shrink tubing that is consistent with the size of the cable. The length shall exceed the crimping tube of the wiring copper nose by about 2cm.

(2) Sleeve the heat shrink tubing on the copper wiring nose so that it completely covers the crimping hole of the copper wiring nose.

(3) Use a hot dryer to tighten the heat shrink tubing.

Step 5 Wiring

(1) Select screws that match the wiring copper nose.

(2) Crimp the wiring copper nose to the DC wiring copper bar.

The battery container is provided with 2 ground points on both sides of the body. The ground point can be reliably grounded with appropriate bronze plates or cables, as shown in the figure:

Fig.15 Ground point introduction and position diagram

8 Debugging and running

8.1 Check

Inspection before power-on:

1. Check whether the DC switch disconnector and 230VAC power supply switches on the HV box panel are disconnected;

2. Check whether the main circuit cable is reversely connected;

8.2 Power-on procedures

1. Close the QF1 (auxiliary power circuit master switch) circuit breaker in the bus area, then open QF2 to QF11 in the bus control container in sequence, and press and hold the UPS switch to start the UPS;

2. Manually close the DC switch disconnector in the HV box of each cluster to the "ON" position; close the 230VAC power supply switch Q1 in the HV box of each cluster, and observe the Q1 operation indicator of the HV box. If the green light is on, then the power supply is normal. In addition, if the red light of the fault indicator L1 is on, then there is a fault in the system, including hardware failure, internal communication failure, battery failure, etc.;

3. After the battery cluster is powered on, the BMS central control automatically issues a closing relay command to the BMS master control in the stack. After the BMS master control self-check is completed, the main positive and main negative relays will be closed. The DC busbar of the 6 battery clusters were successfully powered on, and there is no fault (as shown in the following figure). The system display shows that the status is "Normal". Observe that the relay status is closed. The product is powered on completely, and it enters the state of charging and discharging.

8.3 Shutdown procedures

8.3.1 Normal shutdown

Operation method: Issue the relay disconnection command through the BMS central control screen to check whether the system shuts down normally and the relay disconnects normally.

8.3.2 Emergency shutdown

Operation method: Press the emergency stop switch on the bus area to quickly disconnect the system.

9 Software debugging and upgrade

9.1 Debugging tool

Before online monitoring, the host computer and master or slave control should be connected first. See section 2.4 for specific CAN communication points.

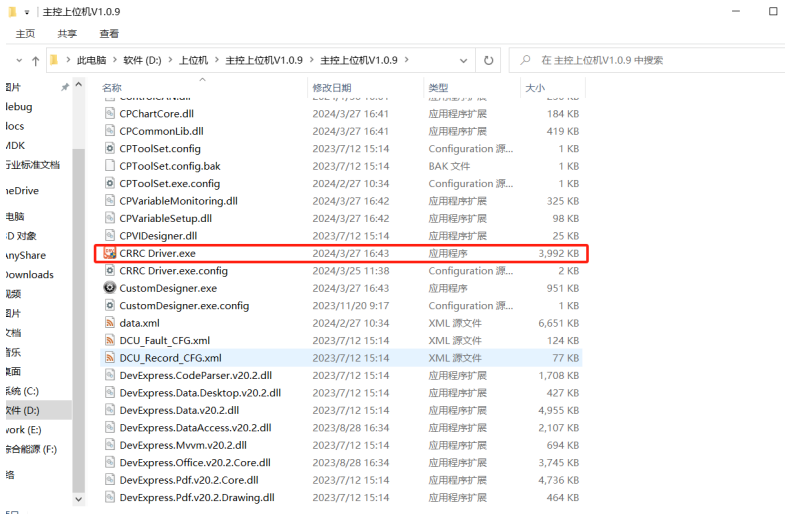


Fig. 16 Debugging master

Click on the folder "Master PC" and find the PTU PC: ZOE Driver.exe.

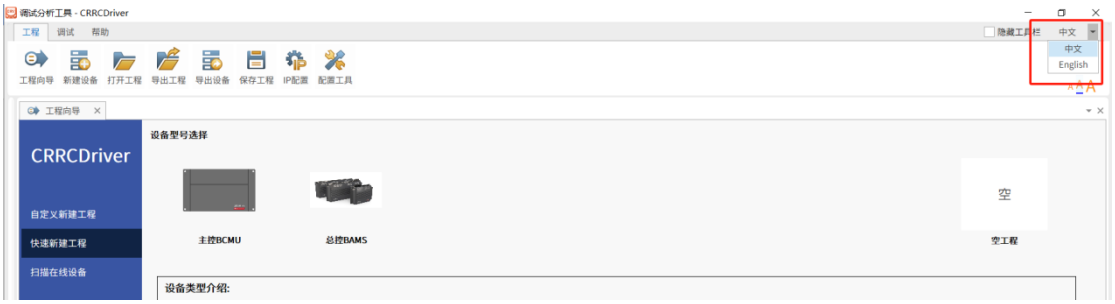


Fig.17 Main interface

Open the host computer, click the "Project" TAB, and click "Open Project" in the drop-down bar.

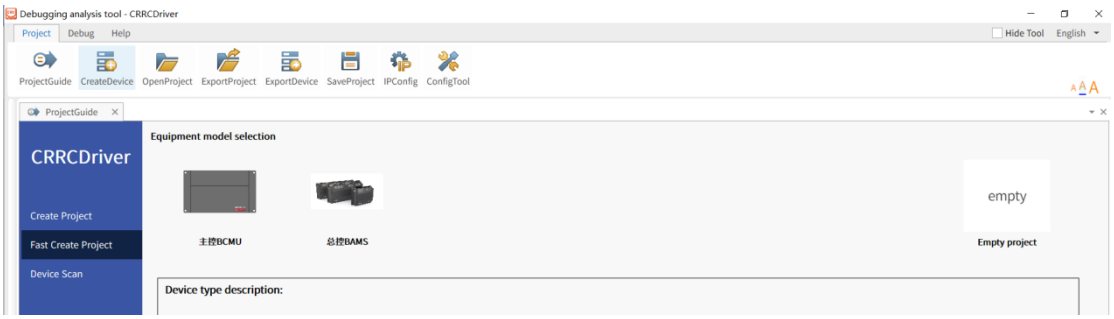


Fig.18 Main interface

In the dialog box that is displayed, open the project file in the appendix.

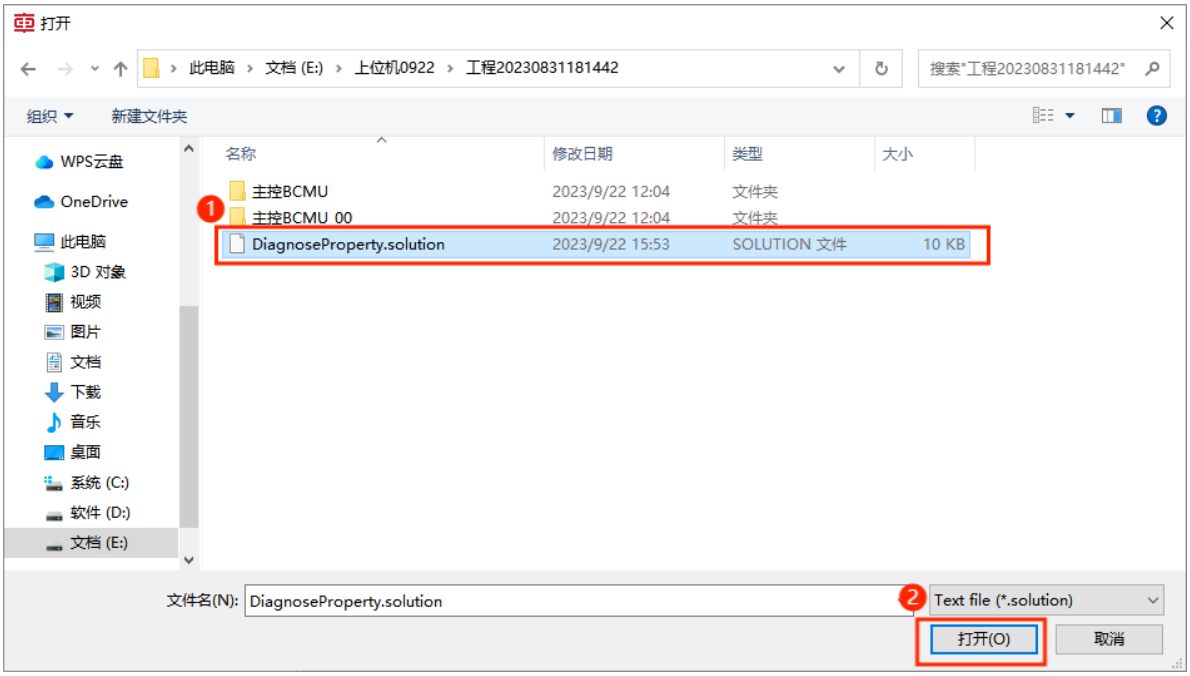


Fig.19 Project selection

The main control project is as follows:

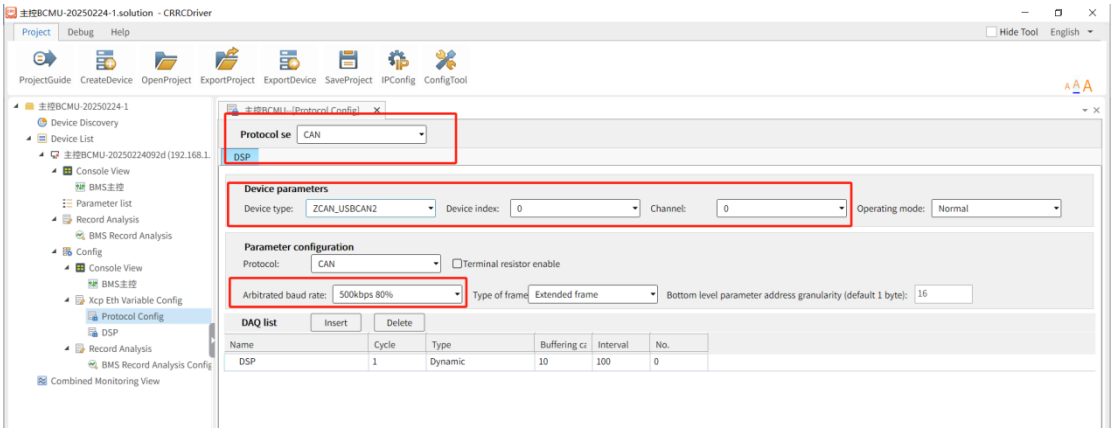


Fig.20 Project Settings

Click Protocol configuration, select CAN box device model, set send and receive frame ID (default receive frame ID 601, send frame ID 12131415), and click "Settings". Double click "BMS Master" and click "Run" to read the data received by the host computer. When the data bounce is observed, the connection is successful.

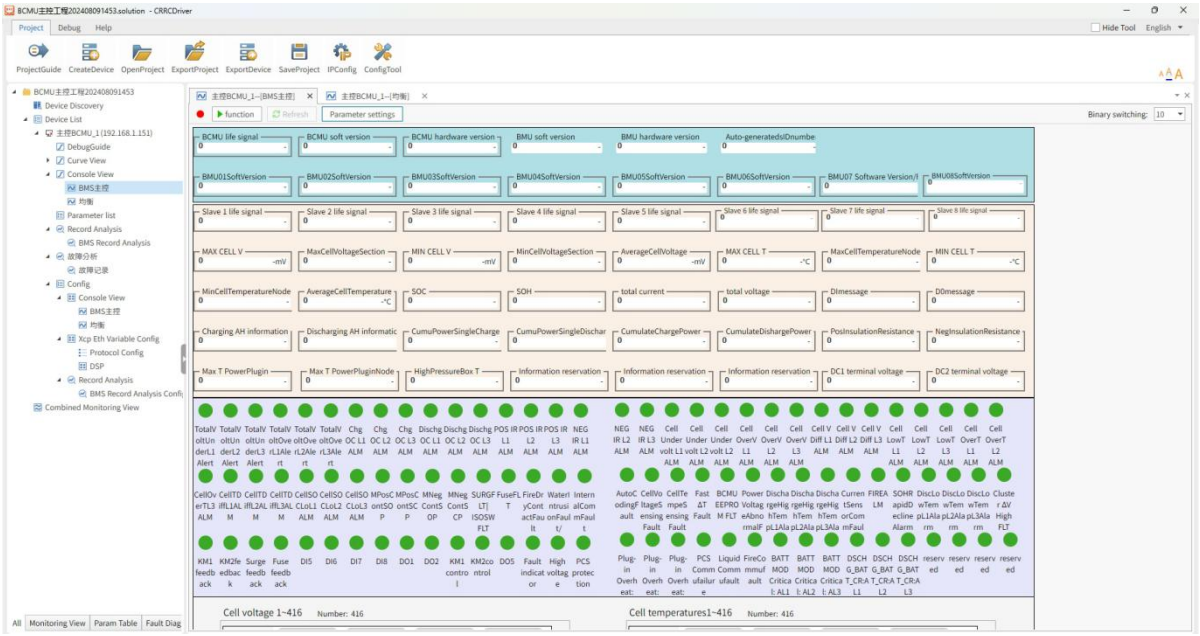


Fig.21 Software main interface

Slave control works are as follows:

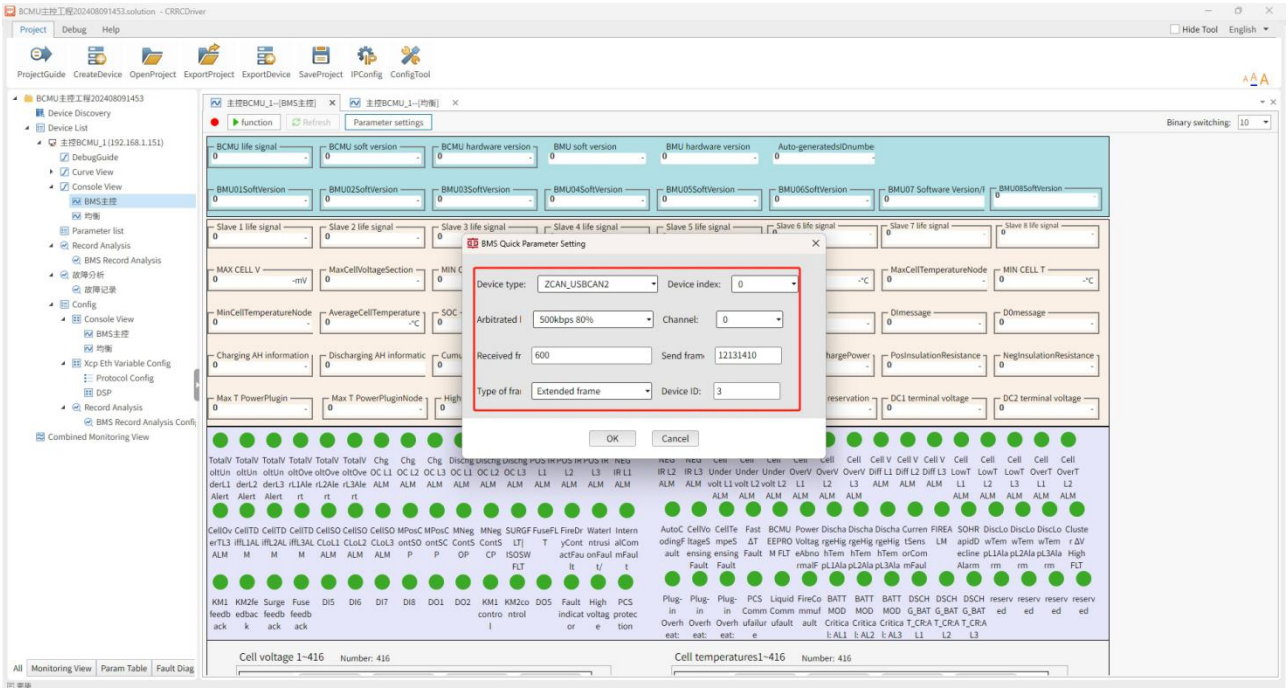


图1 设置界面

Fig.22 Setting interface

Click Protocol configuration, select CAN box device model, set the ID of sending and receiving frames (the default receiving frame ID is 701, and the sending frame ID is 12131421, the last bit of 1 indicates the slave controller ID), and click "Settings". Double click "BMS Master" and click "Run" to read the data received by the host computer. When the data bounce is observed, the connection is successful.

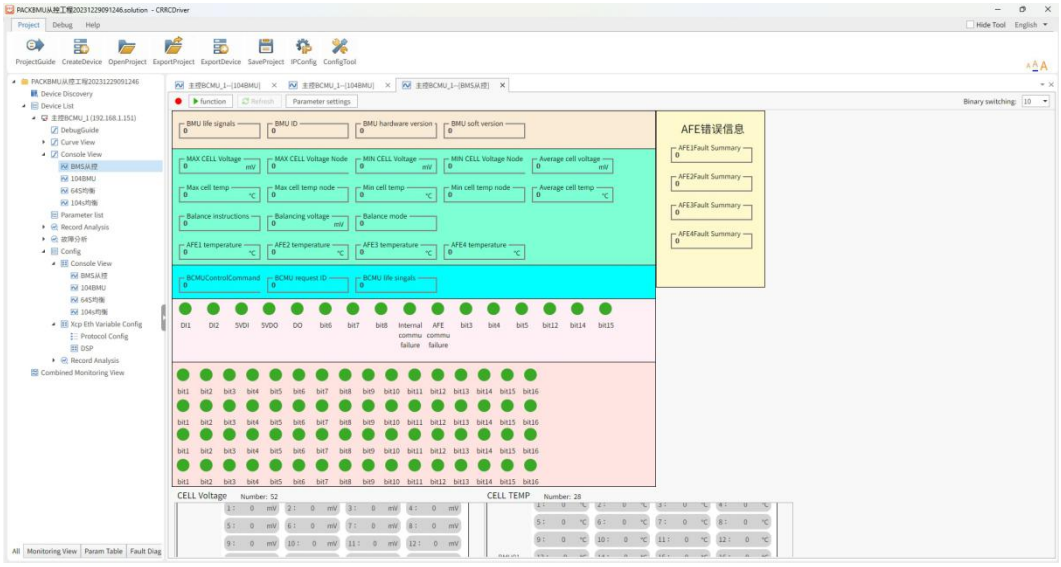


Fig.23 CAN box link

9.2 Software update

Master and slave control software update process is as follows:

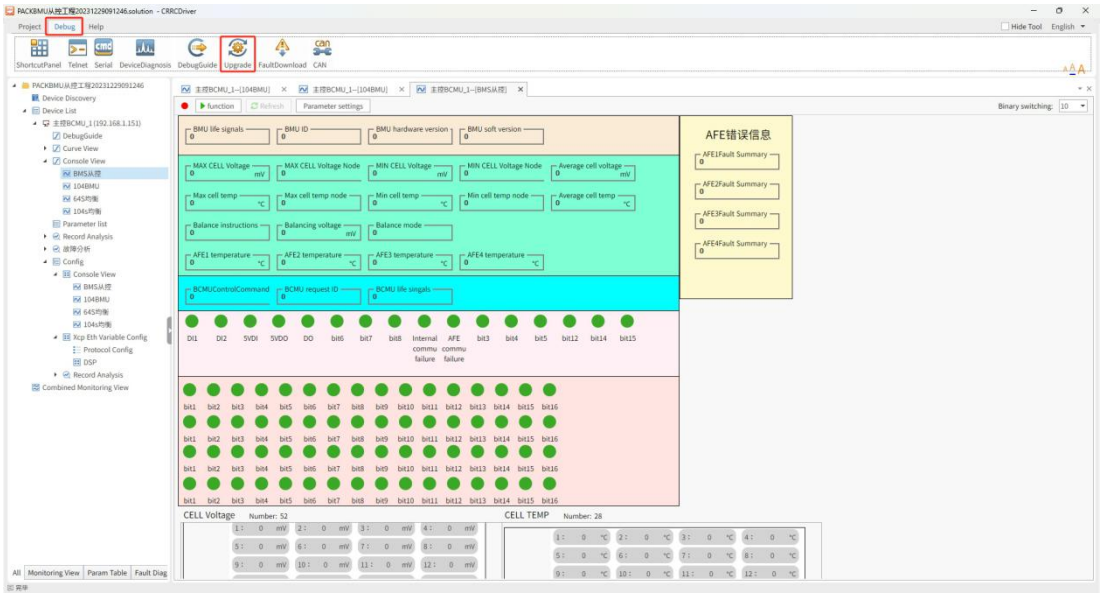


Fig.24 Software update

Click the “Debug” select “Update,” and launch the program update software.

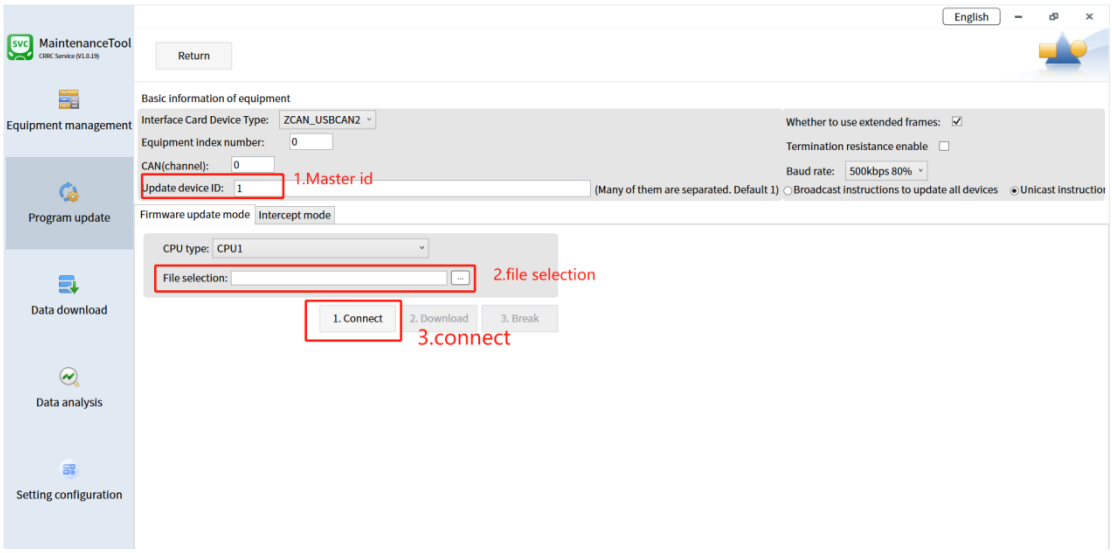


Fig.25 Update procedure

Select the firmware Update (test1.bin) file as follows:

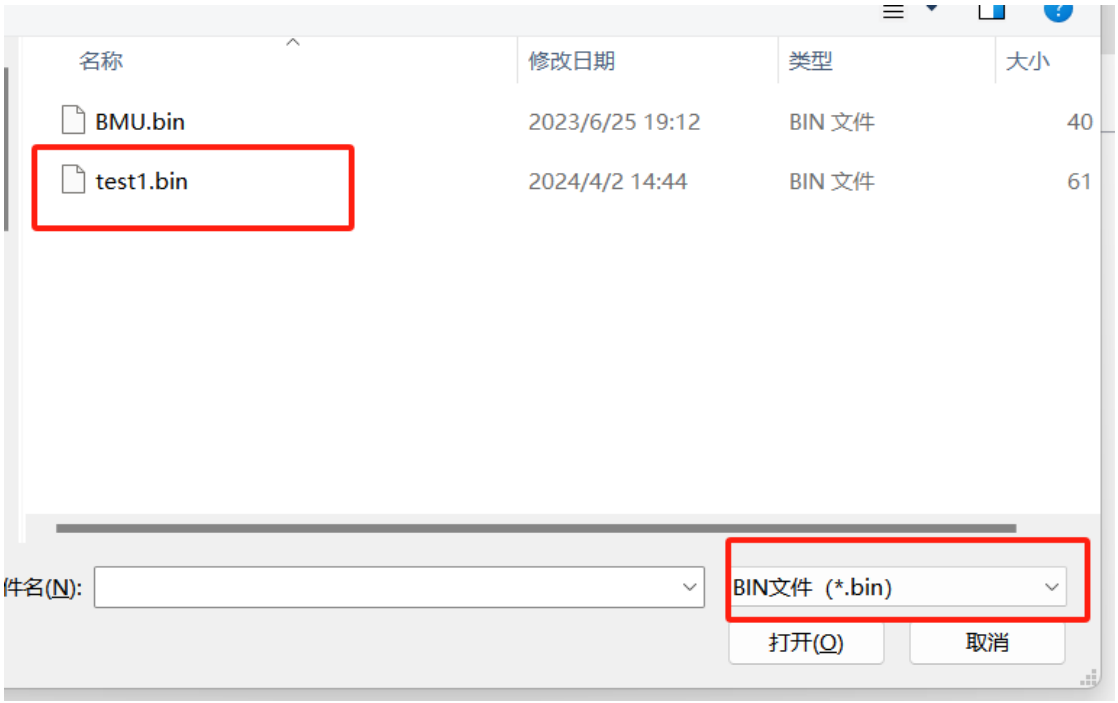


Fig.26 File selection

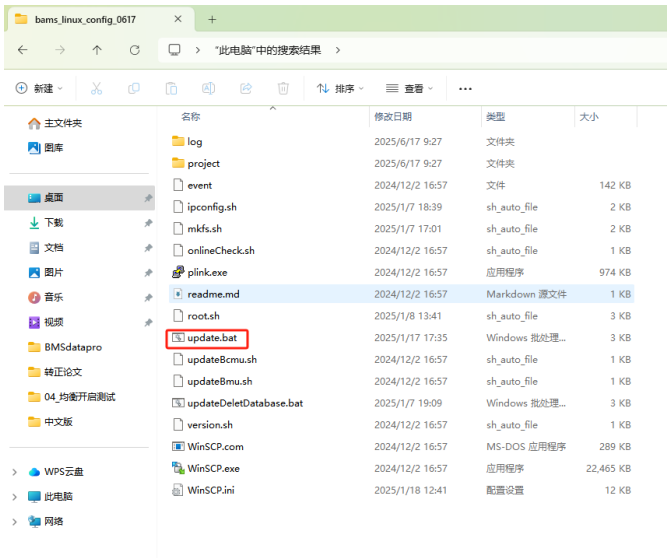


Fig. 27 BAMS Update File Selection

1）Open the master control software update package and select the update.bat file.

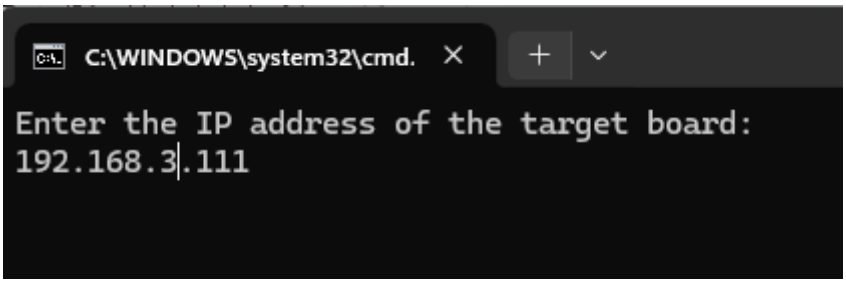


Fig. 28 BAMS Update Panel

1）Enter the IP address of the master control network port that is connected. The IP address of the network port farthest from the master control power supply is usually 192.168.3.111. Before doing this, change the IP address of the update device to 192.168.3.xxx, and use the PING command to check if the master control can be reached.

2）After entering the IP address, press Enter and wait for the update to complete.

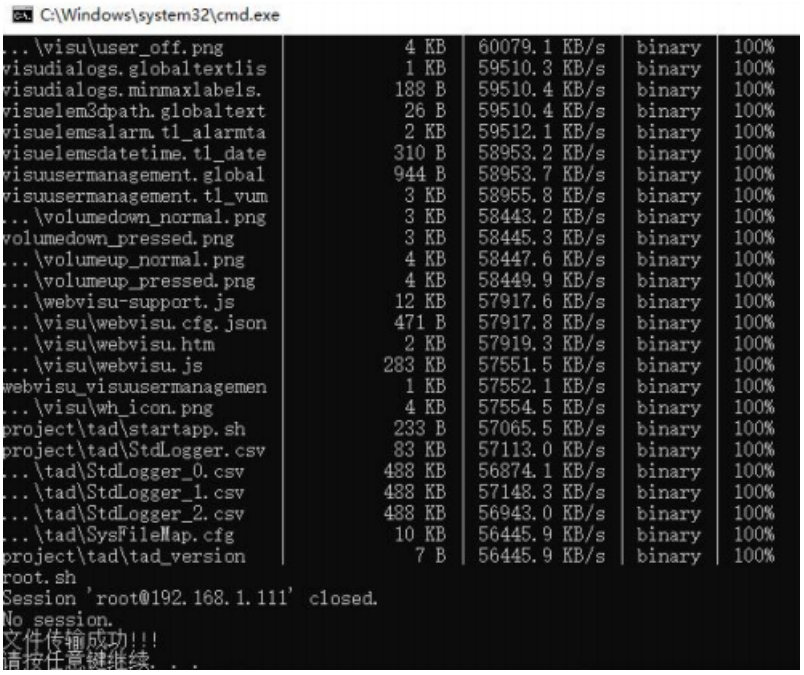


Fig. 29 BAMS Update Successful

Fig.30

9.3 Home page information

- Whether the accumulated total voltage value and charge & discharge capacity of the battery are accurate;
- Whether state of charge (SOC) and state of health (SOH) are normal;
- Whether the power data display is normal;
- Whether the current data is normal;
- Whether the system fault status is normal;
- Whether the cell voltage and temperature values are consistent with the data in the single cluster information;

9.4 System information

System information includes: Max. charge and discharge power, chargeable and dischargeable capacity, chargeable and dischargeable duration, allowable charge and discharge power, positive and negative busbar insulation resistance to ground, battery cluster voltage, battery cluster current, battery cluster SOC, battery cluster SOH, etc.

- The max. charge and discharge power of a single cluster is 417.996KW, and the max. charge and discharge power of the entire stack is1253.99KW.
- The chargeable and dischargeable capacity is updated in real time during charging and discharging.
- The cumulative charge and discharge capacity is updated in real time during charging and discharging.

9.5 Single cluster information

On the single cluster information page, you can view the slave connection status, voltage collection line status, temperature sensing collection line status, cell voltage, cell temperature, max./min. cell voltage, max./min. cell temperature, etc.

- Slave connection status, a total of 6 clusters, each cluster has 8 slaves;
- Voltage collection line status, a total of 6 clusters, each cluster has2*416 cells in parallel for voltage collection;
- Temperature sensing collection status, a total of 6 clusters, each cluster has 2*224 cells in parallel for temperature sensing collection;
- Check the number and value of cell voltages, a total of 6 clusters, each cluster has 2*416 cells in parallel for voltage collection;
- Check the number and value of cell temperatures, a total of 6 clusters, each cluster has 2*224 cells in parallel for temperature collection;
- Whether the max./min. value position and serial number of the cell voltage are accurate;
- Whether the max./min. value position and serial number of the unit temperature are accurate;

9.6 Control information

You can view the status of the HV box switch disconnector, relay, bus control area, liquid-cooled unit, fire protection, temperature and humidity sensor, stack signal and stack output signal.

9.7 Historical data

Click historical data to view fault records, historical data, and historical events.

9.8 Data download

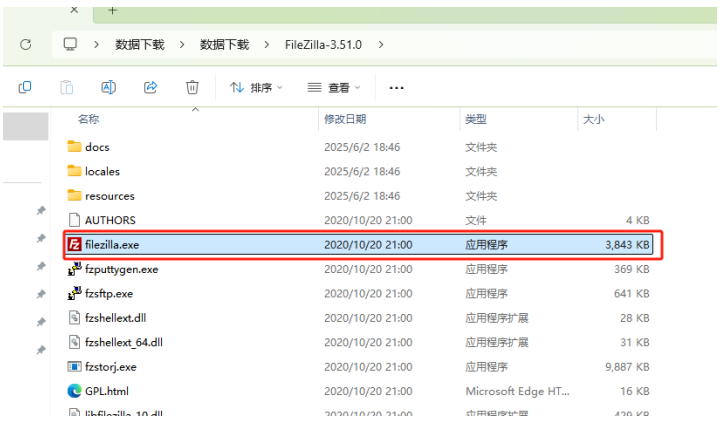


Fig. 31 BAMS Data download software

1. Open the data download software and click on filezilla.exe.

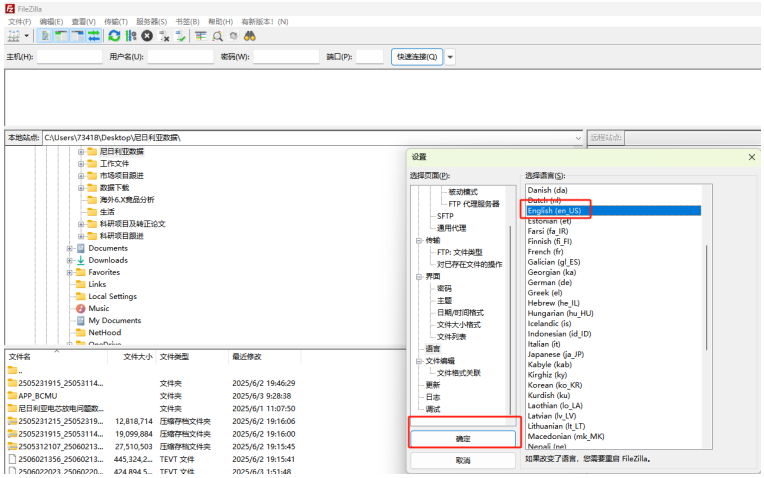


Fig. 32 BAMS Data download software English

2. Click setting，language choice English.

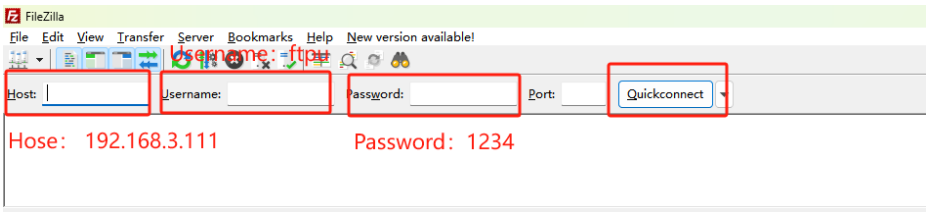


Fig. 33 BAMS Data download software connect

3. As shown in Figure 5, fill in the corresponding content, and then click Quickconnect. If the connection fails, please ensure that your computer's IP address is set to 192.168.3.xxx. In addition, sure make that the Ethernet cable is connected to the third network port on the master control unit, which is farthest from the power supply.

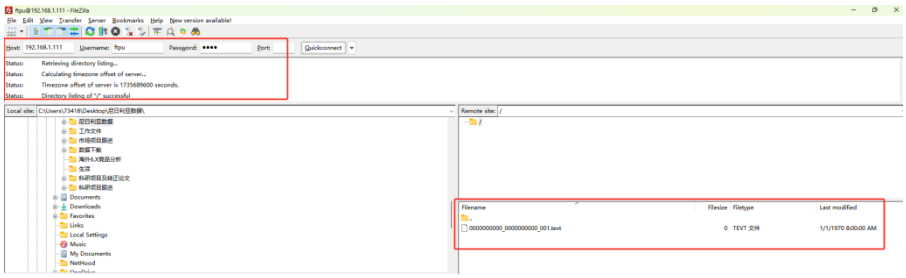


Fig. 34 BAMS Data download

4. After clicking Connect as per step 3, the downloaded data is shown in the red box on the right side of the figure. Simply extract it to the storage on the left-hand computer.lick setting，language choice English.

10 Troubleshooting

The BESS has complete protection functions and warning information. Once a fault occurs, the relevant fault information can be read through the EMS.

Before seeking service, you can perform self-check according to the tips in the table, analyze the cause of the fault, and troubleshoot it. If the problem cannot be solved, please contact the manufacturer.

⚠ CAUTION

Please do not disassemble the product during self-check.

Fault reset methods are divided into auto reset and manual reset.

- Automatic fault reset: After a fault occurs, the system will clear the fault by itself at certain intervals.
- If the fault condition is eliminated, the system exits the fault status;
- If the fault condition still exists, the fault will be reported again.
- The number of times a fault can be automatically reset can be set by the function code. When the number of times the fault can be automatically reset is used up, the fault will be no longer automatically reset until the user manually resets the system, and the number of times the fault can be automatically reset is re-counted.
- Manual fault reset: After the cause of the fault is eliminated, click Reset so that the BESS can resume work.

In the protection strategy, according to the severity of the battery system fault status, the fault status level is divided into warning and error from low to high. The BMS can automatically troubleshoot the fault according to the preset strategies corresponding to different fault status levels.

Table12 External Alarm and Fault Information

SN	State diagnosed
Warning	BMS only displays alarm information and uploads it to PCS, and runs with limited power;
Error	1. BMS displays fault information and cuts off the HV circuit of the battery cluster where the current fault is located; 2.Set the chargeable/dischargeable power to 0 and upload it to the PCS and upper-layer monitoring system, and at the same time output the faulty shutdown signal of the dry contact to the PCS; 3.Cut off all HV circuit outputs on the DC side according to the fault type.

BMS supports real-time monitoring and independent judgment of the operating status of the battery side. The main fault status and diagnosis item descriptions are detailed in the table below.

Table13 External Alarm and Fault Information

SN	Fault status	State diagnosed
1	The voltage of a cell battery (module, cluster) is greater than the voltage setting value	HV of cell battery (module, cluster)(Shall include battery overvoltage threshold)
2	The voltage of a cell battery (module, cluster) is lower than the voltage setting value	LV of cell battery (module, cluster)(Shall include battery undervoltage threshold)
3	The battery temperature is greater than the temperature setting value	High battery temperature (shall include battery over-temperature threshold)
4	The battery temperature is lower than the temperature setting value	Low battery temperature (shall include battery

		under-temperature threshold)
5	The insulation resistance is less than the setting value	Low insulation resistance
6	The charging current (power) is greater than the setting value	Large charging current (power)
7	The discharging current (power) is greater than the setting value	Large discharging current (power)
8	The consistency deviation of cell batteries (modules, clusters) is greater than the set condition	Large consistency deviation of cell batteries (modules, clusters)
9	The HV circuit cannot be opened/closed	HV circuit failure
10	Fire alarm	Fire alarm signal input
11	The internal temperature difference of the battery system is greater than the setting value	Large temperature difference of the battery system
12	The internal voltage difference of the battery system is greater than the setting value	Large voltage difference of the battery system
13	Disconnection failure of voltage/temperature sensing collection line of cell battery	Disconnection failure of collection line

CAUTION

When troubleshooting, disconnect the switch disconnectors at all stages.

11 Preventive maintenance

Due to the influence of environmental temperature, humidity, dust and vibration, the components inside the BESS will age, which may cause potential failure of the BESS or reduce the service life of the BESS. Therefore, the BESS must be maintained regularly.

11.1 Maintenance Considerations

For safe and efficient maintenance and servicing of the system, the maintenance personnel must be professionally trained and qualified.

When performing maintenance and repair work, staff must observe the relevant safety precautions and use the necessary tools and protective equipment.

Do not wear metal jewellery such as gold or silver jewellery and watches when operating and maintaining the system.

For maintenance, use insulated tools and wear insulated gloves and shoes.

Clean up tools and materials after maintenance work. Do not leave metal objects inside or on top of the equipment.

Disconnect all high-voltage and low-voltage switches for connection and removal of system cables.

System operation and maintenance personnel have any questions about the operation and maintenance of the equipment, please contact the manufacturer for advice, do not operate without authorisation.

11.2 Battery container maintenance items

Ambient Temperature: Keep the ambient temperature between 15～40℃ as much as possible.

Long-term static without use: When the battery system is static for a long time without use, it is necessary to disconnect the DC side of the main circuit breaker switch/disconnector, to prevent other equipment from draining the battery power, should be at least every 1 month to the system to check the status of the battery, and every 3 months at the longest for a charging to ensure that the SOC is not less than 50% of the placement.

Regular dusting: Clean the system regularly, especially pay attention to cleaning the air inlet and outlet of liquid cooler and air conditioner to prevent the obstruction of willow and debris, and use hoover to clean up when necessary to ensure that the air can circulate freely in the cabinet. The power supply must be cut off before dusting; rinsing with water is strictly prohibited.

Regularly check the seals for deterioration, damage and good sealing.

Periodically check the cable connection terminals for looseness, serious rust or oxidation on the terminal surface, and good contact.

Regularly check cables for deterioration, breakage and good insulation.

Periodically check that the indicator lights are intact and functioning properly.

SOC Calibration: The battery management system uses SOC to indicate the remaining capacity state of the battery, the SOC value is estimated by the management system through mathematical model based on the current, time and other parameters, due to the battery capacity is related to a number of factors, so the SOC value has a certain degree of error, if you find that the SOC value error during the operation process, it is necessary to carry out the SOC calibration of the battery system.

Unscheduled testing of the system: Unscheduled visits to the site to conduct a comprehensive test of the battery system to determine whether the system functions properly and whether the battery status is normal.

12 Battery system decommissioning and recycling

12.1 Retirement Conditions

Lithium-ion battery systems should be considered for decommissioning under the following circumstances:

Performance degradation: The battery performance deteriorates significantly and cannot meet system requirements.

Safety problems: Potential safety risks, such as overheating and expansion, are detected in the battery.

Service life: Reach the manufacturer's recommended service life.

12.2 Decommissioning process

Assessment status: Conduct a comprehensive assessment of the battery system to determine whether it needs to be decommissioned.

Safe handling: Ensure that the battery is in a safe condition before decommissioning to avoid risks during transportation.

Mark and record: Mark the retired battery and record the relevant information of the battery, including model, capacity, and retirement date.

12.3 Recycling Guide

Choose a recycler: Choose a local qualified battery recycler for battery recycling.

Compliant transportation: Safe transportation of decommissioned batteries to recycling points in accordance with relevant regulations and standards.

Battery classification: According to the type and status of the battery, the appropriate classification processing.

12.4 Recycling Methods

Physical recovery: Separation of valuable materials in batteries by physical methods such as crushing and screening.

Chemical recovery: The use of chemical methods to extract metal elements in the battery, such as lithium, cobalt, nickel and so on.

Material recycling: The reuse of recycled materials for battery manufacturing or other industrial uses.

12.5 Environmental protection and safety

Compliance with regulations: Strictly comply with national and regional laws and regulations on battery recycling.

Environmental protection: Measures are taken to reduce the environmental impact of battery recycling.

Personnel safety: Ensure the safety of personnel in the recycling process and avoid exposure to harmful substances.

12.6 User Responsibilities

Proper disposal: The user is responsible for ensuring that decommissioned batteries are properly disposed of and recycled.

Information provision: To provide recyclers with the necessary battery information to facilitate recycling.

Monitor feedback: Monitor the recycling process to ensure the batteries are properly disposed of.

Please note that this note is for reference only, and the specific operation should follow the local laws and regulations and the manufacturer's guidance. Safety and environmental protection are the primary considerations in the battery decommissioning and recycling process.

13 After-sales, warranty and disclaimer

13.1 Quality warranty provision

- During the warranty period, our company or the designated service provider shall provide quality warranty service for the failure of the approved products caused by the quality defect of the battery system.
- For products beyond the warranty period, we provide paid service.
- Any failure that is not our responsibility is not within the scope of warranty.
- During the warranty period, the faulty parts replaced by our company free of charge belong to our company.

13.2 Quality warranty liability exemption scope

Our company does not provide quality warranty services for the following situations:

- All kinds of failure situations caused by failure to properly use, maintain or repair the product in accordance with the provisions of this manual.
- The product is exposed to more water, impact or other damage than it can withstand.
- Without the authorization of our after-sales service center or service station, the battery system is refitted, installed, disassembled and adjusted.
- When the battery system fails, the customer does not allow our after-sales service center or service station to handle the failure and cause damage.
- Quality problems caused by non-use of pure parts supplied or specified by us.
- Damage caused by the use of charging equipment that does not meet national or regional standards or non-standard charging operations.
- Due to force majeure such as earthquake, typhoon, flood, chemical pollution, lightning strike, hail, sand, flying rocks, fire, political disaster, or

Both parties shall be exempted from liability for damages caused by intentional damage and other factors, as well as for secondary compensation based on such damages.

Our company has the final interpretation of this manual under the permission of law, and reserves the right to modify this manual without prior notice.