AlphaESS
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Product Specification

STORION-LC-TB250/500

Recensions

Item	Ver.	Description	Authored By	Date
1	V0	First release	Jarod	2024.8.16
2	V1	Revision	Buzz, Leonie	2024.08.25

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1. Product Overview

This document is the product specification of STORION-LC TB250/500 from Alpha ESS CO.,Ltd.

Product model: STORION-LC-TB250/500

Product description: Liquid cooling DC outdoor cabinet & Forced air cooling AC outdoor container

System composition:

Liquid cooling DC outdoor cabinet: battery cluster, BMS, power cable, control cable, liquid cooling unit, fire protection system etc.

Forced air cooling AC outdoor container: PCS, Transformer, DCDC/STS*, EMS etc.

*DCDC/STS is optional and can be selected based on project requirements.

Table 1 Equipment List of DC Outdoor Cabinet

No.	Component	Quantity	Description
1	Battery Cluster	1	234S1P
2	BLMU	5	Battery Local Management Unit
3	BCMU	1	Battery Cluster Management Unit
3	Harness	1	Power & Communication Harness
5	Liquid Cooling Unit	1	Rated Cooling Power: 8kW
6	Fire Protection System	1	Aerosol + Sprinkler
7	Cabinet	1	Dimensions (L*W*H, mm): 1700×1500×2450 (±2)

Table 2 Equipment List of AC Container

No.	Component	Quantity	Description
DC Coupling & Grid-connected 250kW			
1	DCDC	2	PDS1-400K
2	PCS	1	PWS1-500KTL-EX subtracted version

3	Transformer	1	WT250KVA380V-400V-Dyn11-AL
4	EMS	1	AlphaESS EMS 4.0, including SCADA system
5	Electricity Meter	1*	DTSU666
6	BAMS	1	BAMS-001P
7	10ft Container	1	Dimensions (L*W*H, mm): 2991×2438×2591
DC Coupling & Grid-connected 500kW			
1	DCDC	2	PDS1-400K
2	PCS	1	PWS1-500KTL-EX
3	Transformer	1	WT500KVA380V-400V-Dyn11-AL
4	EMS	1	AlphaESS EMS 4.0, including SCADA system
5	Electricity Meter	1*	DTSU666
6	BAMS	1	BAMS-001P
7	10ft Container	1	Dimensions (L*W*H, mm): 2991×2438×2591
AC Coupling & Grid-Connected/Off-Grid 250kW			
1	STS	1	PWD-800K
2	PCS	1	PWS1-500KTL-EX Subtracted version
3	Transformer	1	WT250KVA380V-400V-Dyn11-AL
4	EMS	1	AlphaESS EMS 4.0, including SCADA system
5	Electricity Meter	2*	DTSU666
6	BAMS	1	BAMS-001P
7	10ft Container	1	Dimensions (L*W*H, mm): 2991×2438×2591
AC Coupling & Grid-connected/Off-grid 500kW			
1	STS	1	PWD-800K
2	PCS	1	PWS1-500KTL-EX

3	Transformer	1	WT500KVA380V-400V-Dyn11-AL
4	EMS	1	AlphaESS EMS 4.0, including SCADA system
5	Electricity Meter	2*	DTSU666
6	BAMS	1	BAMS-001P
7	10ft Container	1	Dimensions (L*W*H, mm): 2991×2438×2591
Pure Battery Storage & Grid-Connected 500kW			
1	PCS	1	PWS1-500KTL-EX
2	Transformer	1	WT500KVA380V-400V-Dyn11-AL
3	EMS	1	AlphaESS EMS 4.0, including SCADA system
4	Electricity Meter	1*	DTSU666
5	BAMS	1	BAMS-001P

*Standard configuration, the number of meter can be adjusted according to the actual project requirements. The recommended CT accuracy level is 0.5S, and a secondary current of 5A has been selected for the CT.

2. Application

According to PV, power grid, and load characteristics, the highest MW-class energy storage system can be created using the DC outdoor cabinet and AC container. It is suitable for user-side, industrial, and commercial scenarios, enabling functions such as peak shaving, valley filling, self-consumption, load management, and demand response.

3. Terminology

Abbreviation	Description
ESS	Energy Storage System
SOC	State of Charge

DOD	Depth of Discharge
BOL	Beginning of Life
EOL	End of Life
BMS	Battery Management System
BLMU	Battery Local Management Unit
BCMU	Battery Cluster Management Unit
BAMS	Battery Array Management System
AC	Alternating Current
DC	Direct Current
ACIR	Alternating Current Internal Resistance
DCIR	Direct Current Internal Resistance
RH	Relative Humidity
CAN	Controller Area Network
BOL	Beginning of Life
RTE	Round Trip Efficiency
EMS	Energy Management System
SCADA	Supervisory Control and Data Acquisition
PCS	Power Convert System
STS	Static Transfer Switch
DCDC	DC converter

4. Product Configuration

4.1 DC side

- Cell: 280Ah prismatic $LiFePO_4$;
- Battery module: M166280-S (52S1P) standard liquid cooling module;
- Battery cluster: Composed of M166280-S series;

- System: A total of 234 battery cells are connected in series, with a rated voltage of 748.8V and a rated energy of 209.664kWh.

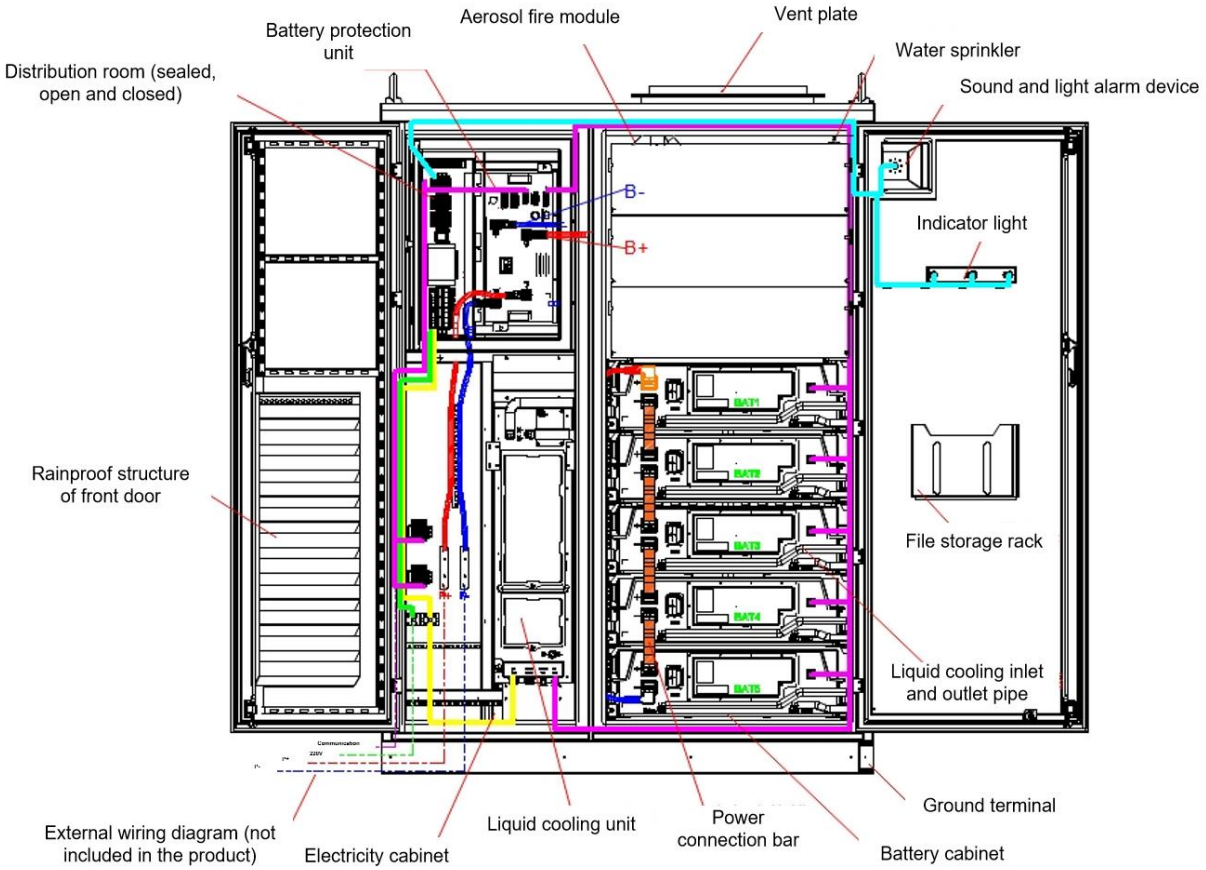

Figure 1 Interior Layout Diagram of the Outdoor Cabinet

4.2 AC side

- PCS: PWS1-500KTL-EX Power Convert System
- DCDC: PDS1-400K DC Converter
- Transformer: WT500KVA380V-400V-Dyn11-AL Transformer
- STS: PWD-800K Static Transfer Switch
- EMS: AlphaESS Energy Management System 4.0

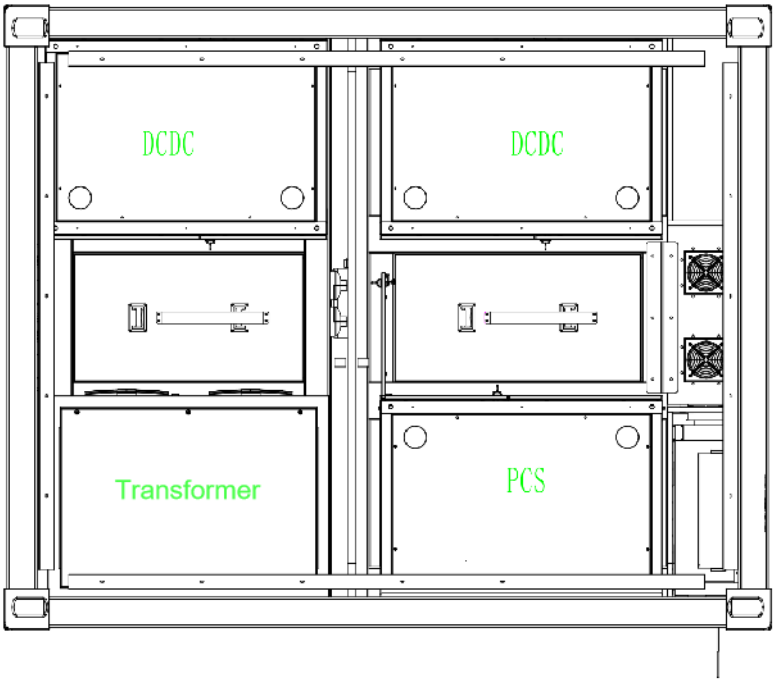

Figure 2 Layout Diagram of DC Coupling Scheme

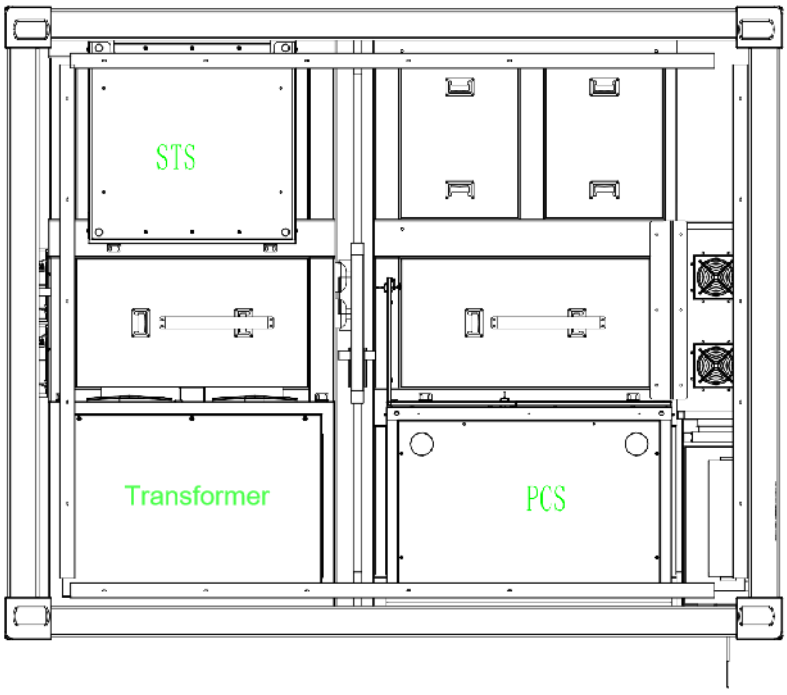

Figure 3 Layout Diagram of AC Coupling Scheme

5. System Design Scheme

5.1.System Introduction

The energy storage system is based on liquid cooling DC outdoor cabinet and forced air cooling AC container. The liquid cooling DC outdoor cabinet integrates batteries, BMS, liquid cooling thermal management system, and fire protection system. The forced air cooling AC container integrates EMS, PCS, DCDC / STS, and transformer systems. These two products can meet the requirements of various energy storage applications. The energy storage system is highly modular, designed with a detachable structure that allows for compact and flexible installation, easy transportation, and maintenance. Communication between the liquid cooling DC outdoor cabinet and forced air cooling AC container supports the monitoring of local equipment. The EMS system has Modbus-TCP remote dispatching protocol, enabling flexible management of the energy storage system.

(1) Liquid cooling DC outdoor cabinet utilizes 3.2V/280Ah lithium iron phosphate cell and a three-level BMS system architecture. Each battery module consists of 52 cells, with a rated energy of 46.592kWh. The cabinet is designed with drawers, each containing a battery cluster. A battery cluster is placed in each cabinet. A single battery cluster series and parallel structure is 234S1P. The rated energy is 209.664kWh. The product supports up to 10 parallel cabinets, creating an efficient and flexible liquid cooling battery system to meet various power configuration requirements across different application scenarios.

(2) The forced air cooling AC container is equipped with PCS, EMS, transformer, and DCDC / STS (optional). Together with the liquid cooling DC outdoor cabinet, it can meet the requirements of PV and BESS applications, including AC coupling for off-grid or grid-connected and pure battery storage.

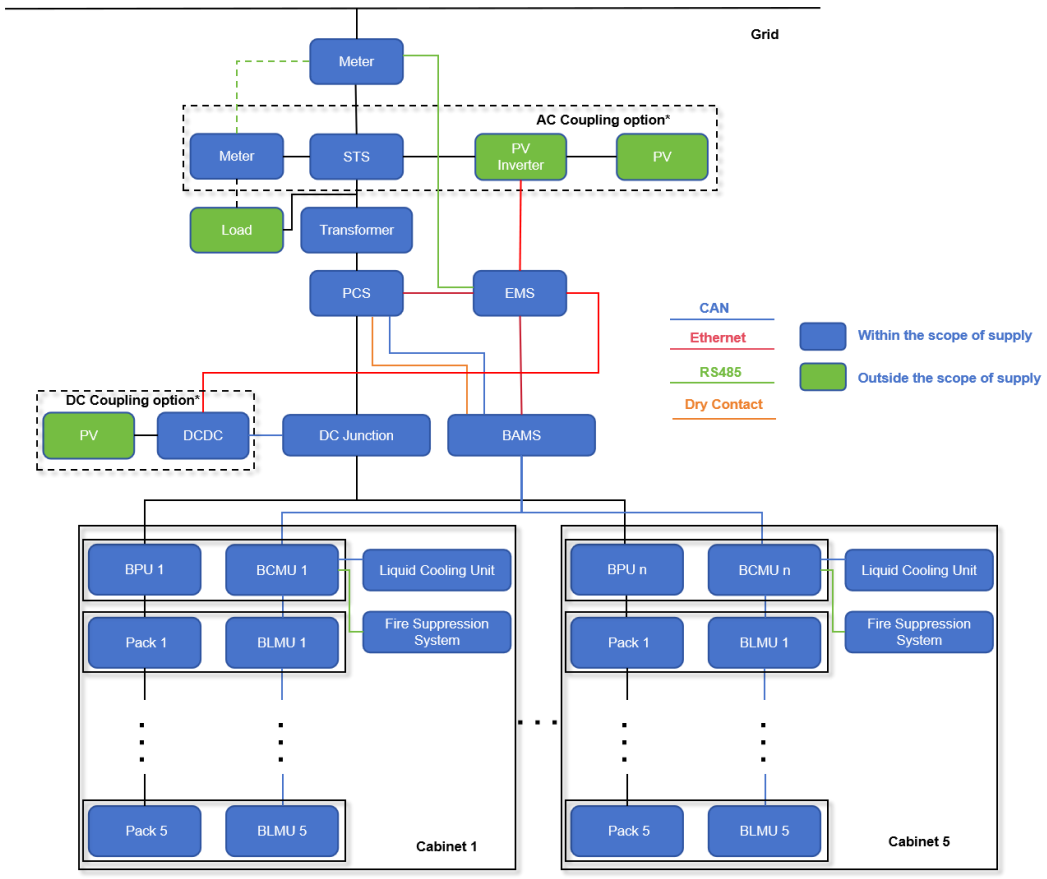

Figure 4 System Topology

AC Coupling Option*: Selection for the AC coupling scheme

DC Coupling Option*: Selection for the DC coupling scheme

5.2 Product Specification

5.2.1 Liquid Cooling DC Outdoor Cabinet

5.2.1.1 Battery Cabinet

Liquid cooling DC outdoor cabinet integrates batteries, BMS, liquid cooling unit, fire protection system, and other equipment, making it suitable for a variety of application needs.

Table 3 Battery Cabinet Parameters

Item	Specification	Remark
Nominal Energy (kWh)	209.664	234*280Ah cells
Serial and Parallel Mode	234S1P	
Nominal Voltage (V)	748.8	

Operating Voltage Range (V)	631.8~842.4	
Depth of Discharge	98% DOD	
Cooling Method	Liquid Cooling	
Weight (t)	≤3.48	
IP Rating	IP54	
Corrosion Class	C3	
Operating Temperature Range (℃)	-30-55	
Operating Humidity Range	0-95%RH (No Condensation)	
Operating Altitude (m)	3000m (≥2000 derate)	
Dimensions (L*W*H, mm)	1700*1500*2450 (±2)	
Fire Extinguisher System	Pack, cabinet double aerosol fire, water fire, smoke, temperature detector and top burst plate design	

Figure 5 System Appearance

5.2.1.2 Cell

LF280K-280Ah $LiFePO_4$ battery features high specific energy, long cycle life, low self-

discharge rate, safety, and no pollution, making it widely used in energy storage systems. The battery cell parameters are as follows:

Table 4 Cell Parameters

No.	Item	Specification	Remark
1	Model	LF280K	Lithium iron phosphate cell
2	Rated Capacity (Ah)	280	0.5P / 0.5P, 25℃+ 2℃, 2.5V~3.65V, fresh battery*
3	Rated Voltage(V)	3.2	(25±2) ℃, Standard charge and discharge
4	Initial Internal Resistance (mΩ)	≤0.25	AC, 1kHz, fresh battery, SOC at shipment: 30%~40%
5	Charging Cut-off Voltage (V)	3.65	
6	Discharge Cut-off Voltage (V)	2.5	T>0℃
7	Rated Charge and Discharge Ratio	0.5P	
8	Charging Operating Temperature (℃)	0~60	
9	Discharging Operating Temperature (℃)	-30~60	
10	Storage Temperature (℃)	One year: 0~35	
11		One month: -20~45	
12	Storage Humidity	<90% RH	
13	Weight (kg)	5490±300	
14	Dimensions (W*H*D, mm)	173.7*207.2*71.7 (±0.5)	

*Fresh cell: Refers to a cell produced within the past 7 days.

Figure 6 280Ah Battery Appearance

5.2.1.3 Battery Module

The battery module consists of 52 cells connected in series (52S1P configuration), with a rated voltage of 166.4V. It features a modular design for easy installation and maintenance and is equipped with liquid cooling thermal management system. The specific parameters are as follows:

Table 5 Battery Module Technical Parameters

No.	Item	Specification	Remark
1	Cell Model	LF280K	
2	Serial and Parallel Mode	1P52S	
3	Rated Voltage (V)	166.4	
4	Rated Capacity (Ah)	280	@25±2℃
5	Rated Energy (kWh)	46.592	@25±2℃
6	Rated Charge and Discharge Power (kW)	23.296	
9	Operating Voltage Range (V)	140.4~187.2	Single Voltage Range: 2.7V~3.6V

10	Operating Temperature Range (℃)		-30~50	Ambient Temperature
11	Recommended Operating Temperature Range (℃)	Charging / Discharging	15~35	
12	Transport and Storage Temperature (℃) (Battery at 30% SOC)	Short-term (Within 1 month)	-20～45	Elevated temperatures lead to higher self-discharge rates and irreversible capacity losses in batteries
		Long-term (Within 1 year)	0℃～35℃	
13	Ambient Humidity	Transport	＜95%	
		Storage		
14	Self-discharge Rate / Month		≤3%	(25±2) ℃ 30%～50%SOC storage
15	ACIR (mΩ)		≤10	
16	Insulation Resistance (MΩ)		≥500	Test voltage: 1000VDC Test environment: Humidity is less than 65% RH

				(no condensation) Test method: the insulation resistance between the positive electrode of the battery module and the exposed conductive part, and between the negative electrode of the battery module and the exposed conductive part
17	IP Rating		IP67	
18	Cooling Method		Liquid cooling	
19	Communication Interface & Protocol		CAN	
20	Weight (kg)		333±2	
21	Dimensions (W*D*H) (mm)		(810±2)x(1110±2)x(237.5±2)	
21	Number of Sampling Points	Temperature Sampling	20	Including 12 cell temperature points, along

				with other pole and additional temperature points
		Voltage Sampling	52	

Figure 7 Battery Module Appearance

5.2.1.4 Battery Protection Unit

Battery protection unit is equipped with a built-in contactor, disconnecting switch, fuse, other power devices and BCMU. Each positive and negative circuit has a contractor to ensure the live circuit of the battery cluster can be safely and quickly disconnected in an emergency. The disconnecting switch is mainly used to reliably isolate the section of the high-voltage distribution device that is powered down from the rest of the circuit. The fuse provides rapid circuit disconnection in the event of a short circuit or high current, ensuring the safety of the battery cluster.

Table 6 Technical Parameters of the Battery Protection Unit

Item		Specification
DC-Side Parameters	Voltage (V)	Max. 1500
	Current (A)	Max. 250
Auxiliary Power Supply	Voltage Range (V)	24
	Power Supply (W)	Max.150
Mechanical Performance Parameters	Enclosure Material	Galvanized steel plate
	Dimension (L*W*H, mm)	526*670*250(±2)
	Weight (kg)	≤30

	Cooling Method	Natural heat dissipation
	Storage Temperature (℃)	-20~70
	Operating Temperature (℃)	-30~50
	Recommended Temperature (℃)	23±5
	Operating Humidity	≤85% RH (No Condensation)

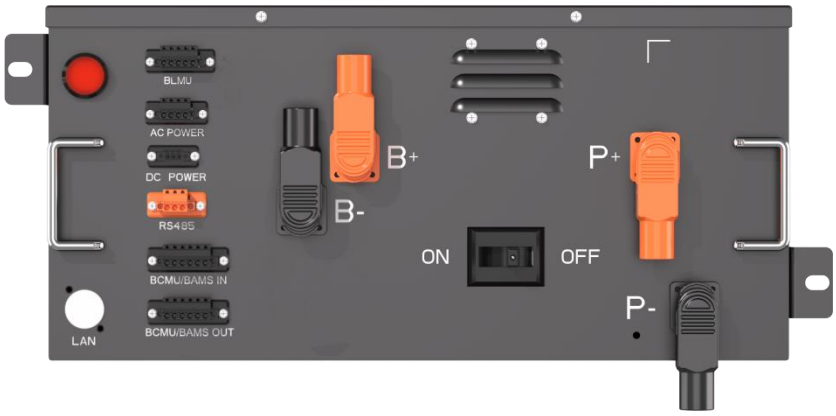

Figure 8 Battery protection unit appearance

5.2.1.5 Control system

The battery management system BMS adopts a three-level architecture: battery local management unit BLMU, battery cluster management unit BCMU, and battery array management system BAMS. BLMU and BCMU are integrated into the liquid cooling DC outdoor cabinet, while the BAMS is integrated into the forced air cooling AC container.

5.2.1.5.1 BLMU

1) Product Functions:

BLMU provides real-time monitoring of cell voltage and temperature, with passive balancing and communication with the BCMU via CAN bus.

●Supports detection of voltage across 52 series-connected single battery cells;

●Equipped with a 20-channel NTC temperature detection;

●Supports passive balance to maintain battery capacity consistency and improve battery

life;

●Support local upgrades via the CAN bus;

●Enables individual cell SOC calculation;

●Provides alarm functions for single voltage (over-voltage, under-voltage), temperature (over-temperature, low-temperature), communication, and other failures;

●Supports detection of harness drops for voltage and temperature acquisition.

Table 7 Main Technical Parameters of BLMU

Item	Specification
Module Operating Power Supply	DC 13-36V
Operating Power Consumption	1W
Battery Balancing Mode	Passive Balancing
Battery Management Configuration	52-series
Single Voltage Measurement Range	0-5V
Communication Interface	CAN
Communication Baud Rate	250Kbps

5.2.1.5.2 BCMU

BCMU primarily manages the battery clusters within the energy storage system and

places them in the battery protection unit. It is mainly responsible for collecting the voltage and current data of the battery cluster, aggregating individual battery information within the cluster, calculating the SOC/SOH of the battery cluster, and implementing the local protection function of the battery cluster based on battery fault information.

1) Product Functions:

- Includes the system power self-check function, covering all sensors, system status, etc.;
- Provides detection of battery terminal voltage, current, temperature, and other parameters;
- Collects data from BLMU and forwards the data simultaneously;
- Estimates SOC&SOH of the battery cluster;
- Performs insulation detection of the battery system;
- Manages abnormal alarms and provides hard contact protection control;
- Supports CAN, RS485, and Ethernet communication functions.

2) Technical Parameters:

Table 8 BCMU Parameters

Item		Specification
Voltage Collection	Collection Range (V)	0-1500
	Collection Accuracy (V)	±5
	Collection Cycle (s)	3
Current Collection	Collection Range (A)	-350~+350
	Collection Accuracy	±0.2% (±0~30A) ±1% (±30~350A)
	Collection Cycle	50

	(ms)	
Temperature Collection	Collection Range (℃)	-20~125
	Collection Accuracy (℃)	±2
	Collection Cycle (ms)	1
Insulation Resistance Collection	Collection Accuracy	>50kΩ: ±20% ≤50kΩ: ±10kΩ
Operating Voltage (V)	10~35 (24)	
Rated Consumption (W)	2.1	

5.2.2 Forced Air Cooling AC Container

5.2.2.1 Appearance Diagram

Figure 9 Forced Air Cooling AC Container Appearance

5.2.2.3 Parameters

Table 9 DC Coupling Configuration Parameters

PCS	
Rated AC Power (kVA)	500
Maximum AC Power (kVA)	550
AC Frequency (Hz)	50/60 (±2.5)
AC Voltage (V)	400 (±15%)
Battery Voltage Range (V)	600 ~ 900
Maximum DC Current (A)	880
Total Harmonic Distortion Rate	≤3%
Power Factor	0.8 ~ 1 advance or lag
DCDC	
HVDC Bus Side Voltage (V)	Low voltage + 40 ~ 850
HVDC Bus Side Current (A)	0 ~ 130×8
LVDC PV Input Voltage (V)	250 ~ 800
LVDC PV Input Current (A)	0 ~ 130×8
Rated Power (kVA)	50 × 8

Table 10 AC Coupling Configuration Parameters

PCS	
Gird-connected Mode	
Rated AC Power (kVA)	500
Maximum AC Power (kVA)	550
AC Frequency (Hz)	50/60 (±2.5)
AC Voltage (V)	400 (±15%)
Battery Voltage Range (V)	600~900
Maximum DC Current (A)	880
Total Harmonic Distortion Rate	≤3%
Power Factor	0.8~1 advance or lag
Off-grid mode	
Rated AC power (kVA)	500
Maximum AC power (kVA)	550
AC Frequency (Hz)	50/60 (±2.5)
AC Output Voltage (V)	380/400 (±10%)
Battery Voltage Range (V)	600~900
Maximum DC Current (A)	880
Maximum Harmonic Distortion Rate	≤2% (Linear load)
Overload Capacity	110%~115% 10min

	115%~125% 1min 125%~150% 200ms
STS	
Rated Output Power (kVA)	800
Rated Gird Voltage (V)	400
Input Grid Range	-15%~15%
Output Grid Range	-15%~15%
AC Frequency (Hz)	50/60 (±2.5)
Long-term Overload Capacity	1.1
Conversion Time (ms)	<20
Rated Current (A)	1215A@380, 1154A@400
Maximum Current (A)	1336A@380, 1269A@400 (1.1 times overload)
Maximum Power	99.5% (full load)
Communication Mode	RS485, CAN, Ethernet
Maximum Power of the Load Side (kVA)	500 (RCD load, pure compatibility or inductive load≤100kW)

Table 11 Essential Parameters

System Parameter	
Cooling Method	Forced air cooling
Noise (dB)	75
IP Rating	IP54
Operating Temperature (℃)	-20~50 (>45℃ derate)
Humidity	0~95% (No condensation)
Dimension (mm)	2991×2438×2591
Weight (t)	≤7
Method of Connection	3P4W
Communication Mode	RS485, CAN, Ethernet

5.2.2.5 Management system

The BAMS, EMS and SCADA systems are all integrated into the AC container. BAMS transmits DC side data to EMS via CAN bus. PCS, STS, and DCDC units in the AC container can report the equipment status to EMS through Ethernet. SCADA uses private protocol to connect with EMS through the TCP network to display the operation status of communication between DC side and AC side equipment.

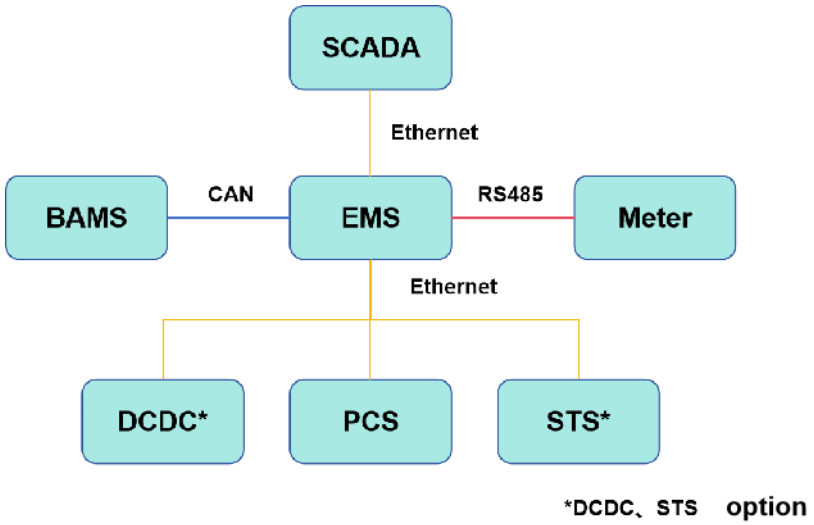

Figure 10 Schematic Diagram of Management System

5.2.2.5.1 BAMS

BAMS conducts numerical calculations, performance analysis, alarm processing, and record storage based on the real-time battery data uploaded by BLMU and BCMU. Additionally, it ensures the overall operational status of all battery packs according to the output power requirements and the SOC of each group.

- Monitoring & display
  - Manages battery pack information, monitors, and displays single battery voltage data, supporting management of up to 20 clusters of battery pack information;
  - Monitors and displays individual battery voltage and current data;
  - Detects the cluster voltage, current, insulation, SOC, and SOH data;
  - Monitors and shows the ambient temperature and individual cell temperature data.
- Alarm function
  - Communication alarms;
  - Over-voltage and under-voltage alarms for both battery clusters and individual batteries;
  - Over-voltage, under-voltage, over-current, and insulation alarm;
  - Over-temperature and low-temperature alarms.
- Protection

- Over-voltage and under-voltage protection for individual batteries;
- Over-voltage, under-voltage, and short-circuit protection for battery clusters;
- Over-temperature and low-temperature protection;
- Fault detection, thermal management control, and protection functions.

- Parameter Setting
  - Battery installation settings;
  - Network communication parameter settings;
  - Interface protocol parameter settings.

Table 12 BAMS Parameters

Model	BAMS-001P
Maximum Power (W)	7
Number of Dry Contact Outputs	13
Number of Dry Contact Inputs	14
Number of Wet Contact Inputs	2
SD Card Storage	32GB
Number of Ethernet Ports	4
Number of CAN Ports	2
Number of RS485 Ports	5
Number of RS232 Ports	1
Statistical Error in Electrical Energy	±3%
Fault Recording Wave	Current: 50ms, Voltage: 1s, Temperature: 5s, Time Span: 10min
Cell-stage Data Upload Cycle	0.5s*Number of Cluster

5.2.2.5.2 EMS

The EMS system integrates communication with BMS, PCS, DCDC / STS, electricity meter,

and other equipment. It uniformly controls and coordinates the whole system, enabling functions such as self-use, time-based charge and discharge, peaking shaving, remote upgrades, sub-device communication, external equipment RRCR, and dry contact detection/dual power switch, etc.

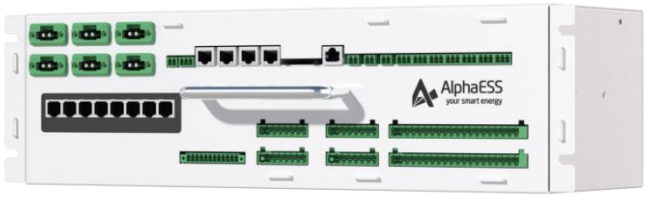

Figure 11 EMS Appearance

Table 13 EMS Parameters

Electrical Parameter	
Rated Input Voltage (V)	DC 24
Maximum Consumption of the Control Panel (excluding SCADA) (W)	5
Maximum Consumption of the Interface Board (W)	5
Performance Parameter	
Processor	Basic frequency: 180MHz; RAM: 256KB; ROM: 1MB
External SDRAM	32MB
External FLASH	64MB
RTC Clock	Supported
EEPROM	Supported
Dimension Parameter	
EMS Box (W×H×D, mm)	447x161x131
Communication Module	

Isolated 485 Communication	6
Isolated CAN Communication	3
Non-isolated 232 Communication	1 (Commissioning Use)
Ethernet Interface	3
SD Card Slot	1 (Supports up to 32GB)
Dry Contact Module	
Output Dry Contact (1 group normally open and normally closed)	8
Passive Input Dry Contact	14
Active Input Wet Contact (rated 24V input)	2
Analog Quantity I/O	
4-20mA Analog Input	4
6-24V Analog Output	1

5.2.2.5.3 SCADA

SCADA system has the functions of monitoring operation status, fault detection, panoramic analysis, remote control, and operational management, among other functions of the energy storage equipment. It provides a unified intelligent monitoring platform for various electrical equipment and intelligent devices within the energy storage system. The system is characterized by real-time performance, security, reliability, scalability, practicability, and ease of use.

SCADA system is suitable for energy storage stations, micro-grids, new energy storage integration, and other project stations to facilitate the centralized monitoring of BMS and PMS of energy storage power stations. It can unify the operation, maintenance, and management, enable quick fault resolution, relieve the pressure of the power grid, reduce the operation cost of the power grid, and improve economic benefits.

Table 14 SCADA Parameters

Resolution Ratio	1920*1080
Internal Storage	8GB
LAN	2
RS485	2
RS232	2
USB	4

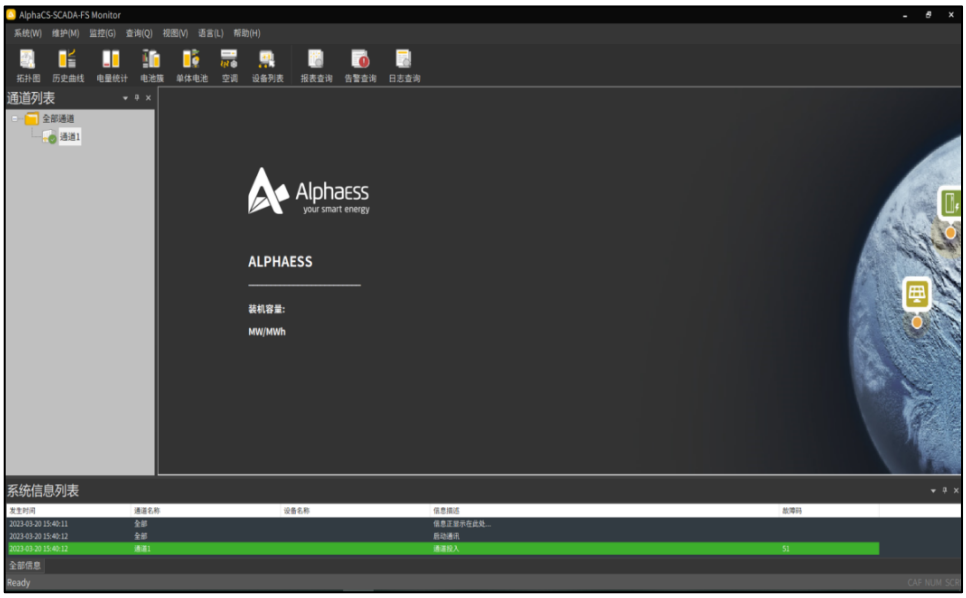

Figure 12 Interface Diagram of SCADA

5.3 Thermal Management System

5.3.1 Design of DC Outdoor Cabinet

The module level thermal management system uses liquid cooling, specifically a bottom liquid cooling design with liquid-electric separation to ensure safety of the system operation. The liquid cooling plate is positioned at the bottom of the box, and the high thermal conductivity interface material are placed in contact with the bottom of the cells for efficient heat transfer. The flow channel are multi-channel, arranged in a series and combined format, positioned at the bottom of the cells to achieve efficient cooling.

At the cabinet level, units are connected in parallel through the system's pipeline and in series with the unit to form the coolant flow path. During circulation, heat generated by the

cells is efficiently removed and dissipated. An intelligent and efficient thermal management strategy ensures real-time linkage with the cell temperature to control the cooling, heating, and self-circulation modes, maintaining the system at the appropriate operational temperature.

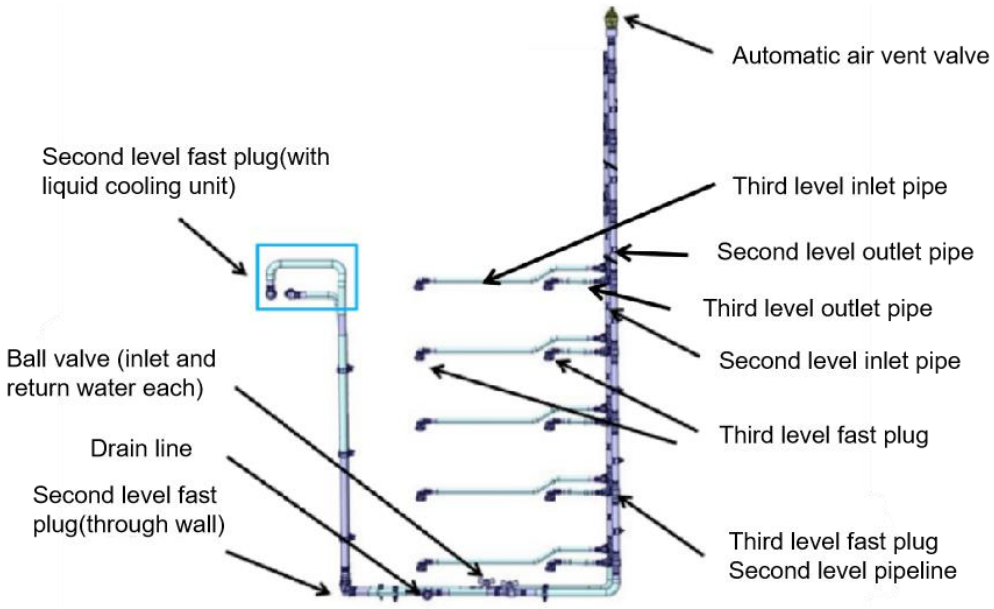

Figure 13 Schematic Diagram of Liquid Cooling System

The cell temperature is controlled within 15~35℃, ensuring the lithium battery work at the best working temperature. This avoids risks such as reduced capacity at low temperatures, rapid degradation at high temperatures, and thermal runaway.

5.3.3 Design of AC container

The 500 kVA transformer 500 kVA PCS, 400 kVA DCDC, and 800kVA STS each require 4 fans for heat dissipation from the equipment.

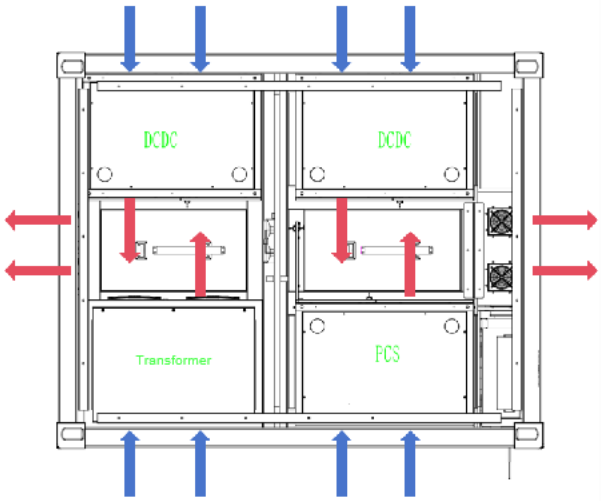

Figure 14 Schematic Diagram of Forced Air Cooling System

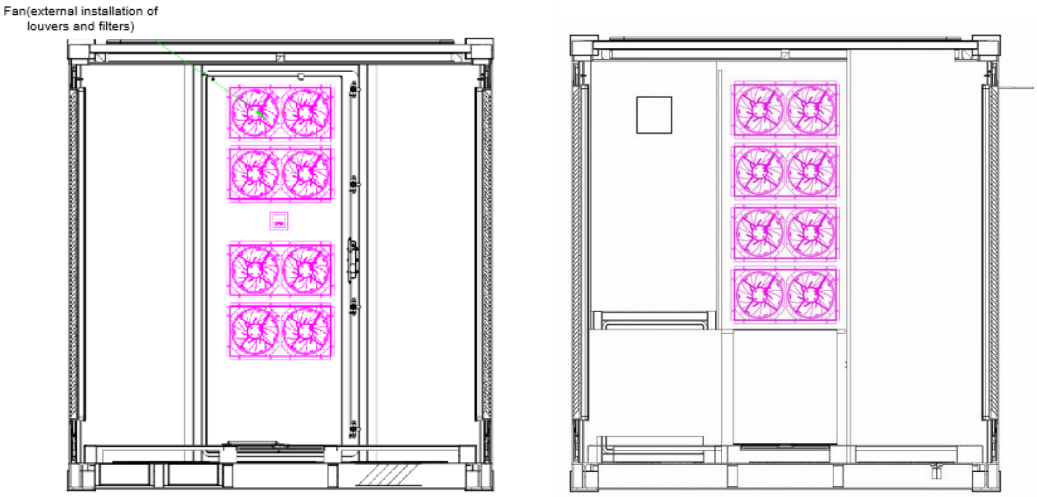

Figure 15 Schematic Diagram of Fans

As shown in the figure, taking the DC coupling scheme as an example, 16 fans should be installed at the end surface of the system, 8 on each end, arranged vertically to ensure uniform airflow and efficient heat exchange. Window blinds should be installed on the air intake side of the container to optimize air intake efficiency, guide airflow, and prevent direct airflow short circuits. Partitions should be placed at the intake and outflow surfaces of the container to reduce surrounding space, avoid hot air short circuits, and ensure heat is effectively managed and utilized. ; In the confluence area, partitions should be set to isolate ambient hot air, maintain internal temperature stability, and prevent thermal effects. The system is also equipped with a dehumidifier to control the ambient humidity, optimize the

thermal management, and prevent equipment performance degradation caused by high humidity. The overall thermal management system ensures the temperature of the cabin equipment is consistent with the external ambient temperature.

5.4 Fire Protection System

Fire protection system is installed in outdoor cabinet according to the relevant fire safety standards and specifications of energy storage system. Smoke detectors, temperature sensors, and an explosion discharge system are installed, using aerosol as the fire extinguishing agent, with provisions for a water-based fire protection system. The fire alarm signal is connected to the BMS system, enabling corresponding linkage control (including circuit breaker, contactor, etc.) based on battery and detector status. If the pressure inside the cabinet exceeds the designed threshold, the burst release plate will automatically open to release the pressure.

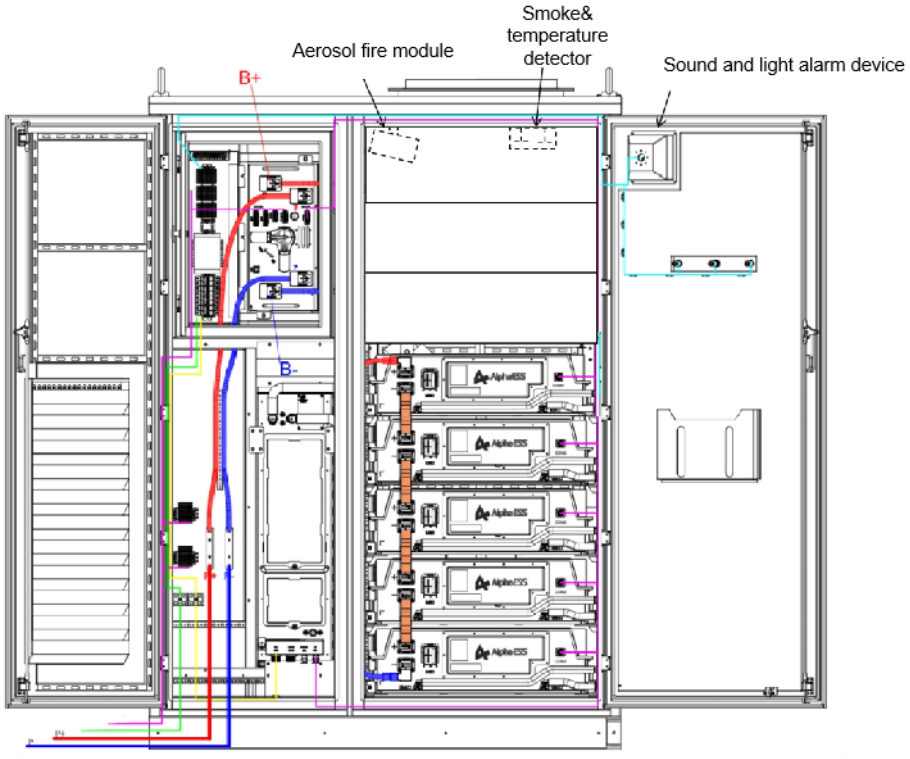

Figure 16 Layout of Battery Cabinet Fire Protection System

6. Storage

1) Liquid-cooling DC outdoor cabinet should be stored at 30% -50% SOC in a dry, clean,

well-ventilated room free of acid or other corrosive, or explosive substances and away from direct sunlight. The distance from any heat source shall be at least 2m. The cabinet shall not be inverted or placed under stress.

If the storage period exceeds 3 months, please check the voltage every 3 months to maintain the battery module at 30% - 50% SOC. If the SOC falls below the required level, recharge the battery.

2) Forced air cooling AC container shall be stored in a dry, room-temperature environment, free of corrosive gases and dust, and compliant with the local fire protection regulations. If the storage period exceeds 6 months, please check the software status of the system every six months and power up the system to ensure the product remains in normal working conditions.

7. Precautions

1) Before using the product, please carefully read the operating instructions and the product surface label.

2) During use, keep the product away from heat source and high pressure, and ensure that children don not come into contact with it.

3) Do not short circuit the positive and negative terminals of the product. Do not disassemble the product by yourself or expose it to moisture to prevent potential hazards.

4) If, upon first use, the product shell is seriously damaged or emits an odor or other abnormal phenomena, do not continue using it. The product should be returned to the seller.

5) If the product is not in use for a long time, please ensure that the battery power remains between 30% and 50% SOC. Storing the battery in a low charge state for too long can lead to battery over-discharge, significantly affecting the product's lifespan and potentially causing damage.

6) Regularly monitor the equipment's status and check for any abnormalities immediately. Ensure the power is off before performing any operations and wear protective equipment.

7) Adhere strictly to all safety regulations and do not open the equipment without

authorization.

8) Avoid subjecting the equipment to strong impacts or vibrations. Ensure that cable connections are firm and reliable.

9) Ensure that the equipment operates within its rated power range.

8. Warning

1) It is strictly prohibited to remove the battery and other components from the product. The product is equipped with protection mechanism and circuit to prevent danger. Improper disassembly will damage the protection function, leading to battery overheating, smoking, deformation, or combustion.

2) Never short-circuit the system. Do not connect the positive and negative terminals of the product with metal, and do not store or move the product with the metal objects. A short circuit can cause a large current flow, damaging the battery and resulting in overheating, smoking, deformation, or combustion.

3) Heating and incineration of products are strictly prohibited. Heating and incineration of batteries will cause the battery isolator to melt, leading to a loss of safety functions or combustion of electrolyte. Overheating can result in the battery overheating, smoking, deformation, or combustion.

4) Do not expose the product to rain or submerge it in water. This can cause the loss of functions and abnormal chemical reactions, leading to battery overheating, smoking, deformation, or combustion.

5) Do not destroy the product or batteries. Avoid using metal objects to chisel into the battery, hammering or smashing the product and battery, or using any other methods to destroy the product. Such actions can cause the battery to overheat, smoke, deform, or combust.

6) It is strictly prohibited to connect the product directly to the power socket. High voltage and high current will flow through the battery, leading to damage, overheating, smoking, deformation, or combustion.

7) Reverse charging is strictly prohibited. Doing so can damage the battery and may

cause it to overheat, smoke, deformation, or combustion.

8) Unauthorized opening of the equipment or performing internal operation is strictly forbidden. Only professional personnel or trained personnel can carry out the equipment operation and maintenance.

9) It is strictly prohibited to conduct any electrical connection or disconnection operation while the equipment is live. All operations must be performed only after the equipment is powered off.

10) The equipment must be operated within the rated power range to avoid equipment damage and potential safety hazards.

11) Never use inappropriate tools or equipment for installation and maintenance. Always use appropriate tools to ensure safe operation and maintain the equipment in good condition.

12) Regular inspection and maintenance of the equipment must not be neglected. The connection status, electrical parameters, and communication interface of the equipment must be checked regularly to ensure normal operation.

9. Disclaimer

1) If the customer needs to operate or use the product under conditions other than those stated in this document, please consult the company for relevant matters first.

2) The company shall not be liable for any accidents resulting from the use of the product outside the conditions specified in this document.

3) The company shall not assume any responsibility for the problems arising from improper customer commissioning operations.