EnerS 565Ah Container Product Specification

地址：福建省宁德市蕉城区漳湾镇新港路 2 号 ADD: No.2 Xin'gang Road, Zhangwan Town, Jiaocheng District, Ningde City, Fujian, PRC 352100
http://www.CATL.com

Version	Date	Changes
1.0	2024/5/14	First Release
1.1	2024/08/22	补充田子格排布；补充 UPS 自取电说明，更新备电时长
1.2	2024/09/03	① 修改 Table 2 Electrical specifications of EnerS 辅源功耗值 ② 更新 Figure 5 Type and Location of Detectors 图片

Contents

Tables

Figures

1 General Introduction

1.1 Confidentiality

This product specification is intended to be seen only by persons directly involved in this project. Transfer to other parties, especially to partners without the approval of CATL, has to be coordinated by the person in charge of this project in CATL and is governed by declarations relating confidentiality in the development contract.

1.2 Purpose of Document

This document is a product specification formulated by Contemporary Amperex Technology Company Limited (CATL) for Battery Energy Storage System developed by CATL. It describes and stipulates the performance index, basic functions, interface and communication, key parameters, safety characteristics, this product, as well as matters needing attention of users and relevant legal statements.

The specifications and parameters of the products are provided in this document. If the contract parties find any inadequacies, they shall inform us so as to develop better products.

CATL possesses the right to update and clarify this document.

1.3 Definitions and Abbreviations

1.3.1 Definitions

BESS: Battery Energy Storage System, using electrochemical cells to storage electrical energy.

Frequency Modulation: The grid should work under stable frequency while other uncontrol events will disturb the frequency. So, the active power shall be supplied to modulate the frequency of grid. The BESS shall provide the active power for the grid.

Voltage Modulation: The grid should work under stable voltage while other uncontrol events, especially the inductive load and capacitive load will disturb the voltage. So, the reactive power shall be supplied to modulate the voltage of grid. The BESS shall provide the reactive power for the grid.

Peak shaving and Valley filling: When the power plants generate more energy than the demand, the containers shall absorb the excess energy which called peak shaving. When the power plants generate less energy than the demand, the containers shall release the lack of energy which called Valley filling.

PV: Photovoltaic power generation.

Wind power: Power get from the rotation blade driven by wind.

Modbus TCP: The Modbus protocol including three kinds of messages: ASCII, RTU, TCP. Modbus TCP is a kind of communication protocol which is widely used in the industrial field.

Container: The container for the battery energy storage system.

Module: A mechanically integrated arrangement of cells connected in series and/or parallel, complete with packaging, thermal management, output DC connections, and associated cell sensing.

Cell: The smallest non-divisible component of the EnerS System, assembled into a battery module in series and parallel arrays.

RTE: Round-trip Efficiency, defined as discharging of the system from 100% SOC to 0% SOC immediately followed by charging the system from 0% SOC to 100% SOC. The Round-trip DC-DC energy efficiency shall be measured at the DC terminals of the container.

1.3.2 Abbreviations

BMS: Battery Management System.

TMS: Thermal Management System.

CAN: Controller Area Communication.

FSS: Fire Suppression System.

PCS: Power Conversion System.

BOL: Beginning of Life.

EOL: End of Life.

SOC: State of Charge.

SOH: State of Health.

CSC: Cell Supervision Circuit， the base unit of battery management.

SBMU: Slave Battery Management Unit, collects and analyses the data from CSC, and uploads to the MBMU.

MBMU: Main Battery Management Unit. The core control unit of the container.

EMS: Energy Management System. Monitoring and manage the charge and discharge of the BESS.

Sub Control Box: Including the SBMU fuse isolation switch and other components.

Master Control Box: Including the IMM, MBMU ETH fiber conversion module.

Distribution Box: Including auxiliary power systemand other components.

2 System Description

2.1 Application

The EnerS container is a modular fully integrated product , consisting of rechargeable lithium-ion batteries, with the characteristics of high energy density, long service life, high efficiency. It can provide stable energy release for over 2h when the batteries are fully charged. The EnerS Energy Storage product is capable of various on-grid applications, such as frequency regulation, voltage support, arbitrage, peak shaving and valley filling, and demand response.In addition, EnerS container can also be used in black start, backup energy, congestion managemet, microgrid or other off-grid scenierios.

2.2 Overview

The overview of the container is shown in Figure 1. The detailed information can be found in the following chapters.

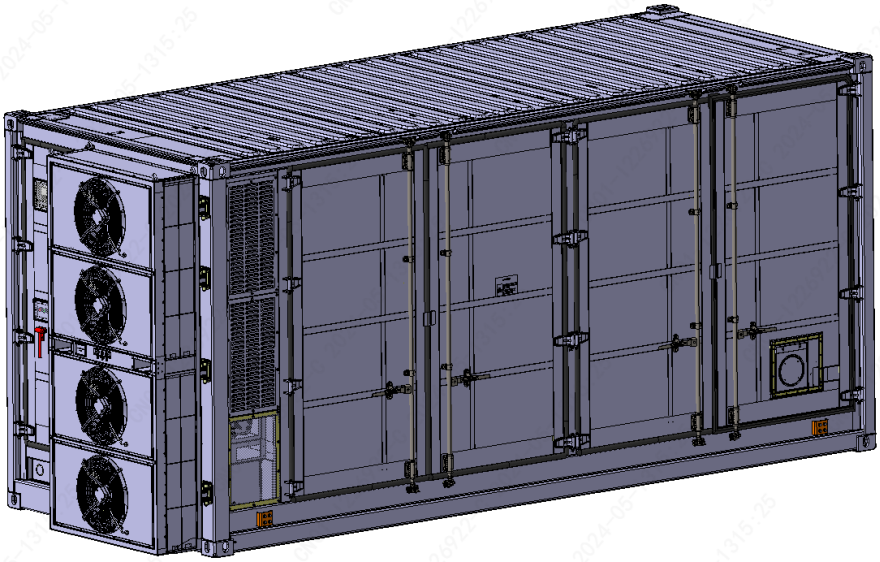


Figure 1 EnerS Liquid Cooling Energy Storage Container – Sideview

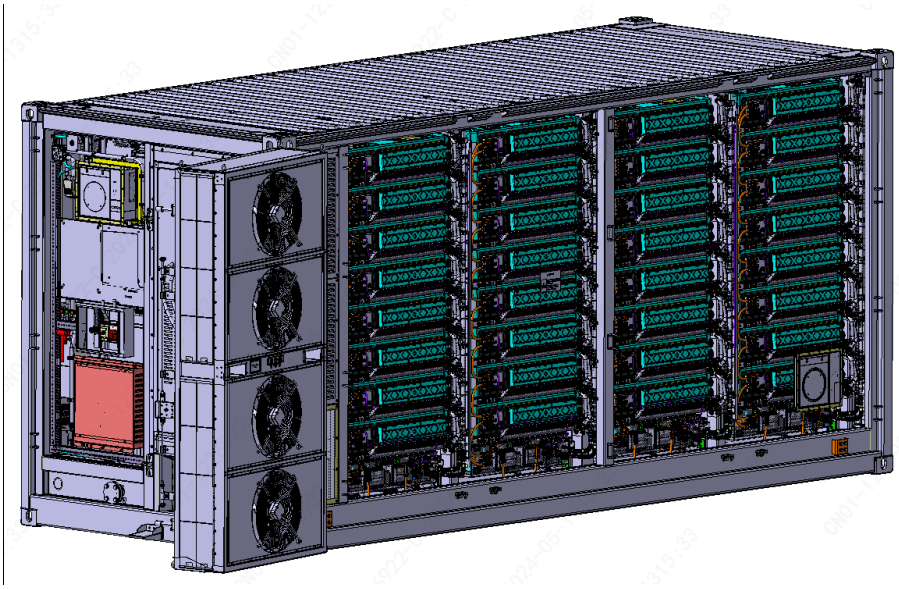


Figure 2 EnerS Liquid Cooling Energy Storage Container – Sideview Without Door

The EnerS container consists of following parts: batteries, BMS, FSS and TMS, which are integrated together to keep the normal working of the container.

2.2.1 Battery

The capacity of cell is 565Ah, 1P104S cells integrated in one module, 4 modules integrated into one rack, 8 racks integrated into one container. As the core of the energy storage system, the battery releases and stores energy.

2.2.2 BMS

BMS adopts the distributed scheme, through the three-level (CSC--SBMU--MBMU) architecture to control the BESS, to ensure the stable operation of the energy storage system. It can manage energy absorption and release, the thermal management system and low voltage power supply according to the detected information: battery voltage, current and temperature. It can monitor high voltage DC/AC security, diagnosis and analysis faults according information from various detectors and dry-contacts. And it can keep communication with PCS and EMS through CAN. The BMS is the most important control unit of EnerS container. The BMS possesses the UPS to keep normal function when facing the temporary out of power.

2.2.3 FSS

FSS consists of smoke detectors, heat detectors, H_2 and CO detectors, the fire control panel, aerosol, the dry pipe, the smoke exhaust ventilation system and the UPS. FSS undertakes functions : monitor the thermal run-away risks of container through the detectors, extinguish the thermal run away, especially the flame

fire, control the loss to minimum. The control panel will control and record information for the fire suppression system. The FSS is independent with any other system and it is the security guard of EnerS container.

2.2.4 TMS

TMS consists of one powerful chiller, the PTC heater and the liquid cooling pipe distributed in each battery module. The TMS will control and keep the temperature of battery within reasonable range. The battery will work at best state and reach longest life under the thermal management system.

2.3 Advantages

Our EnerS container possesses the advantages below:

1) **Standard design for the transportation.** After removing the external cooling fan, the container size meets 20 feet which is very convenient for the transportation.

2) **New generation Cell.** EnerS container integrates the LFP 565Ah cells from CATL, with more capacity, slow degradation（no degradation in the first year or the first three years）, longer service life and higher efficiency.

3) **High integrated.** The cell to pack and modular design will increase significantly the energy density of the same area. The system is highly integrated, and the area energy density is over 387 kWh/m^2.

4) **Extreme safety.** The system supports three aspects of safety:

   Firstly, the cell safety, the highly stable lithium iron phosphate is used in the EnerS container. LFP is a kind of safety material especially for the BESS.

   Secondly, the electrical safety: a) E-Stop design; b) multiple fuse protection design; c) insulation monitor voltage monitor; d) multi-channel isolation design; e) lightning protection design.

   Thirdly, the fire protection design, CATL has four-level fire control strategy. The first-level is the alarm. The second-level is ventilation and smoke exhausting to prevent deflagration. The third-level is aerosol to extinguish initial fire, and the fourth-level is the dry pipe sprinkle fire protection to prevent fire spread.

5) **High performance liquid cooling unit.** Chiller has the advantages of lower auxiliary power consumption(3.8%), lower noise(75dBA) and longer lifetime(20Y).

6) **Independent UPS.** EnerS container have integrated two UPS system, one is for FSS monitoring system which available capacity is 24 hours, Another UPS takes power from the battery rack and can provide standby power about 8 hours.

3 System Specifications

In this chapter, the systems specifications will be introduced in detail. For the BESS, the system specifications included the power and energy, electrical specifications, the environmental specifications, the mechanical specifications and certification standards. The product model is C07565P05L01.

3.1 Power and Energy

Table 1 Power and Energy of EnerS

DC Side Data		
Product Model	**C07565P05L01**	**Remark**
P-Rate	0.5P	
Cell		
Cell type	LFP	
Cell capacity	565Ah	
Cell Voltage range	2.5-3.65V	should not be less than 2.5 V in any case
Cell rated Energy	1808Wh	
System		
Configuration	8P4S(1P104S)	
Rated Energy	6017kWh	
Rated Voltage	1331.2VDC	
Voltage Range	1040 ~ 1500VDC	
Rated Charging Current	1130A*2	
Maximum Charging Current	1147A*2	For 1 minutes
Rated Charging Power	1505kW*2	
Rated Discharging Current	1130A*2	
Maximum Discharging Current	1147A*2	For 1 minutes
Rated Discharging Power	1505kW*2	

3.2 Electrical Specifications

For the auxiliary power supply, the standard configuration is two auxiliary power circuit. Auxiliary 1 and auxiliary 2 is listed in Table 2. The UPS for the BMS components is include in the auxiliary power circuit. The optional configuration is 1 auxiliary power circuit and the detailed configurations can be consulted to CATL.

Table 2 Electrical specifications of EnerS

Auxiliary Power & Communication			
Product Model		**C07565P05L01**	**Remark**
P-Rate		0.5P	
Auxiliary Power 1	**Voltage Range**	3AC+N+PE 480V(380…480V) ±10%， 50/60HZ	
	Power	Max. 46kW	For reference
	Inrush Current	⩽70A， ＜1S	For reference
Auxiliary Power 2	**Voltage Range**	1AC230V(L+N) or 2AC480V(380…480V)	
	Power	Max. 0.5kW (Continuous)	For reference
	Inrush Current	5A	For reference
UPS	**backup duration**	UPS1： DC24V. 24h for FSS UPS2： DC24V. 8h for BMS (take electricity from the battery rack)	The UPS2 is only used to supply power to BMS components.
Communication Protocol		CAN, Modbus/TCP	

3.3 Mechanical Specifications

Table 3 Mechanical Data of EnerS

Mechanical Data		
Product Model	**C07565P05L01**	**Remark**
Transportation	Land or sea transportation	
Size	2896mm(H)*2438mm(D)*6058mm(W) （one cooling unit at the side of the container： 2750mm(H)*1260mm(D)*590mm(W)）	The spacing between the cooling fan of the unit and the container is 100mm
Weight	~50t	
Color	RAL 7042 （7035/6021/9003 Optional）	
IP Level	IP55 (Battery Room)	
	IP55 (Electrical Room)	
	IP67(Electric control box of Chiller)	

3.4 Environmental Specifications

Table 4 Environmental Specifications of EnerS

Environment condition		
Specifications	**Range**	**Remark**
Charge Temperature Range	-35℃…+55 ℃	It is necessary to inform CATL for professional evaluation if temperature beyond range
Discharge Temperature Range	-35℃…+55 ℃	

Storage Temperature Range	-35℃...+60℃	
Application Altitude	≤4000m （no derating）	
Relative Humidity	0 ~ 95 % (non-condensing)	
Degree of Anti-corrosion of Battery Unit	C5, (optional C4)	
Seismic Level	IEEE 693-2018 Moderate design level	

3.5 Certification Standard

Table 5 Certification Standard

Standards & Certificates		
Cell	UN38.3	UN Transportation Testing for Lithium Batteries
	UL1973	Batteries for Use in Light Electric Rail (LER) Applications and Stationary Applications
	IEC62619	Safety requirements for secondary lithium cells and batteries, for use in industrial applications
	UL9540A	Energy Storage Systems and Equipment
Container	UL1973	Batteries for Use in Light Electric Rail (LER) Applications and Stationary Applications
	NFPA855	Standard for the Installation of Stationary Energy Storage Systems
	UL9540A	Energy Storage Systems and Equipment
	IEC 62477	Safety requirements for power electronic converter systems and equipment –Part 1: General
	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 62933-5-2	Electrical energy storage (EES) systems – Part 5-2: Safety requirements for grid-integrated EES systems – Electrochemical-based systems

	IEC61000-6-2	Generic standards – Emission standard for industrial environments
	IEC61000-6-2/4	Electromagnetic compatibility (EMC) –Part 4-6: Testing and measurement techniques – Immunity to conducted disturbances, induced by radio-frequency fields

4 Battery Management System(BMS)

4.1 BMS Overview

BMS is used in energy storage system, which can monitor the battery voltage, current, temperature, managing energy absorption and release, thermal management, low voltage power supply, high voltage security monitoring, fault diagnosis and management, external communication with EMS and ensure the stable operation of the energy storage system.

4.2 BMS Architecture

BMS includes three-level constructure, composed of 1 unit of MBMU, 2 unit of IMM, 1 unit of ETH, 1 unit of optical fiber (optional), 8 units of SBMUs, 32 units of CSCs. This is the architecture that one PCS connected to one container (Figure 3).

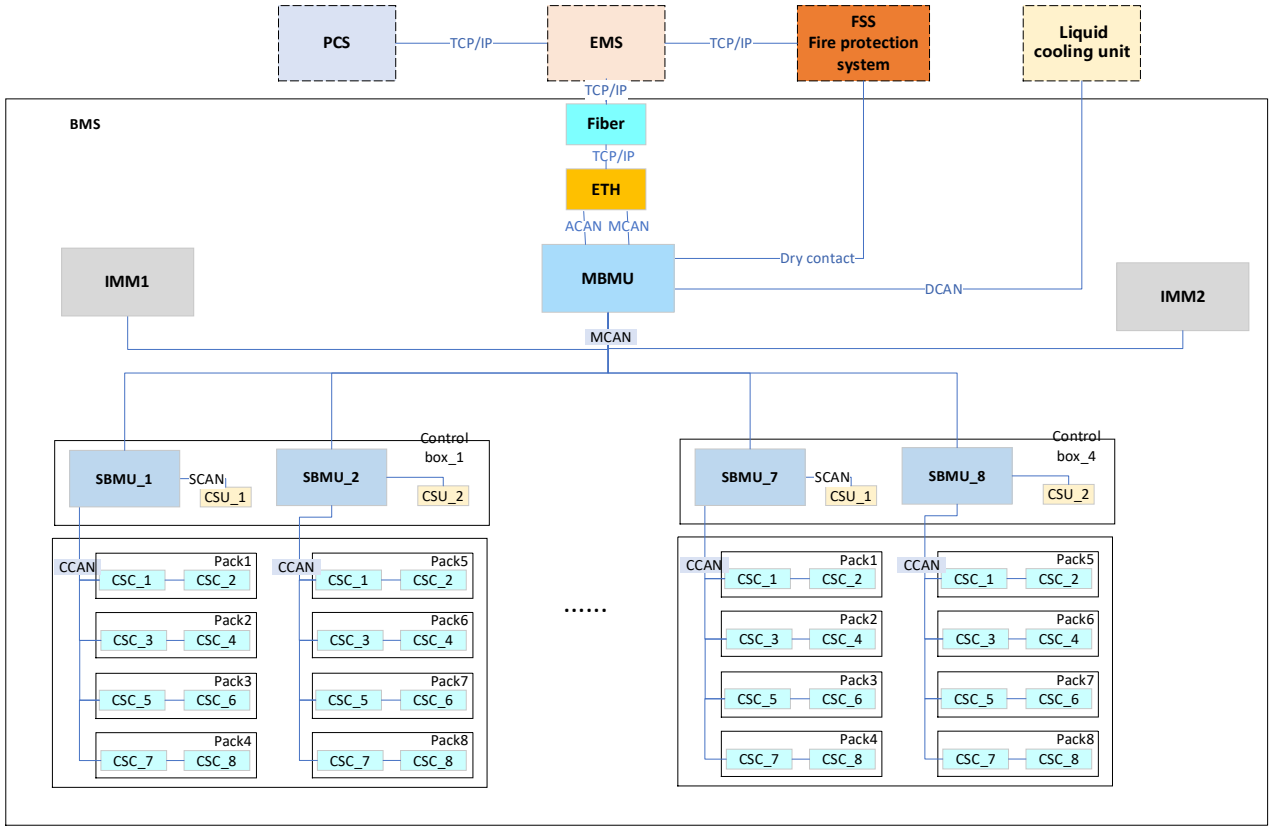


Figure 3 Three-Level BMS Architecture for One Container

4.3 BMS Function

The detailed information of BMS can be seen in Table 6. The parameters including: Cell voltage sampling,

Cell temperature sampling, Current sampling, HV sampling, Ambient temperature detection, Insulation detection and other important parameters.

Table 6 Detailed Performance Parameters of BMS

Item	Performance Parameters	Value	Note
Working voltage	Range	20V~26V	
Cell voltage sampling	Range	1V~4.85V	
	Accuracy	±5mV	0℃ ~ +60℃
		±10mV	-40℃ ~ 0℃or60℃ ~ 85℃
Cell temperature sampling	Range	-40℃ ~ +125℃	
	Accuracy	±2℃	-20℃ ~+60℃
		±3℃	-40℃~-20℃&+60℃~+85℃
Current sampling	Range	± 500A	
	Accuracy	<1%FSR	-40℃ ~ 85℃
HV sampling	Range	0V ~ 1500V	
	Accuracy	1%FSR	
Cell balance	Current	100mA@3.2V	Opened in all channels
SOC	Accuracy	⩽ ±5%	LFP, according to specific conditions
SOH	Accuracy	⩽ ±5%	After calibratio
Ambient temperature detection	Range	-40℃ ~ +85℃	
	Range	±3℃	
Insulation detection	Range	0 ~ 10MΩ	
	Accuracy	-30% ~ 0%	
	Detection Time	≤10s	Y capacitor<0.47μF (for single side)

4.3.1 Battery Status Monitoring

1) BMS monitors the battery's parameters, including cell voltage, module temperature, battery module current and total battery module voltage.

2) BMS detects the battery status such as State of Charge (SOC) accurate to within 5%, SOH and the accurate to within 5%.

3) BMS functions as a safety management system in such cases as under voltage, over discharge, over voltage, over temperature, and over current of the battery. In case of failure, the system will give an alarm to the supervisory equipment, limit the charge and discharge current or power, and control the

disconnection of all HV contactors. This can protect the battery while safeguarding the power systems security.

4) BMS shall provide battery information (including data recording and fault waveform recording) to EMS.

4.3.2 Charging/Discharging Management

1) BMS controls and monitors the high voltage main contactors, auxiliary relays and low voltage coils.
2) BMS has pre-charge control within the parallel connection among racks.
3) BMS works in the management of charge and discharge. It will calculate the charge and discharge power limit according to the existing status of the battery (temperature, SOC) and actual performance of electrical components and then report to EMS which has the function of controlling to these limits.
4) BMS has the function of balance management to extend the reliability of the battery system.

4.3.3 Thermal Management

1) BMS has the function of sample collecting of battery cell temperature and chiller operating status.
2) BMS controls the liquid cooling TMS system based on cell & coolant's temperature.

4.3.4 Program Refreshing

BMS can flash programs on site, which supports the flashing of MBMU, SBMU, IMM, CSC and ETH by using the host computer through MCAN. BMS has the function of remote software flash, which enables to update BMS from a remote client via Ethernet. Furthermore, the system supports the BMS program refreshing through EMS.

4.3.5 High Voltage Safety Monitoring

1) BMS has the function of system insulation detection.
2) BMS has the function of high voltage sampling (collecting data of the main positive voltage).
3) BMS supports the detection of the dry contact of Fuse and Combined Switch, as well as the auxiliary contact of the primary loop contactor.

4.3.6 Peripheral Monitoring and Control Management

1) BMS has the function of ambient temperature sampling and humidity sampling, which matches according to project requirements
2) BMS has multiple high-side drivers and can drive and control peripheral devices according to project requirements.
3) BMS has multiple dry contact interfaces and can monitor external signals according to project requirements.

4.3.7 Fault Diagnosis Management

1) BMS stores information such as operational parameters and historical alarms that can be viewed by ESS host computer.
2) BMS enables storage of latest historical alarms.

5 Fire Suppression System(FSS)

5.1 FSS Overview

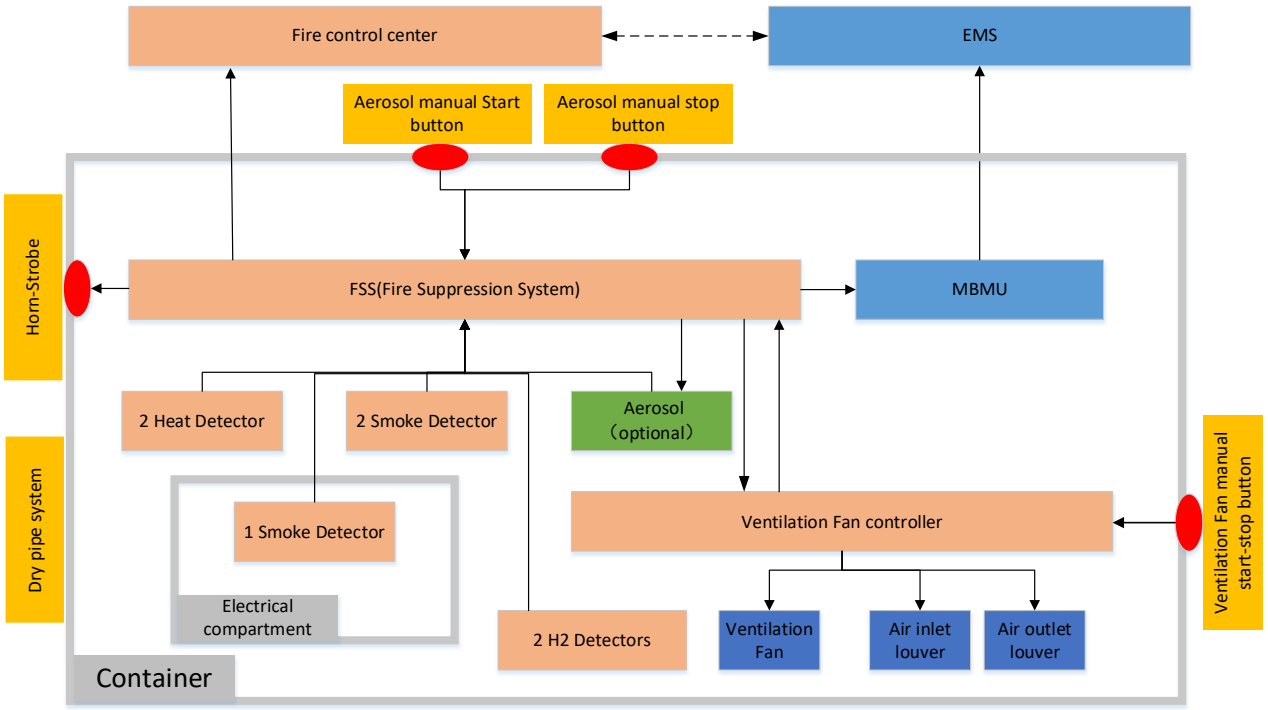
As an outdoor non-walk-in battery energy storage system, EnerS provides a perfect set of fire suppression system solutions with detection, explosion control and fire extinguishing functions. The fire extinguishing control strategy is divided into four levels:

- **First level, alarm warning;**
- **Second level, ventilation and smoke exhaust to prevent deflagration;**
- **Third level, aerosol is released to extinguish the initial fire;**
- **Fourth level, dry pipe spraying to control the spread of fire.**

5.2 FSS Function

The fire suppression system is divided into three parts: detection system, explosion-proof system and fire extinguishing system. The information of the interactive interface is shown in the following Figure .

Figure 4 The Interactive Interface of FSS



5.2.1 Detection System

The detection system has three types of detectors, number and installation positions of which are shown in Table 7 and Figure 5. All detection signals are received and processed by the fire control panel, and the hydrogen(H_2) detectors can be linked with the smoke exhaust ventilation system system.

Table 7 Detector Type and Position Description

No	type	quantity	Configuration	remarks
1	Heat detector	2	standard	Detection of temperature, in the battery room
2	Smoke detector	2+1	standard	Detection of smoke particles, two in the battery room, and one in the electrical room
3	H_2 detector	2	standard	Detection of H_2, in the battery room
4	Fire control panel	1	standard	Receive detector signals and control fire extinguishing system and explosion-proof system, in the electrical room
5	Aerosol	12	standard	When activated, aerosol power will be released rapidly to extinguish thermal runaway
6	Dry pipe system	1	standard	As the last line of defense, the dry pipe system can effectively control the spread of fire.

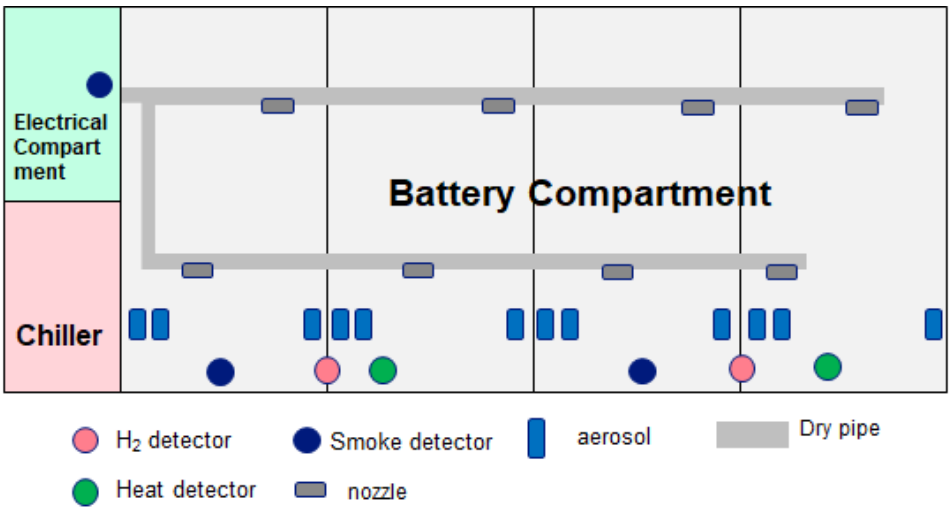


Figure 5 Type and Location of Detectors

5.2.2 Smoke exhaust ventilation System

Smoke exhaust ventilation system system meets NFPA855 (NFPA 69) standard, which is shown in Figure

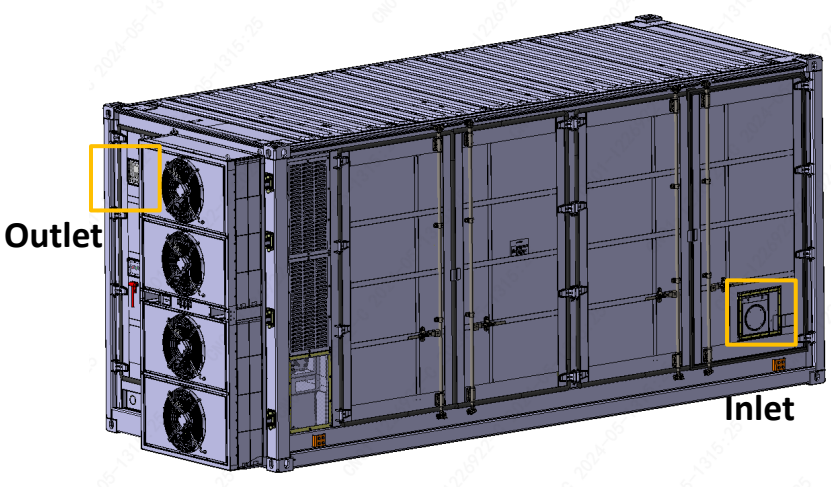


Figure 6 Smoke exhaust ventilation system

The air inlet electric louver receives the alarm signal sent by the H_2 detectors and opens the electric louver. The parameters of the Inlet are shown in Table 8. Table 8

Table 8 The Parameters of the Inlet

Item	Specification
Supply voltage	24V DC
Rated power	60W
Inrush power	85W
Position	On the battery compartment door/between the electrical compartment and battery compartment

The air outlet electric louver will turn on the smoke exhaust ventilation system and releases the combustible gas in the battery room after receiving the alarm signal from the hydrogen(H_2) detectors. The smoke exhaust ventilation fan will manually turn off when the concentration of combustible gas falls within the reasonable threshold. The parameters of the exhaust port are shown in Table 9.

Table 9 The Parameters of the Exhaust Port

Item	Specification
Supply voltage	230V AC
Rated power	215W
Position	On the electrical compartment door

Maximum air volume	1200CFM

5.2.3 Fire Extinguishing System

5.2.3.1 Aerosol

When an initial fire occurs in the battery room, a fire alarm signal will occur, and the fire extinguishing system will automatically control the release of aerosol, which can also be triggered manually. The fixed position of aerosol is shown in Figure .

5.2.3.2 Dry pipe

As the last line of defense, the dry pipe system can effectively control the spread of fire, which is shown in Figure .

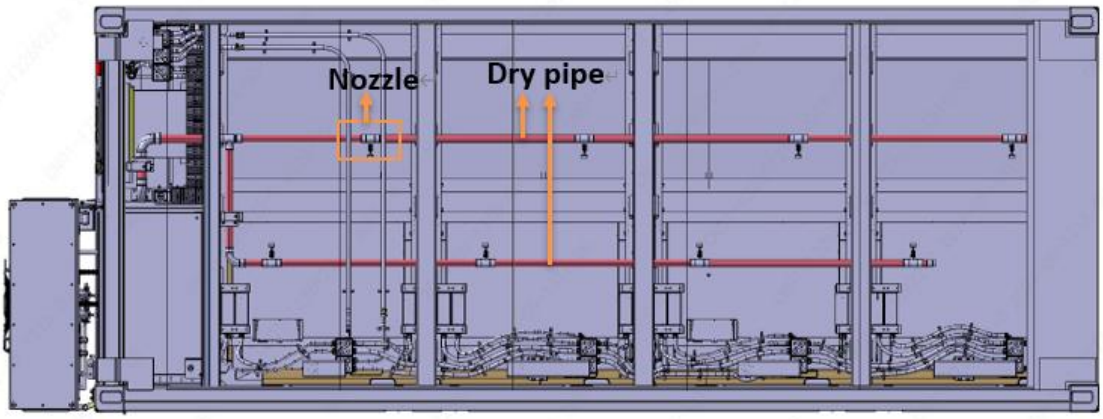


Figure 7 Dry Pipe System

The R thread connection is installed at the entrance of the water fire protection system, to reserve access quick connector or other connections. The parameters of the R thread are shown in Table 10.

- Table 10 The Paraments of threaded interface (with aluminum cap)

Item	Specification
Model	DSM 54xR2 (maximum flow rate ~ 11.49L/s)
Class	PN 16 （1.6Mpa）
Thread type	R2”
End connection	Integrate in Rack

The Standard Horizontal Sidewall Nozzles are open type (non-automatic) nozzles with rubber plug, designed for directional spray application in fixed fire protection system. The parameters of the nozzle are shown in Table 11.

Table 11 The Parameters of the Nozzle

Item	Specification
Model	V2709
Type	Standard Horizontal Sidewall
Maximum working pressure	250psi
End connection	½ BSPT

6 Thermal Management System(TMS)

6.1 TMS Overview

The TMS system of EnerS is liquid cooling, which main function is to maintain the temperature of the battery system to an allowable operating temperature range. Thus, the battery shall work at the best conditions, adsorb and release the maximum energy, slow degradation the SOH and maintain the longest life.

The Thermal management system is composed with the high-efficiency liquid cooling unit, the liquid cooling pipe under the bottom of battery and the PTC heater. The TMS works under the control of BMS. BMS sends the start up or shut down signals to the cooling unit, then the cooling unit and the PTC heater will work together to change the temperature of circulating coolant liquid for heat exchange in the cooling pipe. The circulating liquid will exchange the heat with the battery through the pipe. Thus, the temperature of battery will increase or decrease into appropriate range.

For example, the cooling unit will be started if the BMS detect the battery temperature over the setting value. The cooling mode will be activated to decrease the temperature of circulating liquid until reaching the setting value. When the BMS detects the battery temperature less than the setting value, the heat mode will be activated to increase the temperature of circulating liquid until the setting value. Detailed information will be described below.

6.2 TMS architecture

Figure 8 Overview of the cooling unit of EnerS

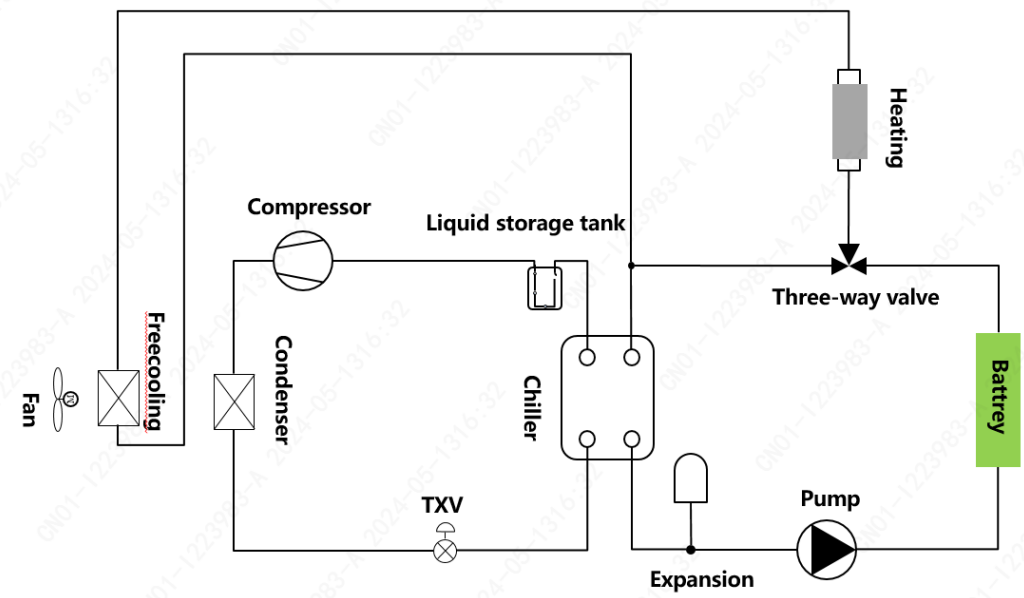


Figure 9 Architecture of Thermal Management System

The overview of cooling unit has been listed in Figure . EnerS own one high power cooling unit at the side of the container. TMS architecture can be described above (Figure 9). The composites parts are listed below:

a) **Compressor.** The function of compressor is to compress the low temperature and low pressure refrigerant gas into high temperature and high pressure refrigerant gas. Then the gas flow to the condenser through the pipe.

b) **Condenser.** The function of condenser is condensing the high temperature and high pressure

refrigerant gas into ambient temperature and high pressure refrigerant liquid. Excess liquefaction heat will be taken away by the fan. Then the liquid flow to the chiller through the pipe.

c) **Chiller.** The function of chiller is to exchange the heat from the refrigerant liquid with the coolant. The ambient temperature and high pressure refrigerant liquid will evaporate into low temperature and low pressure refrigerant gas. The heat will transfer from the coolant to the refrigerant liquid. The low temperature coolant will flow to the cooling plate to cool the batteries while the refrigerant gas return to the compressor. The circle process will continue and the heat of battery will be taken away.

d) **PTC Heater**. The positive temperature co-efficiency resistance. The PTC will heat the coolant when the TMS get signals that the temperature of coolant is below the setting value. Then the coolant will be heated until the temperature increases to the setting value. The battery will be warmed up by the coolant.

e) **Pump.** The pump will force the coolant into circulating in the pipe.

6.3 TMS Specification

Table 12 Main Feature of Thermal Management System

	Coolant: 50%Ethylene glycol,50% Deionized water
	Max. ambient temperature: 55°C
	Power supply: 3AC 380…480V
	70kW Cooling capacity for 0.5P System
	Cooling capacity is auto-adjustable according to ambient temperature & discharge/charge status

The main features of TMS are listed above, which is shown in Table 12. The TMS will work under the ambient temperature range from -35℃ to 55℃. The cooling power is auto-adjustable according to ambient temperature & discharge/charge status. There are four operating modes for the TMS, including shutdown mode, cooling mode, heating mode and self-circulation mode.

Table 13 Power Consumption of Thermal Management System

Type of EnerS	0.5P System
Cooling Capacity	70kW
Maximum Heating Power	16kW
Maximum Cooling Power	70kW
EER	⩾2.8 (18℃ TMS liquid , @35℃ ambient)

7 User Interface

7.1 PCS Requirements

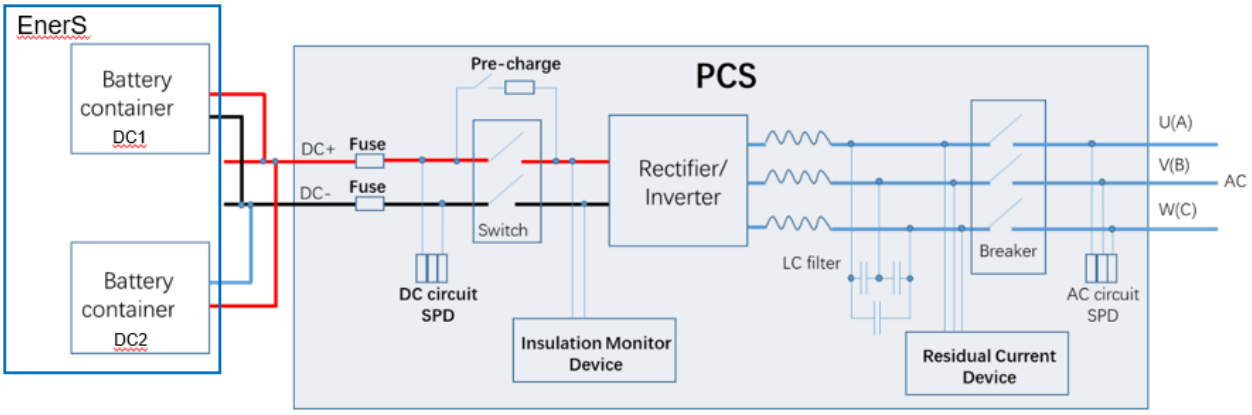


Figure 10 PCS Matching

- If DC1 and DC2 are connected to different PCS, please ensure that the two PCS run synchronously
- Please make sure to use one single copper Busbar for two parallel battery containers cable connection for positive or negative pole in PCS side.
- Please make sure to use Fuse(F) for DC circuit in PCS. The Fuse breaking time in PCS should less than the breaking time of fuse in battery container when short circuit occurs.
- Please make sure PCS have pre-charge circuit.
- Please make sure the PCS has a main circuit switch on the DC side .
- One PCS can match up to 2 battery containers.
- PCS should have SPD in DC high voltage bus.
- PCS should have SPD in AC side.
- PCS should have insulation monitor device. BMS monitor the insulation of DC bus before battery DC relay is closed. PCS monitor the insulation of DC bus after battery DC relay is closed.
- PCS should have residual current device to monitor the leakage current on AC side.
- When the battery is in a low SOC state after discharge, the grid cannot charge the battery in time and needs short-term storage. In this scenario, it is necessary to ensure that PCS is disconnected from the battery to prevent the battery from being over discharged.

7.2 Fuse Matching

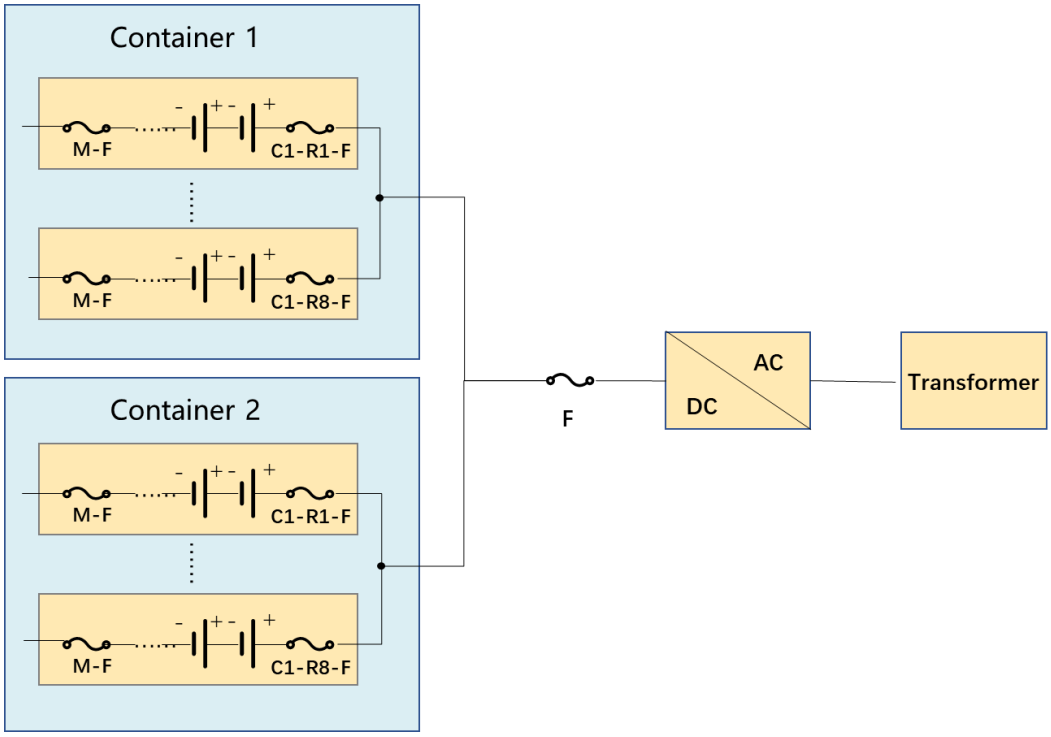


Figure 11 Fuse Matching

- The principle of fuse matching：
- Fuse Breaking Time: F<C-R-F<M-F. the F fuse means the fuses at the DC side of PCS. The C-R-F fuses means the fuses installed in the main control boxes. The M-F fuses means the fuses installed in the packs. The breaking time of F fuse is the minimum value of these three.
- Voltage Level： 1500V
- **Fuse-F breaking ability in a single container： ~60kA**

1. One PCS can connect two battery containers. Every container has 8 racks .
2. PCS DC side fuse is Fuse F.
3. Battery rack fuse is C-R-F.
4. Module fuse is M-F.

7.3 Common Mode Voltage

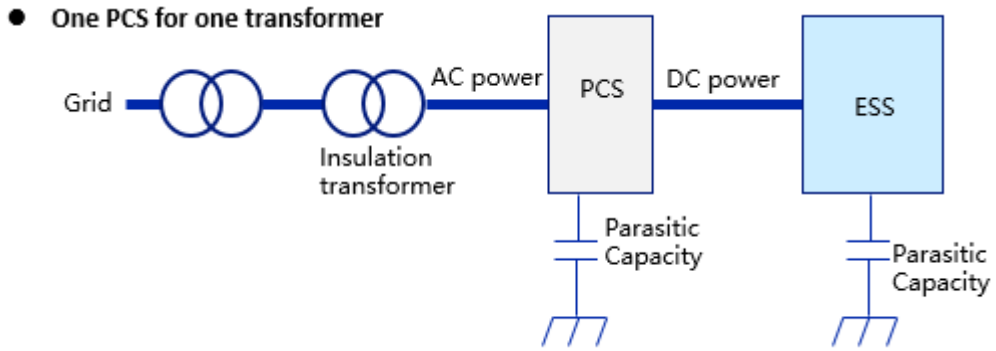


Figure 12 One PCS for One Transformer

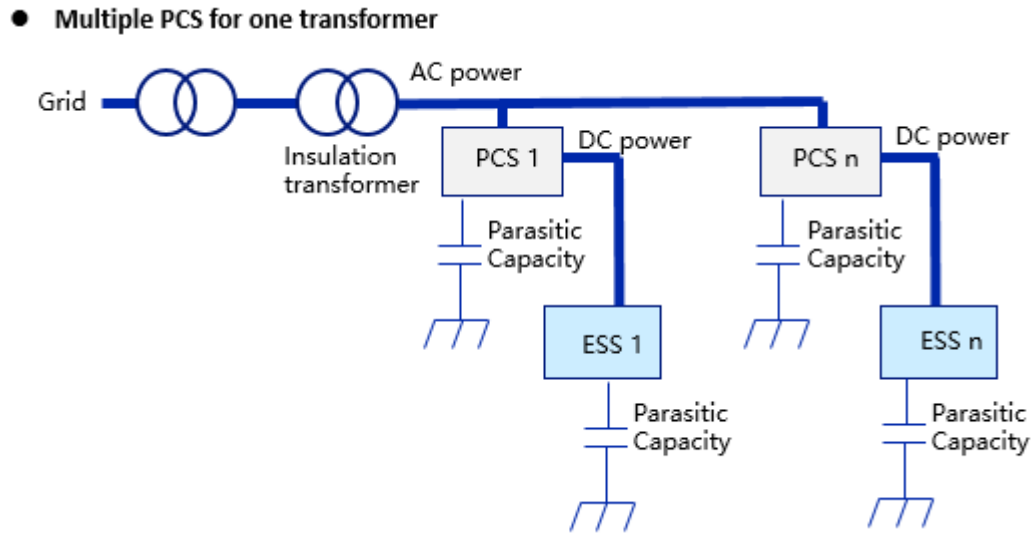


Figure 13 Multiple PCSs for One Transformer

The common mode voltage or current will affect the BESS reliability and personal safety. PCS will generate the common mode voltage and current due to the converter theory. Due to parasitic capacitance, the PCS should improve the insulation resistance isolation.And it is recommended to use insulation transformer. When multiple PCS are parallel connected, make sure that the switching of IGBT inside each PCS will not affect the other PCS to reduce the common mode voltage. The carrier synchronization should be considered in PCS control.

Common mode voltage value in DC side <100VAC, <15kHz

Make sure not to mix the AC and DC power cables, not to mix input and output cables, not to mix power cables and control cables.

7.4 Communication

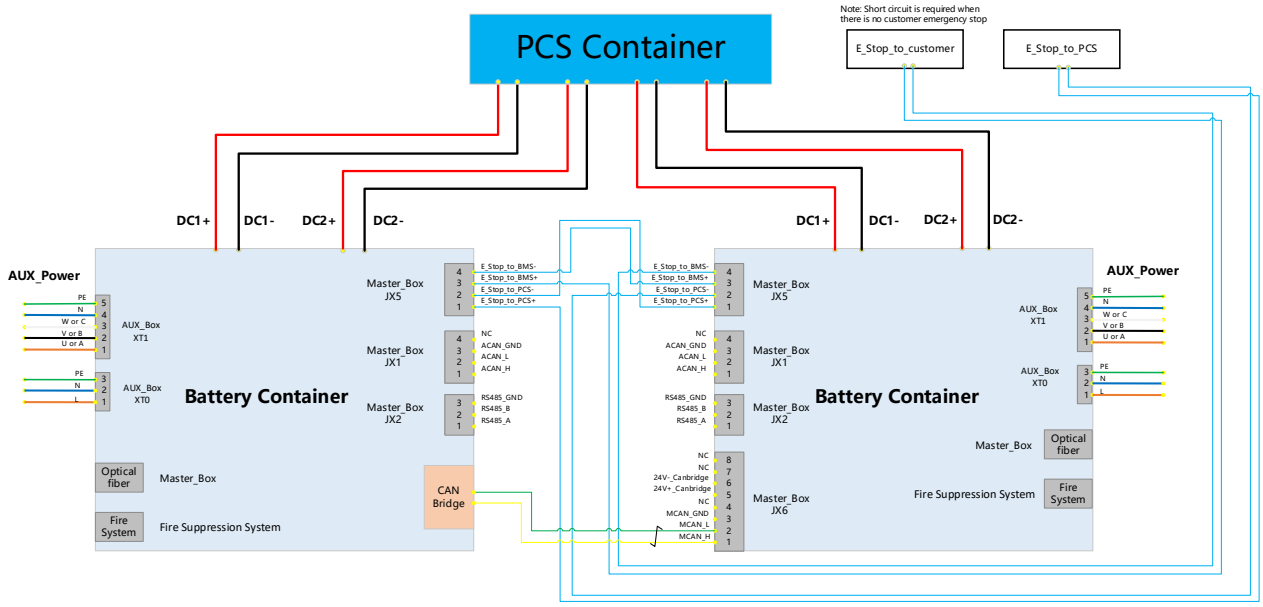


Figure 14 The Communication Architecture of the System in parallel

PCS should respond within 1s after BMS sending out the requirement.

PCS should respond within 1s after BMS sending out the emergency requirement by emergency dry contact.

PCS operation power should not exceed battery power limitation.

PCS should derating power to 0 W within 2s once receiving BMS limit to ZERO current requirement.

When the length of CAN communication loop exceeds to 30m, it is necessary to add CAN bridge to enhance communication signal.

It is recommended to use Ethernet optical fiber to communicating with EMS.

The A-CAN Bus or 485 Bus can be optional. If using the A-CAN Bus or 485 Bus, the Ethernet optical fiber will be not used.

8 Appendix

This is the recommended containers installation layout which is listed below at Figure 5.

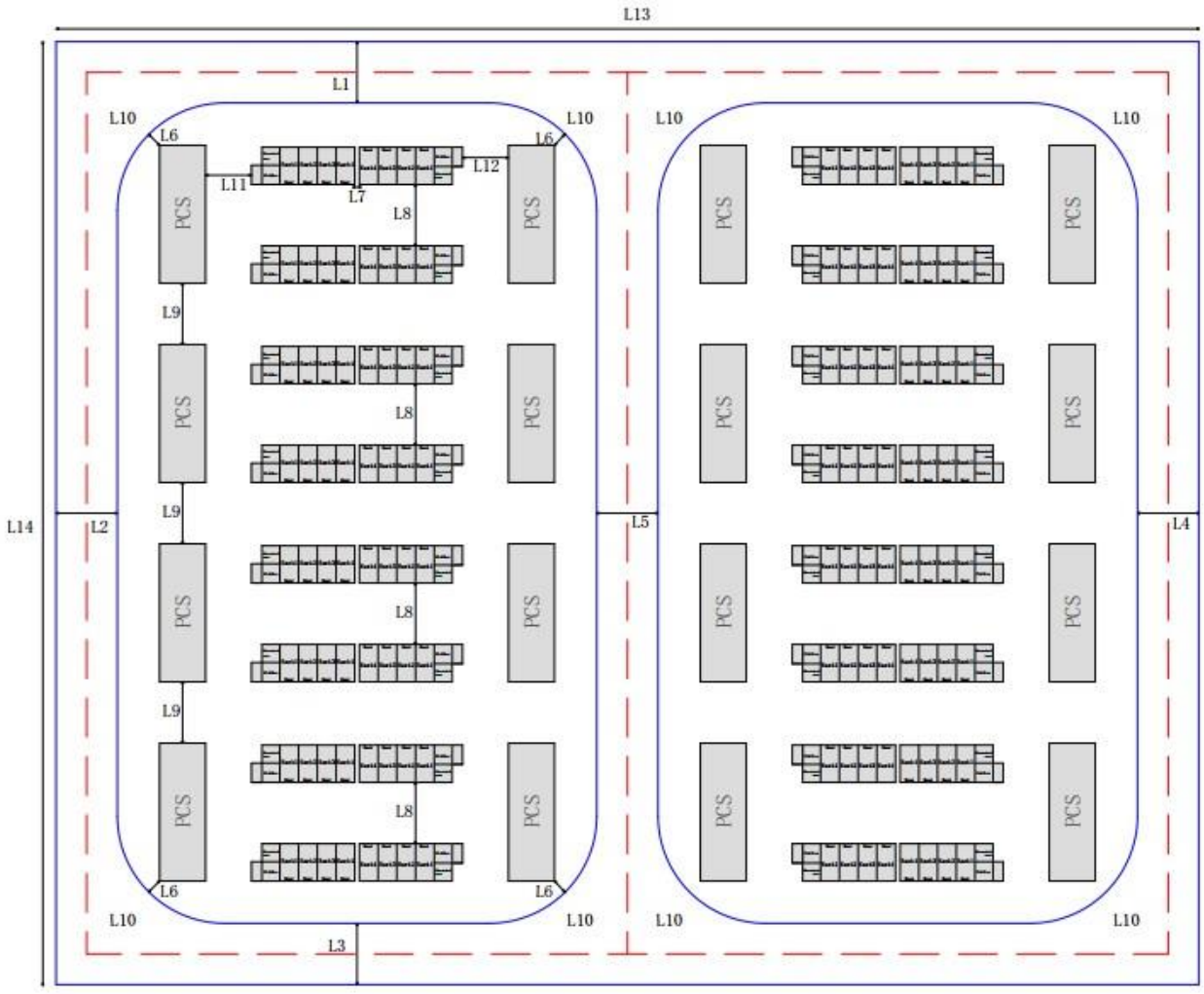


Figure 15 containers installation layout

For this case to avoid the hot air interaction for two containers ,and to maintain the container, the minimum distance L1~L12 must be followed :

L1 : 4m　L2 : 4m　L3 : 4m　L4 : 4m　L5：4m　L6：1m　L7：0.9m

L8 : 4m　L9 : 4m　L10 : 7m　L11 : 3m　L12：3m　L13：74.6m　L4：61.6m

PCS size (W*H*D) : 9000mm*3250mm*3000mm

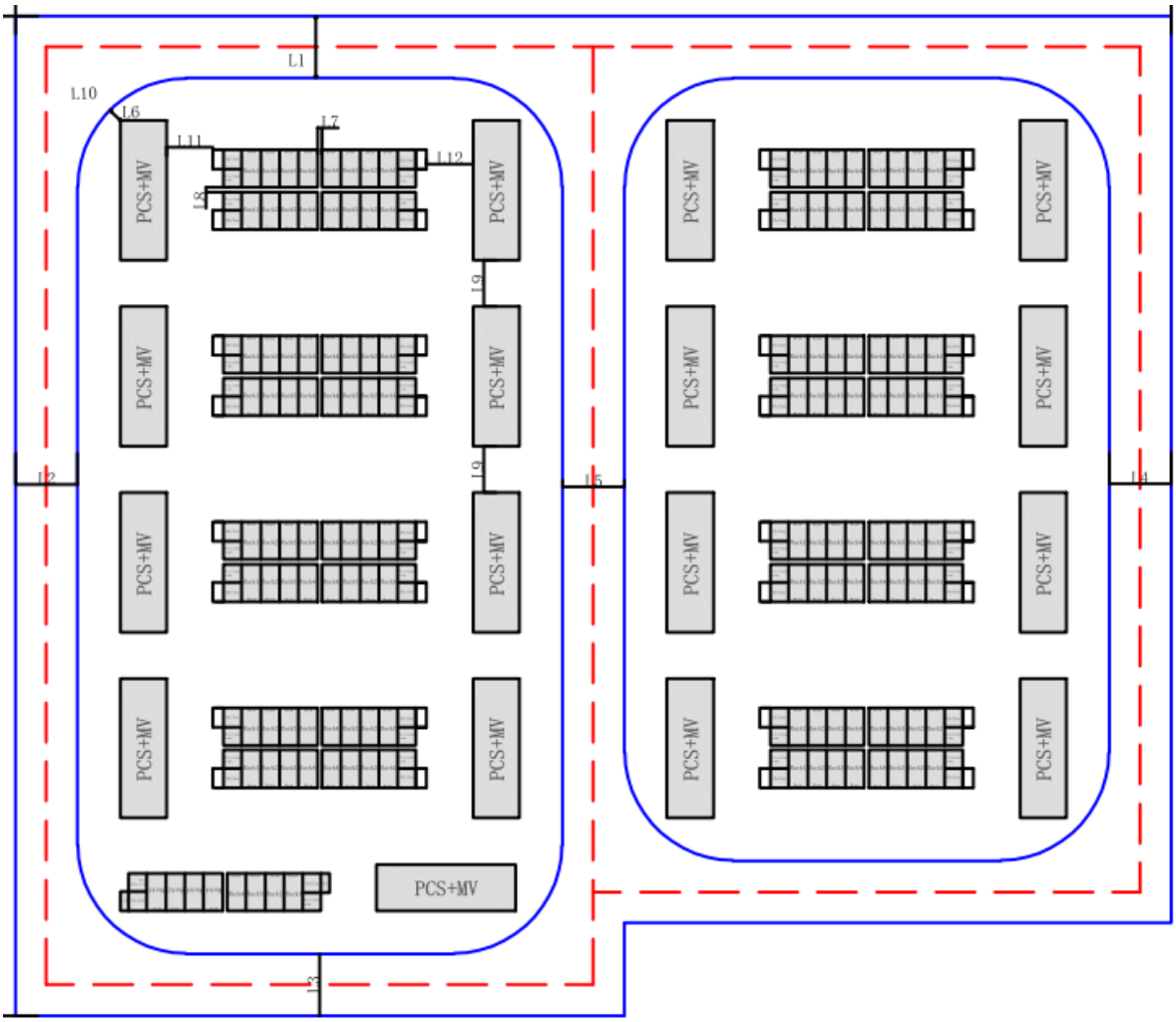


Figure 16 back to back and hand in hand arrangement

For this case to avoid the hot air interaction for two containers ,and to maintain the container, the minimum distance L1~L12 must be followed :

L1 : 4m　L2 : 4m　L3 : 4m　L4 : 4m　L5：4m　L6：1m　L7：0.9m

L8 : 0.9m　L9 : 3m　L10 : 7m　L11 : 3m　L12：3m

PCS size (W*H*D) : 9000mm*3250mm*3000mm

Contact us

To find the contact ways for your region

please refer top our webpage:

www.catl.com

Note

We reserve the right to make technical changes or modify the contents of this document without prior notice. With regard to purchase orders, the agreed particulars shall prevail. CATL does not accept any responsibility whatsoever for potential errors or possible lack of information in this document.