



Max-20HC-3344

Energy Storage System Product Specification

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1. General Introduction

1.1. Confidentiality

This product specification is intended for the personnel's involved in the project only and must not be transferred to other personnel without permission.

1.2. Purpose of the Document

This product is developed by Guangzhou Great Power Energy Storage Technology Co., Ltd. It describes the performance indicators of the product, including basic functions, interfaces, key Specifications, and safety performance.

This document provides the Specifications of the product. If any deficiencies are found, please inform R&D team of Great Power for review and update.

Great Power reserves the right to update this document without prior notice.

1.3. Disclaimer

The technical parameters, performance descriptions and diagrams and other information in this specification are based on test-labs test conditions and design objectives, and may vary depending on the actual environment or mode of use. Guangzhou Great Power Energy Storage Technology Co., Ltd does not guarantee its absolute accuracy and is not responsible for the consequences of relying on such information.

Users should ensure that their application scenarios comply with local laws and regulations, and bear all risks of using this product.

1.4. Definitions and Abbreviations

BMS: Battery Management System
BAU: Battery Array management Unit
BCU: Battery Cluster management Unit
BMU: Battery Module management Unit
TMS: Thermal Management System
FSS: Fire Suppression System
BOL: Beginning of Life
EOL: End of Life
RTE: Round-Trip Efficiency
LC: Local Controller

1.5. Standards Compliance

Compliant with the following standards:

UN38.3	Lithium metal and lithium-ion batteries
NFPA 68	Standard on Explosion Protection by Deflagration Venting
NFPA 69	Standard on Explosion Prevention Systems
NFPA 70E	Standard for electrical safety in the workplace
NFPA 855	Standard for the installation of stationary energy storage systems
IEEE 1584	IEEE Guide for Performing Arc-Flash Hazard Calculations
IEEE 693	IEEE Recommended Practice for Seismic Design of Substations
UL 9540A	Standard for safety test method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems
UL 9540	Standard for safety energy storage systems and equipment
UL 1973	Standard for safety batteries for use in stationary and motive auxiliary power applications
UL 471	Commercial Refrigerators and Freezers
UL 1778	Standard for safety uninterruptible power systems
UL 489	Molded-case circuit breakers, molded-case switches, and circuit-breaker enclosures
UL 1077	Supplementary protectors for use in electrical equipment
UL 98	Standard for safety enclosed and dead-front switches
UL 62368-1	Standard for safety Audio/Video, Information and Communication Technology Equipment-Part 1: Safety Requirements
IEC 62619	Secondary cells and batteries containing alkaline or other non-acid Electrolytes-Safety requirements for secondary lithium cells and batteries for use in industrial applications
IEC 62477-1	Safety requirements for power electronic converter systems and equipment -Part 1:general
IEC 60664-1	Insulation coordination for equipment within low-voltage supply systems – Part 1: Principles, requirements and tests
IEC 61000-6-2	Electromagnetic compatibility (EMC) – Part 6-2: Generic standards Immunity standard for industrial environments
IEC61000-6-4	Electromagnetic compatibility (EMC) – Part 6: Generic standards Section 4: Emission standard for industrial environments
IEC 60730	Software safety requirements for automatic embedded control systems
IEC 62040	Uninterruptible power systems (UPS) – Part 3: Method of specifying the performance and test requirements

2. Technical Solution

2.1. Application

The Max-20HC-3344 energy storage battery system uses a 20HC container and is designed with an independent auxiliary power distribution system, liquid cooling system, alarm system, fire suppression system, and other automatic control and safety guarantee systems. Its design complies with NFPA68 or NFPA 69 standards, with simple operation, and easy wiring. Composed of Great Power' s 314Ah battery cells, it features high energy density, long cycle life, high efficiency, applicable for projects at low temperature and high altitude. It can achieve various grid-end applications, meeting market demand for frequency regulation, voltage support, peak shaving and valley filling, and demand response. Additionally, this product can also be used in black start, backup power, microgrid, and other application scenarios.

2.2. Product Advantages

The Max-20HC-3344 energy storage system has the following advantages:

1. **Standard Design:** Adopts 20HC standard container, compliant with marine transportation standards, saving transportation and on-site installation costs by pre-integration of all batteries.
2. **Convenient Interface:** DC/AC cables are installed vertically, and a single line cable is used for external communication. Plug & Play for easy installation.
3. **High Integration:** The system is highly integrated with a regional energy density exceeding 220kWh/m². The double-door design supports the “田 Shape” layout with 4 containers together, further reducing site-level land occupation.
4. **Adaptive Thermal Management System:** Embedded intelligent temperature control management automatically adjusts with the battery temperature state to extend battery life. High-efficiency air to liquid chiller, further reduces system auxiliary energy consumption.
5. **Independent Backup Power:** Supports operation of low-voltage auxiliary power system for 15 minutes after auxiliary power failure.
6. **Humidity Self-regulation:** Built-in dehumidification system ensures appropriate humidity inside the energy storage system, without condensation, enhancing system anti-corrosion.

7. Ultimate Safety:

- a) **Battery Cell:** Lithium iron phosphate material, ceramic-coated separator and gel flame retardant electrolyte technology, reduce the chance of thermal runaway and combustion.
- b) **PACK:** Aerogel insulation technology, blocking battery cell thermal spread. Fuse protection design, reducing short circuit risks.
- c) **RACK:** Fuse protection, contactor protection, isolator protection design, multi-level protection linkage mechanism, reducing overcharge, over-discharge, and short circuit risks.
- d) **Container:**
Electrical Compartment/battery Compartment isolation technology further enhances system safety.
Emergency stop and lightning protection design, further enhances system safety.
Multi-level fire protection linkage design:
 - **Level 1 Fire Alarm:** Links with local controller to execute relevant control strategies.
 - **Level 2 Ventilation:** Complies with NFPA69 standards, executing container explosion-proof mechanism.
 - **Level 3 Aerosol Fire Extinguishing:** Prevents the spread of fire.
 - **Level 4 Water Spray Fire Extinguishing:** Prevents the spread of fire and executes container cooling.

2.3. Product Overview

The Max-20HC-3344 energy storage system consists of a 20HC container, auxiliary integrated Compartment, FSS, TMS, and BMS. The appearance is shown in the following diagram:



Figure 1: Appearance of Max-20HC-3344 Energy Storage System
(For Reference Only)

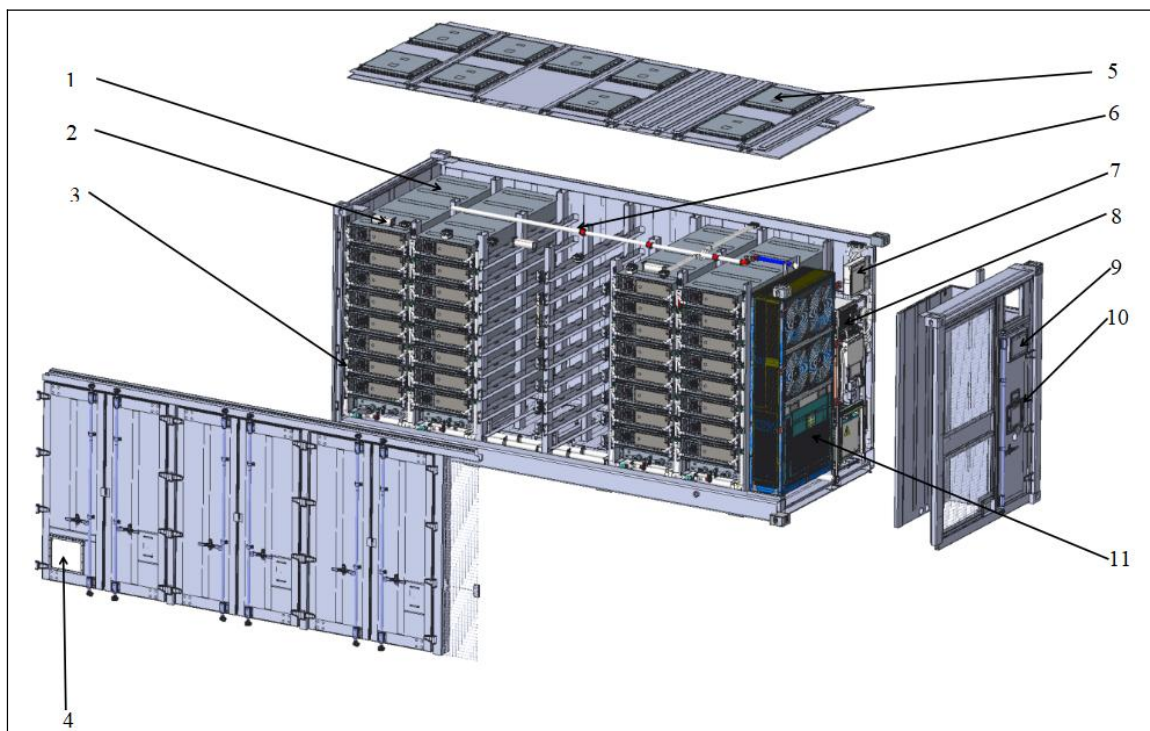


Figure 2: Internal Diagram of Max-20HC-3344 Energy Storage System
(For Reference Only)

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Table 1: Composition of Max-20HC-3344 Energy Storage System

No.	Component	No.	Component
1	Battery Cluster	7	Forced Exhaust Fan
2	Aerosol Pack	8	Electrical Compartment
3	Liquid Cooling Pipeline	9	Alarm Box
4	Inlet Louver	10	Operation Box
5	Deflagration Panel	11	Air to Liquid Chiller
6	Water Sprinkler Pipeline		

2.3.1. DC System

A PACK consists of 104 battery cells of Ultra-314Ah from Great Power, a RACK is formed by 4 PACKs, and 8 RACKs are integrated into the container. The battery is the core of the energy storage system for energy storage and release.

2.3.2. Battery Management System

The battery management system adopts a three-level architecture. Based on detected voltage, current, temperature, and other information, it manages the energy of the battery, diagnoses information, analyzes faults, and ensures the safe and stable operation of the energy storage system.

2.3.3. Thermal Management System

The thermal management system comprises a powerful air to liquid chiller, liquid cooling pipelines, and a liquid cooling circulation system distributed across the liquid cooling bottom plates of each battery pack. It achieves battery heat dissipation and temperature equalization through heat transfer, effectively controlling the battery temperature of the entire system within a reasonable range, allowing the battery to operate in the best state and extending the system's lifespan.

2.3.4. Dehumidification System

The dehumidifier controls the humidity inside the container, preventing high humidity inside the container from causing corrosion to materials.

2.3.5. Fire Suppression System

The Fire Suppression System operates independently from any other systems of the DC block. It adopts smoke detector, temperature detector, and combustible gas detectors for joint detection. The combination of fire extinguishing agent and deflagration system provides effective protection for the energy storage system. Together with a water spray system, it provides multi-level fire protection to the energy storage system.

2.3.6. Local Control System

It communicates with the battery management system, thermal management system, fire suppression system, dehumidification system, etc., analyzes stored data comprehensively, and uploads information to the EMS. It ensures the energy management of EMS for the energy storage system.

3. System Specifications

This chapter describes the Max-20HC-3344 energy storage system in details, including DC system Specifications, auxiliary power supply Specifications and communication, mechanical and environmental Specifications.

3.1. DC System Specifications

Table 2: DC System Specifications

No.	Item	Specification	Remark
1	Product Model	Max-20HC-3344	
2	Power	$\leq 0.5P/0.5C$	
3	Rated Energy (MWh)	5.015	
4	Max Discharge Depth (DOD)	0~100%	Typical 5%~95% SOC
5	Rated Voltage (V d.c)	1331.2	
6	Max Voltage Range (V d.c)	1040 ~ 1497.6	2.6V~3.60V/cell
7	Recommended Voltage Range (V d.c)	1164.8 ~ 1476.8	2.8V~3.55V/cell
8	Rated Charging Power (kW)	$\leq 836kW*2$	Connected to PCS
9	Rated Charging Current (A)	628A@ First DC-bus 628A@ Second DC-bus	Centralized, consisting of two DC-bus.
10	Max Charging Current (A)	772A@ First DC-bus 772A@ Second DC-bus	$\leq 5min$
11	Rated Discharging Power (kW)	$\leq 836kW*2$	Connected to PCS
12	Rated Discharging Current (A)	628A@ First DC-bus 628A@ Second DC-bus	Centralized, consisting of two DC-bus
13	Max Discharging Current (A)	772A@ First DC-bus 772A@ Second DC-bus	$\leq 5min$
14	Round Trip Efficiency (RTE)	93.5%	$\leq 0.5P$

3.2. Auxiliary Power Specifications and Communication

Table 3: Auxiliary Power Specifications

No.	Item		Specification	Remark
1	Auxiliary Power 1	Voltage Range (Va.c)	480±10%, 60Hz Or 380±10%, 50Hz	480Vac for US version 380Vac for Europe version
2		Power (kW)	≤34	For reference only
3	Auxiliary Power 2 (US version)	Voltage Range (Va.c)	240±10% Or 480±10%	For reference only
4		Power (kW)	≤0.2	For reference only
5	UPS	Voltage Range (V a.c)	220V±10%, 50/60Hz	UPS is only used to power low-voltage communication equipment such as LC and BMS and is included in the auxiliary power supply
6		Capacity (Ah)	9	
7	Operating Noise (dB)		≤80	
8	Communication Protocol		CAN, Modbus-TCP	

3.3. Mechanical and Environmental Specifications

Table 4: Mechanical and Environmental Specifications

No.	Item		Specification	Remark
1	Container Dimensions (mm)		6058(W)*2438(D)*2896(H)	Suitable for land and sea transportation
2	Weight (T)		≈30.8	
3	IP Rating	Battery Compartment	IP55	
4		Electrical Compartment	IP55	
5		Chiller	IP67	Electrical Part
6	Corrosion Protection Level		C4	C5 for option
7	Color		RAL 7035	
8	Operating Environment Temperature (°C)		-30~+55	
9	Storage Environment Temperature (°C)		-35~+55	
10	Altitude (m)		≤4000	Derated above 2000m
11	Relative Humidity (RH)		0~100%	No condensation
12	Seismic Grade		Moderate intensity	

4. System Principle

4.1. Auxiliary Power System

The auxiliary power system of the Max-20HC-3344 energy storage system mainly consists of two parts for power: Auxiliary Power 1 and *Auxiliary Power 2 (US version)*. Auxiliary Power 1 is mainly used for conventional auxiliary equipment power supply in the container and chiller power supply. It also includes UPS internally, as backup power for low-voltage equipment, local controller, and BMS. The UPS supports backup power for no less than 15 minutes. And also used for explosion-proof system power supply by Europe version.

Auxiliary Power 2 is mainly used for explosion-proof system power supply by *US version*. The specific principle diagram is shown below:

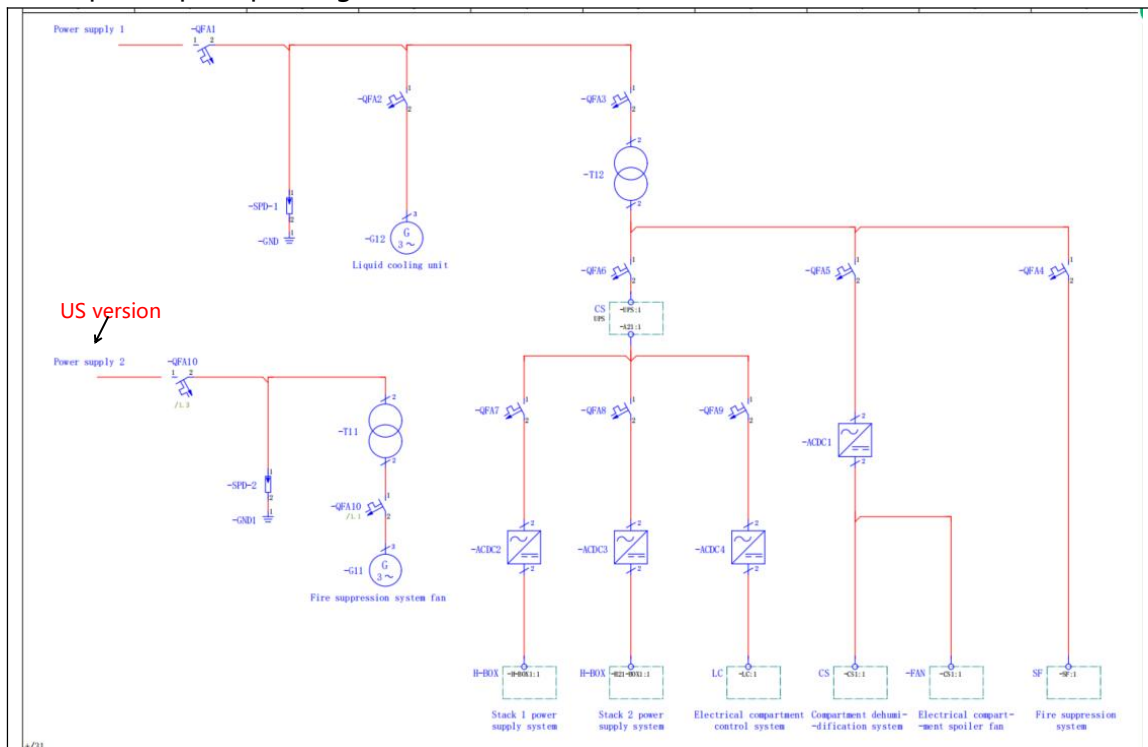


Figure 3: Auxiliary Power Principle Diagram

4.2. DC System

The DC part of the Max-20HC-3344 energy storage system mainly consists of two battery stacks. Each battery stack includes 2 high-voltage boxes. Each high-voltage box manages 2 battery clusters, and each battery cluster consists of 4 PACKs, with each PACK containing 104 battery cells. The principle diagram is shown below:

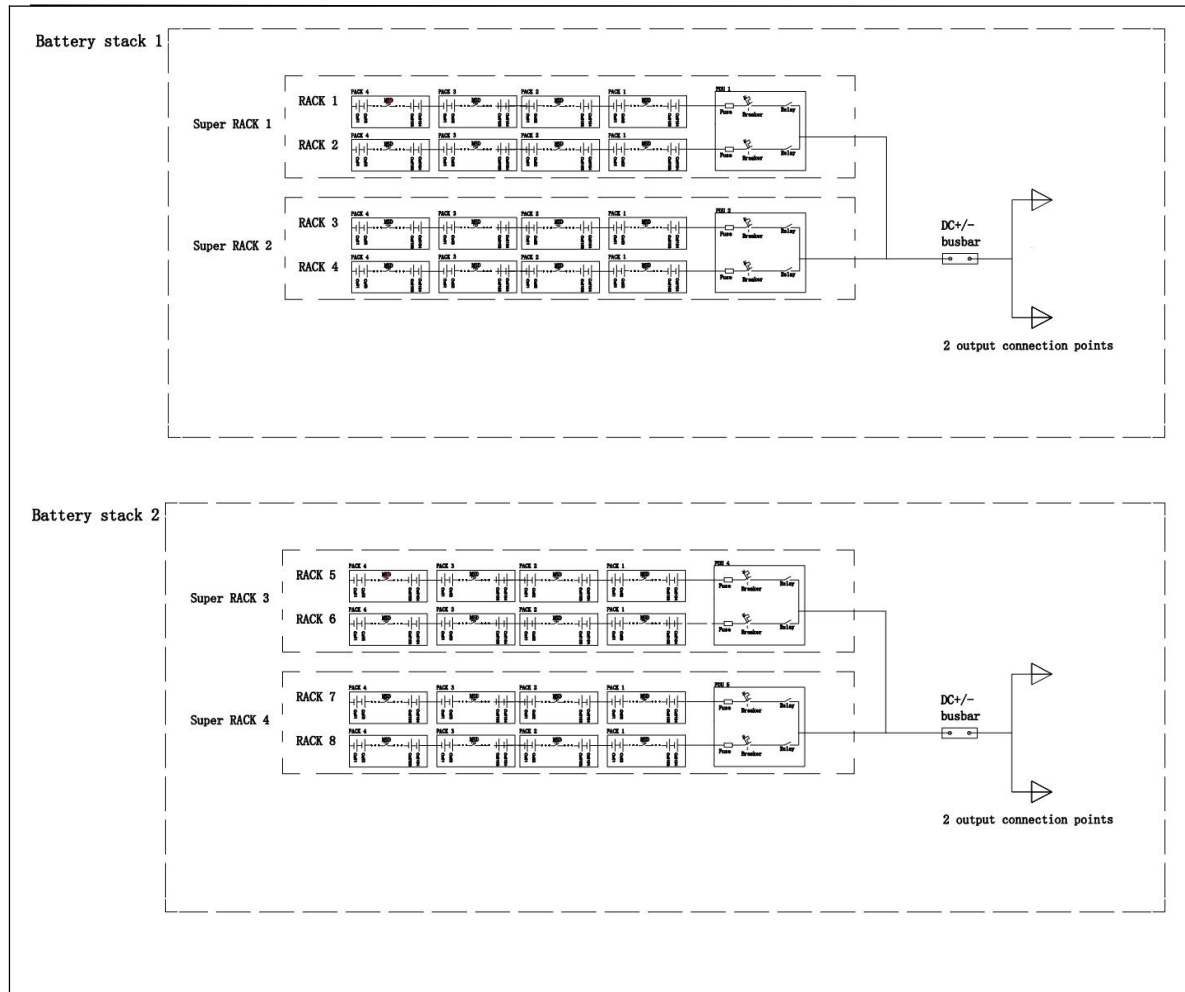


Figure 4: DC System Principle Diagram

4.3. Communication Topology Principle

The Max-20HC-3344 energy storage system adopts a standard communication method. Through the local controller communicating with the EMS, it uploads the internal information of the energy storage system, such as battery system information, FSS information, TMS information, dehumidification system information, and IO information. Physical connections can transmit information through switches, network cables, or optical fibers. The communication principle diagram is shown below:

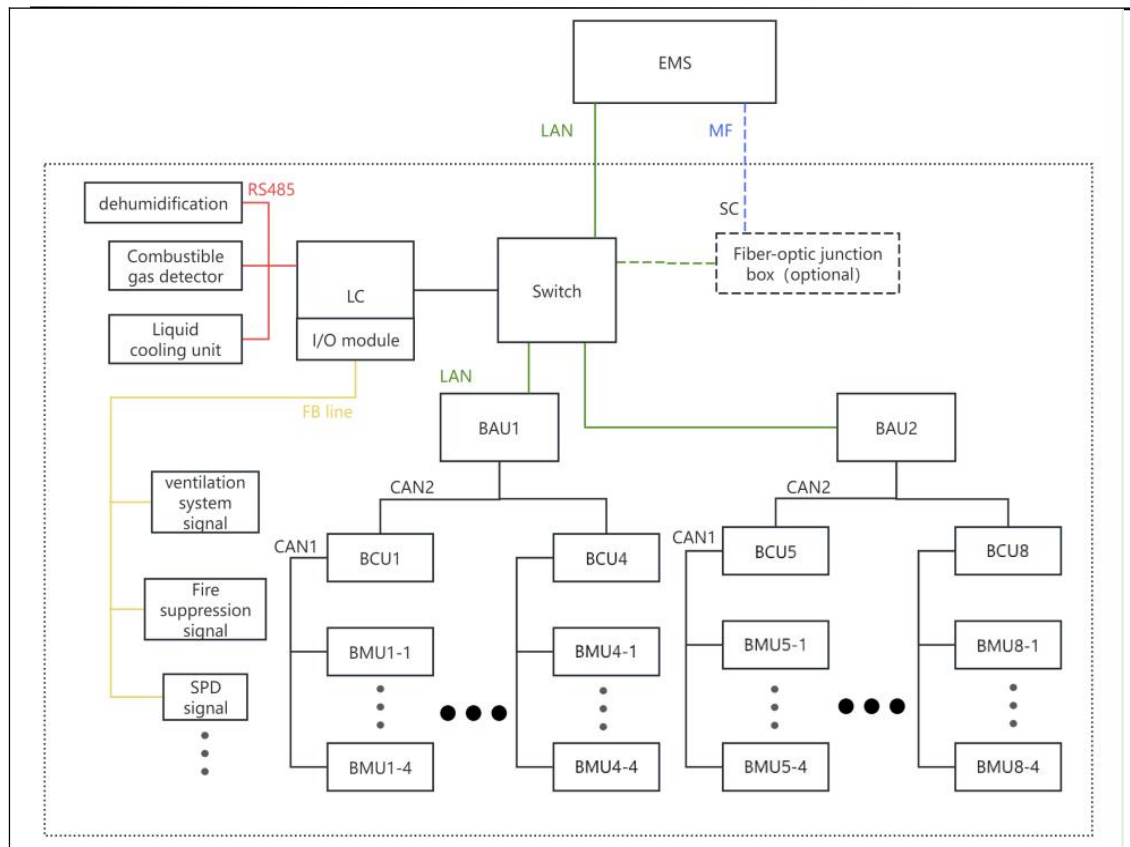


Figure 5: Communication Principle Diagram

4.4. Interface Diagram

4.4.1. AC Power/Communication Interface Diagram

The bottom of the electrical Compartment of the Max-20HC-3344 energy storage system includes the wiring terminal for clients, mainly consisting of interfaces such as Auxiliary Power 1, Auxiliary Power 2, and EMS communication RJ45 (optical fiber optional).

Table 5: AC Power/Communication Interface Schematic

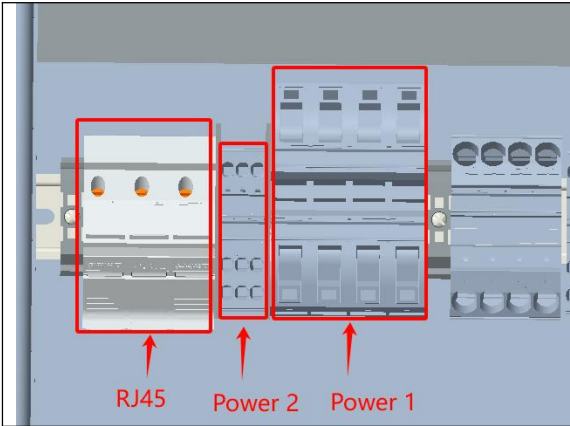
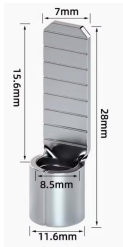
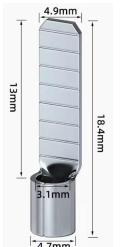
 The image shows a close-up of the AC power and communication interface of the Max-20HC-3344 container. Three red boxes highlight the RJ45 ports, Power 2 ports, and Power 1 ports. Red arrows point to each of these sections with labels 'RJ45', 'Power 2', and 'Power 1' respectively.	Terminal Arrangement : From Left to Right Numbering				
	Power 1		Power 1		Communication
	1	L1	1	L	RJ45
	2	L2	2	1	
	3	L3	3	L	
	4	N		2	

Table 6: Terminal Model and Specification

Type	Power 1	Power 2	
Terminal Model	C45-25  The image shows a terminal model C45-25 with dimensions: 7mm width, 15.6mm height, 28mm length, 8.5mm base width, and 11.6mm base depth.	C45-4  The image shows a terminal model C45-4 with dimensions: 4.9mm width, 13mm height, 18.4mm length, 3.1mm base width, and 4.7mm base depth.	Class B Connection
Cable Model	4AWG	12AWG	Over 6 models

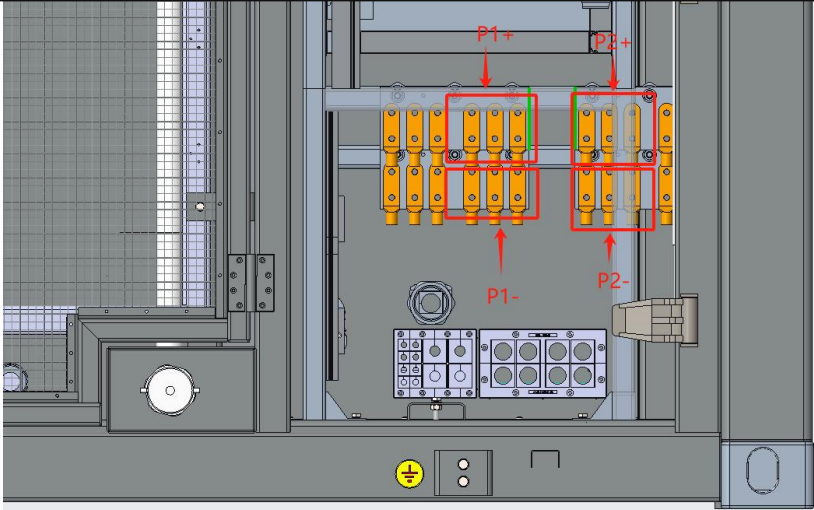
4.4.2. DC Interface Diagram

The main confluence points in the electrical Compartment of the Max-20HC-3344 energy storage system are mainly composed of two sets of copper bars, with each set of positive and negative copper bars spaced 145mm apart.

The left side P1+ and P1- are the DC interfaces of the first battery stack.

The right side P2+ and P2- are the DC interfaces of the second battery stack.

Table 7: DC Interface Schematic

	Terminal Model
	CL120-2H-10 
	Cable Model
	AWG 4/0

5. Design Specifications

5.1. DC System

5.1.1. Battery Cell

The Max-20HC-3344 energy storage system uses the ULTRA-314Ah battery cells of Great Power, which is safe & reliable and widely used in Utility-scale energy storage and industrial and commercial energy storage scenarios. It has high safety performance approved by certifications such as UL, IEC, UN, RoHS. The Specifications are shown in the table below:

Table 8: Battery Cell Specifications

No.	Item	Specifications	Remark
1	Model	GSP71173204F	
2	Nominal Capacity (Ah)	314	
3	Nominal Energy (Wh)	1004.8	
4	Nominal Voltage (V)	3.2	
5	Voltage Range (V)	1.672~3.65@T > 0°C 2.0~3.65@T ≤ 0°C	
6	Charging Temperature (°C)	0~60	
7	Discharging Temperature (°C)	-30~60	
8	Storage Temperature (°C)	-40~60	Recommended storage temperature: -10°C~35°C
9	Cycle Life	≥8000@70%	
10	Application Altitude (m)	≤3344	
11	Application Scenario	FCR, Stand-alone, industrial and commercial BESS, etc.	
12	Product Certification	GB/T36276、UL1973、UL9540A、IEC62619 UN38.3、RoHS、Reach	

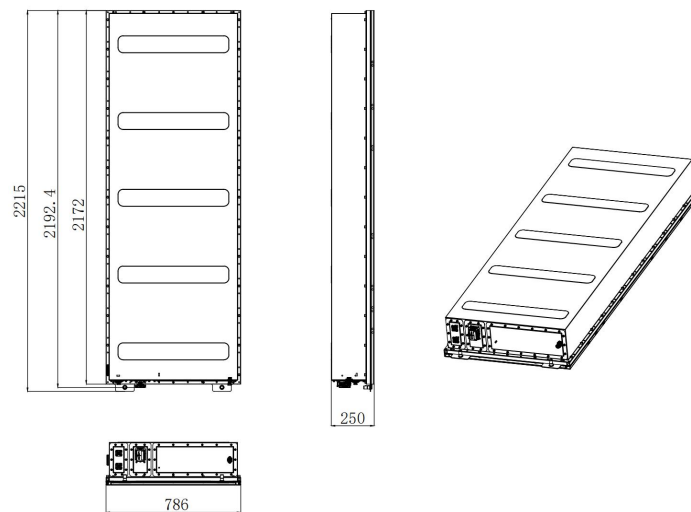
5.1.2. Battery Pack

Each battery pack contains 8 modules. Each module consists of 13 battery cells in series. Temperature of each module is measured by 6 or 7 temperature sensors (NTC), voltages of each cells in each module is measured by 14 acquisition points. The Specifications are shown in the table below:

Table 9: Battery Pack Specifications

No.	Item	Specification	Remark
1	Product Model	PLL03C2-D1P104S-A01	
2	Combination Method	1P104S	
3	Rated Energy (kWh)	104.499	
4	Rated Voltage (V d.c)	332.8	
6	Maximum Voltage Range (V d.c)	270.4~374.4	2.6V~3.60V/cell
6	Recommended Voltage Range (V d.c)	291.2~369.2	2.8V~3.55V/cell
7	Rated Charging Power (kW)	52	
8	Rated Charging Current (A)	157	
9	Maximum Charging Current (A)	193	≤5min
10	Rated Discharging Power (kW)	52	
11	Rated Discharging Current (A)	157	
12	Maximum Discharging Current (A)	193	≤5min
13	Communication Protocol	CAN	

Schematic



5.1.3. Battery Cluster

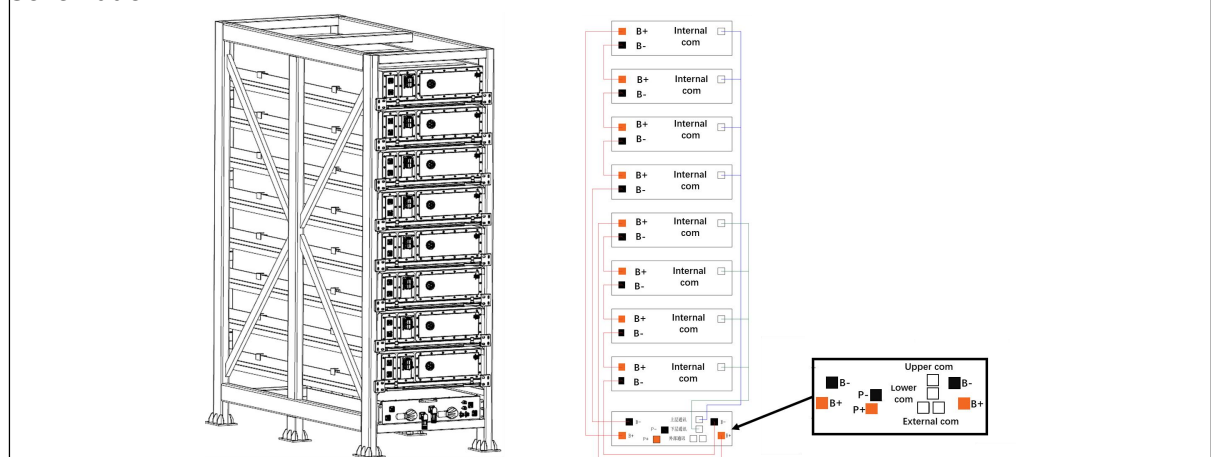
A single-row battery rack consists of 2 battery clusters, divided into upper and lower layers. The upper layer is composed of 4 battery packs forming one cluster, and the lower layer is composed of another 4 battery packs forming another cluster. The two clusters

share one combined 2-in-1 high-voltage box and matching harness, forming a complete single-row battery rack. The modular design allows for strong interchangeability, and the battery rack can accommodate different numbers of modules to achieve system capacity expansion and reduction. The Specifications of the battery cluster are as follows:

Table 10: Battery Cluster Specifications

No.	Item	Specification	Remark
1	Model	RLL03C2-D1P104S1R4-A01	RLL03C2-D2P104S1R4-A01
2	Combination	1P416S	
3	Rated Energy (kWh)	417.996	
4	Rated Voltage (V d.c)	1331.2	
7	Max Voltage Range (V d.c)	1081.6~1497.6	2.6V~3.60V/cell
8	Recommended Voltage Range (V d.c)	1164.8~1476.8	2.8V~3.55V/cell CP
9	Rated Charging Power (kW)	209	
10	Rated Charging Current (A)	157	
11	Max Charging Current (A)	193	≤5min 1200Vdc
12	Rated Discharging Power (kW)	209	
13	Rated Discharging Current (A)	157	
14	Max Discharging Current (A)	193	≤5min
15	Communication Protocol	CAN	

Schematic



5.2. Battery Management System

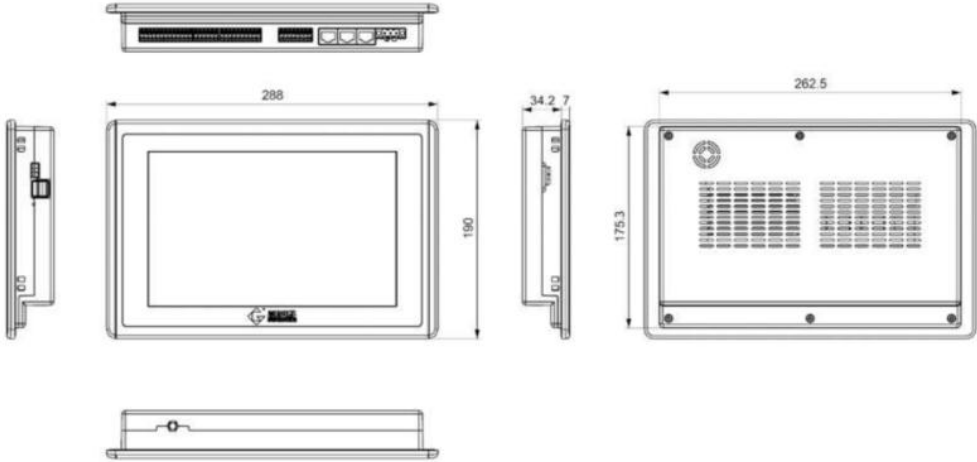
The DC system of the Max-20HC-3344 energy storage system is divided into 2 battery stacks, each composed of 4 battery clusters. Therefore, the battery management system is divided into 2 of three-level architectures, each of them manages 4 battery clusters.

5.2.1. Battery Array Control Unit (BAU)

BAU, also known as the third-level BMS, is a control management host suitable for energy storage battery management systems. It performs numerical calculations, performance analysis, alarm handling, and record storage on the real-time data uploaded by BCU (second-level BMS) and BMU (first-level BMS). Additionally, it can achieve linkage control with the local controller, optimizing load control strategies according to the output power requirements and the SOC status of each battery cluster, ensuring the safe, stable, and efficient operation of the battery system. The hardware Specifications are as follows:

Table 11: Battery Array Control Unit (BAU) Specifications

No.	Item		Specification	Remark
1	Model		ESMU-100256	
2	Input Voltage Range (V d.c)		9~32	
3	Power Consumption (W)		≤10	Initial state with screen on
4	Processor		ARM, 4core	
5	Operating System		Linux	
6	Event Log Database (nos)		≥100000	
7	Data Recording Interval (S)		≤1	
8	Storage (GB)		256	
9	Operating Environment (°C)		-10~60	
10	Relative Humidity (RH)		< 95%	
11	Communication Interface	LAN	3 channels	
12		CAN	3 channels	
13		RS485	5 channels	
14	IO Input/Output	DI	12 channels	
15		DO	12 channels	
16	Dimensions L*W*D (mm)		288*190*34.2	

No.	Item	Specification	Remark
Schematic			
			

5.2.2. Battery Cluster Control Unit (BCU)

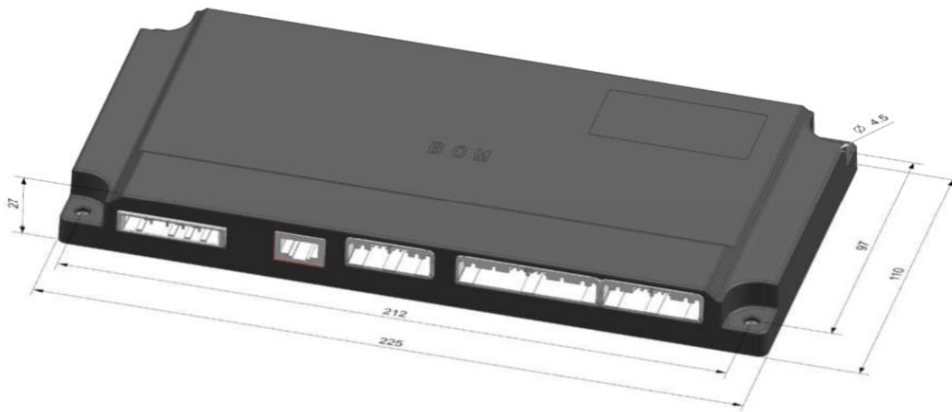
The BUC manages the battery clusters in the energy storage battery system, generally placed in the high-voltage control box of the battery cluster. It is responsible for collecting the voltage and current of the battery cluster, summarizing the voltage and temperature information of the single batteries in the cluster, calculating the SOC/SOH status, executing balance strategy judgments and battery fault diagnosis, and implementing local protection and relay control of the battery cluster based on fault information. BCU has CAN communication interfaces to achieve data communication with the BMU and BAU. It also has insulation collection functions and single SOC/SOH state calculation functions, with redundant CAN communication interfaces, RS-485 communication interfaces, and Ethernet communication interfaces for external device communication. The BCU control management module is the core module of the energy storage battery management system, ensuring the safe, reliable, and efficient operation of the energy storage system. The hardware Specifications are as follows:

Table 12: Cluster Control Unit (BCU) Specifications

No.	Item	Specification	Remark
1	Model	ESBCM-F133-L	
2	Input Voltage Range (V d.c)	9~32	
3	Power Consumption (W)	≤3	
4	Total Voltage Collection (V d.c)	0~1500	±0.1%FS

No.	Item		Specification	Remark
5	Current Collection (A)		± 500	$\pm(0.5\%FS+0.5\%RD)$
6	Temperature Collection ($^{\circ}C$)		-40~125	4 collection channels
7	Insulation Resistance (M Ω)		0~10	$\pm 15\%$, <100K within 15K error
12	Communication Interface	LAN	1 channel	
13		CAN	3 channels	
14		RS485	1 channel	
15	IO Input/Output	DI	8 channels	
16		DO	8 channels	
17	Dimensions L*W*D (mm)		225*110*27	

Schematic



5.2.3. Battery Module management Unit (BMU)

The BMU provides real-time detection of single battery voltage and temperature, while also having thermal management and balancing capabilities. It can form a highly flexible cluster battery management system with the main control unit ESBCM via CAN bus. The BMU supports low-power mode collection, with current reduced to 50uA or lower in this mode. It supports single cell SOC/SOH calculation, single cell voltage (over-voltage, under-voltage), temperature (over-temperature) communication fault alarms, and harness (voltage, temperature) disconnection detection.

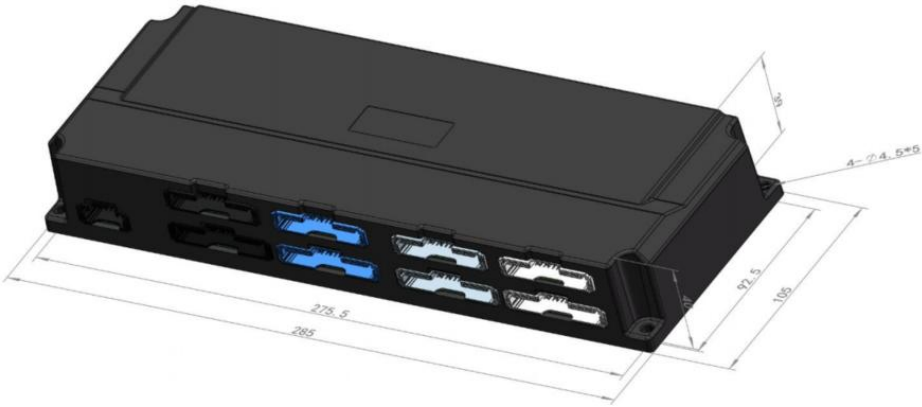
The BMU is available in active and passive balancing modes.

The following are the hardware Specifications for the active balancing module, it' s the default selections for Max-20HC-3344.

Table 13: Active Balancing Module BMU

No.	Item		Specification	Remark
1	Model		ESBMM-A422-F	
2	Input Voltage Range (V d.c)		9~32	
3	Power Consumption (W)		≤1	
4	Voltage Collection	Channels	104	
5		Range (V d.c)	0~5	±5mV
6	Temperature Collection	Channels	112	±1℃@-25℃~65℃,
7		Range (℃)	-40~125	±2℃@other range
8	Balancing Current (A)		2	
9	Communication Mode		CAN	
10	Dimensions L*W*D (mm)		285*105*39	
11	Operating Temperature (℃)		-20~65	
12	Storage Temperature (℃)		-40~85	
13	Relative Humidity (RH)		5~95%	
14	Operating Altitude (m)		≤3344	

Schematic

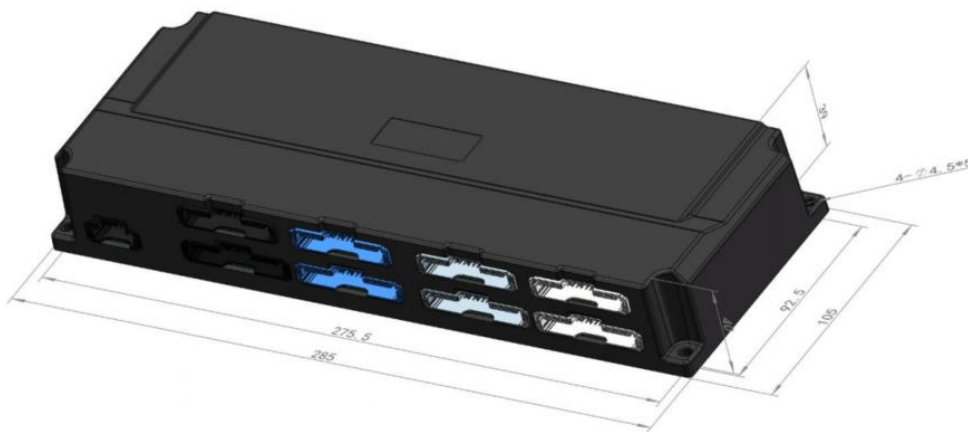


The following is a table of hardware Specifications for the passive equalization module

Table 14: Passive Balancing Module BMU

No.	Item		Specification	Remark
1	Model		ESBMM-B212-F	
2	Input Voltage Range (V d.c)		9~32	
3	Power Consumption (W)		≤0.8	
4	Voltage Collection	Channels	112	
5		Range (V d.c)	0~5	±5mV
6	Temperature Collection	Channels	112	±1°C@-25°C~65°C, ±2°C@other range
7		Range (°C)	-40~125	
8	Passive Balancing Current (mA)		100	
9	Communication Mode		CAN	
10	Dimensions L*W*D (mm)		285*105*39	
11	Operating Temperature (°C)		-40~85	
12	Storage Temperature (°C)		-40~85	
13	Relative Humidity (RH)		5~95%	
14	Operating Altitude (m)		≤3344	

Schematic



5.3. Thermal Management System

The thermal management system of Max-20HC-3344 energy storage system, its main function is to keep the temperature of the battery system in a suitable working range, so that the battery is working at the optimal temperature for charging, discharging and

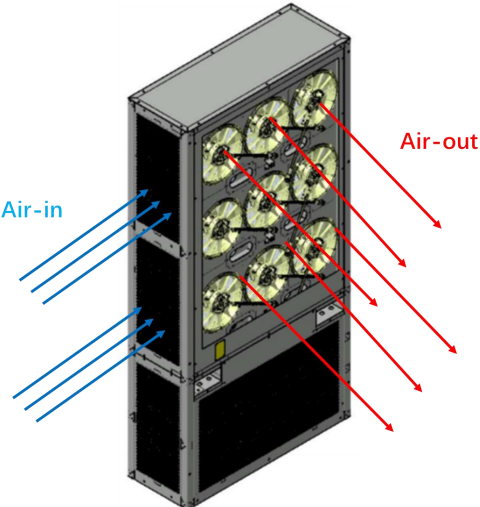
resting, in order to guarantee the service life per the simulated degradation.

The thermal management system comprises a powerful air to liquid chiller, liquid cooling pipelines, and a liquid cooling circulation system distributed across the liquid cooling bottom plates of each battery pack. It achieves battery heat dissipation and temperature equalization through heat transfer, effectively controlling the battery temperature of the entire system within a reasonable range, allowing the battery to operate in the best state and extending the system's lifespan.

The Specifications of the chiller are as follows:

Table 15: Liquid Cooling Unit Specifications

No.	Item	Specification	Remark
1	Model	BTMS-600-ESA	
2	Rated Cooling Capacity (KW)	50	Ambient temperature: 45°C, water temperature: 18°C
3	Rated Heating Capacity (KW)	16	
4	Voltage Range (V a.c)	480/380	408V~552V/323V~437V
5	Frequency (Hz)	50/60	
6	Rated Cooling Power (KW)	30	
7	Max Cooling Power (KW))	36	
8	Heating Power (KW)	17	
9	Refrigerant Type	R410A	R32 coming in 2026.
10	Flow Rate (L/min)	500	150kPA
11	Noise (dBA)	≤80	1m
12	Communication Mode	RS485	
13	Dimensions L*W/H (mm)	1200*440*2400	
14	Operating Environment Temperature (°C))	-30~55	
15	Altitude (m)	≤4000	
16	IP Rating	IP26	IP67(electrical parts)

No.	Item	Specification	Remark
Schematic			
			

The thermal management system primarily includes a compressor, heat exchanger, condenser, solenoid valve, water pump, heater, and battery pack cooling plates. The principle diagram is shown below:

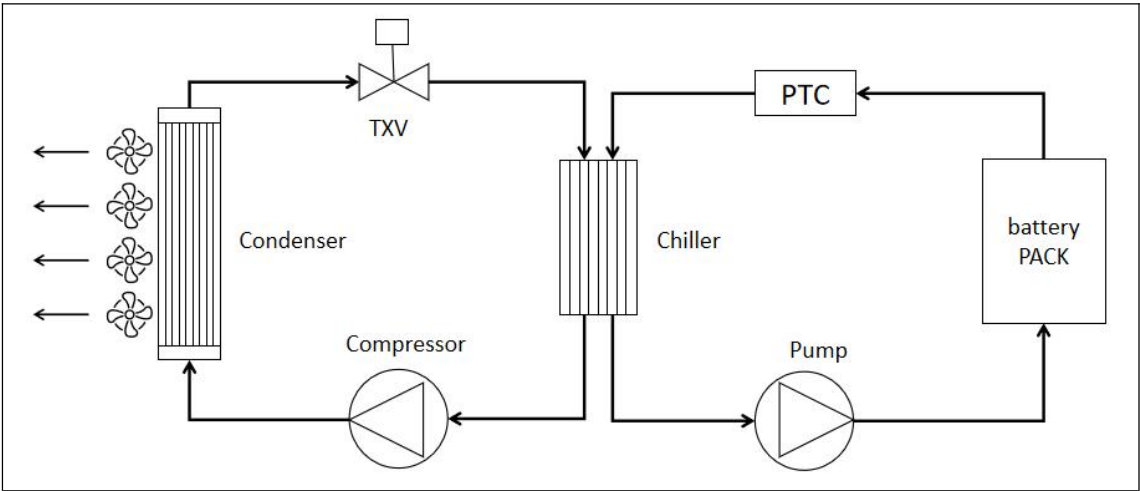


Figure 6: Thermal Management System Principle Diagram

- Compressor: Responsible for compressing low-temperature, low-pressure gaseous refrigerant into high-temperature, high-pressure gaseous refrigerant, providing the necessary driving force for the refrigeration cycle.
- Heat Exchanger: Transfers heat from the heat fluid to the cold fluid through heat conduction or heat convection, achieving cooling.
- Condenser: Converts high-temperature, high-pressure gaseous refrigerant from the

compressor into low-temperature, high-pressure liquid refrigerant.

- Solenoid Valve: Controls the flow of refrigerant, precisely regulating the flow and direction of these liquids to achieve temperature control of the entire system to ensure that the equipment to be cooled can be in the appropriate temperature range of stable operation.
- Water Pump: Drives the circulating flow of the coolant within the system.
- Heater: Heats the coolant.
- Battery Pack Cooling Plate: In direct contacts with the battery cells, transferring heat from the cells to the coolant, achieving thermal control of the battery.

The thermal management system in the Max-20HC-3344 energy storage system adopts a three-level pipeline method, specifically as follows:

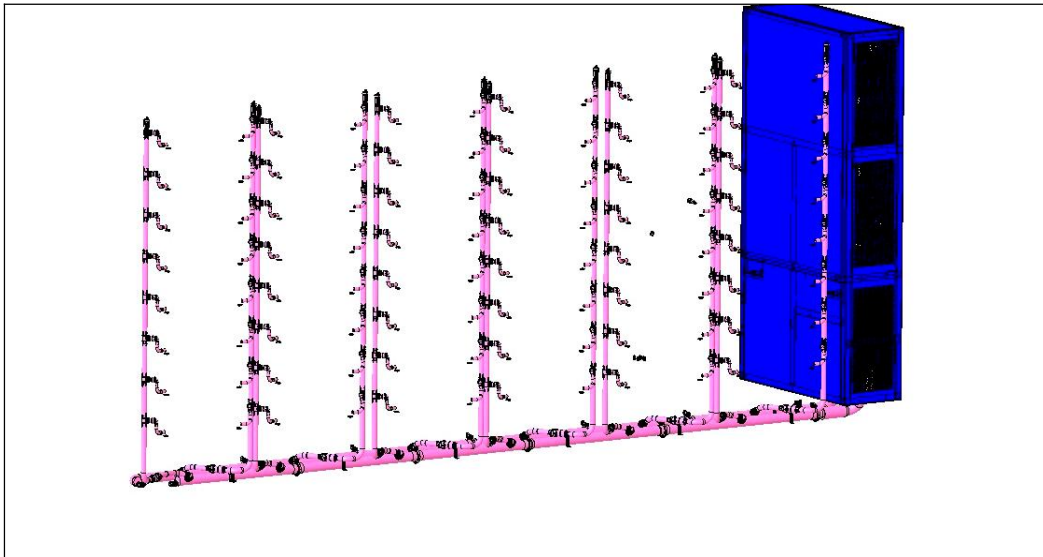


Figure 7: Three-level Pipeline Diagram

- First-level Pipeline: Connects the chiller to provide the main channel for coolant flow, ensuring smooth inflow and outflow of the coolant.
- Second-level Pipeline: Battery cluster level coolant pipeline, achieving even distribution of coolant to each PACK.
- Third-level Pipeline: Provides transitional connection between battery PACKs and second-level pipeline, ensuring smooth coolant flow. Integrated with quick connectors for easy installation and maintenance.

5.4. Dehumidification System

The dehumidification system in the battery Compartment of the Max-20HC-3344 energy storage system uses semiconductor cooling dehumidification. It actively draws in the moist air in the battery Compartment through the fan into the dehumidification duct, where the moisture in the air condenses into water after passing through the semiconductor cooling chip and is then drained out through the drainage pipe, achieving excellent dehumidification effects. By reducing the air's water content, both relative and absolute humidity drop without increasing the temperature, avoiding the negative effects brought by temperature differences, fundamentally preventing or reducing accidents. It effectively prevents equipment aging, insulation strength reduction, and structural component corrosion in the battery Compartment, ensuring the safe operation of the energy storage system.

Table 16: Dehumidifier Specifications

No.	Item	Specifications	Remark
1	Model	SDUL-60D	
2	Rated Voltage (V d.c)	24	
3	Dehumidification Power (W)	60	
4	Dehumidification Efficiency (mL/day)	≥480	±10mL
5	Humidity Detection Range (RH)	20%~95%	±3%RH
6	Temperature Detection Range (°C)	-25~95	±1%°C
7	Communication Mode	RS485	
8	Dimensions L*W*H (mm)	242*126*68	

The semiconductor dehumidification device consists of a power system, air supply system, semiconductor cooling chip, and drainage pipeline.

- **Power System:** Ensures the normal operation of the dehumidifier and provides energy for its operation.
- **Air Supply System:** Draws in moist air through the fan into the internal air duct.
- **Semiconductor Cooling Chip:** Condenses moisture in the air into water, which drips into the water collection tank under gravity.
- **Drainage Pipeline:** Drains water from the water collection tank outside the battery Compartment.

The principle diagram is shown below::

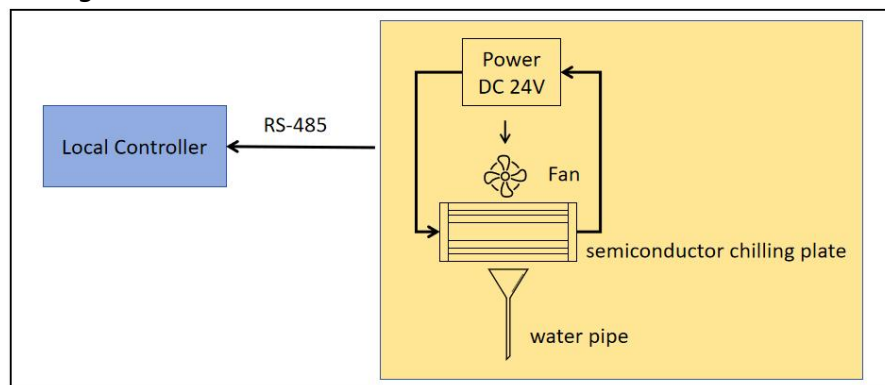


Figure 8: Dehumidifier Principle Diagram

5.5. Fire Suppression System

The Fire Suppression System of Max-20HC-3344 energy storage system consists of container-level aerosol fire protection system, deflagration system (NFPA69), forced ventilation system (NFPA68), and sprinkler system. (Either deflagration system or forced ventilation system is enough). The control logic of the fire suppression system is generally divided into four levels:

Level 1: The smoke or temperature detector is activated first, then alarm triggered, and fire alarm status reported to the local controller. After the LC is uploaded to the EMS, the EMS performs PCS shutdown.

Level 2: Combustible gas detector keeps detecting gas concentration. If it reaches the threshold, the LC will activate the deflagration system to prevent explosion.

Level 3: After the smoke and temperature detectors are activated, the fire control controller activates the aerosol to extinguish the fire. After LC is uploaded to the EMS, the EMS performs PCS shutdown. The LC performs a disconnection of auxiliary power 1 and the DC system.

Level 4: After the first three levels of FSS are activated, based on the on-site situation,

the fire sprinkler system could be activated manually for fire extinguishing.

The logic diagram is shown below:

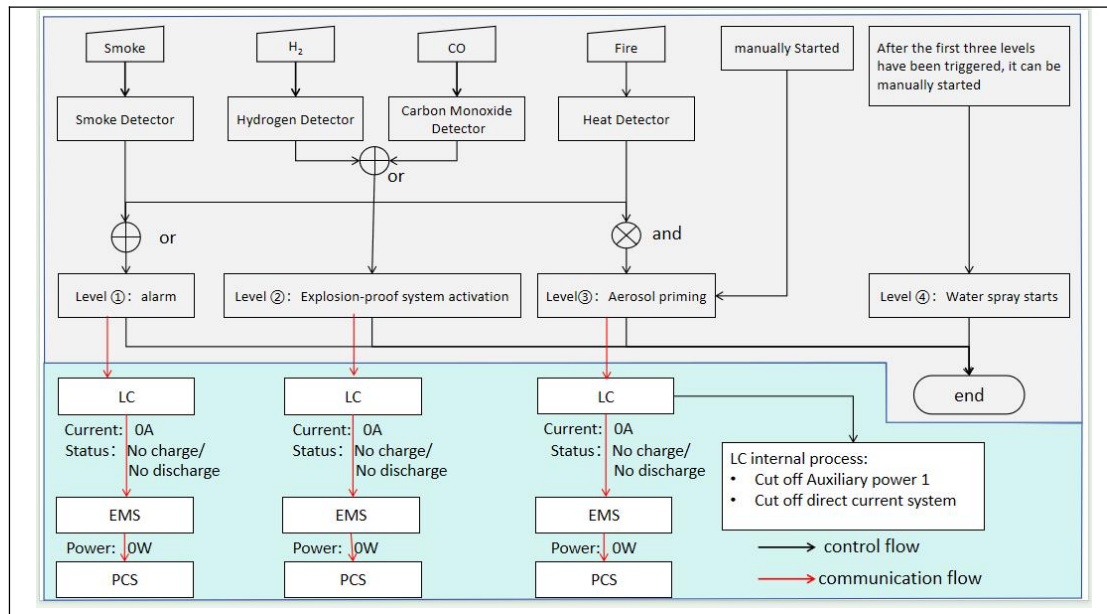


Figure 9: Four-level Fire Suppression Logic Diagram

5.5.1. Aerosol Fire Protection System

The aerosol fire protection system in Max-20HC-3344 energy storage system is a highly efficient and automatic fire extinguishing system that functions for fire protection through smoke-like aerosols generated from aerosol generating agents the action of thermal energy.

When the aerosol fire extinguishing device receives a start signal, the aerosol generator in the cartridge is activated, decomposing the upper layer of chemical coolant, thereby enabling the aerosol generator and coolant to work together to extinguish the fire.

The principle diagram, position diagram, and strategy diagram are shown below:

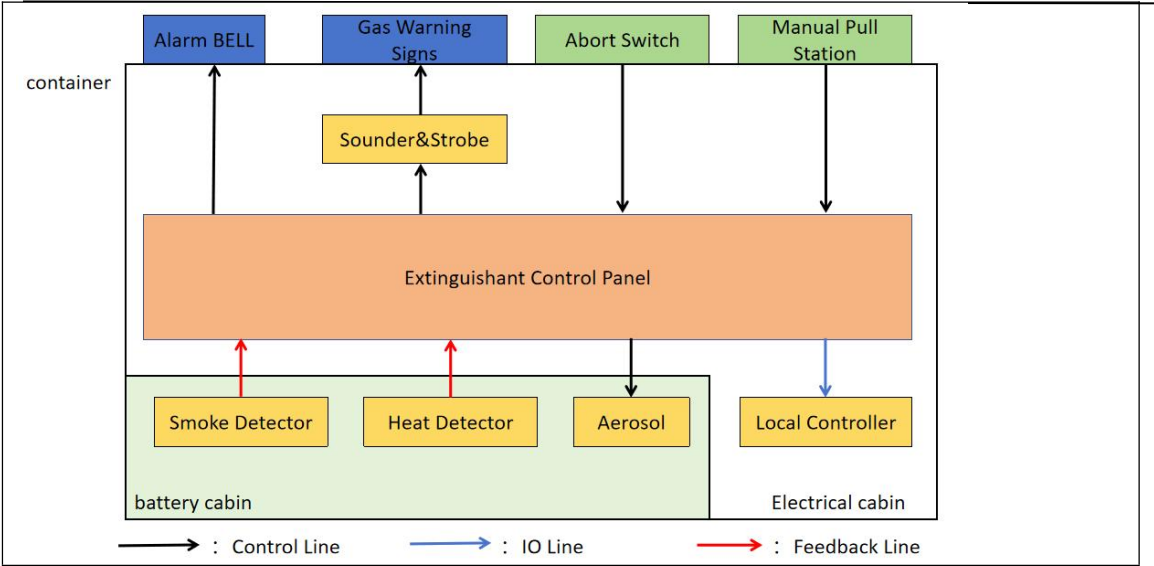


Figure 10: Aerosol Fire Protection Principle Diagram

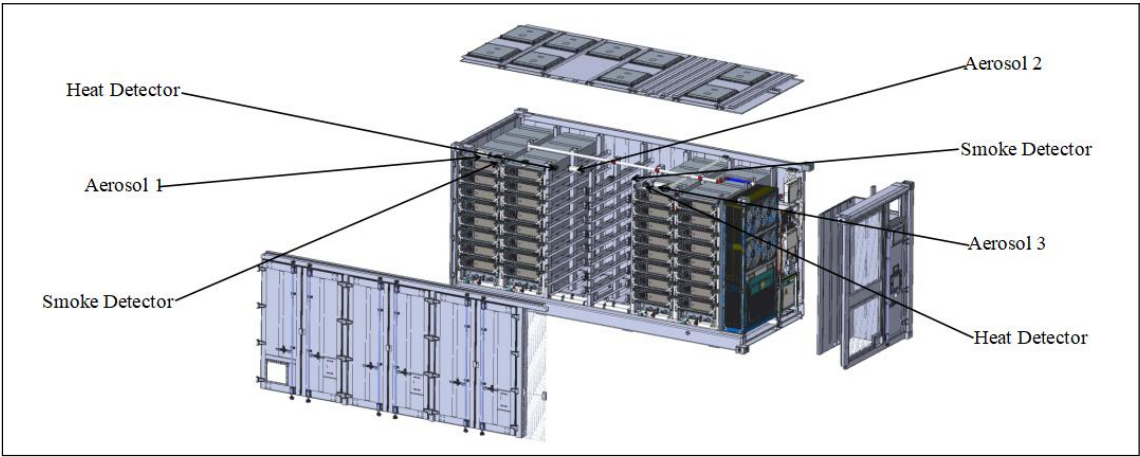


Figure 11: Aerosol Fire Protection Layout Diagram

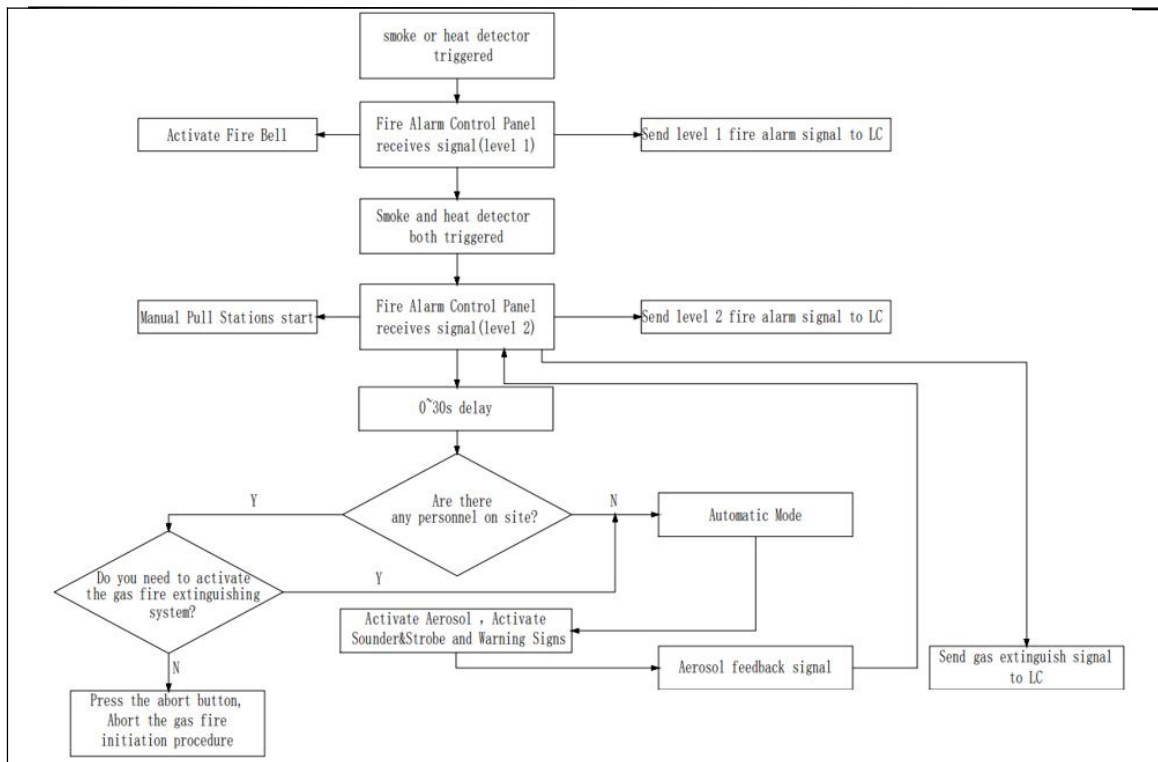
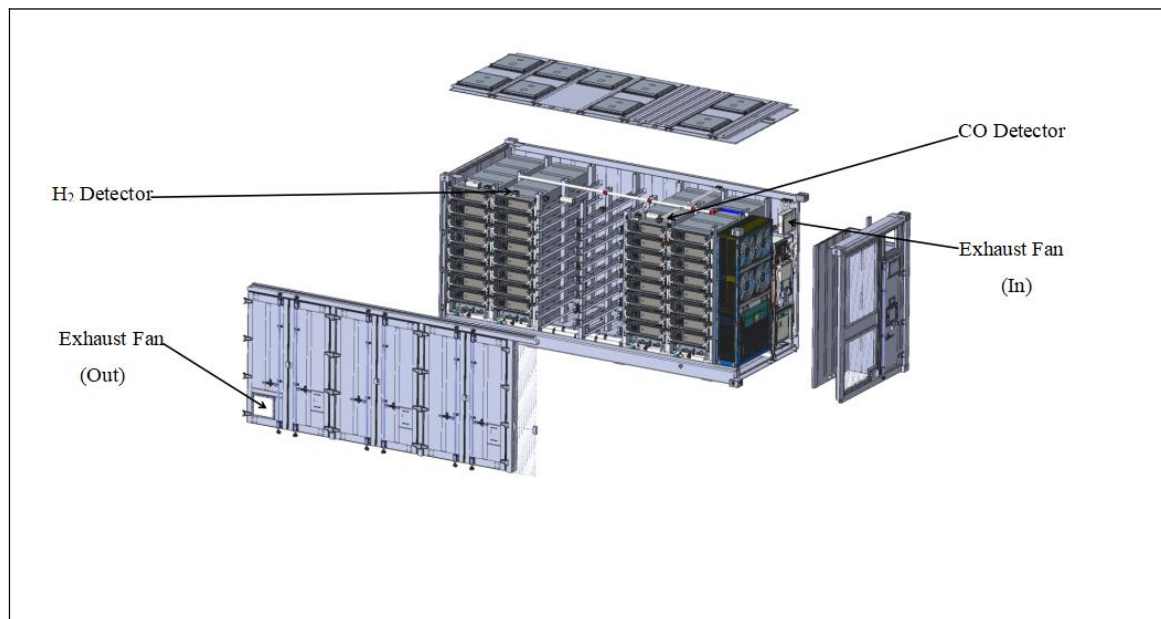
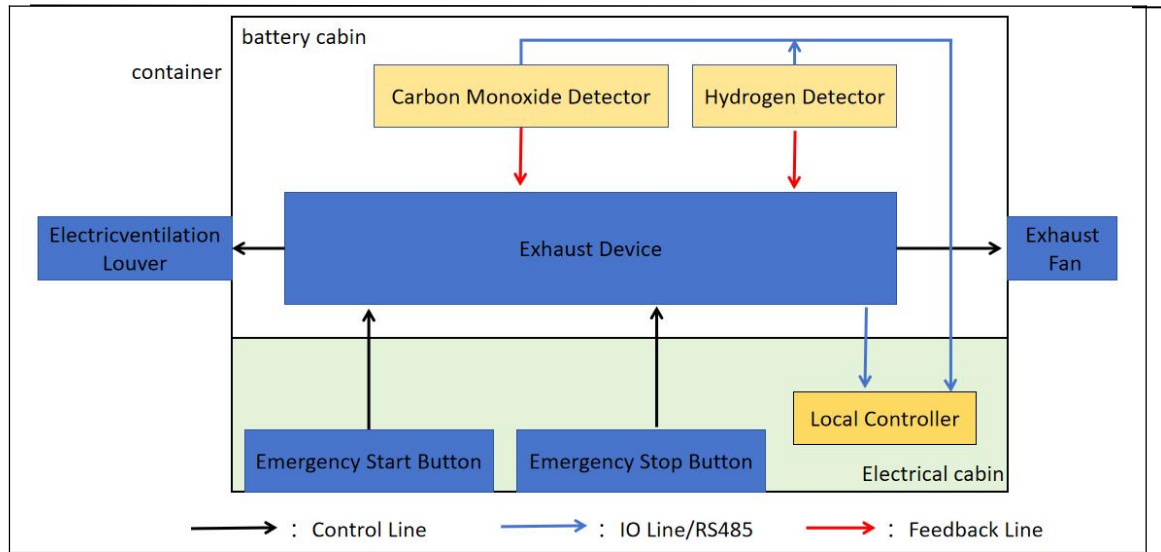


Figure 12: Aerosol Fire Logic Diagram (for reference only)

5.5.2. Explosion Protection System

The Explosion Protection system is a crucial part of the safety design for energy storage systems. When the energy storage system is in thermal propagation with flammable gases, the local controller can quickly detect the concentration of flammable gases and activate the deflagration system based on the gas concentration value for the purpose of ventilation to reduce the concentration of flammable gases. The Max-20HC-3344 energy storage system complies with the design philosophy of NFPA69. Through reasonable design, it can effectively prevent and control explosion risks. Using H₂ and CO sensors, the controller collects the concentration of flammable gases inside the container. When the concentration reaches the lower limit, the ventilation system will activate to reduce the concentration of flammable gases inside the container to prevent explosions.

The principle diagram, position diagram, and strategy diagram are shown below:



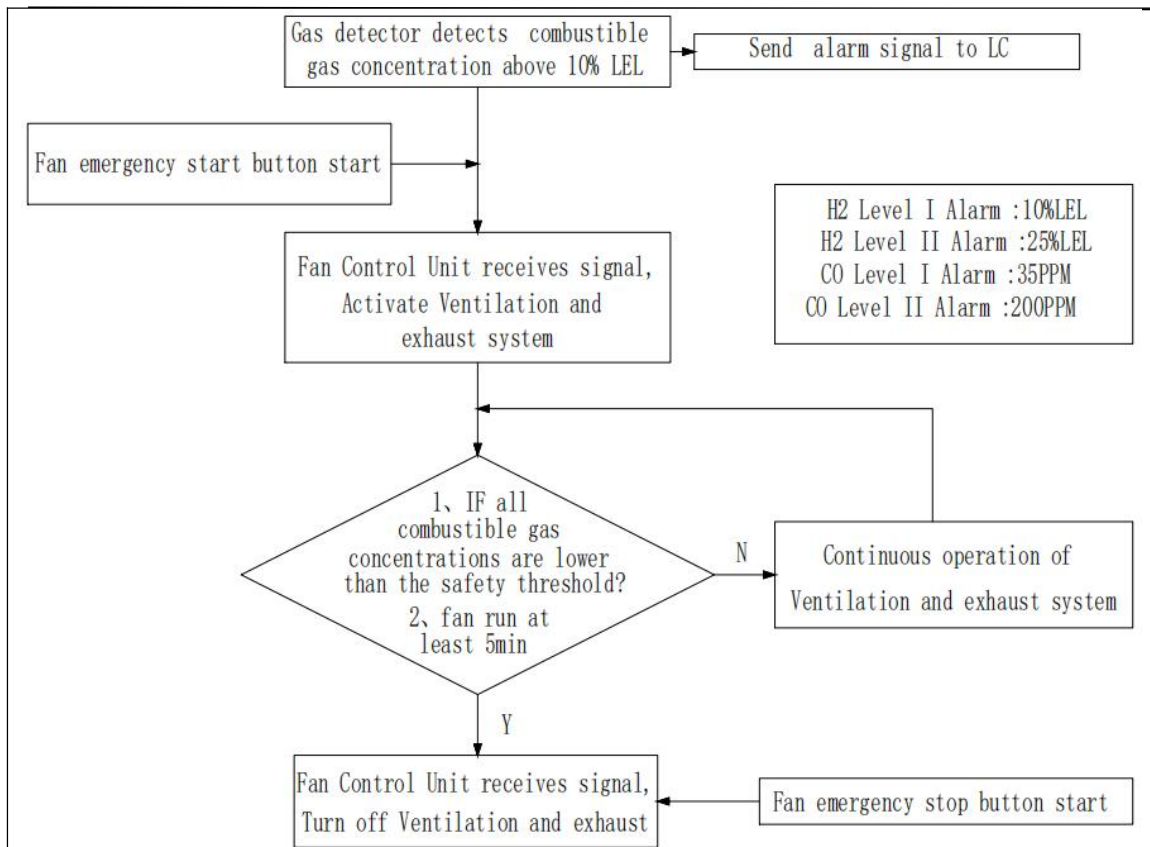


Figure 15: Explosion Suppression System Logic Diagram (For Reference Only)

5.5.3. The Deflagration System

The Deflagration system is also a critical part of the safety design for energy storage systems. It effectively manages potential explosion risks to minimize the impact of the accidents. The Max-20HC-3344 energy storage system complies with the design philosophy of NFPA68. It adopts a top deflagration design considering the complexity of application scenarios. The deflagration process quickly for complete releases of pressure to avoid explosion risks.

The above designs comply with both explosion protection (NFPA69) and deflagration (NFPA68), which allows specific project choices.

The layout diagram for the explosion venting panel is shown below:

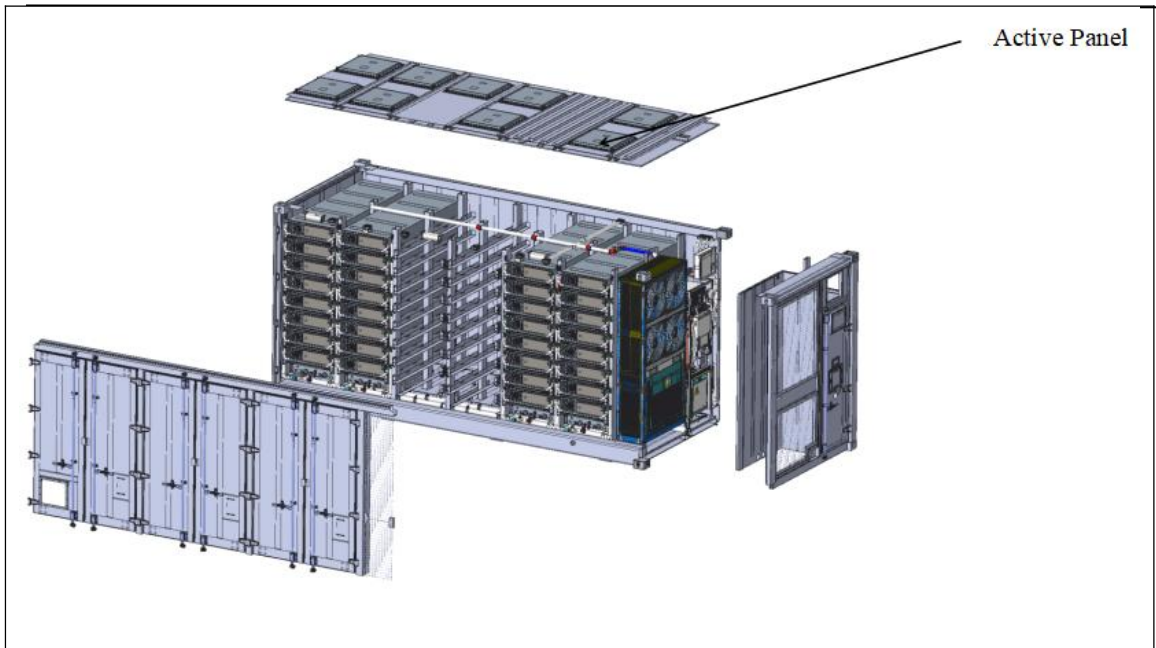


Figure 16: Explosion Venting System Layout Diagram

5.5.4. Sprinkler System

The water sprinkler system is a key safety measure and the last line of defense in FSS for the energy storage system. The Max-20HC-3344 energy storage system uses a sprinkler system with the following advantages:

- **Rapid Cooling:** In the event of battery thermal runaway, the sprinkler system can quickly spray water into the battery compartment to reduce temperature.
- **Fire Suppression:** The large amount of water provided by the sprinkler system can effectively suppress fire spread.
- **Structural Protection:** Cooling reduces the possibility of damage to the battery compartment and surrounding structures due to high temperature.

The sprinkler system's inlet uses a standard DN65 connector for easy pipe connection. The layout diagram of the sprinkler system inside the container is shown below:

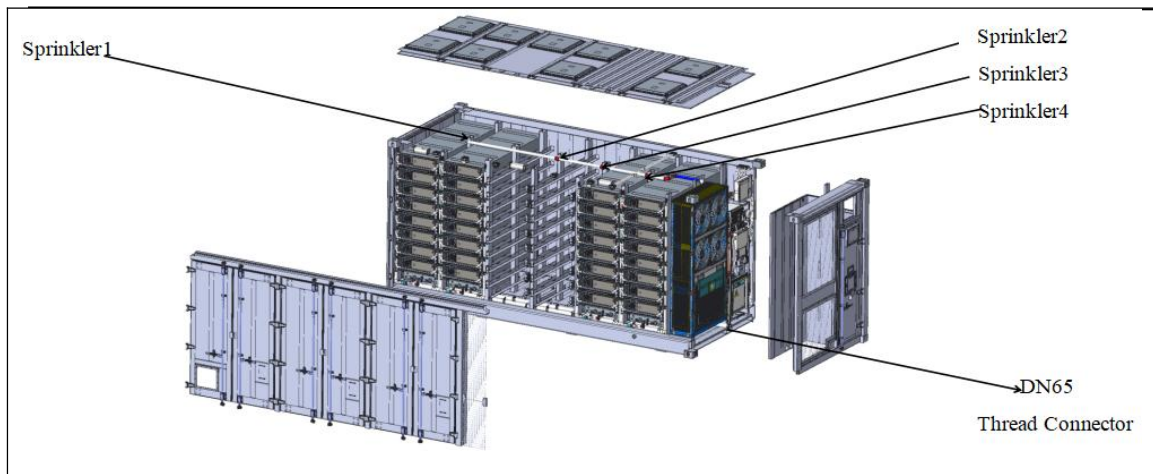


Figure 17: Sprinkler System Layout Diagram

5.6. Local Control System

The local controller in the Max-20HC-3344 energy storage system is one of the core components responsible for monitoring and managing various functions of the energy storage system. By collecting data from different devices and executing corresponding control logic based on these data, it ensures the efficient and safe operation of the energy storage system.

5.6.1. Data Collection

The local controller collects data from various devices such as the battery management system, thermal management system, dehumidification system, fire suppression system, and other auxiliary devices. It also collects the dry contact status of other auxiliary equipment.

5.6.2. Control Logic

Based on the status of each device, the local controller executes control logic, such as adjusting charging and discharging strategies, monitoring the thermal management system, and identifying the fire suppression system status to make corresponding strategies, ensuring the safe operation of the energy storage system.

5.6.3. Safety Monitoring

The local controller monitors Specifications such as battery temperature, voltage, and current to prevent overcharging and over-discharging. In abnormal situations, it triggers

safety mechanisms such as cutting off power supply and activating the fire protection system.

5.6.4. Fault Diagnosis

The local controller automatically identifies and reports fault conditions to help maintenance personnel quickly locate problems, providing fault troubleshooting orders and assisting maintenance work.

5.6.5. Communication Interface

The local controller communicates with the EMS to report real-time data and receive instructions, supporting the Modbus TCP protocol. The hardware supports RJ45 and optical fiber communication, convenient for customer selection.

5.6.6. Specification List

The local controller principle diagram refers to Figure 5. The local controller hardware Specifications are as follows:

Table 17: Local Controller Specifications

No.	Item	Specification	Remark
1	Model	AMAX-5580	
2	Input Voltage Range (V d.c)	24	±20%
3	Rated Power (W)	15	
4	Processor	Intel® Celeron™ 3955U 2.0GHz	
5	Memory (GB)	4	
6	Storage (GB)	1000	
7	Serial Port	RS232/485	2channels
8	Network Port	RJ45	2channels
9	Dimensions W*H*D (mm)	139*100*80	
10	Operating Temperature (°C)	-10~60	
11	Storage Temperature (°C)	-40~85	
12	Relative Humidity (RH)	10~95%	

No.	Item	Specification	Remark
			

5.7.Surge Protection Design

5.7.1. AC Surge Protection Design

Surge Protective Device (SPD) can effectively absorb transient overvoltage and overcurrent in the power system. As an important measure for internal surge protection design, SPD is functioning to discharge surge current step by step to achieve the purpose of equipment protection.

The SPD installed on the AC side in the DC container is of Class 2 protection for surge impulse current 8/20us. And a Class 1 SPD for surge impulse current 10/350us needs to be configured outside in front of the AC side of the DC container.

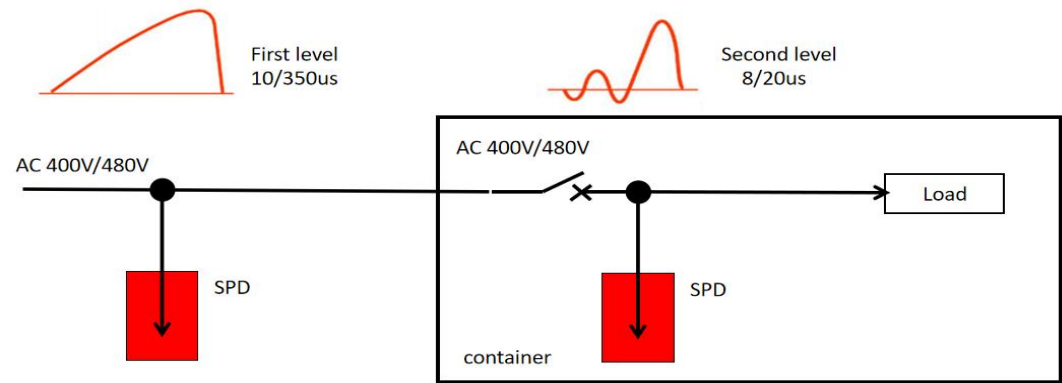


Figure 18: AC SPD

5.7.2. DC Surge Protection Design

The SPD installed on the DC side of the DC container is a Class 2 surge protection device for lightning impulse current 8/20us equipped with fuses. And a Class 1 SPD for surge impulse current 10/350us needs to be configured outside in front of the DC

side of the DC container.

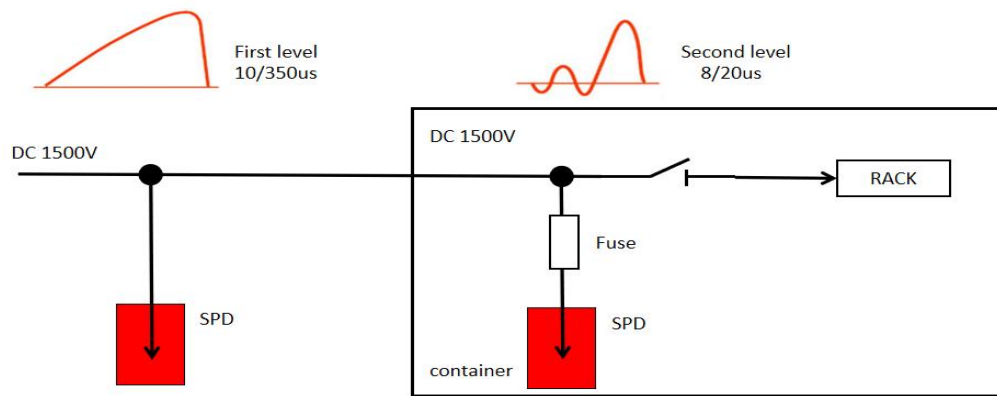


Figure 19: DC SPD

6. Application Scenarios

6.1. PCS Matching

The Max-20HC-3344 energy storage system mainly consists of 2 battery stacks. According to the matching of fuses, there can be two ways of PCS connections under the 0.5P system, two ways of PCS connections under the 0.25P system, and one way of PCS connection under the 0.125P system.

6.1.1. DC 0.5P System

When choosing a mode with 1 PCS SKID of 1.672MW, containing 2 pcs of PCS of 0.836MW, the following connection method can be adopted, with each PCS corresponding to one battery stack.

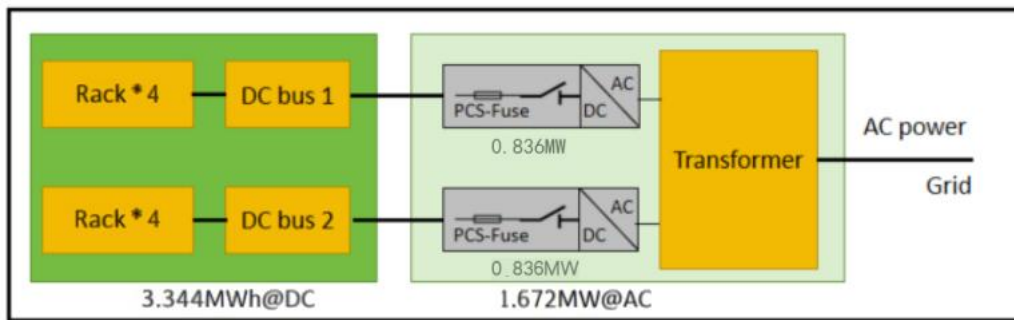


Figure 20: 0.5P System 2 PCS Connection

When choosing a mode with 1 PCS SKID of 1.672MW, containing 1 PCS of 1.672MW, the following connection method can be adopted, with the DC busbar converging at the PCS.

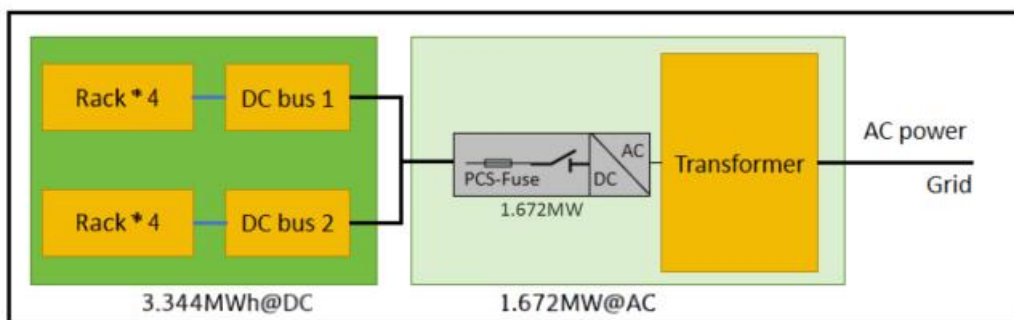


Figure 21: 0.5P System 1 PCS Connection

6.1.2. DC 0.25P System

When choosing a mode with 1 PCS SKID of 1.672MW, containing 2 PCS of 0.836MW, the following connection method can be adopted, with each PCS corresponding to one energy storage system, and the DC busbar of 2 battery stacks of each energy storage system converging at the PCS.

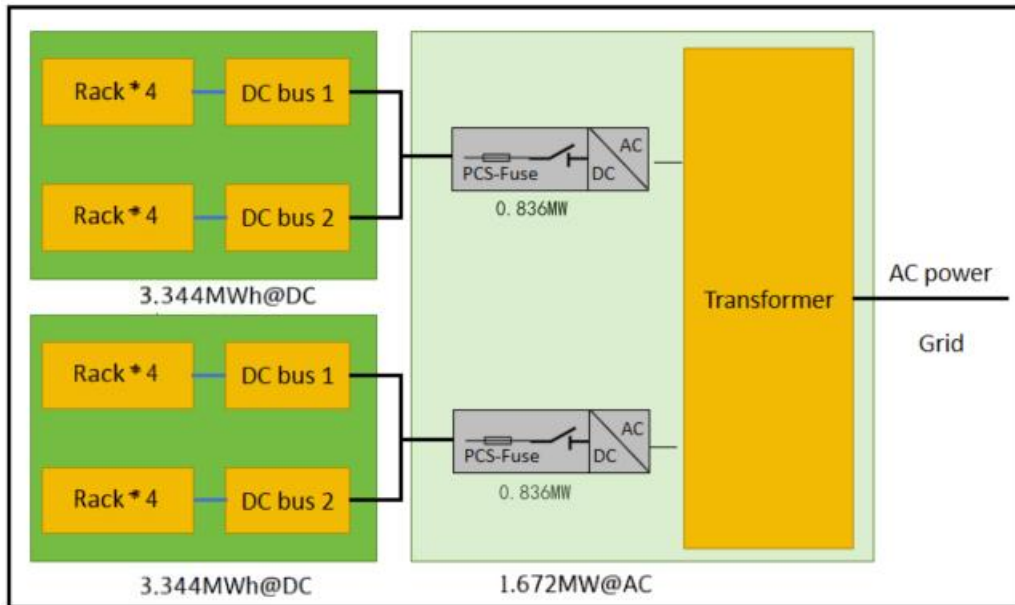


Figure 22: 0.25P 2 PCS Connection

When choosing a mode with 1 PCS SKID of 1.672MW, containing 1 PCS of 1.672MW, the following connection method can be adopted, with 1 PCS corresponding to 2 energy storage systems, and the DC busbar of 2 battery stacks of each energy storage system converging at the PCS.

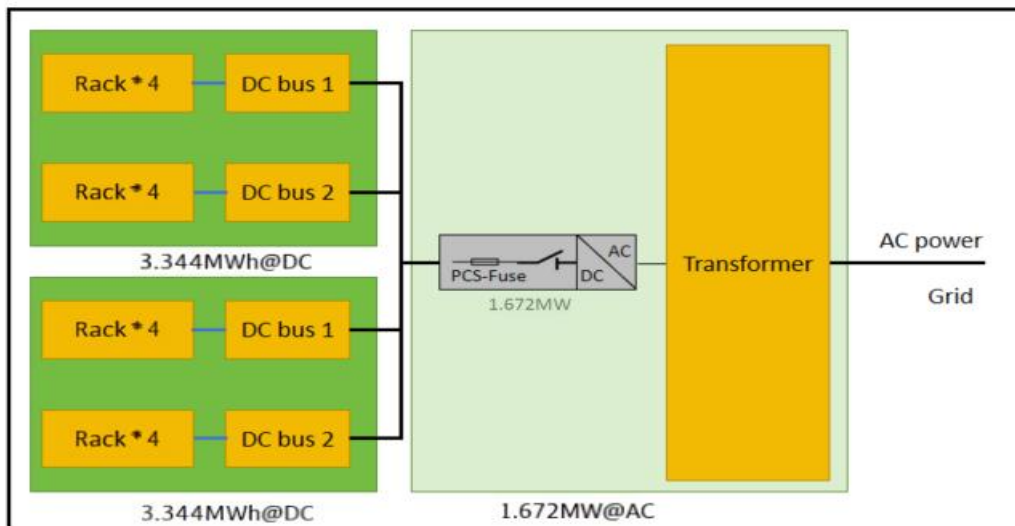


Figure 23: 0.25P 1 PCS Connection

6.1.3. DC 0.125P System

When choosing a mode with 1 PCS SKID of 1.672MW, containing 1 PCS of 1.672MW, the following connection method can be adopted, with 1 PCS corresponding to 2 energy storage systems, and the DC busbar of 2 battery stacks of each energy storage system converging at the PCS.

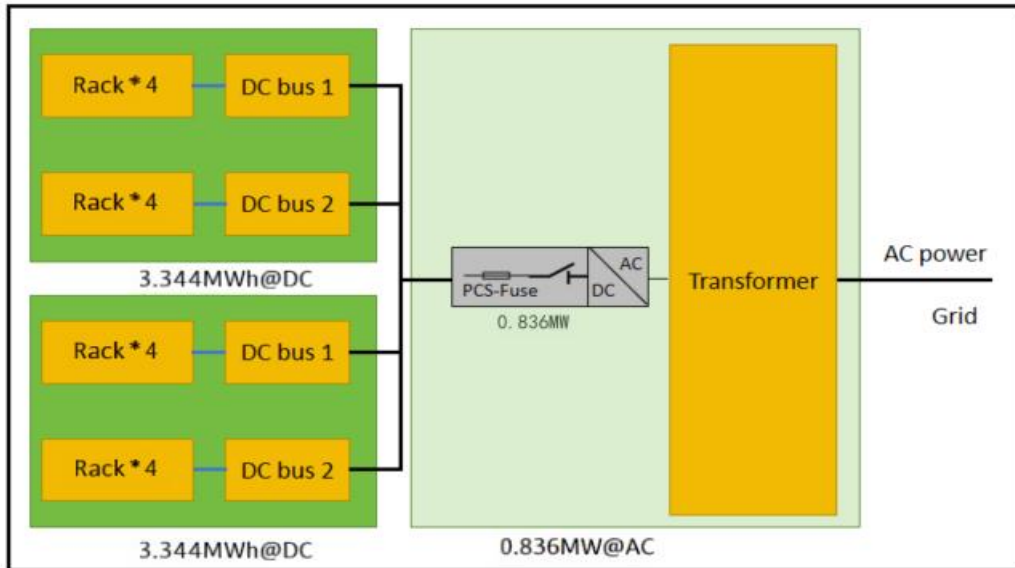


Figure 24: 0.125P System Connection

6.1.4. Precautions

- 1) Correctly connect the DC cables to the positive or negative side of the PCS.
- 2) Ensure that the PCS DC side includes a pre-charge circuit.
- 3) Ensure that the PCS DC side includes the main circuit switch.
- 4) Ensure that the PCS DC side has a DC SPD.
- 5) Ensure that the PCS AC side has an AC SPD.
- 6) Ensure that the fuses used on the PCS DC side have a disconnection time shorter than that of the energy storage system fuses during a short circuit.
- 7) The PCS DC side should have an insulation detection device. Before the DC relay of the energy storage system closes, the BMS will monitor the insulation condition of the DC end of the energy storage system. After the DC contactor closes, the BMS will turn off the insulation detection function. At this time, the PCS should monitor the insulation on the DC bus.
- 8) When the energy storage system is in a low SOC state and the grid cannot charge in time, at a short-term storage situation, it must be ensured that the PCS is disconnected from the energy storage system to prevent over-discharge of the

energy storage system.

- 9) The energy storage container and the PCS SKID should be grounded nearby, connecting the ground wire simultaneously to the ground network.

6.2. Fuse Matching

The Max-20HC-3344 energy storage system is equipped with fuses in the high-voltage box and inside the PACK. The principle is shown below:

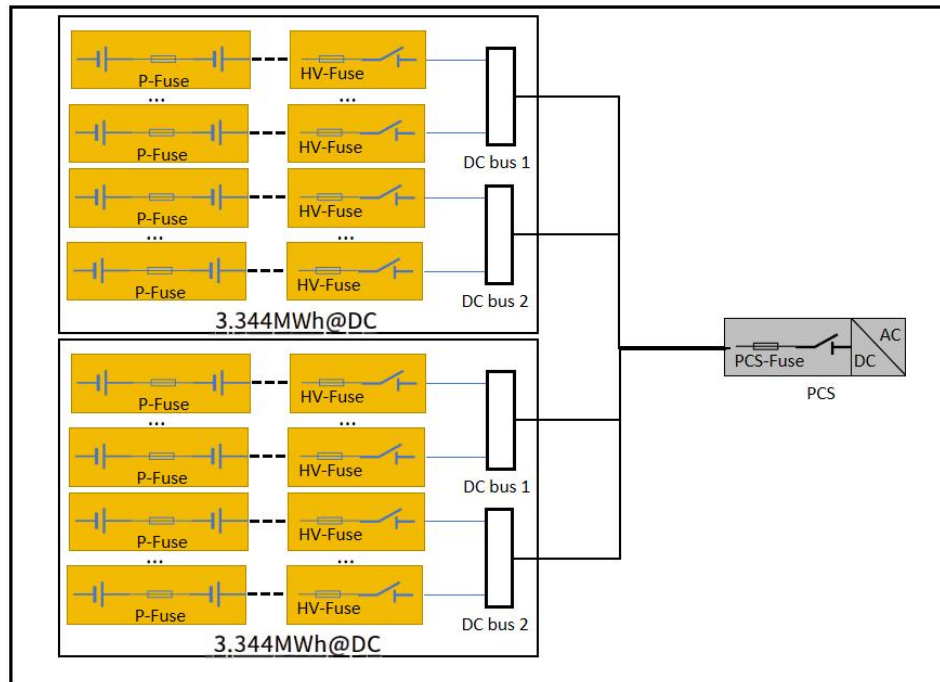


Figure 25: Fuse Matching

- P-Fuse: The fuse inside the PACK MSD, used to protect PACK-level short circuit faults.
- HV-Fuse: The fuse inside the high-voltage box of the cluster, used to protect cluster-level short circuit faults.
- PCS-Fuse: The fuse on the DC input side of the PCS, used to protect short circuit faults on the PCS DC bus.

According to the principle of three-level protection for fuses, the break time requirements between them are: PCS-Fuse < HV-Fuse < P-Fuse.

The fuses used in the HV-Fuse have a voltage of 1500VDC with a maximum breaking capacity of 250KA.

For a single container, the theoretical calculation value of the short circuit current for DC bus 1 or 2 is >56KA. The theoretical calculation value of the short circuit current for a single container is >112KA.

Therefore, the DC side should not have more than two containers connected in parallel.

6.3. Communication Matching

The communication method between containers of the Max-20HC-3344 energy storage system can transmit data through a switch, adopting hand-in-hand communication with network cables externally. It can also transmit information to the EMS via network cables or optical fibers through the switch. The communication configuration is as follows:

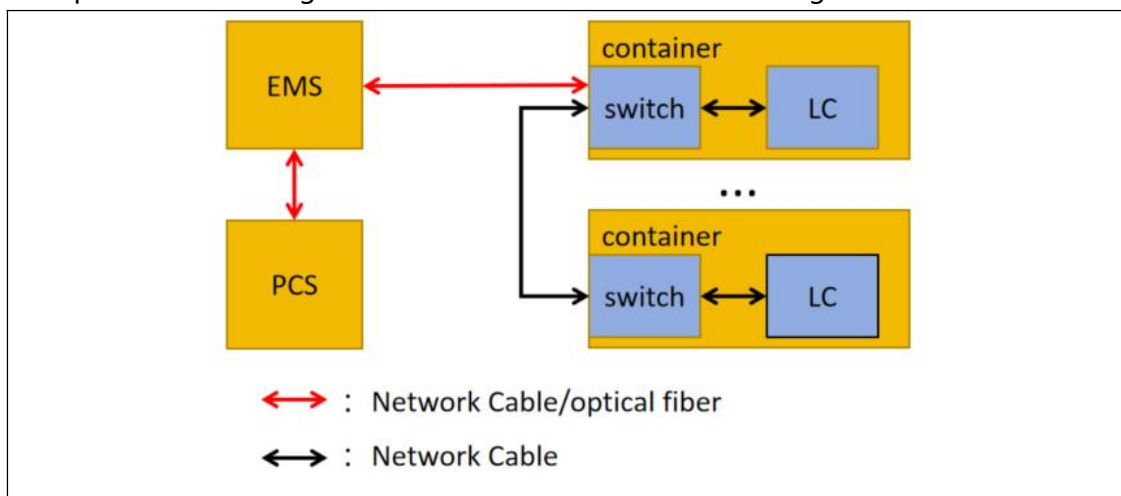


Figure 26: Communication Structure

The EMS should respond within 1 second after receiving a request from the LC.

The EMS should respond within 1 second after receiving a request from the LC to reduce current and control the PCS. The power limit should not exceed the request value sent by the LC.

The EMS should respond within 1 second after receiving a request from the LC for zero current and control the PCS. The PCS should reduce power to zero within 1-2 seconds. If the distance between the container and the EMS is quite far, optical fiber communication can be considered.

6.4. Mechanical Layout

The front view, top view, and side view of the Max-20HC-3344 energy storage system are shown below. For detailed installation information, please refer to the user manual.

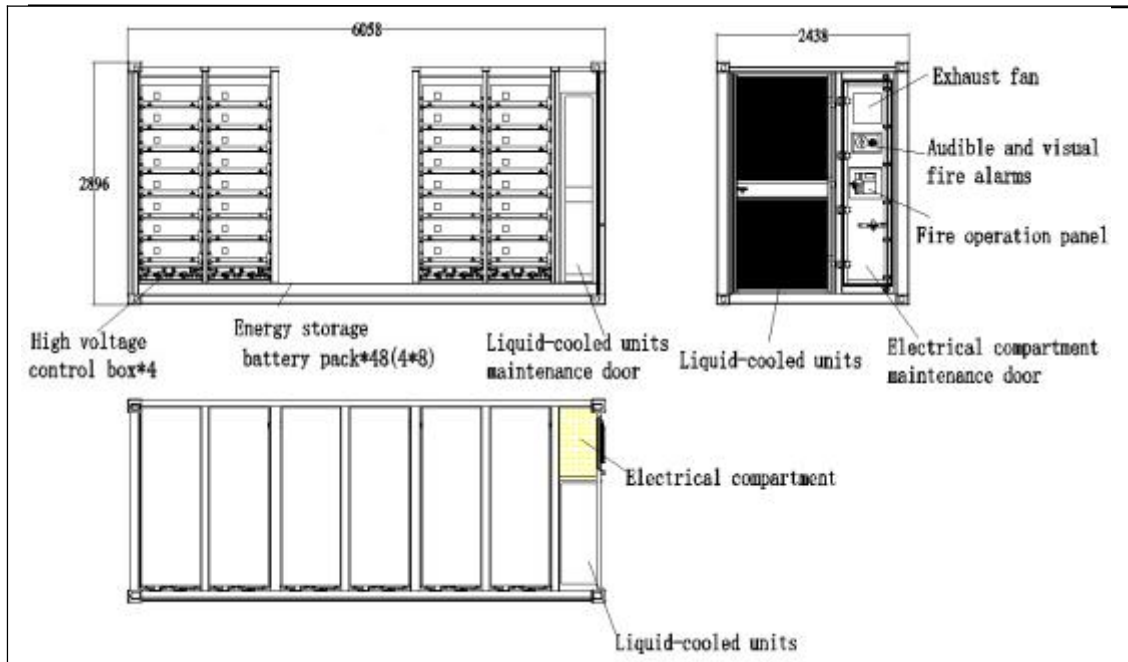


Figure 27: Container Three-View Diagram

6.4.1. Distributed Layout

Containers can be distributed as shown below. There are two sides without container doors, allowing distance reduction according to the UL9540A standard. When two containers are connected to the same PCS, the cable length from the PCS to the container should be controlled to prevent excessive differences in cable length from causing inconsistency in the bus voltage at the container.

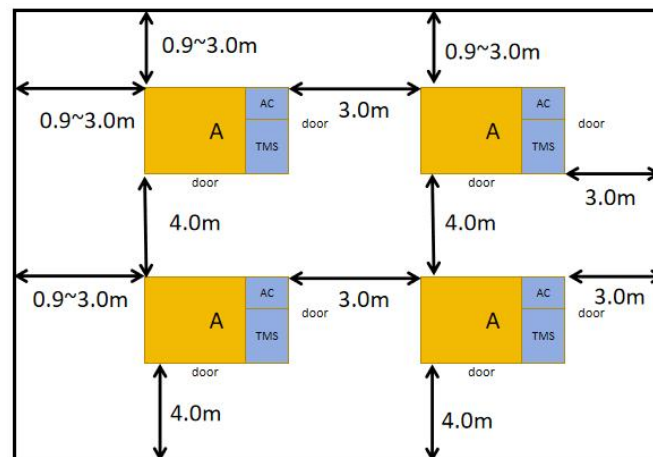


Figure 28: Distributed Layout of Containers (For Reference Only)

6.4.2. Centralized Layout

Containers can also be centrally arranged as shown below. Two sides without container doors allow for effective distance reduction, improving site utilization. This layout includes two designs: container A and container B, which are in mirror states. The positions of the electrical Compartment and the liquid cooling chiller unit are swapped, but the functions remain unchanged. When two containers are connected to the same PCS, the cable length from the PCS to the container should be controlled to prevent excessive differences in cable length from causing inconsistency in the bus voltage at the container.

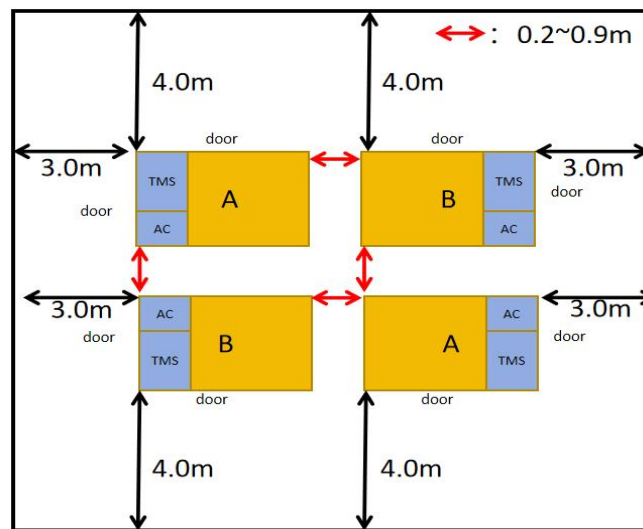


Figure 29: Centralized Layout of Containers (For Reference Only)

7. Storage and application requirements

7.1.Transport storage requirements

- 1)The product should be carefully and gently placed during transport to avoid collision and knocking, and it is strictly prohibited to put it together with corrosive items such as acid and alkali.
- 2)The products are not allowed to be tilted, collapsed and other bad during normal consignment or placement.
- 3)After the client receives the arriving products, the storage inspection should be completed within 15 days, with specific reference to the inspection specification negotiated by both parties.
- 4) When storing the products, they should be placed in a warehouse with air circulation, relative humidity not greater than 95%, temperature within the range of -20~35°C, altitude <4000m, waterproof, anti-corrosive and dust-proof, and the SOC should be kept at 20%~50%.
- 5) If the battery products are stored for more than 6 months, it is recommended that customers carry out a charge/discharge maintenance to adjust the SOC to 20%~50% to reduce the capacity loss of the prefabricated cabin caused by storage.

7.2.Product application requirements

The customer should ensure that the following application conditions relating to the product are strictly observed.

- 1) The customer must use the products in pairs according to the product batch, and not mix different batches without obtaining consent.
- 2) The customer shall use the product in strict accordance with the contents of this

specification, and the customer shall ensure that the user of the product shall use the product in accordance with the contents of this specification, e.g.: the range of operating ambient temperature: -30 ~ 55°C. If the product does not meet the parameters of the product, the quality of the product shall not be affected.

Otherwise, Greatpower will not be responsible for any product parameter discrepancies, quality problems, failures and any losses.

3)Prohibit the product from overcharging/overdischarging, otherwise it may cause overheating of the cells in the battery cluster and fire accidents.

4)The product should be protected from mechanical vibration, collision and pressure shock during use, otherwise the product may be short-circuited internally, generating high temperature and fire. The products are potentially dangerous and must be operated and maintained with appropriate protective measures, otherwise Greatpower shall be exempted from liability.

5)In order to avoid affecting the performance of the product, the customer may not modify the design and framework of the battery management system without authorisation, otherwise the direct causality quality problems or quality accidents shall be exempted from the responsibility of Greatpower.

6) The customer should keep complete monitoring data of the system or battery cell operation in the product, which can be used as a reference for product quality responsibility, otherwise Greatpower will not bear the responsibility of product quality guarantee.

7) When the capacity of the product in use is less than or equal to 65% of the nominal capacity, the customer should stop using the product, otherwise Greatpower will not be responsible for any parameter inconsistency, quality problems, core failure and any loss.

8. Other Agreements

- 1) The customer is obliged to keep the content of this specification confidential, and the customer shall not disclose it to any third party without authorisation, as specified in the confidentiality agreement signed by both parties.
- 2) Acceptance, warranty, after-sales service and technical service shall be subject to the agreement of the business contract between the two parties.

9.The End

The content and technical specifications described in this document are the result of substantial research, design, and validation by Great. Any updates or revisions to the document will be communicated as necessary to ensure the information remains accurate and current. The Max-20HC-3344 energy storage system has been designed with a focus on safety, efficiency, and reliability, adhering to the highest industry standards.

For further details or inquiries regarding the product, please contact our technical support team or visit our website.



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