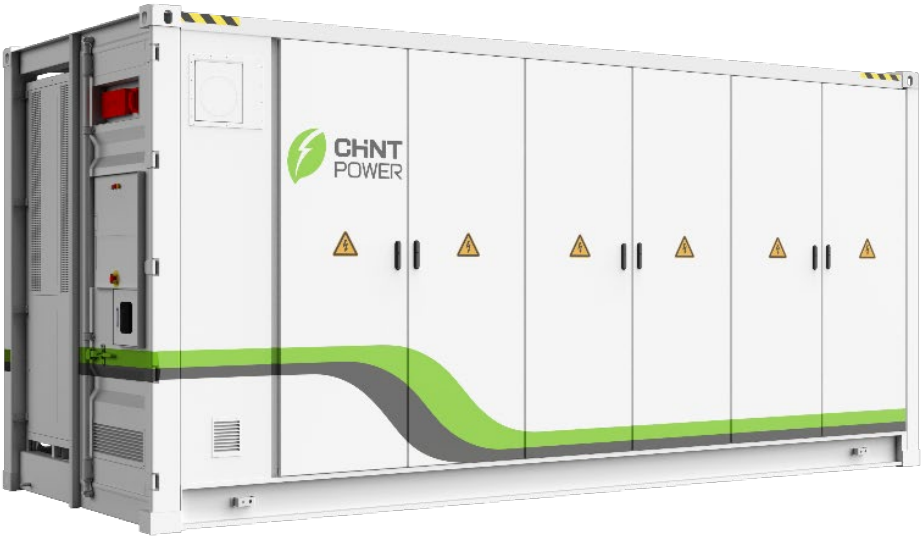
CPS ES-5015KWH-EU

Liquid Cooling Battery Energy Storage System

Installation Manual



Shanghai Chint Power Systems Co., Ltd.

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Contents

1. Foreword

This Installation Manual is applicable to the Power Block 2.0 Series CPS ES-5015KWH-EU Liquid Cooling Battery Energy Storage System (BESS) developed and produced by Shanghai Chint Power Systems Co., Ltd.

Main content

- This Manual includes instructions on how to operate BESS, such as how to install and debug BESS. Therefore, please read this Manual carefully before using this system and operate this system according to the method described in this Manual, to avoid equipment damage or personal injury.

Target readers

- This Manual is only applicable to authorized and qualified installation engineers or authorized operators.

Copyright restriction

- The contents of the Manual and the pictures and identifications used in the Manual belong to Shanghai Chint Power Systems Co., Ltd., and part or all of the contents shall not be reproduced publicly without written authorization.

Version upgrade

- Due to the update and improvement of products, the contents of the Manual will be updated, adjusted and revised accordingly, and the products purchased by users shall be subject to the physical objects. You can get the latest version of the Manual through the corresponding sales channels, or you can download the latest version of the Product User Manual from our official website www. chintpowersystems.com.

Important information!

- Please keep this Manual where you can get it, so that you can use it in case of emergency.
- Please read this Manual carefully and make sure that you fully understand all contents before performing any operation.

2. Safety Information Instruction

Obeying the following warnings, safety instructions and precautions can ensure safety, prolong the service life of products and prevent property losses.

The location of the system should be solved by effective equipment operation, design, specification and installation, so as to minimize the electrical hazard of personnel contact.

All electrical work shall be completed by qualified service personnel with appropriate training and authorization in accordance with the latest local electrical, building, fire protection and other codes, standards, regulations or public utility requirements applicable to installation, as well as relevant instructions and appropriate practices. If the installation is not carried out according to the safety instructions in this Manual, resulting in personal injury or equipment damage, the Company has the right not to assume responsibility and provide quality assurance.

The following precautions provide general safety guidelines when using or closing to BESS. The complete safety parameters and procedures are unique to each project and should be formulated by the customer or the final user according to the actual situation of the project.

Only authorized and fully trained electrical operators can operate the system. A clear, permanent and restricted access area should be set up around the system. According to the actual project location, local laws and applicable rules and regulations should be consulted to determine the requirements of the permit. If necessary, the housing should be properly marked before work.

2.1. Relevant Warnings in this Manual

Please pay attention to several safety warning messages before reading the Manual, which are very important. Being familiar with them can make you safer in installation and operation.

Qualified operators:

- The operator must be fully familiar with all warnings and installation procedures described in the Installation Manual.
- Only qualified personnel who hold valid electrical knowledge certificates, meet specification requirements and safety standards, and have rich experience in various types of work can work on circuits and equipment.
- Only qualified personnel familiar with the battery and safety precautions can install and operate the battery. Do not let unauthorized personnel touch the battery.

Electrical safety operation:

- All live electrical work requires a live work permit. A qualified operator should release all stored electric power and verify that the equipment has been powered off and the proper locking/marking procedures have been carried out before starting electrical work.
- When working near the electrified overhead power cable, the boom, mast, crane and other equipment or their loads are never allowed to be within the evaluation distance limit from the power cable.
- Field electrical devices, even if considered temporary, must be planned and manufactured in an appropriate way, and materials and industrial electrical components must be used to ensure the normal operation of the equipment and the integrity of work.

Safe handling of batteries:

Please note that the battery has the risk of electric shock, including HV short-circuit current. Please observe all safety precautions as follows when operating the battery:

- Do not smoke or use fire near the battery!
- Do not use organic solvents to clean the battery!
- Do not put the battery into the fire, or it may explode!
- Do not disassemble the battery, which contains electrolyte harmful to skin and eyes!
- Do not place tools or any metal parts on the top of the battery!
- Take off watches, rings and other metal accessories!
- Use tools with insulated handles to avoid accidental short circuit!
- Before connecting or disconnecting the terminal, please disconnect the charging power supply and load!
- Use proper lifting methods when handling batteries, and wear all appropriate safety clothes and equipment!
- Stay away from heat sources or any places that may generate sparks (such as circuit breakers and fuse boxes) for 0.5m!
- Avoid the risk of local overheating, such as direct sunlight on the battery rack!
- Batteries must be handled, transported, recycled or discarded in accordance with federal, state and local regulations!

Precautions for installation:

- Before installation, all personal protective equipment (PPE) required to supervise the installation process shall be in place, as shown in Annex 2 List of Personal Protective Equipment (PPE).
- Before installation, the installation personnel shall receive safety training and fill in the Safety Installation Training Record Form, as shown in Annex 1 Safety Training Record Form.
- Unless proper power-off measures are taken, all power cables are considered to be electrified.
- Before installation, please cut off the power supply of the power grid and ensure that the battery is turned off.
- All battery racks must be grounded with good conductors to form a good grounding network.
- The fixing screws at the battery polarity terminals and the power interface of BMS (Battery Management System) high-voltage box are M8 external hexagon screws, and the tightening torque ranges from 19 to 24 N.m (168 to 212 in-lbs), which should be fixed with a torque wrench.
- Before the electrical performance test, check whether the cable bolts and bronze bolts are loose. If loose, tighten them with a special tool.

2.2. Warnings on Personnel and Equipment

Symbol	Meaning
	**Warning - Electric shock hazard!** Do not touch the system connectors or terminals. Do not open the closed door unless proper locking/tag procedures and related training are carried out in accordance with local laws and regulations.
	**Warning - Arc flash hazard!** All electrical equipment has the risk of arc flash. Any equipment modification (such as opening the door) has serious risk of arc flash. Arc flash accidents can cause serious injuries. Therefore, appropriate training is required according to local regulations.
	**Warning - Fire hazard!** Fire may occur under certain fault conditions.
	**Attention - Sharp objects!** There are many sharp objects in most system components. Please note that it is easy to trigger the risk of serious injury when working around the equipment housing.
	**Attention - Electrostatic sensitivity!** Electrostatic discharge can damage electronic equipment. Therefore, correct handling procedures are necessary. Please wear an antistatic wrist strap grounded, and prevent electrostatic discharge when touching the grounded surface near the equipment.
	**Dangerous voltage!** BESS supports multiple power supplies. Even if the equipment is not running, there may be dangerous voltage. Please make sure that you fully understand the precautions and warnings in this Installation Manual. Failure to do so may lead to serious injury or death. Please follow all safety procedures issued by manufacturers.

2.3. Safety Requirements for the Owner

The Owner must follow the following requirements:

- The personnel operating the energy storage system must be trained and qualified electrical workers, otherwise they cannot operate the energy storage system. Improper or wrong operation may cause serious injury to the operator;
- The personnel operating the energy storage system should be fully familiar with the working principle of the energy storage system;
- The personnel operating the energy storage system should be fully familiar with this Manual;
- The personnel operating the energy storage system should be fully familiar with the local electrical regulations and standards;

- Regularly check the safety equipment in the system to ensure that the safety equipment is reliable;
- Any warning signs damaged or illegible on the equipment shall be replaced immediately;
- No inflammable and explosive articles are stored in or near the container;
- The ground for storing energy storage system products must be solid and reliable;
- Transportation, installation and debugging can only be carried out by professional personnel recognized by the manufacturer;
- Before operating the energy storage system, evaluate the events that may lead to system danger and handle these events;
- This Manual describes the safety instructions in details. Working personnel shall read it carefully for full understanding.
- The software, housing and internal components of the equipment cannot be changed without the approval of the manufacturer; if they are changed without authorization, the quality assurance of energy storage system is invalid;
- The sealing strip on the equipment shall not be damaged. If it is damaged, the quality assurance of the equipment will be invalid.

2.4. Locking/Marking Guidance

2.4.1. Hazard

Please always follow all applicable locking/marking procedures. Failure to follow the correct locking/marking procedure may result in serious injury or death.

When power is applied to battery energy storage system (BESS), dangerous voltage exists on some components. To prevent accidental death or injury, please don't touch any components in the housing unless there are special instructions. To reduce the risk of electric shock, please ensure that all equipment is reliably grounded. For more information, please refer to 3.4 Grounding Wire.

2.4.2. Warning

The door of the container system must be kept closed unless it is necessary to enter the container. If possible, personnel should keep a safe distance from the housing when the equipment is powered on. Please always follow local/state and national locking/marking guidelines when working near BESS. Please lock out/mark out requirements that the procedure must meet or exceed.

Please follow all the guidelines put forward in the Chint safety document. Please complete the following regulations before entering the potentially dangerous area or operating BESS:

- Identify and wear protective clothing and shoes.
- Identify and isolate all power sources and stored energy sources.
- Use appropriate locking/marking equipment. When locking/marking BESS, don't touch anything in the container unless there are clear instructions in the working procedure.
- Complete site-specific locking/marking procedures and safety checklist before work.

2.4.3. General Warning

- When powered on, this system has potential danger of electric shock, death and burn. Only authorized personnel who are fully familiar with the equipment and fully trained can install, operate or maintain the equipment.
- To avoid death, personal injury or product damage, please follow all safety procedures specified in EHS (Environmental, health, and safety) guidelines, and identify and isolate all power sources and stored energy sources.
- To minimize the risk of electric shock, death and burns, the approved grounding practices and procedures should be strictly observed.
- To avoid personal injury and equipment damage, aerial work personnel must abide by aerial work site regulations.
- To avoid personal injury or equipment damage caused by equipment failure, only properly trained personnel can modify any programmable machine.
- Please always ensure proper compliance with applicable standards and regulations.
- Certified equipment is used as a key component of the security system. Never assume that a safety-critical control loop is working properly.

Please pay attention to warning signs inside and outside BESS container.

Warning signs inside container			
 Read Manual carefully	 Warning	 Electric shock hazard	 Recycle
Warning signs outside container			
 Protective earthing	 Emergency shutdown		
			

3. System Introductions

3.1. System Scope of Supply

- LFP Cell, battery PACK, battery cluster, cabinet, connecting power cable, communication cable, power supply equipment, communication equipment, protection equipment and accessories, so as to complete the installation and internal connection of the system.
- All battery management system (BMS) modules and cluster-level and system-level BMS cables and equipment.
- Packaging, supply, transportation to the site, transportation insurance, import duties and taxes (if applicable) and unloading at the place specified in the Agreement.
- Debugging and site acceptance test on all items within the scope of supply.
- Please refer to document list for all documents
- Certifications required for all equipment within the scope of supply.

3.1.1. System Notes

This energy storage system consists of multiple energy storage components, including thermal management system, fire suppression system, power distribution system, battery management system and the most important battery PACK. Detailed system notes are shown in the following figure:

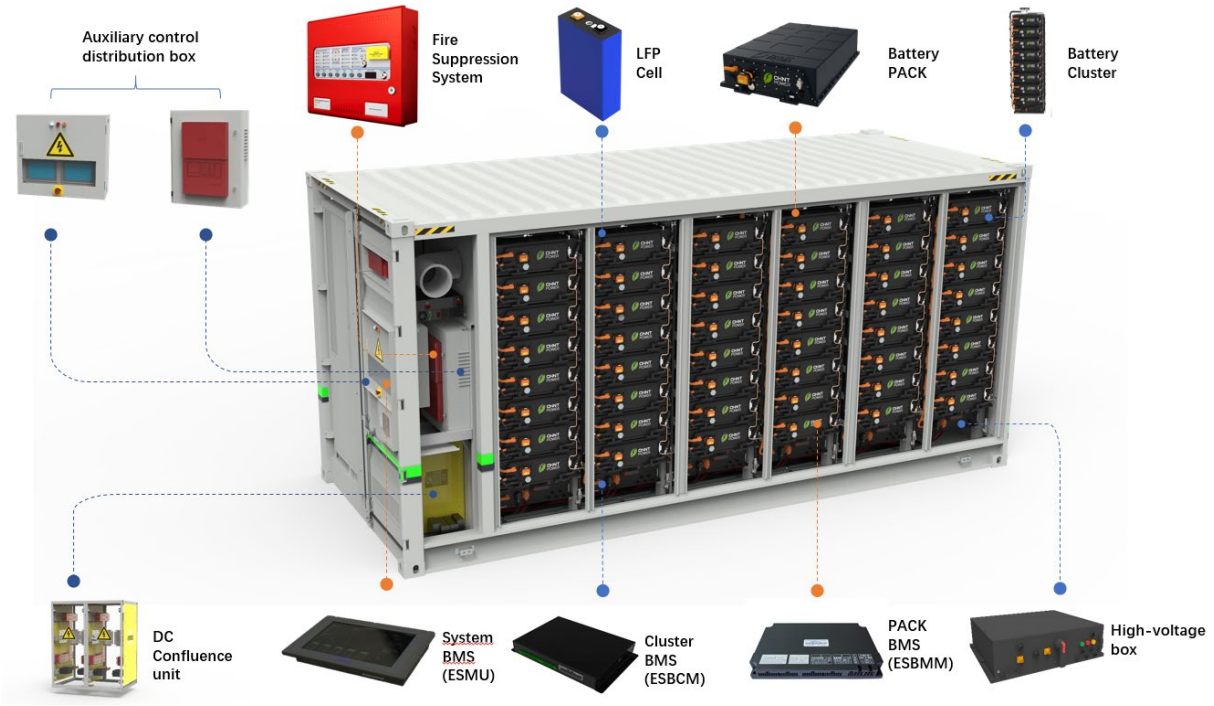


Figure 3- 1 Notes of System Components

3.1.2. Detailed System Parameters

The technical parameters of this energy storage system are based on the test results of standard battery clusters at room temperature (25±2)℃ and humidity (55±20)%. Refer to the following table for detailed parameters:

Table 3- 1 Battery System Detailed Specifications

Item	Parameter	Condition
Cell capacity	314Ah	Standard charge and discharge CHG/DCHG rate. 0.5C
Serial/parallel mode	12P416S	N.A.
Nominal voltage	1331.2V	N.A.
Nominal capacity	5015.96kWh	Standard discharge
Overall dimension (L*W*H)	238.5 *114.0 * 96.0 (in) /6058 * 2896 * 2438 (mm)	See drawings for details
Weight	＜45T	Full load
Discharge cut-off voltage	1164.8V or any battery cell in the battery cluster reaches 2.8V	N.A.
Charge cut-off voltage	1497.6V or any battery cell in the battery cluster reaches 3.6V	N.A.
Rated charge /discharge current	157A	(25±2)℃
Communication mode	CAN, RS485, TCP/IP	N.A.
Operating temperature range	-25~50℃	N.A.
Storage temperature range	-30~60℃	N.A.
Service life of the product guaranteed under the operating condition	(25±5)℃	N.A.
System thermal management mode	Liquid cooling	N.A.
Fire protection system	NOVEC1230	It can be replaced with other gas extinguishing chemicals according to customer's requirements and equipped with water spraying system (optional).
IP rating	IP54	N.A.
Noise	80dB	At a distance of 1 m, a height of 1.7 m, 35°C

3.1.3. System Communication Architecture Diagram

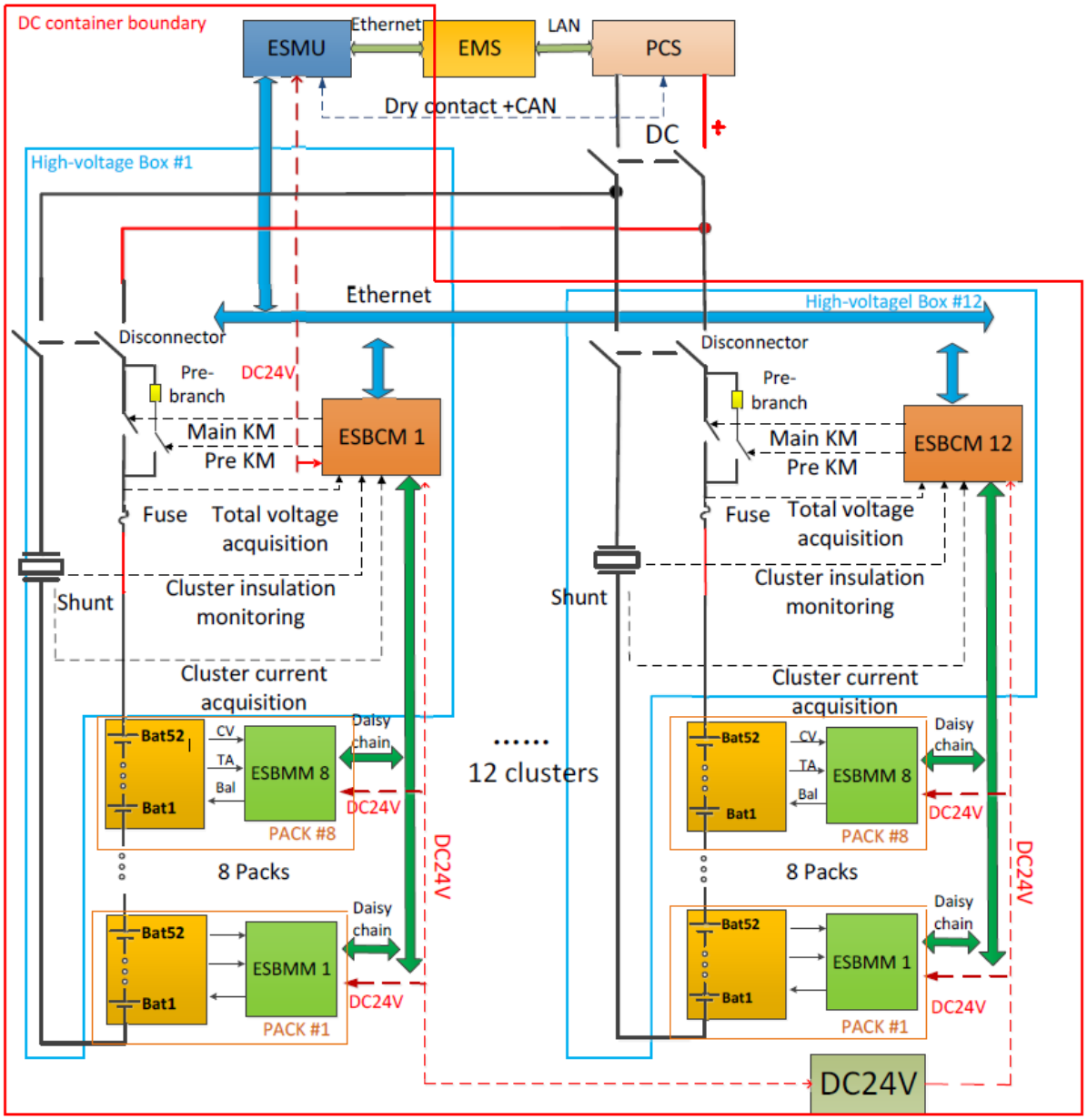


Figure 3- 2 System Communication Architecture

3.1.4. Electrical Architecture Diagram

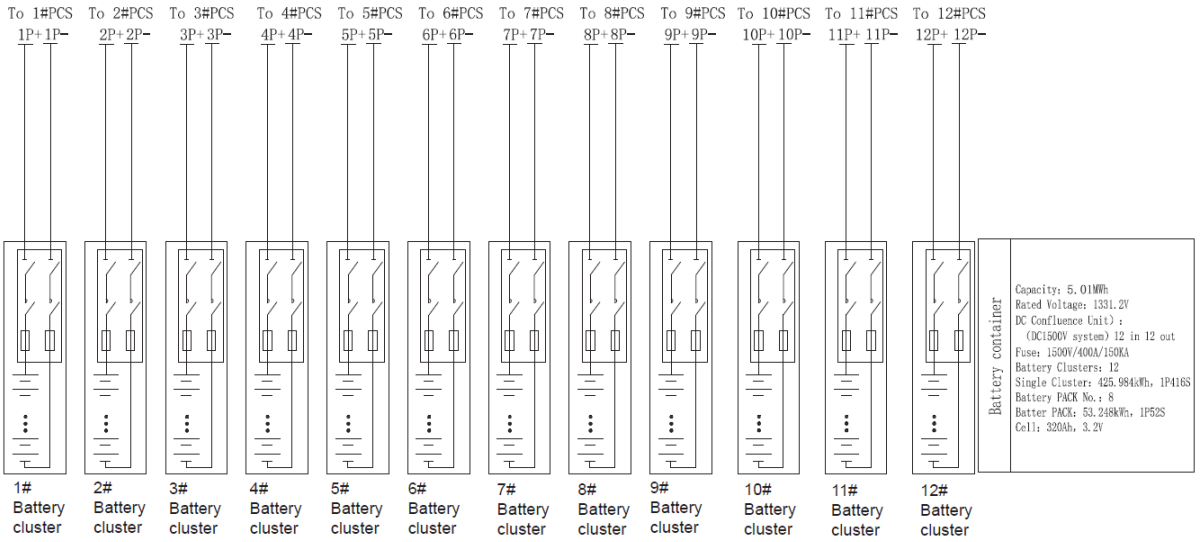


Figure 3- 3 System Electrical Architecture

3.1.5. Arrangement of System Equipment

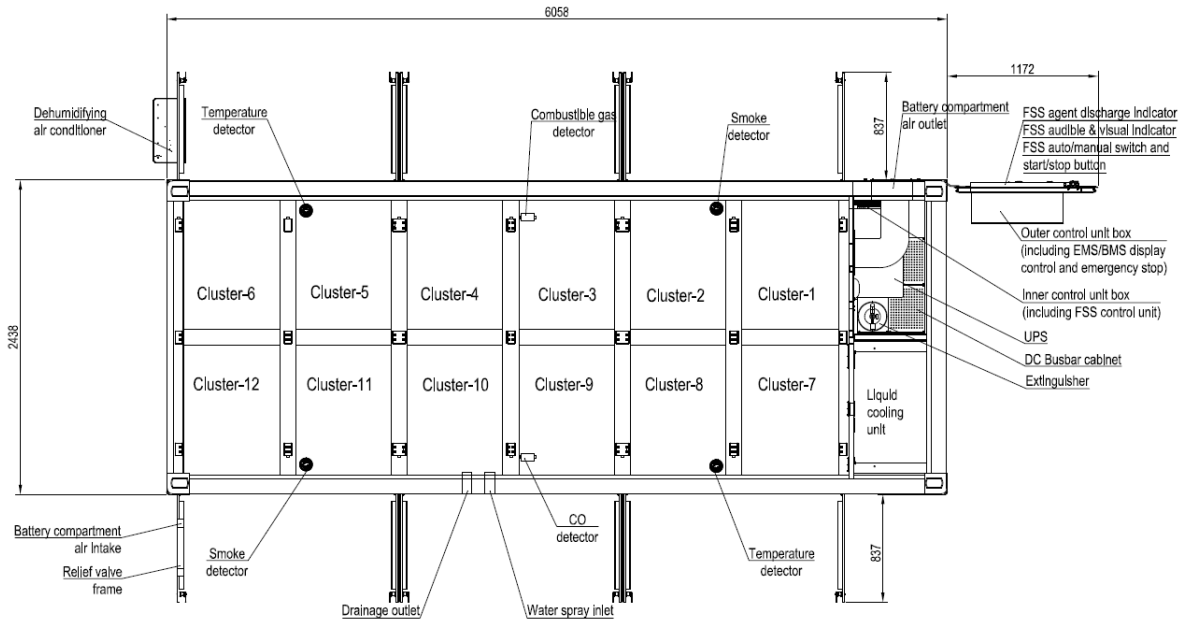
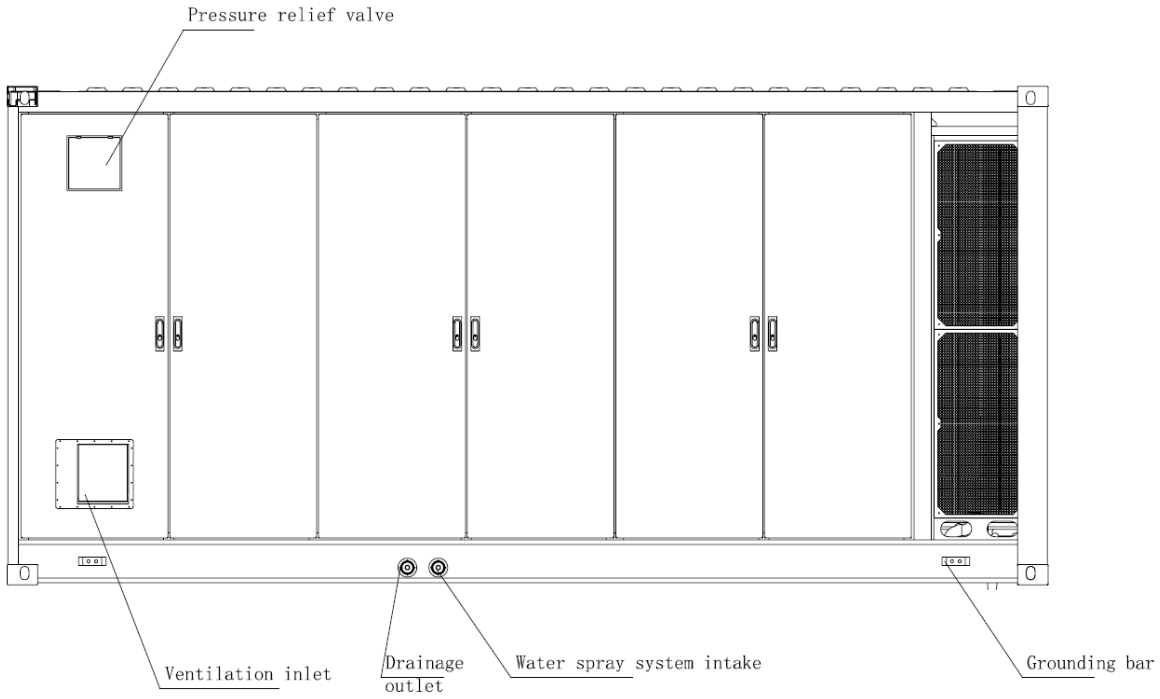


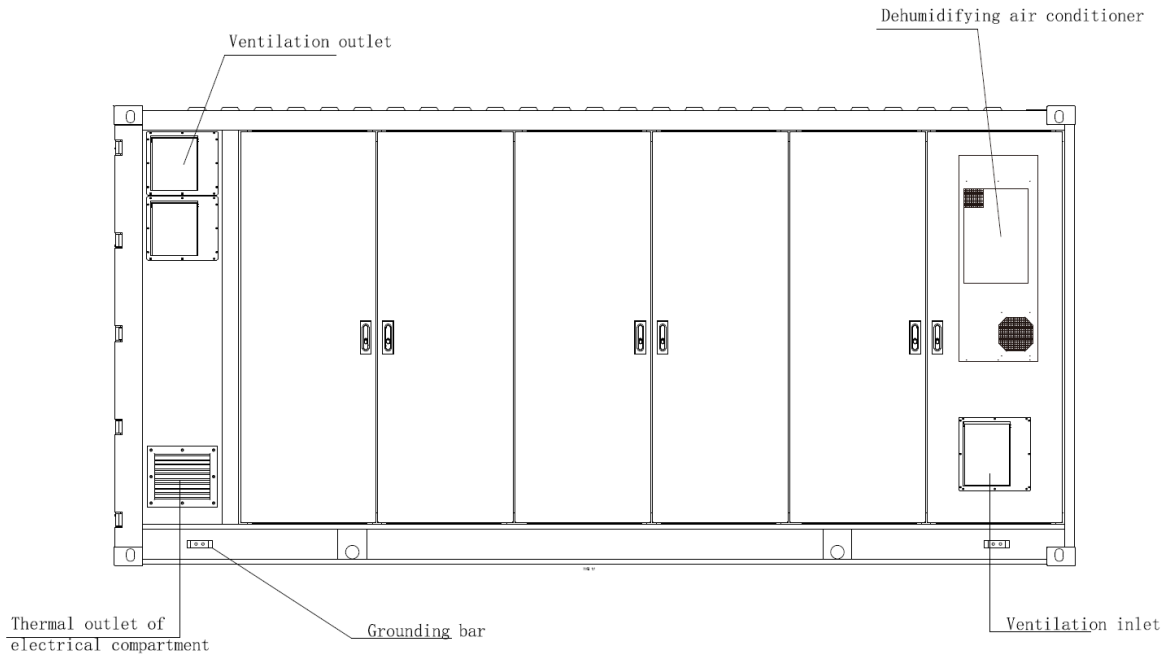
Figure 3- 4 Equipment Arrangement in Energy Storage System

Description of each view of the system is as follows:



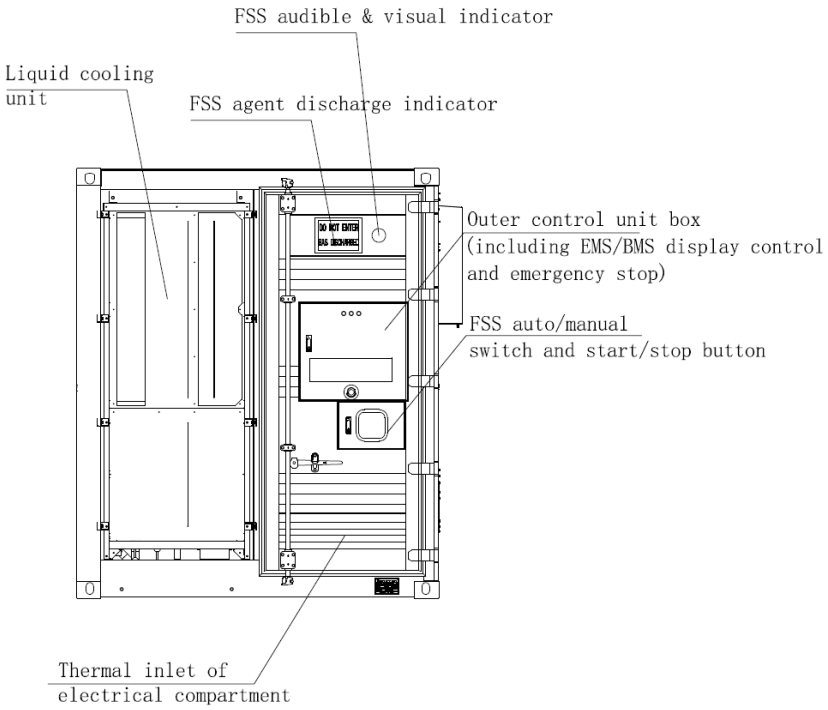
Front view

- The front view of the container includes three pairs of double-leaf folding doors;
- A ventilation inlet is arranged below the left door;
- A pressure relief valve is arranged at the upper left corner;
- There are 2 corner fittings at the bottom of the container for lifting;
- The external grounding point of the container is located at the lower left and right corner.
- A drainage outlet and a water spray system intake are located at the bottom of the container.



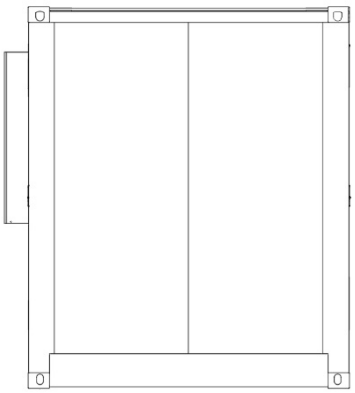
Rear view

- The rear view of the container includes three pairs of double-leaf folding doors;
- A ventilation outlet is arranged at the upper left side;
- There are two corner fittings at the bottom of the container for lifting;
- The external grounding point of the container is in the lower left and right corner.
- A thermal outlet of electrical compartment is reserved at the lower left corner of the container.



Left view

- The left view of the container includes a single-leaf door;
- A liquid cooling unit is located on the left side.
- The right door is equipped with FSS agent discharge indicator, FSS audible and visual indicator, FSS auto/manual switch and start/stop button, outer control unit box (including EMS/BMS display control and emergency stop).



Right view

- No equipment or openings are arranged in the right view of the container;

3.1.6. Design of System Incoming and Outgoing Lines

In order to facilitate the on-site cable connection, all cables between the internal equipment of the energy storage system should be connected before leaving the factory.

Cables of the energy storage system and external equipment should be routed through the bottom of the container. All cables entering and leaving the energy storage system should be properly protected, such as cable pipes, which need to be protected from rodents. After the cables are connected, all cable entrances shall be sealed with fireproof mud or other appropriate materials.

The cable access holes are shown in the following figure.

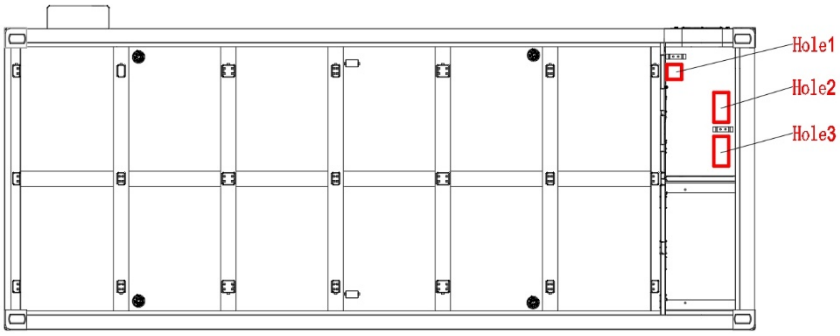


Figure 3- 5 Incoming and Outgoing Line Holes

The function of each hole is as follows:

No.	Name	Description
Hole-1	Communication/power supply cable port	Communication cable is connected with PCS, EMS (Energy Management System) and other equipment through this hole, and power supply cable is connected with auxiliary control power supply equipment.
Hole-2/ Hole-3	DC side output cable port	Connect with the DC side input power cable of PCS compartment through this hole.

3.1.7. Nameplate of Energy Storage System

Users can identify the energy storage system products through the nameplate, which is located in the lower left corner of the end door of the battery container, as shown in the following figure, and the detailed nameplate information is shown in Figure 3- 7.

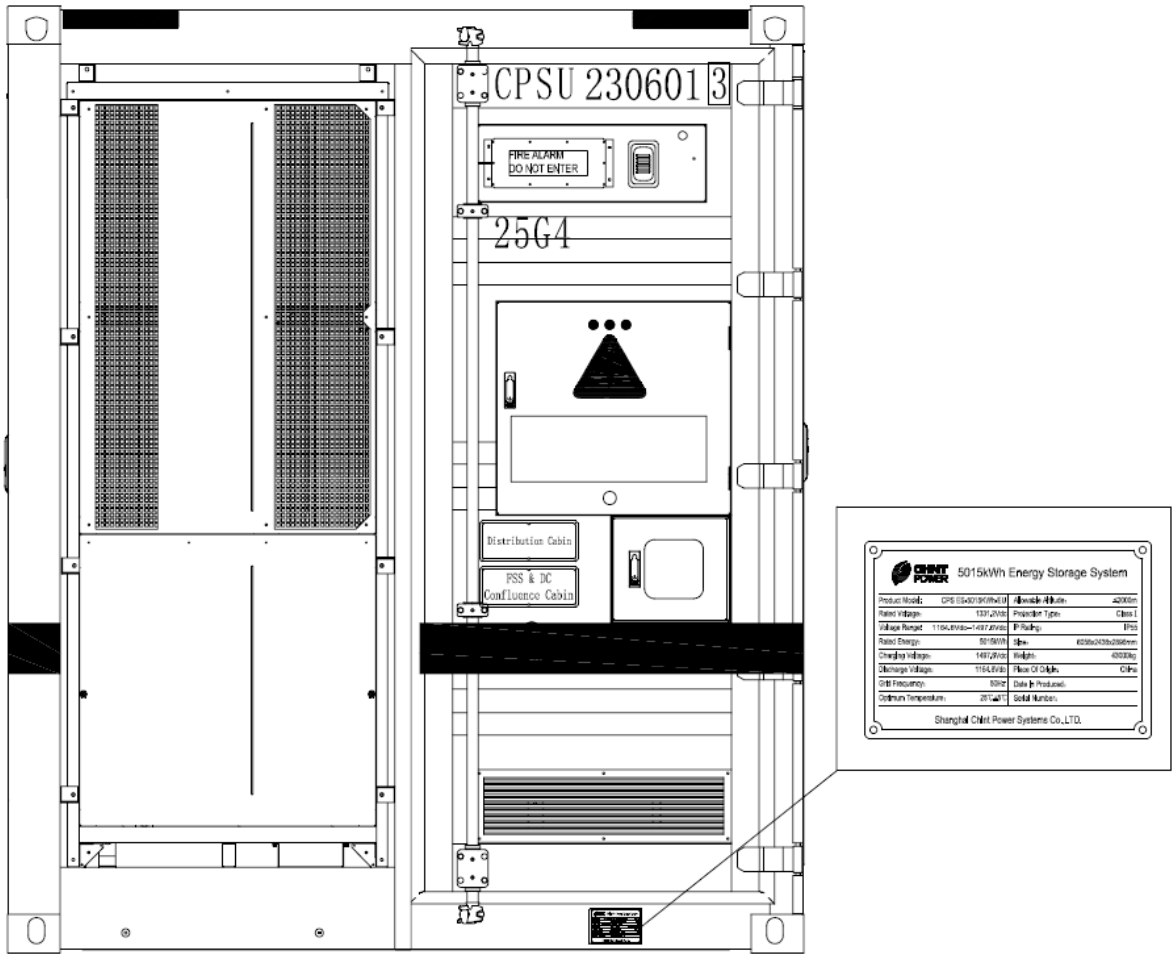


Figure 3- 6 Position of Energy Storage System Nameplate

CHINT POWER 5015kWh Energy Storage System

Product Model:	CPS ES-5015kWh-EU	Allowable Altitude:	≤2000m
Rated Voltage:	1331.2Vdc	Protection Type:	Class I
Voltage Range:	1164.8Vdc-1497.6Vdc	IP Rating:	IP55
Rated Energy:	5015kWh	Size:	6058x2438x2896mm
Charging Voltage:	1497.6Vdc	Weight:	43000kg
Discharge Voltage:	1164.8Vdc	Place Of Origin:	China
Grid Frequency:	50HZ	Date In Produced:	
Optimum Temperature:	25℃±5℃	Serial Number:	

Shanghai Chint Power Systems Co.,LTD.

Figure 3- 7 Energy Storage System Nameplate

The information contained in the nameplate includes:

(a). Product name, specification and model;

(b). Name and trademark of the manufacturer;

(c). Factory number (identified by serial number) and date of manufacture;

(d). Technical parameters:

- System operating parameters: Rated output voltage (V), rated output current (A), rated capacity (kWh), rated working frequency (Hz), etc.
- Hardware parameters: Altitude (m), size (mm) and weight (kg);
- Use temperature.

Warning:
The parameters on the nameplate of the energy storage system are very important, and it is forbidden to destroy or remove them.

3.2. Battery Cluster

The liquid cooling battery cluster is mainly composed of battery module (also battery PACK), high-voltage box, cabinet and BMS. BMS adopts a 3-level architecture, comprimising ESBMM (Energy Storage Battery Management Module), ESBCM (Energy Storage Battery Control Module) and ESMU (Energy Storage Management unit). ESBMM is pre-installed on the battery panel, ESBCM in the high-voltage box and ESMU in the equipment compartment.

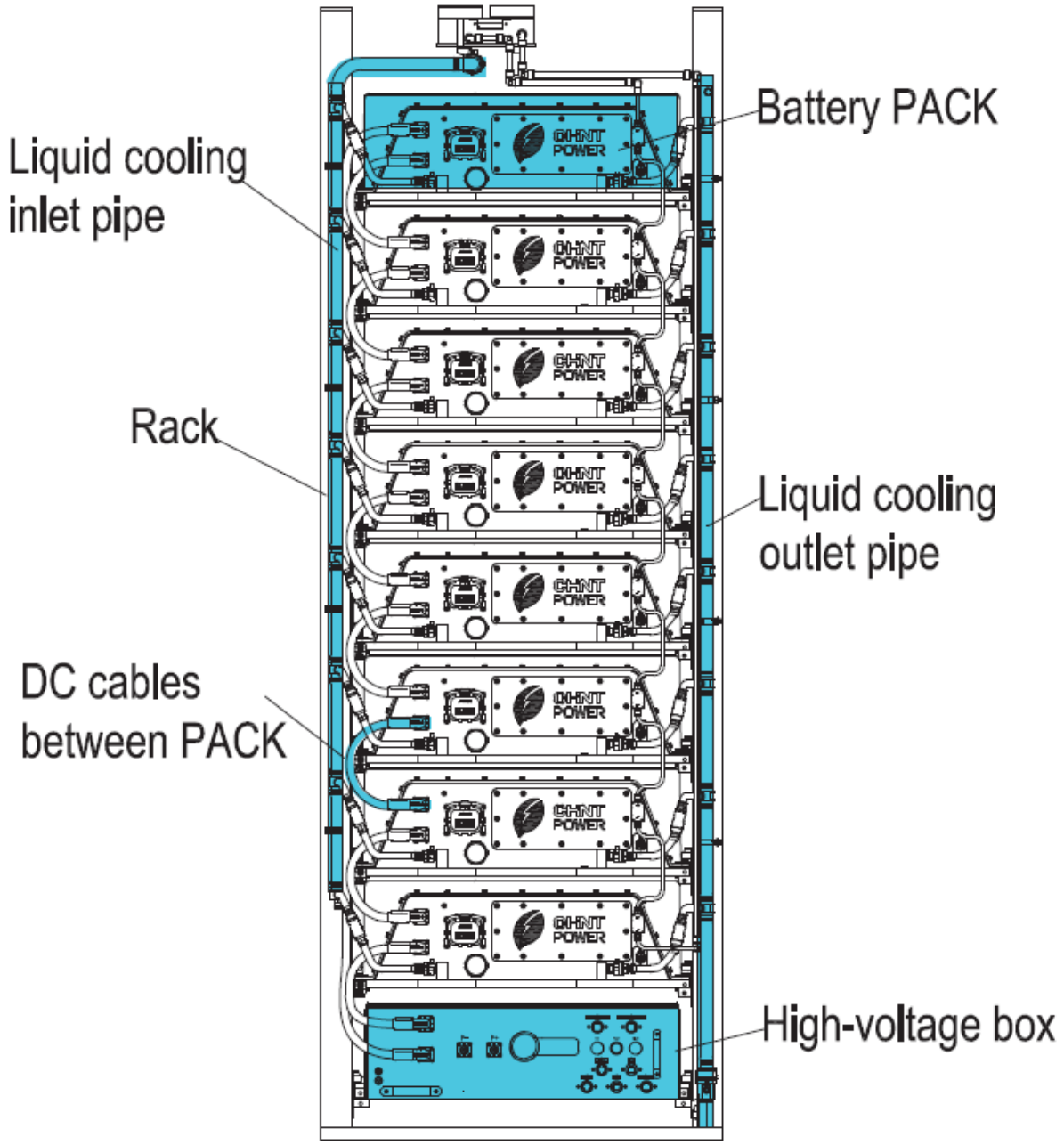


Figure 3- 8 Schematic Diagram for Connection of Battery Cluster

3.2.1. Battery PACK

Battery PACK consists of lithium iron phosphate battery cell 1P52S. The corresponding plugs and sockets of positive and negative power cables are orange and black, as shown below:

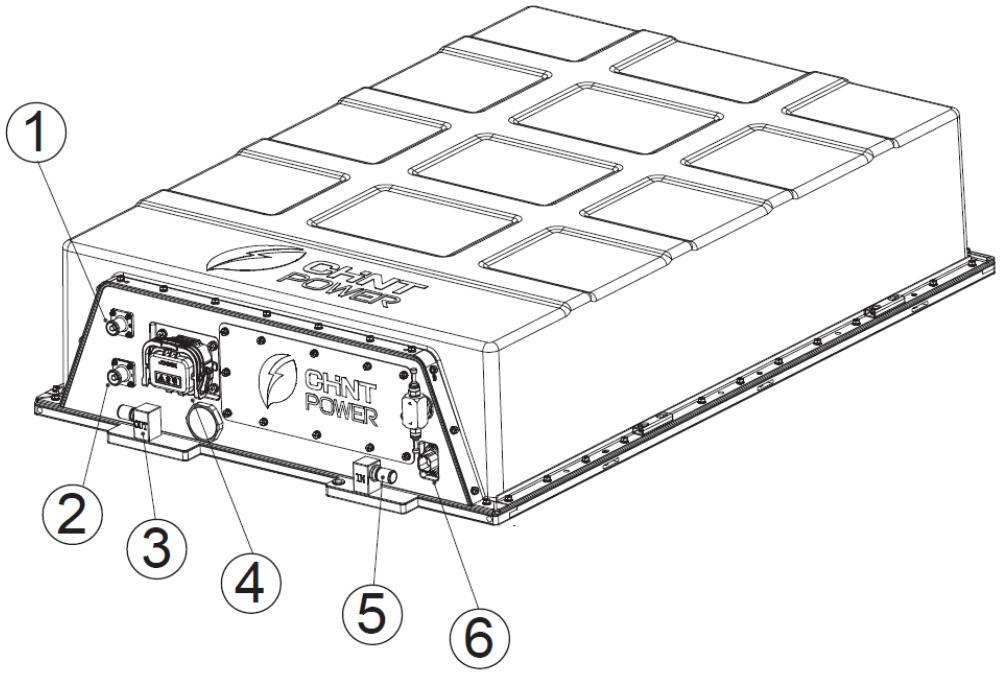


Figure 3- 9 Sockets of Positive and Negative Power Cables

No.	Name
1	Positive power cable interface
2	Negative power cable interface
3	Coolant outlet port
4	MSD
5	Coolant inlet port
6	Communication cable interface

3.2.2. High-voltage box

The disconnect switch and ESBCM of high-voltage box are shown as below:

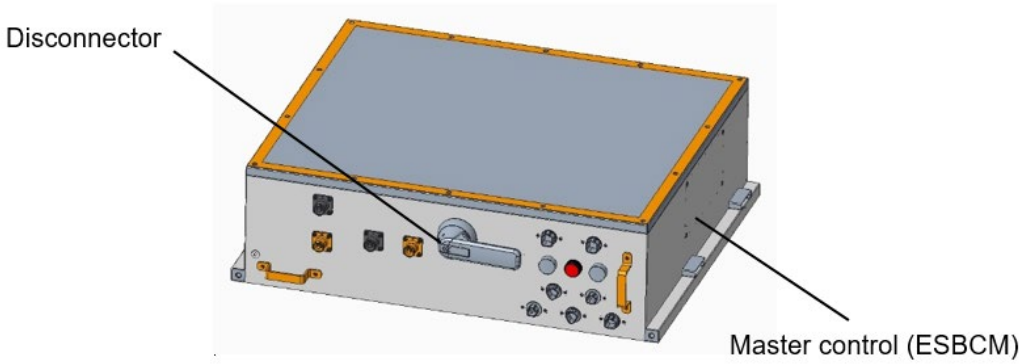
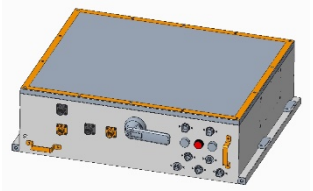


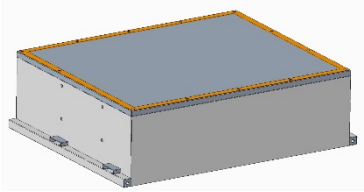
Figure 3- 10 High-voltage box

The following figures show the front and rear views of the high-voltage box and integrated ESBCM.

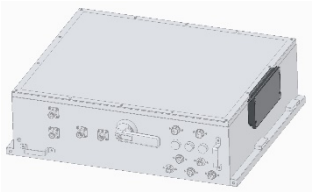
Front view of high-voltage box



Rear view of high-voltage box



Front view with ESBCM integration



Rear view with ESBCM integration

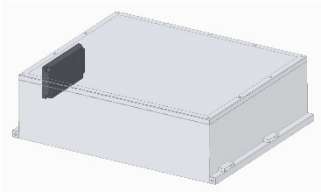


Figure 3- 11 Front and rear views of high-voltage box and integrated ESBCM

The following figure shows the interfaces of high-voltage box:

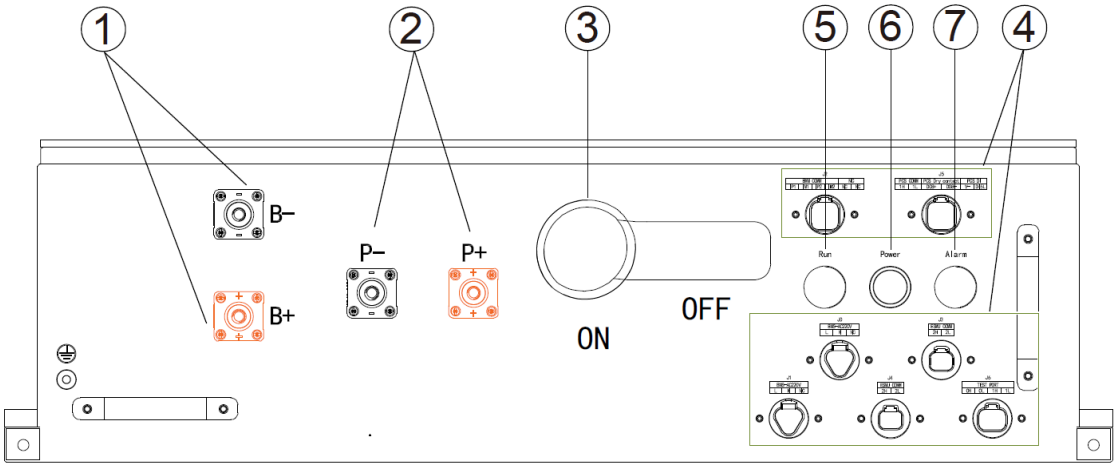


Figure 3- 12 High-voltage Box

Table 3- 2 Definition of High-voltage Box

S/N	Definition	Description
1	Battery cluster plug	DC cable connection plug of battery PACK
2	PCS plug	PCS DC cable connection plug
3	Disconnector switch	Battery cluster switch at DC side
4	Power supply and communication input/output interfaces of high-voltage box	Refer to Table 3- 3 for the definitions of power supply and communication input/output interfaces.
5	Run indicator	Indicating the high-voltage box is running
6	Power button	Indicating the control power is supplied
7	Alarm indicator	Indicating there is failure in the high-voltage box

The high-voltage box is connected to the battery cluster through "B+" and "B-" terminals, and connected to the copper busbar through "P+" and "P-" terminals on the front of high-voltage box. The schematic diagram of high-voltage box interface is shown in the following figure, and the definitions of power supply and communication input/output interfaces are shown in Table 3- 3:

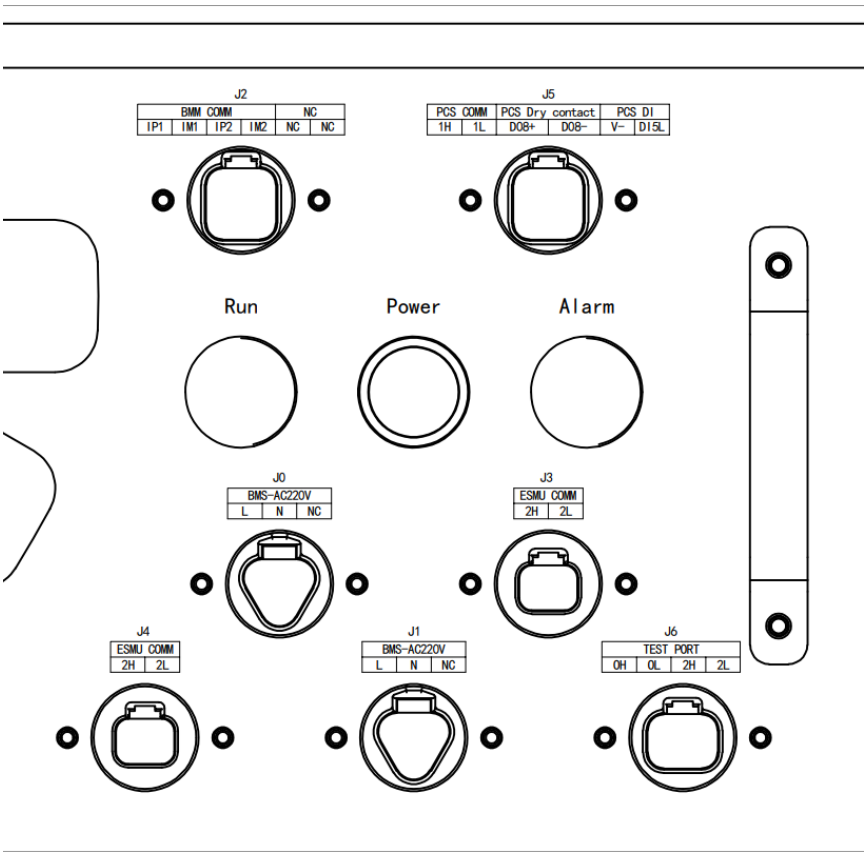


Figure 3- 13 Power Supply and Communication Input/Output Interfaces of High-voltage Box

Table 3- 3 Definition of Power Supply and Communication Input/Output Interfaces of High-voltage Box

Name	Function definition	Definition	Function description	Remarks
J0/J1	BMS-AC220V	L	External AC220V power input to supply power for BMS switch inside the high-voltage box	
		N		
		NC		
J2	ESBMM COMM	IP1	Daisy-chain communication	To IP2/IM2 of the first ESBMM
		IM1	Daisy-chain communication	
		IP2	Daisy-chain communication	To IP2/IM2 of the last ESBMM
		IM2	Daisy-chain communication	
	NC	NC	Reserved	
		NC	Reserved	
J3	ESMU COMM	2H	Daisy-chain communication	Connect to the previous 2H/2L of ESMU
		2L	Daisy-chain communication	
J4	ESMU COMM	2H	Daisy-chain communication	Connect to the next 2H/2L of ESMU
		2L	Daisy-chain communication	
J5	PCS COMM	1H	Communication with PCS	
		1L		
	PCS Dry Contact	D08+	It is used for fault transmission from BMS to PCS, serious fault output, passive normally closed, and disconnection in case of abnormality (PCS tripping)	
		D08-		
	PCS DI	V-	Used for fault transmission from PCS to BMS, passive normally open node, closed in case of fault (PCS tripping)	
		DI5L		
J6	1	0H	Intranet commissioning port	
	2	0L		
	3	2H	External network commissioning port	

Name	Function definition	Definition	Function description	Remarks
	4	2L		

3.3. BMS System

BMS adopts a 3-level architecture, comprimising ESBMM, ESBCM and ESMU. Their installation positions are detailed in the following table:

Table 3- 4 Installation Positions of BMS Components

Level	Name	Position	Function
Level 1, battery PACK level	ESBMM	Inside the battery PACK's maintenance panel	Check voltage and temperature information of battery cells in battery PACK
Level 2, battery cluster level	ESBCM	In high-voltage box	Carry out data collection, analysis and decision-making and cluster level protection; upload the information to ESMU;
Level 3, system level	ESMU	In equipment compartment	Collect the information of each ESBCM and communicate with EMS and SCADA (supervisory control and data acquisition)

The schematic diagram of the installation position of ESMU in the equipment compartment is as follows:

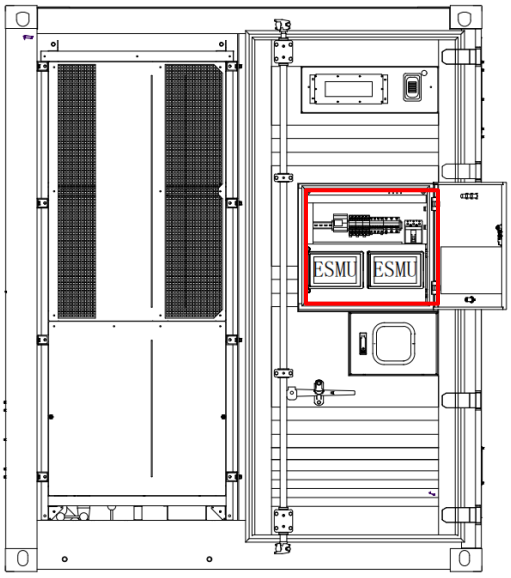


Figure 3- 14 Installation Position of ESMU

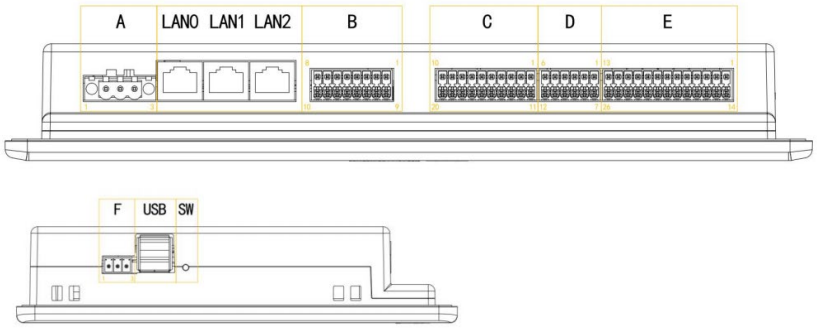


Figure 3- 15 Schematic Diagram of ESMU Interface

ESMU has eight interfaces. Interface A is the power port, and LAN is the Ethernet communication port. Interfaces B, C, D, E and F are communication ports, and USB is the port for exporting data and importing upgrade programs.

ESMU has 11 pairs of output dry contact interfaces located on all pins of interface E.

In the conventional design, we only introduce two input dry contact lines. Two wires of each dry contact are connected to the input interface of the PCS dry contact. When the BMS is normal, the ESMU dry contact outputs a closed signal, and when the BMS fails, the ESMU output is open-circuited.

Interfaces of ESMU are defined as follows:

Table 3- 5 Definition of ESMU Interfaces

Port name	No.	Definition	Function	Use
A	1	V+	Positive input of power supply	Power input
	2	V-	Negative input of power supply	
	3	PE	System grounding	
LAN	-	LAN0	100M/1000M Ethernet	EMS
	-	LAN1	100M/1000M Ethernet	EMS
	-	LAN2	10M/100M Ethernet	ESBCM
B	8	VDD	Output positive electrode of DI isolated power supply	DI power supply
	16	VSS	Output positive electrode of DI isolated power supply	
	7	DI1H	Detects a high level (24V) is effective	Level-2 warning signal
	15	DI2H	Detects a high level (24V) is effective	-
	6	DI3H	Detects a high level (24V) is effective	Trip signal input
	14	DI4H	Detects a high level (24V) is effective	Emergency stop
	5	DI5H	Detects a high level (24V) is effective	-
	13	DI6H	Detects a high level (24V) is effective	High density trip signal of combustible Gas
	4	DI7L	Detects a low level	-

Port name	No.	Definition	Function	Use
			(24V-) is effective	
	12	DI8L	Detects a low level (24V-) is effective	-
	3	DI9L	Detects a low level (24V-) is effective	-
	11	DI10L	Detects a low level (24V-) is effective	-
	2	DI11L	Detects a low level (24V-) is effective	-
	10	DI12L	Detects a low level (24V-) is effective	-
	1/9	DI0+/DI0-	AC (220Vac 50Hz) detection	-
C	10/9	0A/0B	0#RS485	PCS
	8/7	1A/1B	1#RS485	Air conditioner
	6/5	2A/2B	2#RS485	Air conditioner
	4/3	3A/3B	3#RS485	Liquid cooling
	2/1	4A/4B	4#RS485	-
	19/17 /15/13 /11	RB0~RB4	RS485 terminal resistance; if RB is suspended, there is no internal resistor 120R; if RB is short-circuited to xB (0B/1B, etc.), there is an internal resistor 120R	-
	20/18 /16/14 /12/10	RG0~RG4	Shielding grounding point of each RS485, suspended by default	-
D	6/5	0H/0L	0#CAN	ESBCM
	4/3	1H/1L	1#CAN	PCS
	2/1	2H/2L	2#CAN	-
	11/9 /7	RL0/RL1/RL2	CAN terminal resistance; if RL is suspended, there is no internal resistor 120R; if RL is short-circuited to xL (0L/1L/2L), there is an internal resistor 120R	-
	12/10 /8	CG0/CG1/CG2	Shielding grounding point of each CAN, suspended by default	-
E	13/26	D0+/D0-	0# normally open dry contact output	-
	12/25	D1+/D1-	1# normally open dry contact output	-
	11/24	D2+/D2-	2# normally open dry contact output	-
	10/23	D3+/D3-	3# normally open dry contact output	-

Port name	No.	Definition	Function	Use
	9/22	D4+/D4-	4# normally open dry contact output	-
	8/21	D5+/D5-	5# normally open dry contact output	-
	7/20	D6+/D6-	6# normally open dry contact output	-
	6/19	D7+/D7-	7# normally open dry contact output	System fault signal output
	5/18	D8+/D8-	8# normally open dry contact output	System protection trip output
	4/17	D9+/D9-	9# normally open dry contact output	-
	3/16	D10+/D10-	10# normally open dry contact output	-
	2/14	NO11/COM	11# normally open dry contact output	-
	15/14	NO11/COM	11# normally closed dry contact output	
F	1	TX	RS232 sending port	-
	2	RX	RS232 receiving port	
	3	GND	RS232 reference ground	
USB	1	USB1	USB Type A (firmware upgrade port)	-
	2	USB0	USB Type A	-
-	-	SW	Auxiliary firmware button	-

3.4. Grounding Wire

In order to reduce and eliminate the electrical noise in the system and prevent the danger of electric shock, it is necessary to ground the system. Grounding methods and requirements will vary according to specific projects and system configuration. All grounding methods shall comply with Article 250 of NEC.

Grounding wire shall be at least 16mm², with M8 or M10 ring terminal; the specifications are as follows:

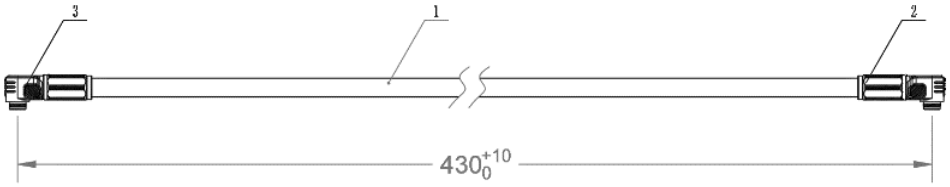
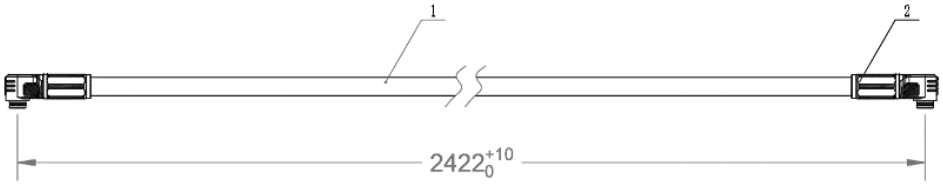
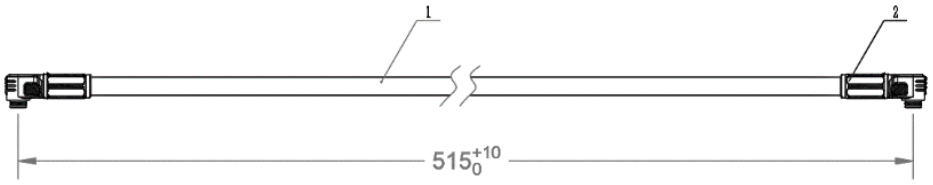
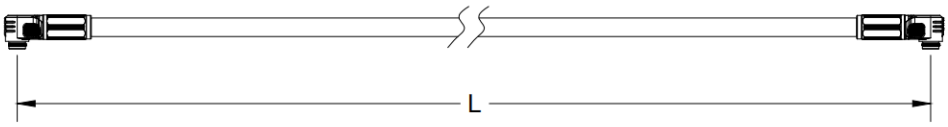
Table 3- 6 Specifications of Grounding Wire

Grounding wire Specification	Grounding screw	Screw specification	Screw hardness	Screw pitch	Screw material
16mm²	Conventional grounding	M8*14L	HRC32 Grade 8.8	1.25mm (0.05in)	SS304
16mm²	Rack grounding	M10*30L			
25mm²	Multi-cluster rack grounding	M10*25L (Side)			

3.5. Connect power cable between battery PACK

The power cable is used to connect the battery PACK in series to form a complete battery cluster, which is finally connected to the high-voltage box.

Table 3- 7 Specifications of Connecting cable

No.	Specification of connecting cable
1	Connect between upper and lower battery PACKs 
2	Connect between the positive socket of battery PACK and B+ socket of high-voltage box. Positive socket part number: ESP-250A-70-OR-00; Negative socket part number: ESP-250A-70-BK-00. 
3	Connect between the negative socket of battery PACK and B- socket of high-voltage box. The conductor size: 2/0 AWG. 
4	Connect from P+、P- terminal of high-voltage box to DC output 

4. Preparations

Before installing BESS equipment, the following items should be prepared.

4.1. Personnel Requirements

All personnel engaged in installation activities should be trained and have relevant experience in Chint BESS. Individuals should meet all training prerequisites and must complete systematic training. These personnel include:

- Service personnel who perform any installation work within the scope of work of the Owner specified in this document.
- The Owner's representative who performs any installation work within the scope of work of the Owner specified in this document.

4.2. Personal Protective Equipment And Tools

Warning:

- Do not wear watches, rings, jewelry or other metal objects.
- Wear a helmet correctly before entering the construction site to protect your head.
- Wear insulating gloves and safety shoes.
- Use tools with good insulation to prevent accidental electric shock or short circuit.

Before operation and installation, the technical service engineer shall prepare personal protective equipment (PPE) and tools. As shown in the safety instructions earlier in this Manual, basic PPE is required. Before any installation activities, check the condition of PPE and confirm its availability.

The recommended tools and equipment are listed in the following table. See Annex 3 List of Tools for details. Confirm that all equipment is calibrated through the approved calibration procedure and that the calibration has not expired. Due to the different scope and scale of project construction involved in each project, the types and quantities of required items should be different according to the actual situation.

4.3. Documents

Before installation, all relevant documents, such as contracts, technical agreements, shipping lists and installation drawings, should be collected, and ensured in the final version. These electronic project documents should be handed over to the document management department for archiving.

Technical service personnel should make all preparations before installation and know the initial installation status of the system. The battery has been installed and fixed in the factory, so just check and fill in the BESS installation checklist in turn according to the following steps.

Table 4- 1 Installation Checklist of BESS

No.	Steps	Inspection item	Record
1	Preparation	1.1 Ensure the correctness of project data and documents, including packing list and drawings.	
		1.2 Ensure that required PPE, tools and equipment are available.	
2	Product delivery	2.1 Confirm the installation date	
		2.2 Confirm the unloading site conditions and unloading methods.	
		2.3 Delivery: Partial shipment is allowed/Partial shipment is not allowed and relevant parties are informed.	
3	Product arrival	3.1 Unloader: Buyer/ Contractor/Seller	
		3.2 Count the number of accessory boxes	

No.	Steps	Inspection item	Record
4	Unpacking inspection	4.1 Check whether the file package in the accessory box is complete.	
		4.2 Ensure that cables, screws, bolts and other accessories are complete	
		4.3 Re-seal the accessory box	
		4.4 Complete receipt for arrival inspection	
5	Check before installation	5.1 Ensure that the installation site meets the installation conditions.	
		5.2 Train the installation personnel and complete the Safety Installation Training Record Form	
6	Battery cluster system inspection	6.1 Check the appearance of the battery PACK for no damage or leakage.	
		6.2 Check whether the battery PACK on the battery rack is fixed and loose.	
7	Battery PACK installation process training	7.1 Train installation workers and emphasize the importance of safety precautions for battery PACK replacement and installation.	
		7.2 Train installation workers to transport battery PACKs in a correct way (terminals up).	
		7.3 Train installation workers to correctly place the battery PACK in an order.	
		7.4 Check the open circuit voltage of the battery (the original inspection items can be postponed according to the site conditions).	
8	Cable connection	8.1 Ensure that the battery PACK is connected correctly according to the correct steps.	
		8.2 Train the installation personnel and emphasize the risks and dangers of incorrect installation.	
		8.3 Ensure that the installation tools are well insulated.	
		8.4 The installation personnel shall ensure that the battery polarity area is clean and tidy.	
		8.5 When connecting one end of battery PACK, conduct the insulation protection of the connector at the other end.	
		8.6 Conduct simple wiring installation training for installation personnel.	
		8.7 Special installation personnel are responsible for the complicated parts of battery PACK connection.	
		8.8 Supervise the connection of cells in the same cluster in a single row.	
		8.9 Supervise the connection of main positive and main negative with specific cables	
		8.10 Supervise the connection of the cables in the "safe area" after the voltage test.	

No.	Steps	Inspection item	Record
		8.11 The installation personnel shall ensure that all cable connectors are plugged in place.	
		8.12 Check whether all cable connectors are plugged firmly to ensure that the connector locking structure has been opened (necessary inspection items, which can be postponed according to site conditions).	
9	Connection of liquid cooling pipelines	9.1 Ensure that the liquid cooling pipelines are plugged in place with the interfaces of the liquid cooling plate.	
		9.2 Ensure that the liquid cooling secondary inlet/outlet pipelines are installed in accurate positions and fastened.	
		9.3 Make sure that there is no leakage at each connector on the liquid cooling primary, secondary and tertiary inlet/outlet pipelines, and the pipelines are covered with thermal insulation cotton.	
10	Inspection of integrity of positive and negative logos and numbers	10.1 Check the serial number sequence of each battery PACK.	
		10.2 Battery PACK stickers should be neat, clean and tidy.	
		10.3 Check whether the positive/negative logos of the battery PACK are complete and clear.	
11	Delivery of documents	11.1 Provide relevant documents, such as user manuals and certificates.	
		11.2 Other documents required	
	Remarks		
	After the above inspection items are completed, please tick in the inspection record, and then go to the next inspection item.		
	Please underline this part.		

4.4. Transportation and Delivery

4.4.1. Transportation Conditions

The internal equipment of the energy storage system has been installed and fixed before leaving the factory, and the whole system can be transported. The energy storage system can be lifted and transported with a crane;

The energy storage system is transported to the power station site by the freight company, and the site management personnel of the power station will be contacted in advance to negotiate and arrange the specific delivery and unloading. The transportation after delivery and unloading needs to be completed by the power station site construction personnel.

Warning:

During the transportation, loading and unloading of the energy storage system, the operation safety regulations of the country/region where the project is located must be observed.

- All instruments used during transportation need to be maintained.
- All personnel engaged in loading, unloading as well as bolting and tightening should receive corresponding training, especially safety training.

Note:

Please always keep in mind the mechanical parameters of the energy storage system during transportation and loading and unloading. Battery container:

- L×W×H: 6,058mm×2,438mm×2,896mm
- Gross weight: about 43,000 kg

The transportation and movement of energy storage system shall at least meet the following conditions:

- The doors of the energy storage system are locked.
- According to the site conditions, the appropriate means of transport should be selected, usually a crane. The means of transport used must have sufficient bearing capacity.
- If it is necessary to move on a slope, etc., additional traction devices may be required.
- All obstacles that exist or may exist during moving should be removed, such as trees and cables.
- The energy storage system should be transported and moved under better weather conditions as far as possible.
- Warning signs or warning belts must be set up to prevent non-working personnel from entering the lifting and transportation area, so as to avoid accidents.
- In addition, when the energy storage system is placed on the ground.
- Handle with care when placing. The energy storage system should not be dragged or pushed on any surface.
- The energy storage system should be placed on the solid and flat ground, with good drainage and no obstacles and protrusions, and supported only by the base.

4.4.2. Lifting

Warning:

- During the whole process of lifting the energy storage system, the safety operation regulations of the crane must be strictly followed.
- It is forbidden to stand within 10m of the operation area. In particular, it is forbidden to stand under the lifting arm and the lifted or moved machine to avoid casualties.
- In case of bad weather conditions, such as heavy rain, fog and strong wind, the lifting operation should be stopped.

When lifting the energy storage system, at least the following requirements shall be met:

- Site safety must be ensured during lifting.
- During the lifting and installation operations, there should be professionals on site to command the whole process.
- See the lifting schematic diagram below for the sling used, lifting angle and lifting speed.
- The crane shall have sufficient arm length and radius of rotation.
- Ensure that all sling joints are safe and reliable, and all slings connected with lifting rings are of equal length.
- The length of the sling can be properly adjusted according to the actual requirements of the site.
- During the whole lifting process, the energy storage system must be stable and not skewed.
- Please use the four rings of the energy storage system to lift the energy storage system.
- Take all necessary auxiliary measures to ensure the safe and smooth lifting of the energy storage system.

The following figure shows the crane operation schematic diagram of the energy storage system during lifting. In the figure, the A circle in the inner layer indicates the working range of the crane. When the crane is working, it is forbidden to stand in the B circle on the outer layer.

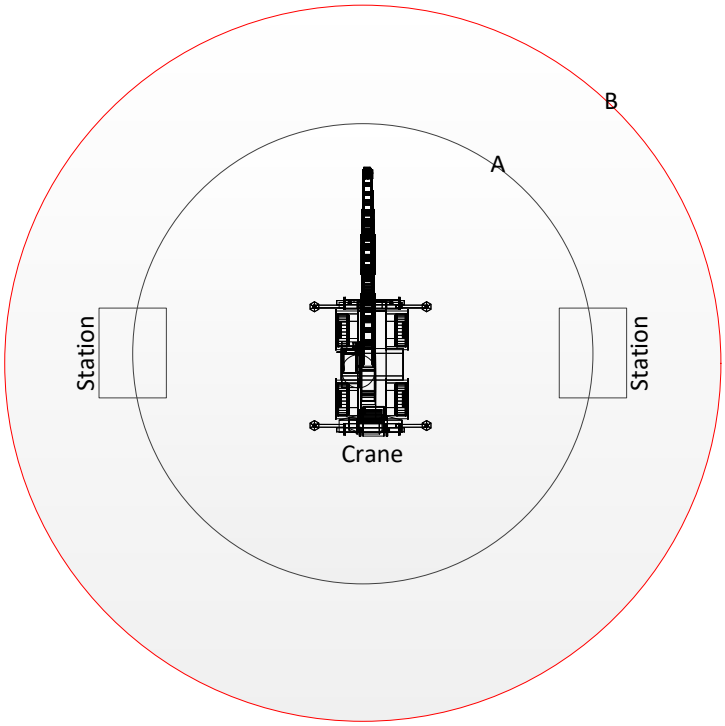


Figure 4- 1 Schematic Diagram of Lifting Energy Storage System

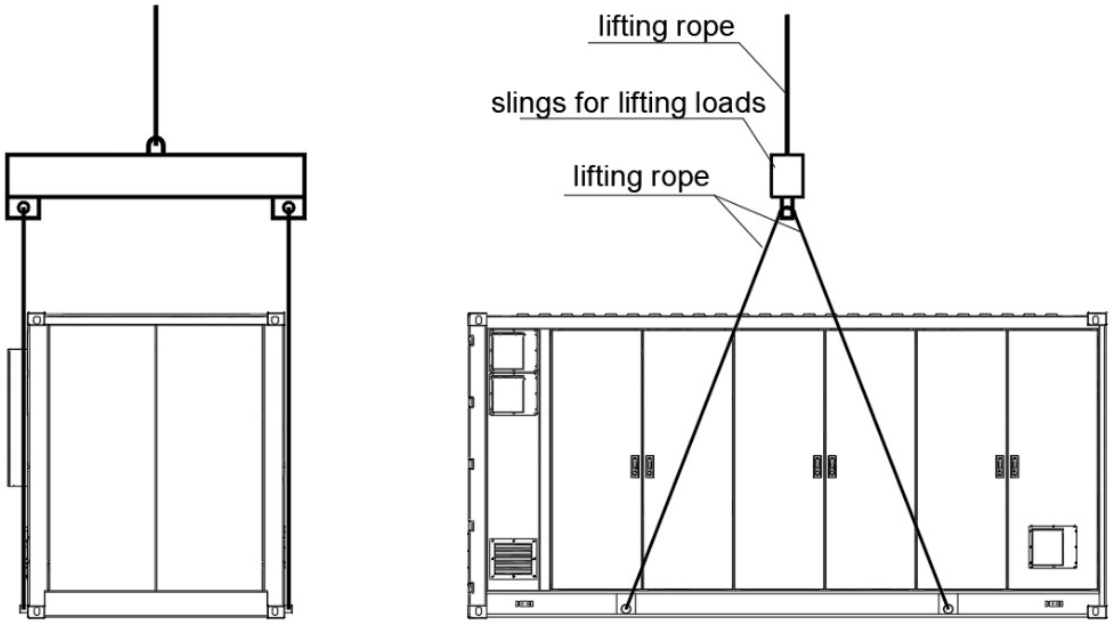


Figure 4- 2 Reference Diagram for Lifting Energy Storage System

Technical requirements:

- Recommended lifting scheme: Vertical lifting at both ends;
- The force applied by the lifting equipment on the corner of the container should be vertical and upward;
- The lifting speed should not exceed 5 meters per minute;
- Protection measures should be taken for the container during lifting, especially at the areas where the lifting rope contacts with the container body.
- The external dimensions of the container are as follows: 6058mm x2438mm x2896mm.
- The estimated total weight of the container is 43 ton.
- Professional lifting companies should consider sufficient safety factors for the lifting slings and ropes.

4.5. Installation Requirements for Energy Storage System

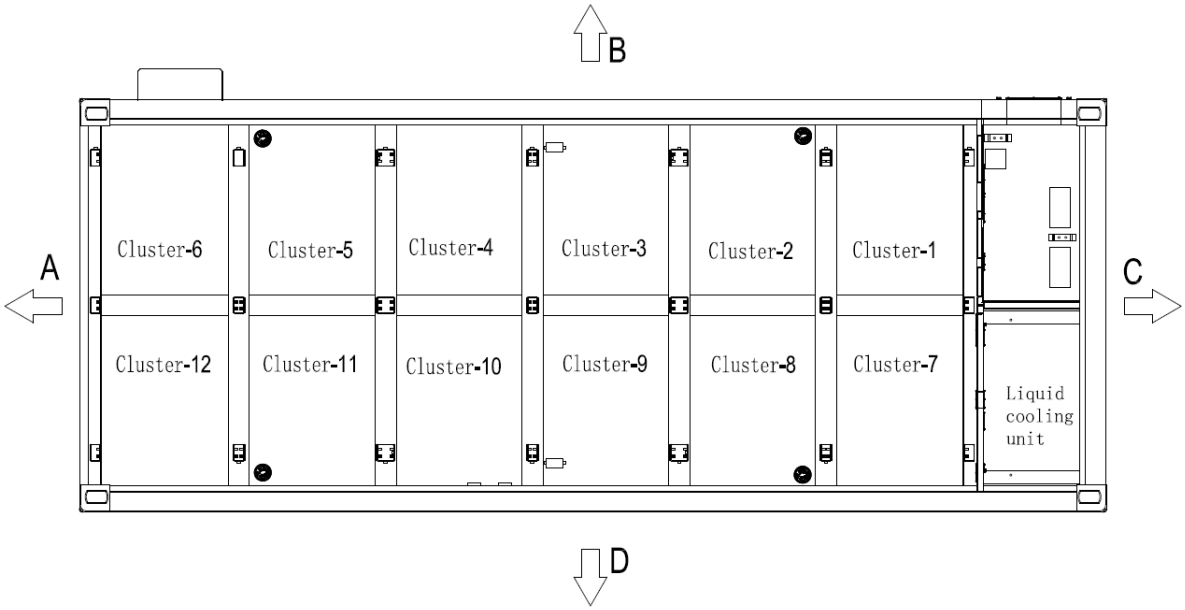


Figure 4- 3 Installation Clearance Requirements

The installation clearance requirement for 5MW BESS is as follows:

A	Distance from container to left object：≥0 mm
B	Distance from container to upper object：≥2000 mm
C	Distance from container to right object：≥1500 mm
D	Distance from container to front object：≥2000 mm

The energy storage system shall be installed on the structure supported by cement foundation or channel steel. It is necessary to make sure that the foundation is smooth, solid, safe and reliable, and has sufficient bearing capacity. The foundation surface shall not be sunk or inclined.

The energy storage system can be welded with the foundation steel plate, or in other ways with the same connection firmness.

The number of supporting points of the energy storage system on the foundation, the supporting unit bearing capacity and the installation position of the base plate are shown in the following figure:

Technical specification:

- This foundation drawing is only used as a reference for customer to design the foundation;
- The foundation base plane of the container needs to be higher than the horizon and above the maximum precipitation height of the project site;
- This project involves fully loaded containers with equipment and battery PACKs, with a maximum total weight of approximately 43 tons. The foundation requires sufficient strength, and the load on each support point C1-C4 and D1-D2 should be greater than 10.5 tons;
- The flatness of the entire foundation base plane should be controlled within ±2mm;
- Prior to placing the container on the foundation, it is strictly necessary to place the spacer plate at the position shown in the drawing. The spacer plate is included in the packaging accessories of the container. If the spacer plate is not placed at the designed location, after the container is fully loaded with battery PACKs,

it may cause the side door of the container to be unable to open normally or lead to permanent deformation that cannot be repaired, even if structural repair is required. Please strictly comply with this requirement.

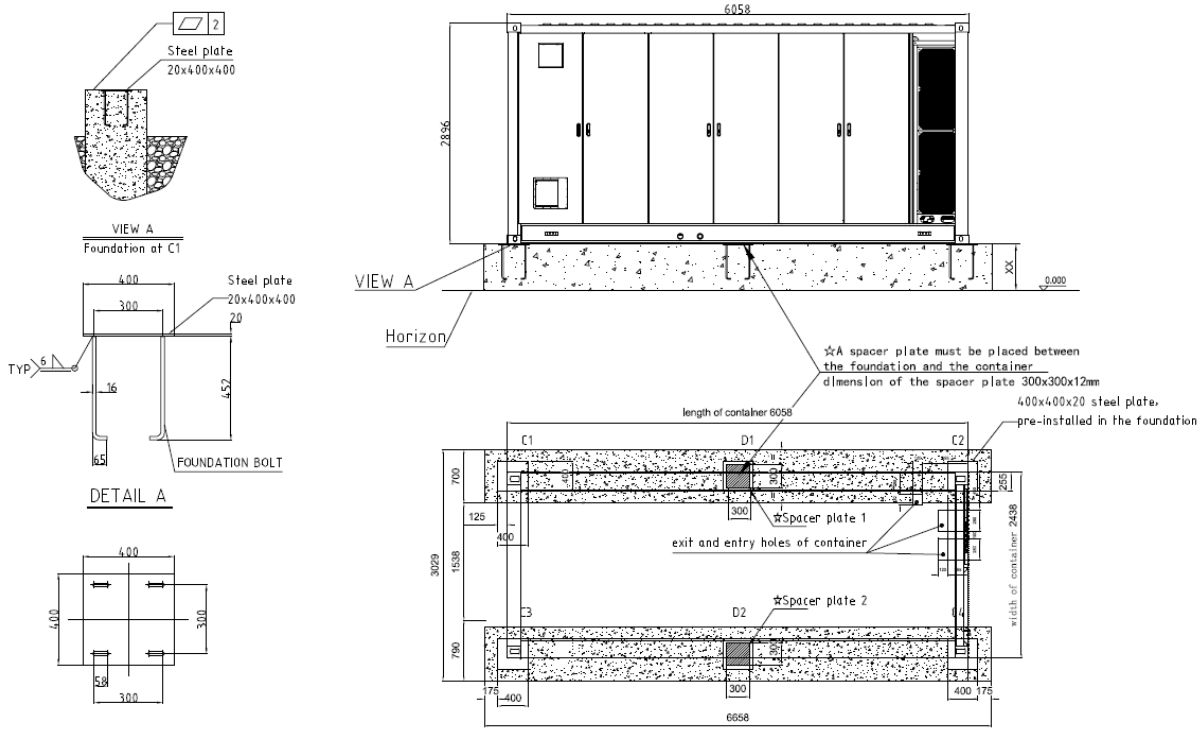


Figure 4- 4 Supporting Points of Energy Storage System

4.6. Unpacking

Warning:

- Do not wear watches, rings, jewelry or other metal objects.
- Wear insulating gloves and safety shoes.
- Store in a dust-free place, with humidity not exceeding 60% and temperature not exceeding 23℃±5℃.
- Avoid direct sunlight.

Please check the following parts when unpacking. Quantity is based on 12 clusters of racks and 96 battery PACK installation parts.

Table 4- 2 List of Cable Accessories

S/N	Description	No.	Qty.	Remarks
1	Upper and lower connecting cables	6.0302.2102A0	84pcs	For upper and lower battery PACKs
2	Main positive cable	6.0302.2103A0	12pcs	For battery main positive and high-voltage box main positive
3	Main negative cable	6.0302.2104A0	12pcs	For battery main negative and high-voltage box main negative

4	Communication between battery PACKs and power supply communication	6.0302.2113A0	1 Set	For communication and power supply between battery PACKs, from battery PACKs to high-voltage box
5	Cluster-to-cluster communication and power supply communication	6.0302.2115A0	1 Set	Used for communication and power supply between battery clusters

4.7. Checking

The installation personnel shall make records according to the checklist after unpacking. After unpacking, check the following items, fill in the Goods Receipt, and sign it by the customer (customer representative) and the installation personnel. If any defects are found during the inspection, please contact the After-sales Service Department of Chint to solve the problem.

Table 4- 3 Inspection of Battery Cluster Modules

Module name	Inspection item
Battery PACK	Use the battery tester to test voltage and internal resistance Whether the outside is damaged Whether the screws are missing or bulging Whether the paint peels off
Battery protection unit	Whether the outside is damaged Whether the screws are missing or bulging Whether the paint peels off
ESMU	Whether the outside is damaged Whether the screws are missing or bulging Whether the paint peels off
Accessories	Qty. Specification

Note: If there are a large number of accessories, please make a spot check. In order to ensure the safety of connecting accessories, all accessory boxes containing connecting accessories should be resealed after inspection, and the required accessories should be taken out until the battery needs to be connected.

5. General Installation

5.1. Installation Time

The estimated time required for battery cluster installation is shown in the following table.

Table 5- 1 Time Required for Installation of Single Cluster Battery Accessories

Step	Operation content		Estimated time (hour: minute)
1	Unpacking		00:15
2	Checking		00:15
3	Accessory installation	Connecting cable	00:30
		Battery-to-battery communication harness	00:30
		Installation of liquid cooling pipeline	00:30
		Cluster-to-cluster communication/power supply harness	00:30
		BMS configuration	02:00

5.2. General Principles of Installation

Instructions:

Please read the following installation sequence carefully before installation.

- Ensure that the high-voltage box is always at the bottom layer; meanwhile, the handle of disconnecting switch of the high-voltage box needs to be in "OFF" state;
- The configuration of single cluster battery will be different for different projects. The following figure shows an example of a standard battery cluster;
- A battery cluster instruction is provided to clarify the understanding of the complete material.

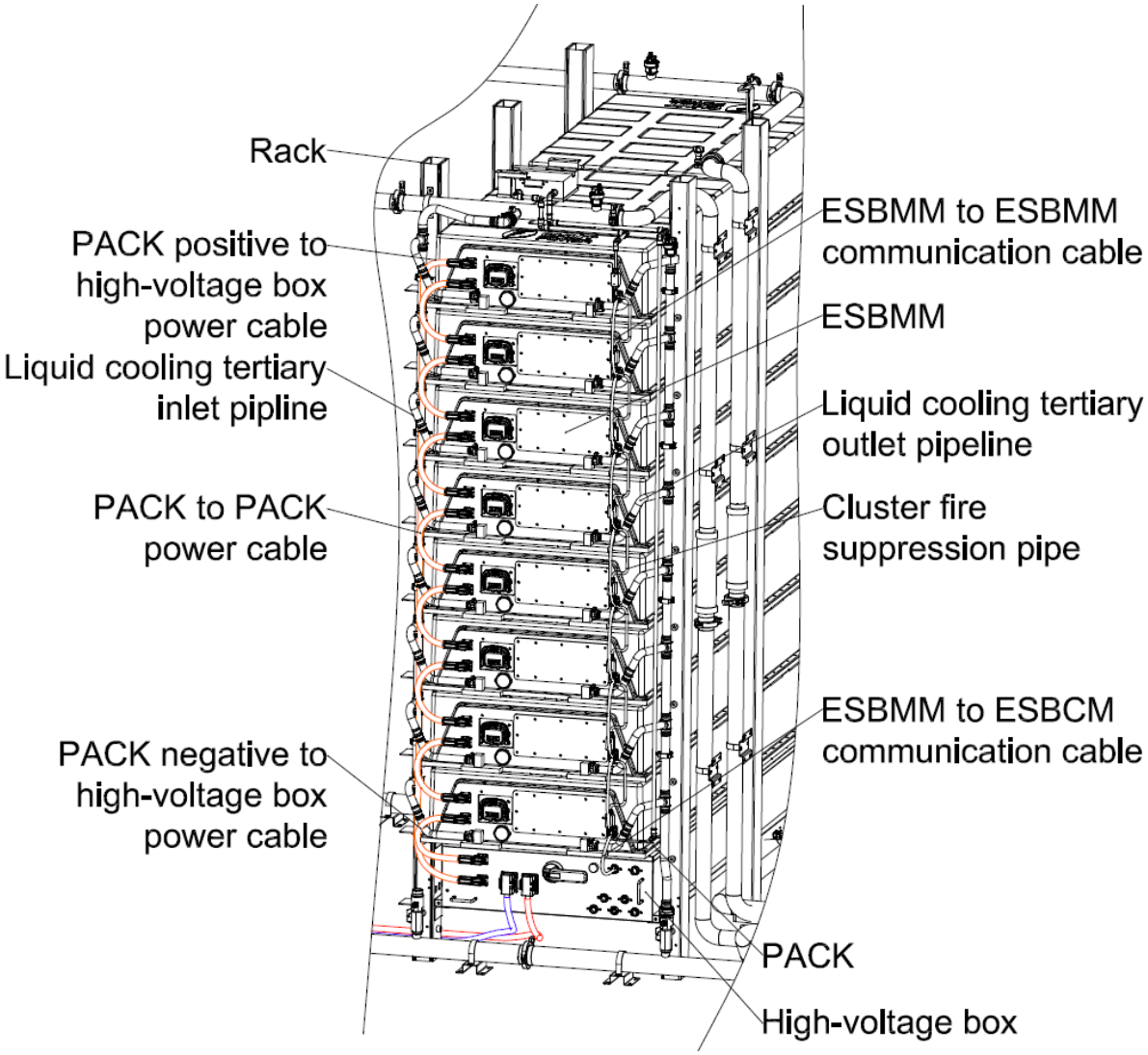


Figure 5- 1 Systematic Description of Battery Cluster Mounting Materials

In a standard battery cluster configuration, all battery PACKs share identical structure and configuration with uniform polarity configuration. During system delivery, battery PACKs are pre-installed in position, requiring only cable connections in series. The battery PACK arrangement sequence is shown in the following figure:

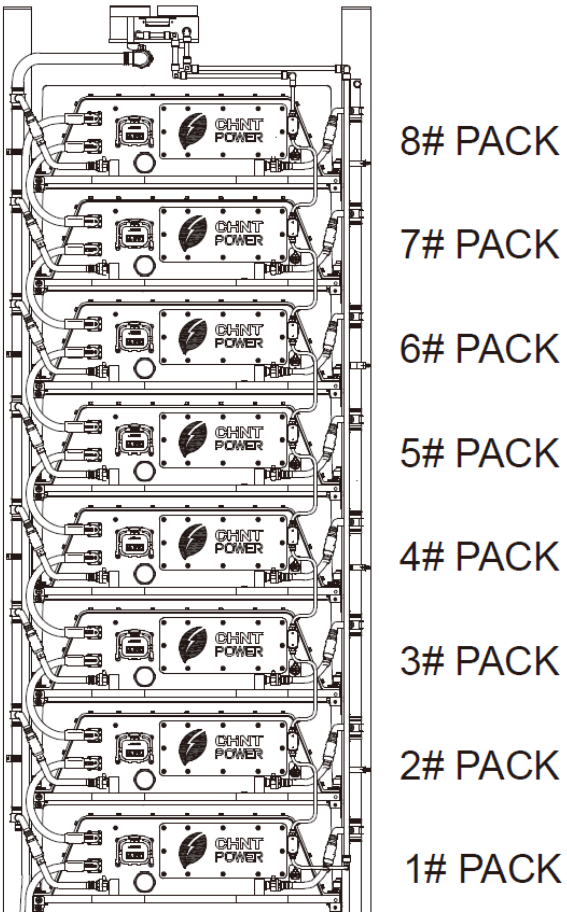


Figure 5- 2 Battery PACK Sequence

6. Connection of Power Cables

6.1. Safety Instructions

Warning:

- Execute operations with caution to prevent electrical shorts between battery PACK positive/negative terminals.
- Ensure terminals remain isolated and avoid contact with non-designated surfaces during installation.
- When installing cables, connect only the corresponding positive/negative terminals of two battery PACKs. After installing power cables for each battery PACK, ensure proper insertion of cable connectors
- Ensure that disconnecting switch on the high-voltage box is in the "OFF" position.
- Ensure that there is no 120/220VAC auxiliary control power input in the high-voltage box.
- The tightening torque of M10 screw at the terminal of high-voltage box is 12~15 N.m (106-133 in-lbs).

Once the cables connecting battery PACKs and those between battery PACKs and the high-voltage box are connected, the entire battery cluster establishes a complete circuit. Connection steps of cables are detaild as shown below:

1. Make sure that the disconnect switch of high-voltage box is in "OFF" state, i.e. the red handle of disconnect switch is in the horizontal direction.

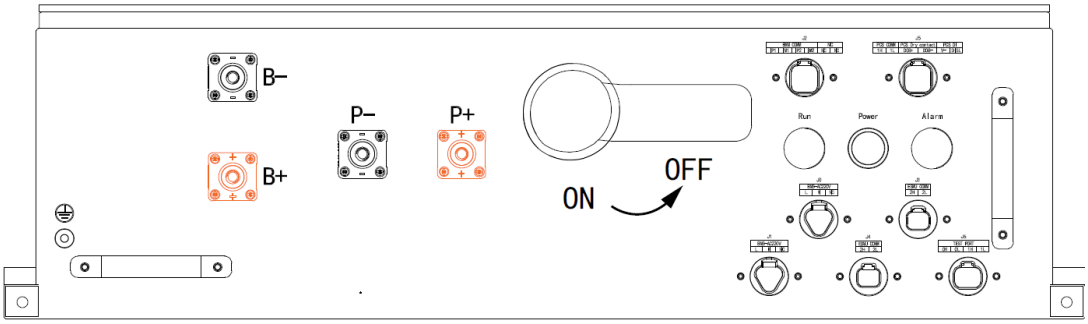


Figure 6- 1 Disconnect Switch of High-voltage box

2. Connect plugs of main negative cable to negative socket of 1# battery PACK and B- socket of the high-voltage box (sockets have the same color with plugs). If a "click" sound is heard, it indicates that they are plugged in place.

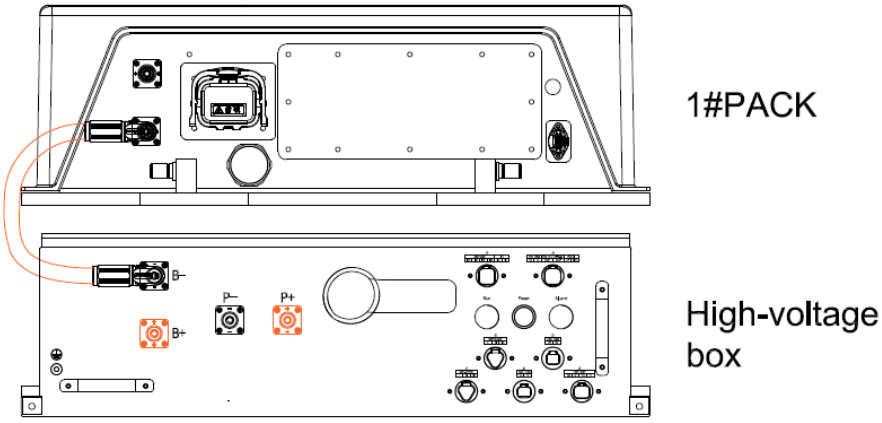


Figure 6- 2 Insert the Cable Plugs to Negative Sockets

3. Connect plugs of main positive cable to positive socket of 8# battery PACK and B+ socket of the high-voltage box (sockets have the same color with plugs). If a "click" sound is heard, it indicates that they are plugged in place.

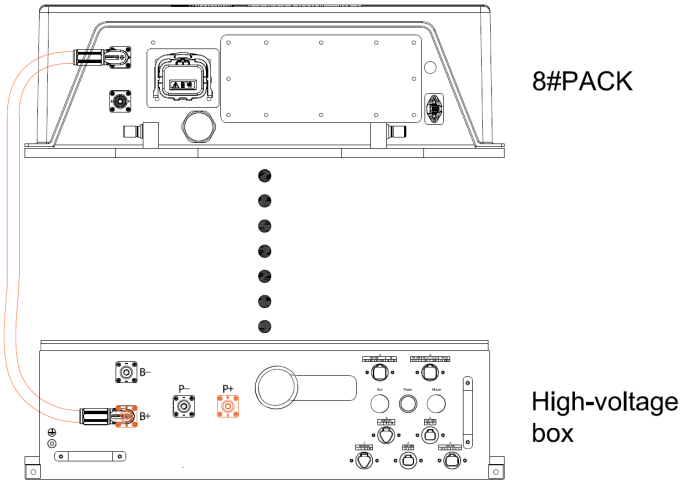


Figure 6- 3 Insert the Cable Plugs to Positive Sockets

4. Connect plugs of PACK connecting cable into the negative socket of 8# battery PACK and the positive socket of 7# battery PACK (sockets have the same color with plugs). If a "click" sound is heard, it indicates that they are inserted in place.

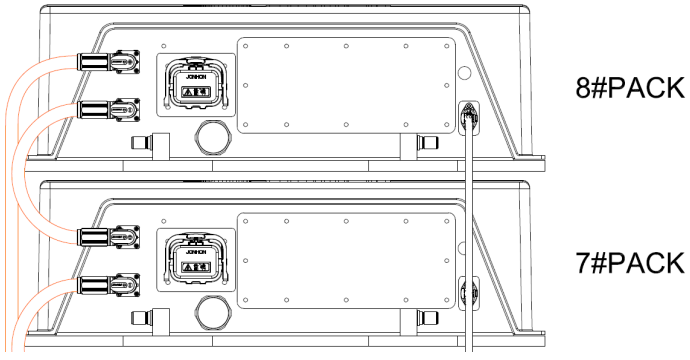


Figure 6- 4 Insert Cable Plug into Negative Socket

5. Repeat step 4 and install it downward in turn until inserting the cable plug into the negative socket of 2# battery PACK and the positive socket of 1# battery PACK.

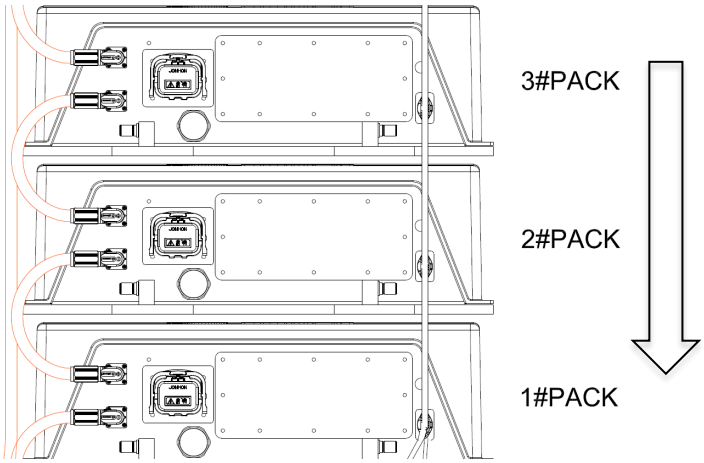


Figure 6- 5 Install Downward in Turn

6.2. Installation of Communication Harness

6.2.1. Harness Installation

Warning:

- Use signal cables that meet the following specifications.
- Do not plug both ends of the harness into the same "battery PACK".

The specifications of the signal cables connected between the high-voltage box and battery PACK are as follows, the connector pinout can be found from the back of the battery PACK:

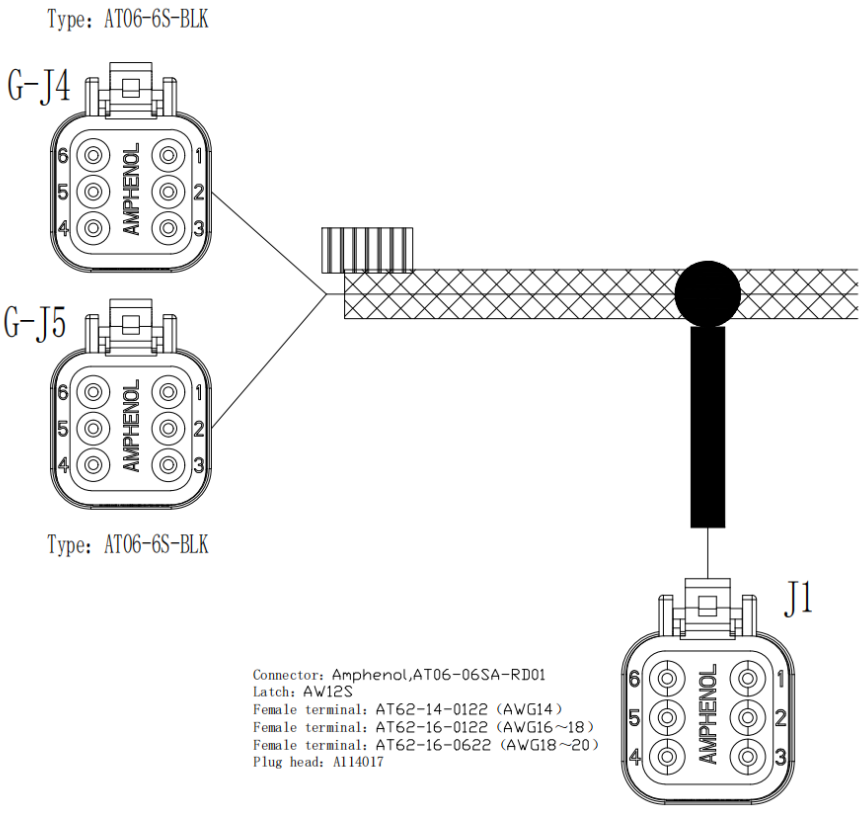


Figure 6- 6 Communication Harness Plug-Socket Between ESBCM and ESBMM

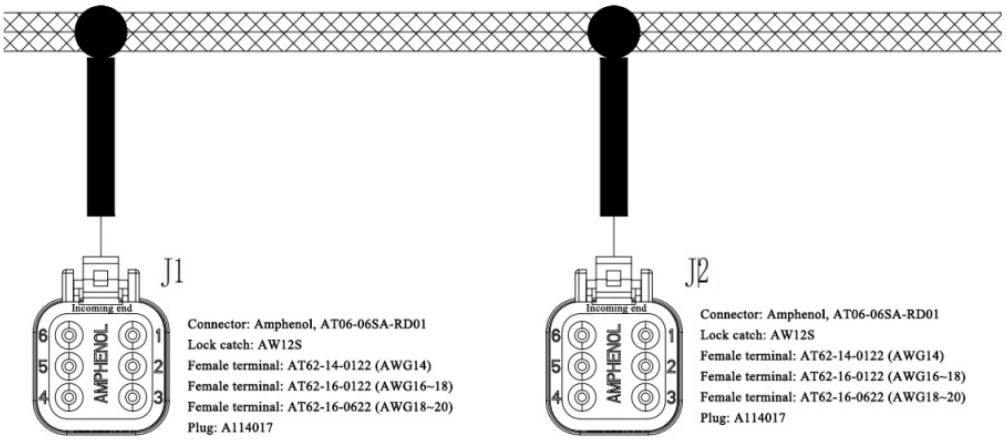


Figure 6- 7 Communication Harness Plug-Socket between ESBMMs

J1-1	J1-2	J1-3	J1-4	J1-5	J1-6	J2-1	J2-2	J2-3	J2-4	J2-5	J2-6
IM1	IM2	Res.	IP1	IP2	Res.	IM1	IM2	Res.	IP1	IP2	Res.

Installation steps of Communication/power Supply Harness Between Battery protection unit and ESBMM and Between ESBMMs are as below:

1. Connect the communication/power supply harness between the ESBCM communication port of high-voltage box and communication port of 1# battery PACK.

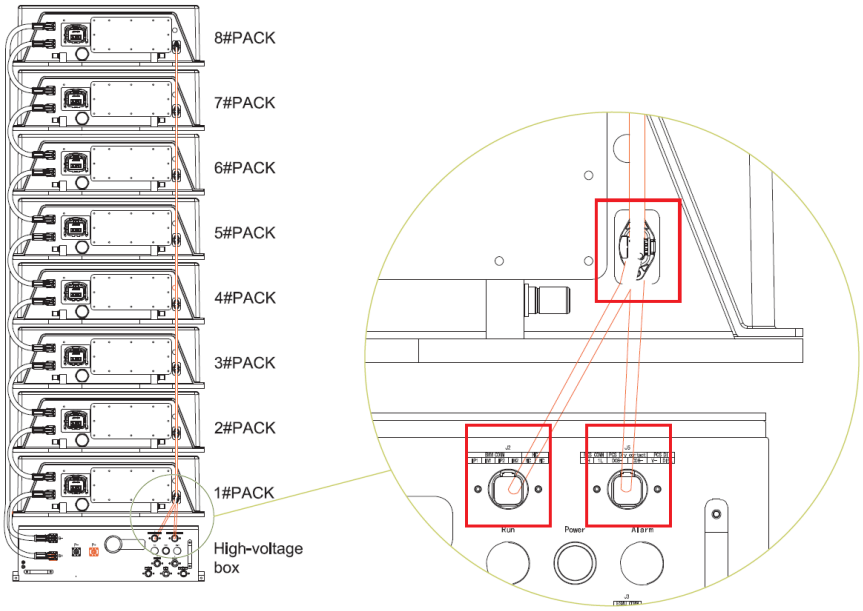


Figure 6- 8 Connect Communication/Power Supply Harness

2. Connect the communication/power supply harness between communication port of 1# battery PACK and communication port of 2# battery PACK.

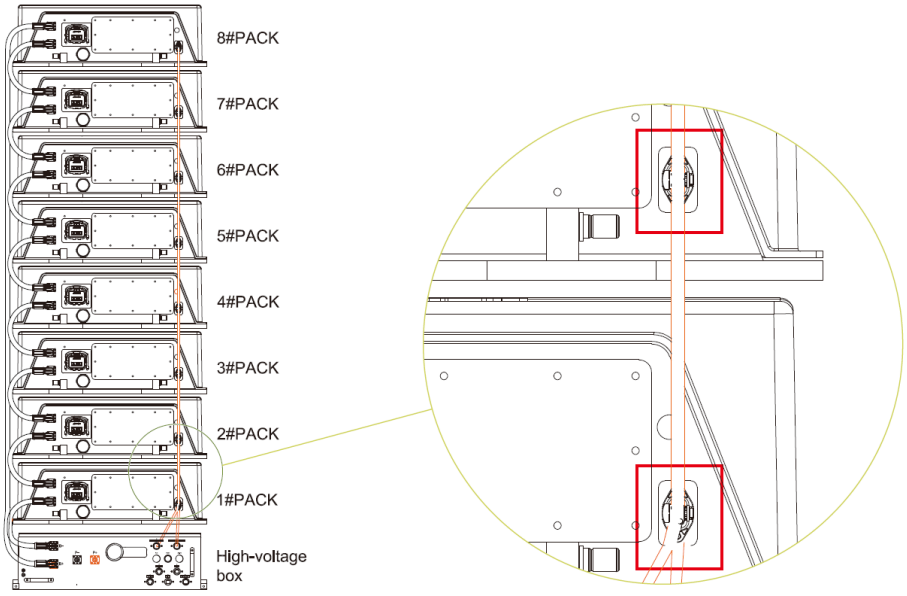


Figure 6- 9 Connect Communication/Power Supply Harness

3. Repeat step 2 to connect the communication/power supply harness between communication ports of the rest PACKs in the cluster.

6.3. Installation of High-voltage Box Power Supply Cable

Warning:

Use power supply cables that meet the following specifications.

Specifications of power supply cables are shown in the following context:

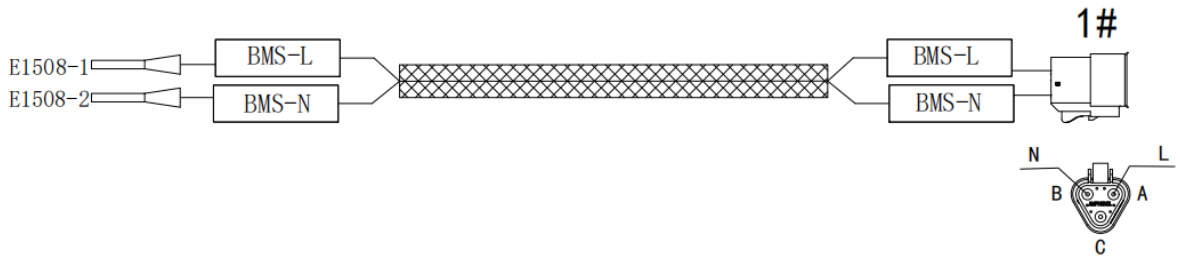


Figure 6- 10 Main Power Supply to 1# Cluster Power Supply Harness

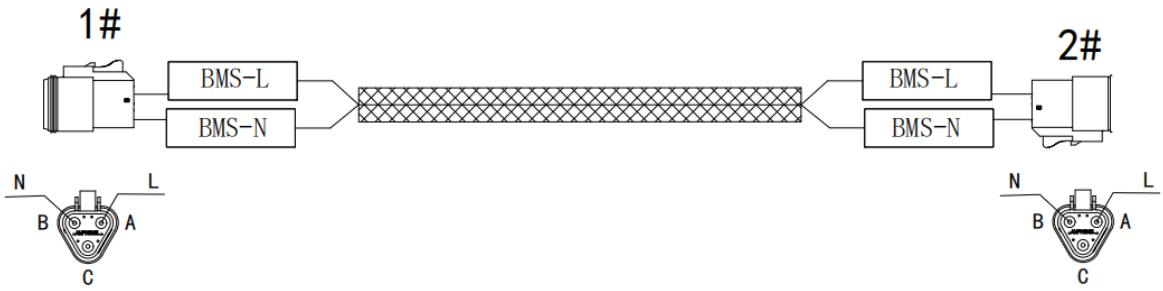


Figure 6- 11 Inter-cluster Power Supply Harness

Connect the power supply harness of high-voltage box in the order of battery cluster as below.

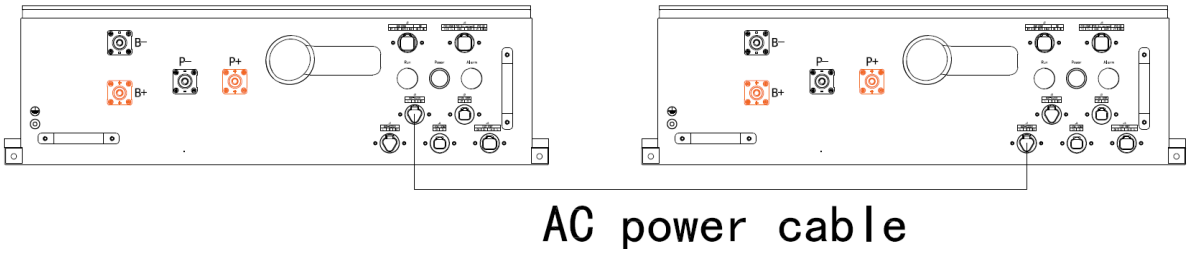


Figure 6- 12 Installation Diagram of Power Supply Harness

6.4. AC Input Commissioning

Warning:

After the above harness is installed, check the bolt fastening, screw fastening torque, high-voltage power cable connection, battery connection and high-voltage box connection by sampling.

After the battery system is installed, turn on the AC input power of BMS before turning on the BMS. Commission AC input of high-voltage box in accordance with the following steps:

1. Before connecting the AC input auxiliary power supply of the high-voltage box, ensure that the handle of disconnecting switch is in the "OFF" position.

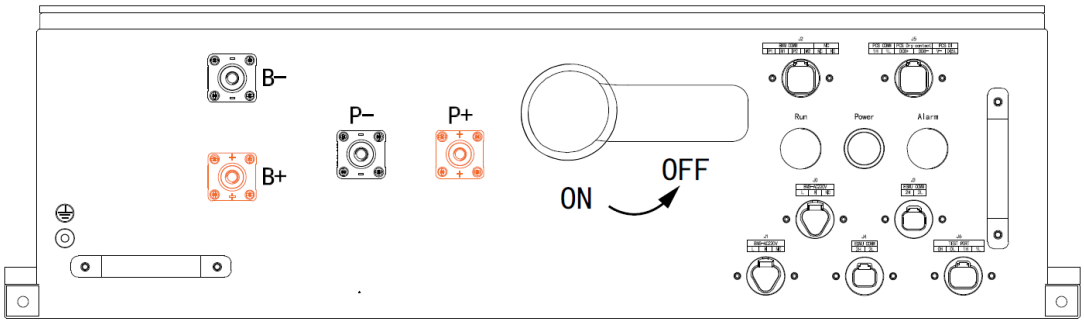


Figure 6- 13 Handle of Disconnecting Switch in "OFF" Position

2. Turn the handle of disconnecting switch to ON.

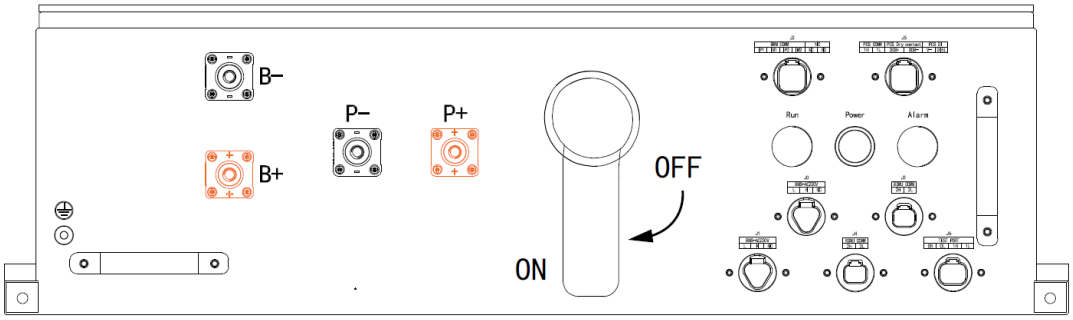


Figure 6- 14 Turn Handle of Disconnecting Switch to ON

3. Check the color of the power indicator;

- If the power indicator lights up as red, it indicates that the power supply of the high-voltage box is normal.
- If the power indicator is not on, it indicates that the power supply of the high-voltage box is abnormal.

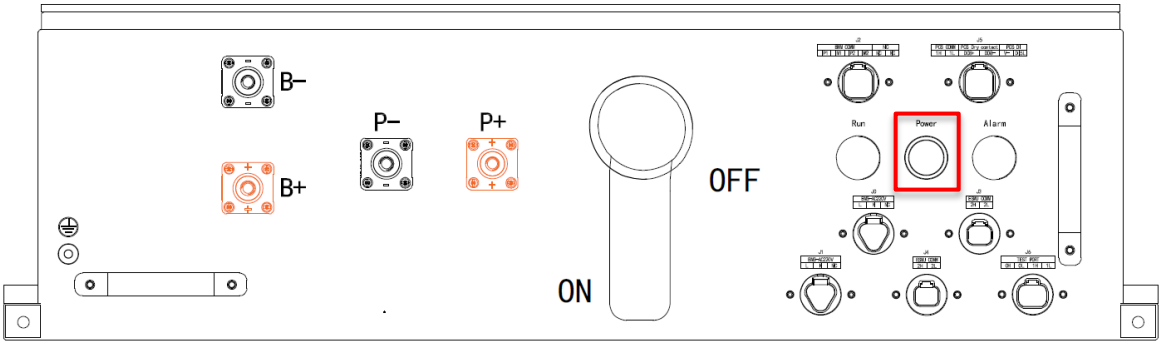


Figure 6- 15 Check Color of Indicator

6.5. Installation of Liquid Cooling Pipeline

Warning:

Install the liquid cooling pipe according to the following table.

Note: When the normal system is shipped, the primary, secondary and tertiary liquid cooling pipelines have been installed.

6.5.1. Install Secondary and Tertiary Inlet Pipelines in Cluster

Install secondary and tertiary inlet pipelines in the cluster in accordance with the following steps:

1. The main bodies of the secondary and tertiary pipes have been assembled when leaving the factory. The secondary pipe connector pasted with a blue tag is connected to the male connector of the primary pipe pasted with a blue tag. It is necessary to confirm that the lock of the connector has been clamped into the connector groove and cannot be pulled out.

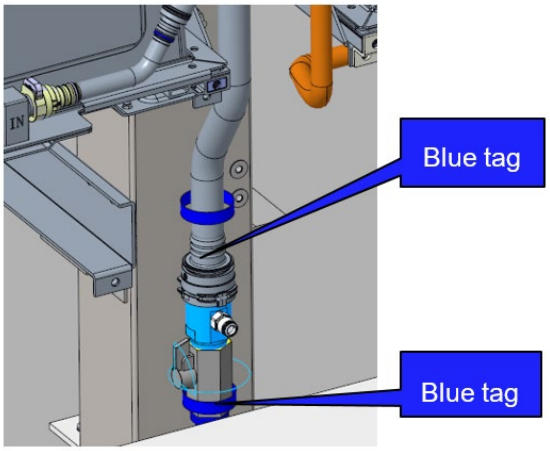


Figure 6- 16 Connect Secondary Pipe Connector to Primary Pipe Male Connector

2. Connect the tertiary inlet pipe connector to the male connector of the battery PACKs from #1 PACK to #8 PACK in turn, and fasten the clips. A "click" sound shall be heard to confirm that the connector is fastened and cannot be pulled out.

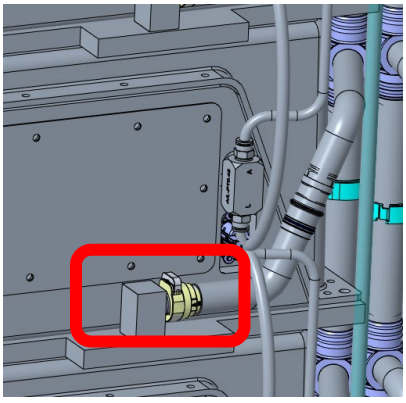


Figure 6- 17 Connect Tertiary Inlet Pipe Connector to Male Connector

3. Each secondary inlet pipeline is fixed to the inner hole of the sheet metal part with 4 plastic pipe clamps. The pipe clamp needs to reduce the inner diameter to clamp the pipeline and to be inserted into the hole of fixing the sheet metal part, making sure that there is no loose insertion.

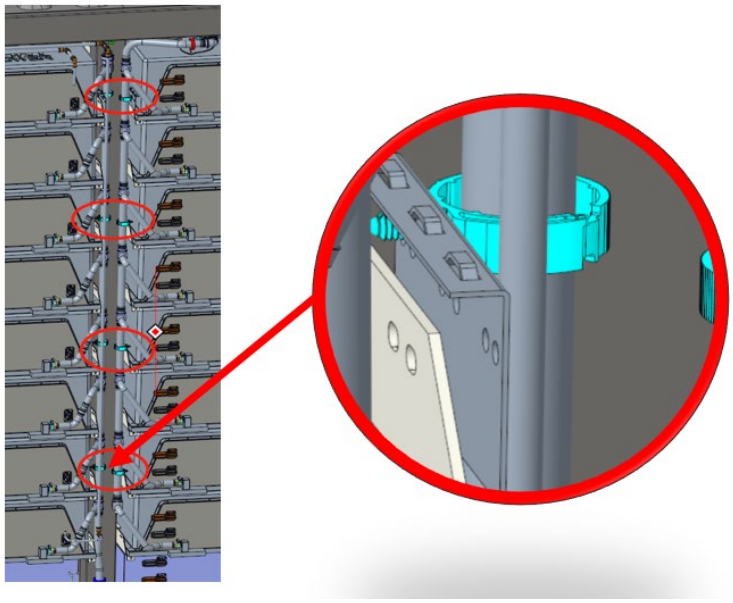


Figure 6- 18 Fix Secondary Inlet Pipeline to Sheet Metal Part Inner Hole

6.5.2. Install Secondary and Tertiary Outlet Pipelines in Cluster

1. The secondary and tertiary pipes have been assembled when leaving the factory. The secondary pipe connector pasted with a red label is connected to the male connector of the primary pipe pasted with a red label. It is necessary to confirm that the lock of the connector has been clamped into the connector groove and cannot be pulled out.

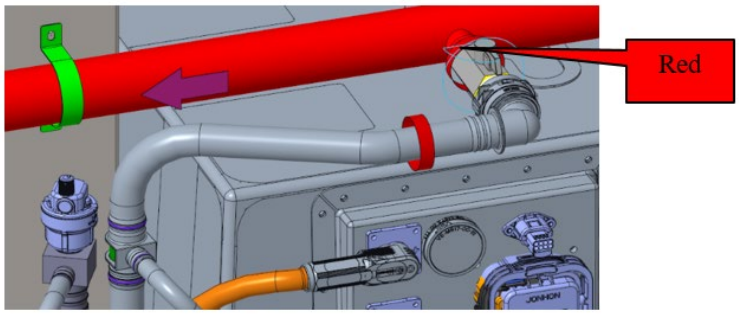


Figure 6- 19 Connect Secondary Pipe Connector to Primary Pipe Male Connector

2. Connect the tertiary outlet pipe connector to the male connector of the battery PACKs from #1 PACK to #8 PACK in turn, and fasten the clips. A "click" sound shall be heard to confirm that the connector is fastened and cannot be pulled out.

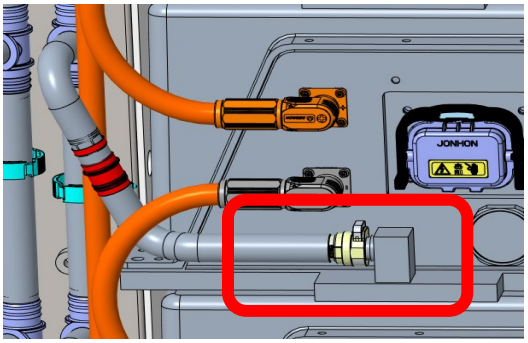


Figure 6- 20 Connect Tertiary Outlet Pipe Connector to Male Connector

3. Each secondary outlet pipeline is fixed to the inner hole of the sheet metal part with 4 plastic pipe clamps. The pipe clamp needs to reduce the inner diameter to clamp the pipeline and to be inserted into the hole of fixing the sheet metal part, making sure that there is no loose insertion.

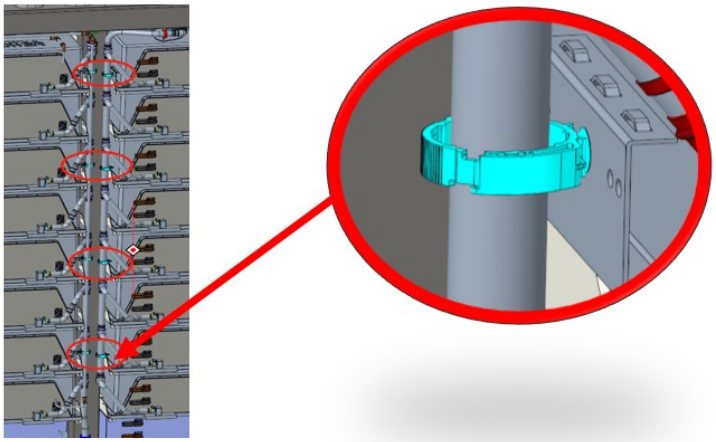


Figure 6- 21 Fix Each Secondary Outlet Pipeline to Sheet Metal Part Inner Hole

6.5.3. Install MSD on PACK Panel

1. Make sure that the high-voltage box disconnecting switch is in "OFF" state.

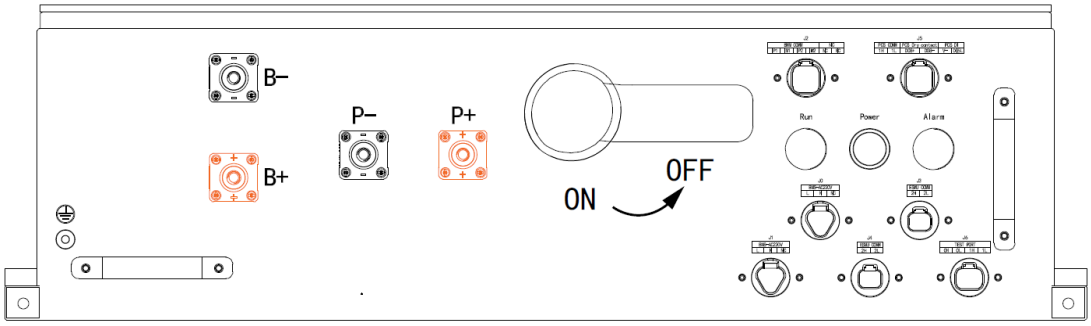


Figure 6- 22 Disconnecting Switch in "OFF" State

2. Align the upper cover handle of the maintenance switch vertically with the base guide groove on 8# PACK panel and push it in. Rotate the handle after pushing in. After hearing a "click" sound, push in the secondary lock.

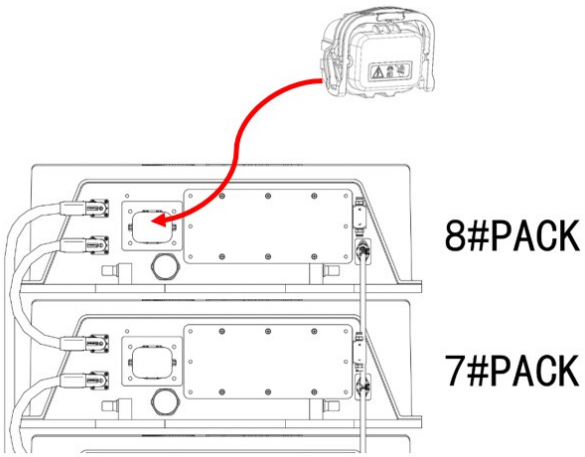


Figure 6- 23 Push in Upper Cover Handle of Maintenance Switch

3. Repeat step 2 to install MSD on the remaining battery PACKs in turn until 1# battery PACK is installed.

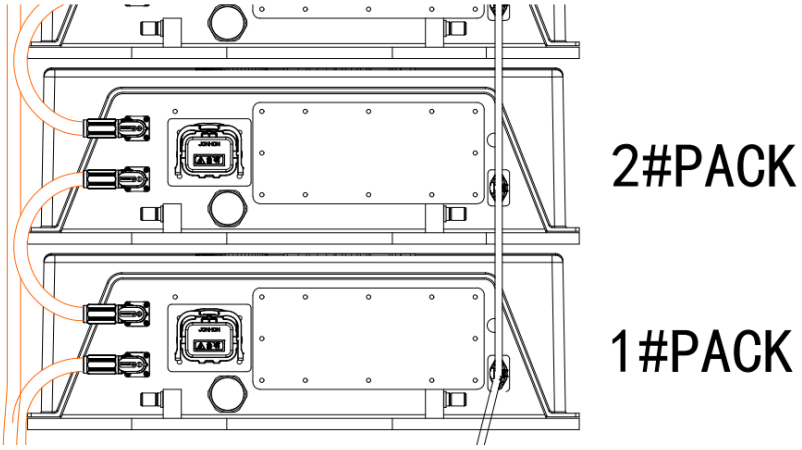


Figure 6- 24 Install MSD on Remaining battery PACKs in Turn

7. BMS System Configuration

7.1. BMS System Architecture

CHINT strongly recommends that authorized factory representatives configure and debug BMS.

Multiple system-level ESMU can communicate with EMS through Ethernet /ModbusTCP. ESMU does not communicate with each other and should be treated as an independent subsystem. EMS identifies different ESMU by IP address. The sample architecture is as follows:

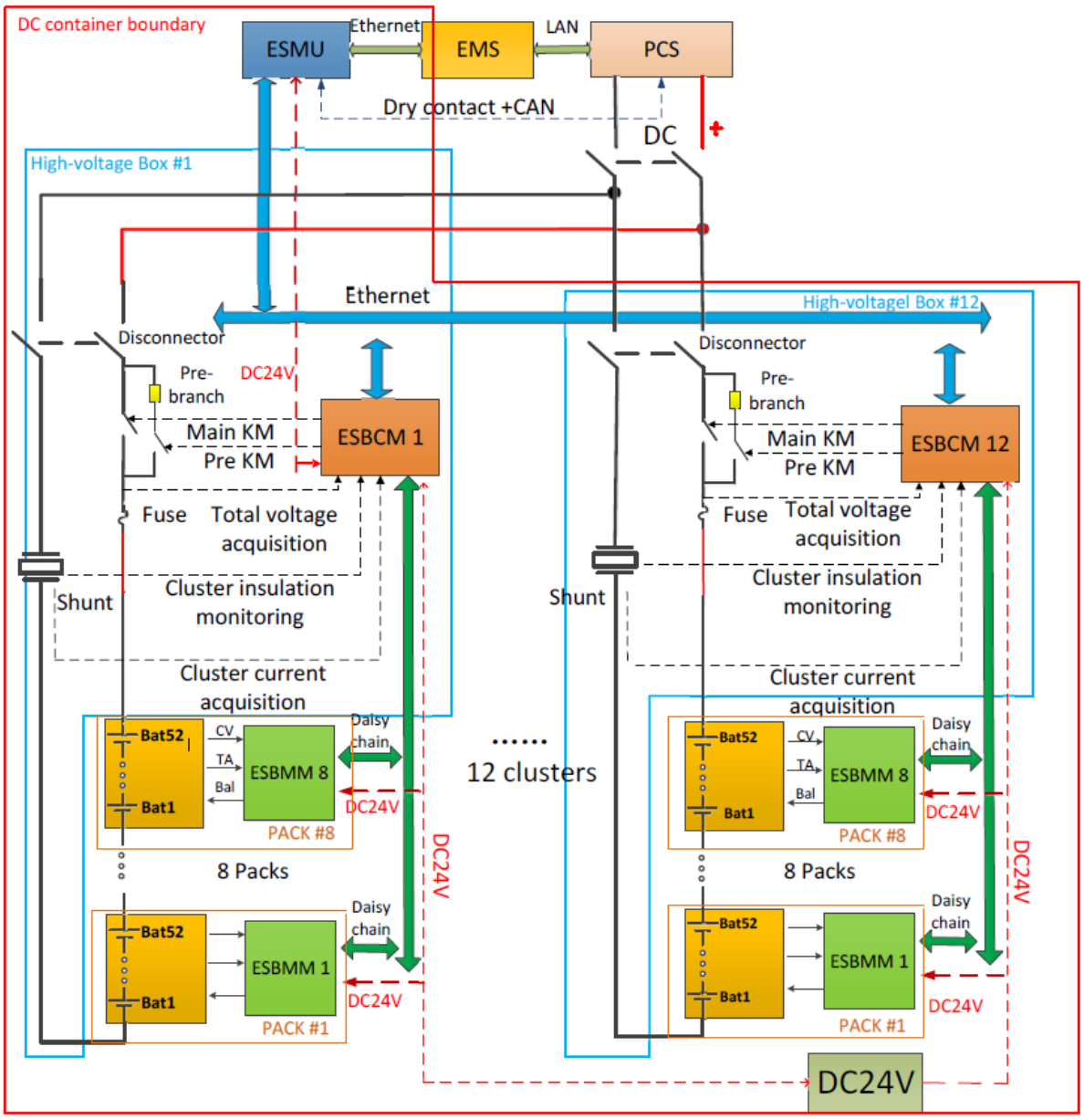


Figure 7- 1 BMS System Architecture

7.2. System Configuration Preparation

Before system configuration, the following materials shall be prepared:

- BMS communication cable: Used for direct connection of CAN, it is a debugging communication line for BMS system debugging
- Adapter: The tool used is USB to RS485
- RJ45 connector: Used to connect the high-voltage box
- D-SUB connector on CAN to RS485 adapter (Brand: ZLG, Model: USBCAN-2E-U)
- CAN to RS485 adapter, V2
- Standard network cable: Connect to ESMU to realize ModbusTCP communication
- Laptop: Operating system with Windows 7 SP1 or higher installed

7.3. BMS System Configuration

Warning:

- If multiple battery clusters are installed, the ESBMM address is automatically assigned.
- When configuring ESBMM, disconnect the DC power line of the high-voltage box and turn off all other ESBMMs.
- After configuring all ESBMMs, reconnect all DC power cables of high-voltage boxs.

7.3.1 ID information of ESBMM

After the system is installed or ESBMM is replaced, there is no need to actively allocate ESBMM address because the daisy-chain communication mode is adopted in the battery cluster.

7.3.2 CAN data uploading

As shown in the figure below, all ESBMMs communicate with ESBCM through daisy chain. Each ESBMM has a unique ID on the battery cluster with the function of address assignment.
ESBCM can collect data from all ESBMMs, and ESBMM can also update data and alerts to ESBCM through a daisy chain.

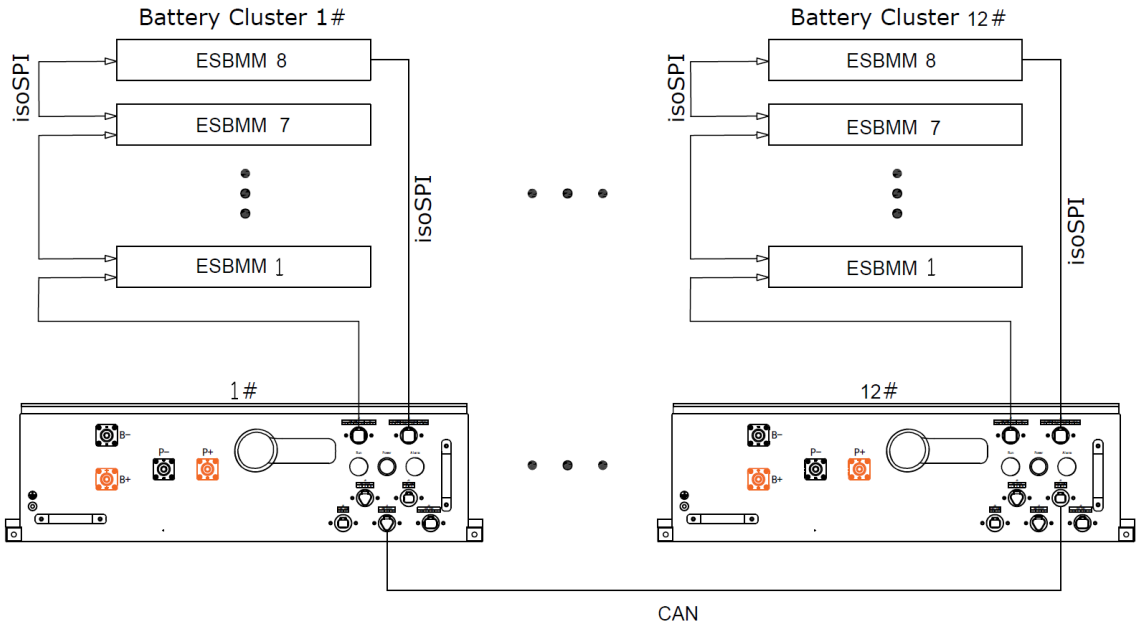


Figure 7- 2 Communication Architecture of Multiple ESBCMs

7.3.3 Software upgrading

The internal software of ESBMM can be upgraded through the daisy chain. In order to simplify the upgrading process, BMS can upgrade all ESBMM software through daisy-chain communication. Software upgrading can be finished easily just by importing latest procedures via ESMU.

7.4. ESMU Configuration

7.4.1. Display All Information on Display Screen

The main interface displays voltage, current, SOC, and operating status for each battery cluster, along with the total system voltage and current.

Click the "AI info" button to view real-time parameters, including charge / discharge power, temperature, current, SOC, alarm, etc.

Figure 7- 3 Display of Multi-cluster Parameters on HMI (for reference)

Click "Cell info" on the top right side of the page to display the voltage of each battery PACK, temperature at each position, alarm/fault information, etc.

Figure 7- 4 Display of Single Cluster Parameters on HMI (for reference)

7.4.2. Parallel connection of battery cluster

To address potential risks such as circulating currents during parallel operation of multiple battery clusters, the BMS program incorporates a pre-connection self-check mechanism. If no faults are detected after self-check, the system automatically establishes grid connection; otherwise, an alarm prompt will appear on the interface, allowing EMS to retrieve fault details via communication protocols.

In case of abnormalities in any battery cluster during operation, the program triggers an automatic disconnection. The operational interface is shown in the following figure:

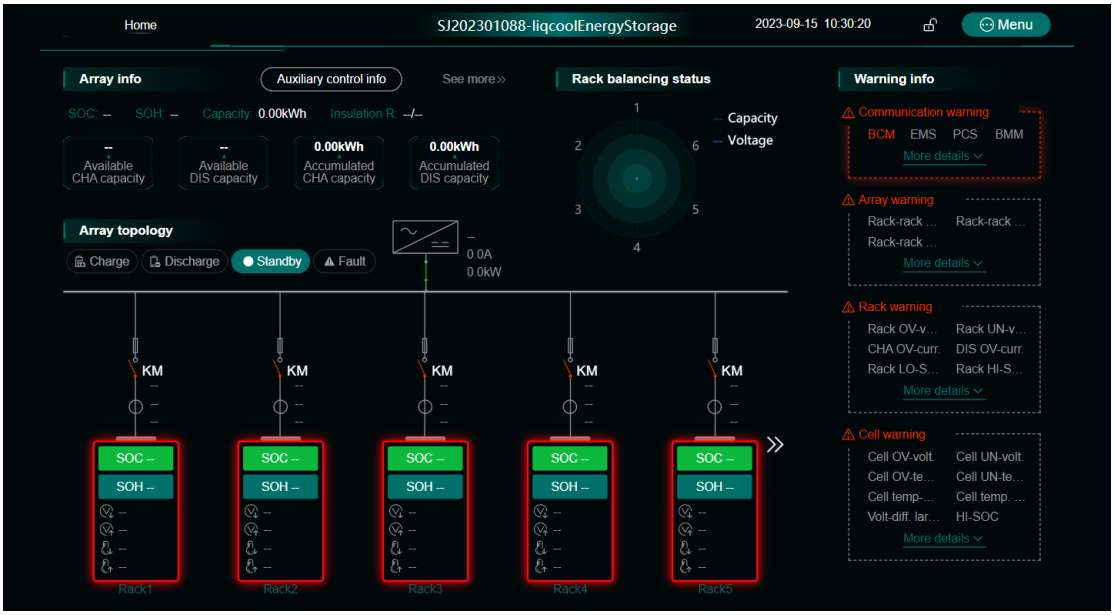


Figure 7- 5 Operating Interface of Grid Connection of Battery Cluster (for reference)

7.5. Configuration of Network Interface

After installation, wiring and configuration are completed, connect the Ethernet cable to ESMU, communicate through MODBUS, and check whether the system BMS provides the correct data.

The default IP address is: 192.168.1.199 (which may vary in different systems).

Port No.: 502

7.6. Typical Protection Policy

The basic protection policy is summarized as follows (which may vary according to the specific requirements of the application):

1. Source of protection signal
   - Module/unit information based on BMS analysis and triggered alarms
   - BMS hardware fault
   - Communication problems within BMS or with EMS/PCS
   - BMS sends signals to PCS/EMS through Modbus.
2. EMS/PCS turns off the inverter
3. If the inverter is not turned off after 3-5s, BMS activates the hardwired signal to turn off it
4. If the inverter is not turned off after 5s, BMS disconnects the battery by turning on the contactor

8. Annex

Annex 1 Safety Training Record Form

Customer name		Training place	
Training purpose		Contact no.	
Trainer		Training time	
Training contents			
Basic requirements	• Wear PPE before entering the site. • Installation personnel on site shall not use metal accessories (i.e. watches and necklaces). • Special types of construction projects must be carried out by the holder within his/her scope of work.		
Battery handling	• Do not make the battery short-circuited. • Do not use the wire rope as a means of transportation. • Do not pull the battery terminal forcibly. • Handle with care. Avoid the strong impact and vibration. Do not place the battery upside down. Do not throw the battery. Do not expose the battery to the sun and rain.		
Battery installation	• Check each battery visually and find defects in time. • Place the battery in strict accordance with the supervisor’s instructions. Note the terminal position. • Handle with care to ensure the personal safety and not damage the battery.		
Battery connection	• Insulate the wrench and other metal tools to prevent short circuit when falling. • The supervisor should pay strict attention to the battery connection to avoid short circuit. • Make sure that all the bolts on the battery are tightened.		
Overall	• Install a protective cover on the cable in time. • Clearly mark on the battery: Electrified Equipment • Do not construct around the battery PACK. If it is inevitable, wrap the battery PACK with the insulating plastic cloth before construction, so as not to damage it.		
Signature			
If the above requirements can be met, please sign here:			

Note: If an accident occurs due to improper operations, the Company does not assume any responsibility.

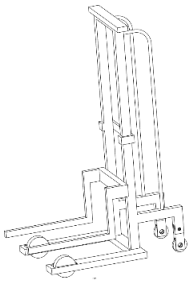
Annex 2 List of Personal Protective Equipment (PPE)

No.	Category	Sample	QTY	Requirements
1	Safety helmet			Your hard hats must meet one of the two types: TYPE I: Protects the top of the head; TYPE 2: Protects both the top and the sides of the head. Your hard hats must meet with one of the three classes: CLASS G: These are general hard hats rated for 2,200 volts. CLASS E: These are electrical hard hats rated for 20,000 volts. CLASS C: These are conductive hard hats, and they do not offer electrical protection at all 1) Wear a helmet correctly before entering the construction site to protect your head. 2) The helmet shall meet the requirements of GB 2811-2007 Safety Helmet.
2	Electrician clothes			Service personnel on site shall wear electrician's clothes.
3	Protective shoes			1) Wear protective shoes during battery PACK transportation and installation. 2) Service personnel on site shall wear protective shoes.
4	Insulating gloves-480V ac			Maintenance personnel on site shall wear insulating gloves.
5	Insulating gloves-1500V dc			Maintenance personnel on site shall wear insulating gloves.
6	Masks			Service personnel on site shall wear masks

Note: Other types of PPE and their corresponding quantity depend on the requirements on site.

Annex 3 List of Tools

No.	Name	Material	Spec.	Sample	Qty.	Calibrate Date	Validity
1	Laptop				2		
2	Tape measure	Steel	5m		1		
3	Wrench (insulated)	Stainless steel	1 set		1		
4	Socket wrench (Insulation)	Stainless steel	1 set		1		
5	Insulated torque wrench	Stainless steel	1 set		2		
6	Screwdriver	Stainless steel	1 set		1		
7	Gradiometer (Gradienter)	Aluminum alloy	1000mm		1		
8	Electric wrench				1		
9	Electric drill				1		

No.	Name	Material	Spec.	Sample	Qty.	Calibrate Date	Validity
10	Multimeter- DC 2000V				1		
11	Battery tester		HIOKI 3564		1		
12	Lift truck				1		

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