AT1.5MW/1.6MWh Integrated Energy Storage Container Specification

Catalog

1.Introduction

The energy storage system includes lithium iron phosphate batteries, battery management systems, energy management systems, inverters, AC/DC distribution cabinets, fire protection systems, lighting systems, temperature control systems, etc.

Energy-type battery packs are used as energy storage components to store electricity when the electricity is in the "valley" period and discharge when the electricity is in the "peak" period, realizing peak-shaving and valley-filling of the electricity. This can not only reduce the peak load of the power grid, but is also beneficial to the security of the grid. Operation can also produce huge economic benefits.

On this basis, the energy storage system can also realize value-added service benefits of electric power "energy storage +": such as participating in demand-side response, emergency power support, transformer loss reduction, reactive power compensation and other value-added service values.

2.Terminology and Reference Technical Specifications

2. 1 Term

PCS (Power Conversion System): Energy conversion system, i.e. converter, is a bidirectional commutation system that performs inversion and rectification.

SoC (State of Capacity): The remaining capacity state of the battery, expressed as a percentage.

SoH (State of Health): Battery pack health status, expressed as a percentage.

DoD (Depth of discharge): The depth of discharge of the battery, expressed as a percentage.

BMS (Battery Management System): Battery management system, responsible for the management and control of the battery part of the energy storage system.

EMS (Energy Management System): Energy management system is a device that monitors and controls the entire system.

2.2 Reference technical specifications

GB 51048-2014 Design specifications for electrochemical energy storage power stations

GB/T 36276-2018 Lithium-ion batteries for power energy storage

GB/T 36547-2018 Technical regulations for connecting electrochemical energy storage systems to the power grid

GB/T 36548-2018 Test specifications for electrochemical energy storage systems connected to the power grid

GB/T 34131-2017 Technical specifications for lithium-ion battery management systems for electrochemical energy storage power stations

GB/T 34120-2017 Technical specifications for energy storage converters for electrochemical energy storage systems

GB 21966-2008 Safety requirements for lithium primary batteries and accumulators during transportation

NB/T 42091-2016 Technical specifications for lithium-ion batteries for electrochemical energy storage power stations

NB/T 33014-2014 Operation control specification for electrochemical energy storage system connected to distribution network

NB/T 33015-2014 Technical regulations for the integration of electrochemical energy storage systems into distribution networks

NB/T 33016-2014 Test procedures for electrochemical energy storage systems connected to distribution network

GB 4208-2008 Enclosure protection level (IP code)

GB 7947 Basic and safety rules for human-machine interface marking Color or number identification of conductors

GB/T 14537-199 Impact and collision test of measuring relays and protective devices

GB/T 14598.27-2008 Measuring relays and protective devices

DL/T 620-1997 Over voltage protection and insulation coordination of AC electrical installations

DL/T 621-1997 Grounding of AC electrical installations

GB 50217-2007 Design specifications for power engineering cables

GB 14048.1 Low-voltage switch gear and control equipment Part 1: General provisions

GB/T 2829 Periodic inspection counting sampling procedures and sampling tables (applicable to inspection of production process stability)

GB/T 2423.1-2008 Environmental testing of electrical and electronic products Part 2: Test methods Test A: Low temperature

GB/T 2423.2-2008 Environmental testing of electrical and electronic products Part 2: Test methods Test B: High temperature

GB/T 2423.3-2006 Environmental testing of electrical and electronic products Part 2: Test methods Test Cab: Constant humidity and heat test

GB/T 2423.8-1995 Environmental testing of electrical and electronic products Part 2: Test methods Test Ed: Free fall

GB/T 2423.10-2008 Environmental testing of electrical and electronic products Part 2: Test method Test Fc: Vibration (sinusoidal)

GB 8702-88 Electromagnetic radiation protection regulations

GB/T 17626 Electromagnetic compatibility testing and measurement technology

GB 17625.2 Electromagnetic compatibility limits limit voltage fluctuations and flickers produced by equipment with a rated current not greater than 16A in low-voltage power supply systems

GB/Z 17625.3 Electromagnetic compatibility limits limit voltage fluctuations and flickers produced by equipment with a rated current greater than 16A in low-voltage power supply systems

GB 17799.3 General standards for electromagnetic compatibility Emission standards in residential, commercial and light industrial environments

GB 17799.4 Electromagnetic Compatibility General Standard Emission Standard in Industrial Environment

3.Energy Storage System Configuration Characteristics

——Using lithium iron phosphate battery, which is safe, environmentally friendly, has excellent performance and long cycle life;

——Use the battery management system (BMS) and adopt hierarchical management strategies. The system configuration is flexible and reliable, easy to expand and upgrade. It can monitor the voltage, current, temperature and other operating parameters of the battery system in real time. It also has a battery dynamic balancing management strategy, which can Automatically and quickly complete battery maintenance;

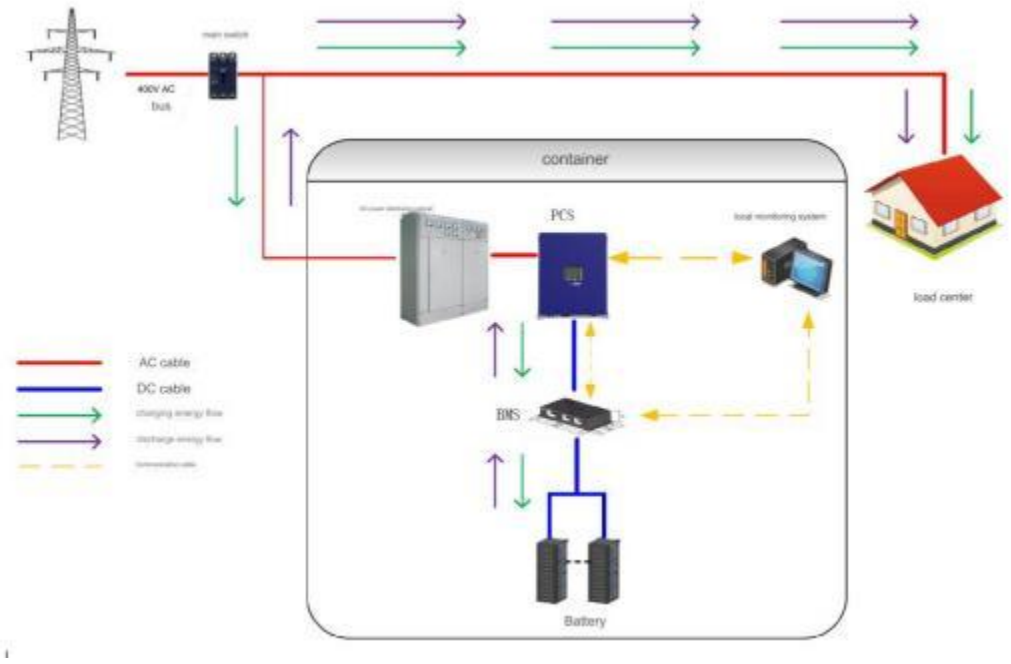
——Using the display control module, the display interface adopts LCD touch screen, which makes viewing data more intuitive and operating more conveniently. It also has CAN, RS485 and other communication methods to facilitate customers' computer remote monitoring;

——Use a specially designed intelligent fire protection system that can monitor changes in temperature and smoke inside the system in real time through smoke and temperature sensors and other devices, and activate fire alarms and/or fire extinguishing devices when necessary to ensure the fire safety of the energy storage system;

——Use a specially designed intelligent thermal management control strategy to optimize the air duct design and heat exchange design to improve the operational safety and service life of the energy storage system;

——The use of modular and standardized design solutions will help improve product quality management, further improve system safety performance and overall energy conversion efficiency, and facilitate installation and maintenance;

4.System Topology Diagram



1.5MW/1.6MwhEnergystoragesystemconfgurationlist

NO.	Main components	Specifications and models	quantity
1	1.6MWh Energy storage system	standard container	1 unit
2	Battery module	1P15S (Battery cell:280A*15)	120 pieces （1P15S*8）
3	Battery clusters	1P225S (Battery module*15)	8 clusters
4	Battery storage system	8P225S (Battery cluster*8p)	
5	battery management system	BMS	3 sets
6	Energy storage bidirectional inverter	500KW PCS	3 units
7	local monitoring system	Station-level centralized monitoring	1 set
8	Convergence cabinet	DC	3 sets
9	Distribution Cabinet	AC	1 set
10	Temperature Control System	Air conditioning, air duct	1 set
11	Fire Fighting System	Heptafluoropropane	1 set

5.System Composition

5.1 Battery Module

The battery module consists of 15 single cells, 1P15S, capacity 13.44kWh, nominal voltage 48V.

The battery module is equipped with BMU, the acquisition module of BMS, to collect the voltage, temperature and other parameters of the module.

Battery Module technical parameters (actual is subject to official design)

NO.	name	Specification	Remark
1	Module size	Module size: excluding connector 500mm(W)*600mm(D)*225 mm(H)	±2mm
2	Nominal capacity	280Ah@0.5C,25℃	
3	Nominal voltage	48V (15cells)	
4	Working voltage range	37.5-54.75V	

5	Maximum continuous charging rate	1C@25℃	280A
6	Maximum continuous discharge rate	1C@25℃	280A
7	weight	<100kg	
8	Rated energy	13.44kWh	
9	Insulation standards	2570VDC, no breakdown, leakage current <5mA	Reference GB36276-2018
10	Withstand voltage standard	2830VDC, no breakdown, leakage current <5mA	Reference GB36276-2018
11	Maximum charging voltage of single unit	3.65V	Any cell
12	Single unit minimum discharge voltage	2.5V	Any cell
13	Discharge overcurrent protection current	280A@90min	
14	Charging high temperature protection	55℃	Battery temperature in battery module
15	Discharge high temperature protection	55℃	Battery temperature in battery module
16	Charging low temperature protection	0℃	Battery temperature in battery module
17	Discharge low temperature protection	-20℃	Battery temperature in battery module
18	use environment	Indoor, dry, constant temperature	
19	waterproof level	IP20	
20	Operating temperature range (℃)	-20～55	
21	Storage temperature range (℃)	-40～60	
22	Storage environment humidity (RH)	5%～95%	
23	Working environment humidity (RH)	≤85%	

5.2 Battery Cluster

Battery clusters composed of 15 modules, a total of 8 clusters, form a 1.6MWh integrated energy storage

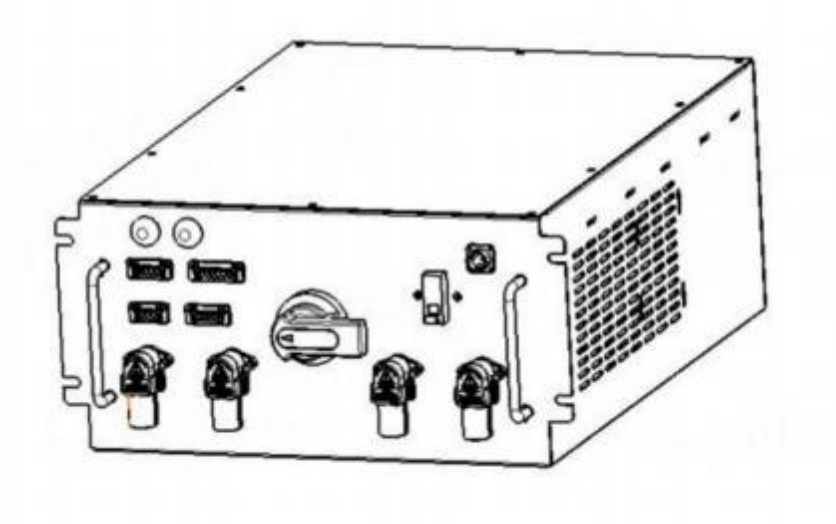
Battery cluster technical parameters (actual is subject to formal design)

NO.	parameter	Specification	Remark
1	Battery cluster size	1172mm(W)*630mm(D)*2065 mm(H)	±10mm, excluding connectors
2	Nominal capacity	280Ah@0.5C,25℃	
3	Nominal voltage	720V	
4	Working voltage range	562.5V~821.25V	
5	Maximum charging rate	1C@25℃	280A
6	Maximum discharge rate	1C@25℃	280A
7	Standard weight	≤1.5T	Rack included
8	Standard energy	201kWh	
9	Insulation standards	Battery box insulation resistance ≥500MΩ (1500VDC)	Reference GB36276-2018
10	Withstand	Battery box 2570VDC, no	Reference

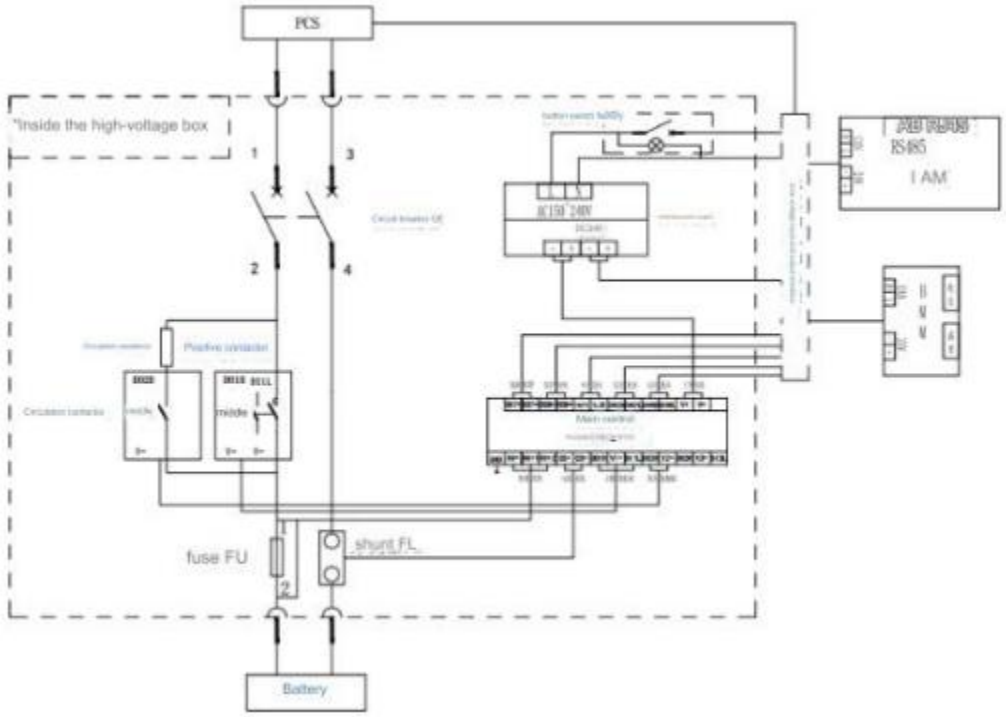
	voltage standard	breakdown, leakage current <20mA	GB36276-2018
11	Maximum charging voltage of single unit	3.65V	Any cell
12	Single unit minimum discharge voltage	2.5V	Any cell
13	Discharge overcurrent protection current	280A@90min	
14	Charging high temperature protection	55℃	Battery temperature in battery module
15	Discharge high temperature protection	55℃	Battery temperature in battery module
16	Charging low temperature protection	0℃	Battery temperature in battery module
17	Discharge low temperature protection	-20℃	Battery temperature in battery module

5.3 High Voltage Box

The high-voltage box contains the BMS main control unit and electrical components, which are used to manage and protect the operating status of the entire battery cluster.



5.3a High voltage box



5.3b High voltage box schematic diagram

5.4 Battery Management System BMS

The battery management system (BMS) has a three-level architecture. Each battery socket is managed by the battery management unit BMU. The BMU is responsible for performing functions such as cell voltage, temperature collection, and balancing of the batteries. The BMU communicates using the CAN bus, and the battery's cell information (cell voltage, cell temperature, cell SOC, cell SOH, equilibrium status, etc.) is sent to the upper end by the BMU.

The battery cluster is equipped with a battery control unit (BCU), which collects the total voltage and current of the battery cluster and controls the battery pack contactor, and performs data communication (CAN communication) with it.

The battery cluster control unit (BCU) can upload battery information, fault alarms, data records, etc., and communicate with the PCS and monitoring background. It communicates with the PCS through CAN, and communicates with the background through the network port, using the standard MODBUS TCP/IP protocol.

BMS technical parameters (actual is subject to formal design)

Voltage collection	Voltage detection range	<1000V
	Voltage detection accuracy	±0.2%
	Voltage acquisition cycle	100ms
Current collection	Current detection range	±500A (according to Hall range)
	Current detection accuracy	≤±0.5% (more Hall accuracy)
	Current acquisition cycle	100ms
Temperature collection	Temperature detection range	-20～85℃
	Temperature measurement accuracy	±1℃/±0.1℃(according to temperature sensing range)
	Temperature collection cycle	100ms
Insulation resistance collection	Insulation resistance measurement accuracy	±5%
	Insulation resistance collection cycle	2s

Operating Voltage	9～32Vdc
Operating temperature	-20～65℃
Operating power consumption	<2.1W
Communication Interface	RS485*1, CAN*3
Communication baud rate	9600bps, 250Kbps (default)
DO (switch)	2*2A/input power supply (9-30V)
DO (active)	6*2A/input power supply (9-30V)
DI	3*high level, 3*low level, 2*passive
Input insulation resistance	≥10MΩ,1500VDC
Installation dimensions	180*105*27.8mm (length*width*height)
Installed	frame

5.5 Power Conversion System

The PCS is composed of a DC/AC bidirectional converter, a control unit, etc., which controls the charging and discharging process of the battery, converts AC to DC, and directly supplies AC loads without a power grid.

The PCS controller receives background control instructions through communication, controls the converter to charge or discharge the battery according to the sign and size of the power instruction, and regulates the active power and reactive power of the grid.

The PCS controller communicates with the BMS through the CAN interface to obtain battery pack status information, which can implement protective charging and discharging of the battery to ensure safe battery operation.

PCS technical parameters (actual is subject to formal design)

NO.	project	parameter	Remark
1. AC side parameters			
1	AC access method	Three-phase three-wire	
2	rated power	500kW	
3	Overload capacity	110%: long-term operation 120%: ≥ 10min	
4	Rated voltage	380V	It can adapt to ±10% fluctuation of grid voltage.
5	Rated current	957A	
6	Rated grid frequency	50Hz	Consistent with grid frequency
7	THD	<5% (rated power)	The total current waveform distortion rate is <5% under rated power.
8	Power factor adjustable range	-1～+1	
9	Reactive power response time	≤30ms	
10	Power control deviation	≤2%	When the power is 20% greater than the rated power, the power control deviation shall not exceed 2%.
11	DC component	0.5% (rated current)	When running at rated power, the DC current component of the AC side current does not exceed 0.5% of the rated current.
2. DC side parameters			
12	DC voltage range	580V～850V	
13	Voltage stabilization accuracy	±5%	
14	Steady flow accuracy	±5%	
3. Protection			

15	low voltage ride through		have	
16	high voltage ride through		have	
17	Anti-islanding protection		have	
18	AC overcurrent/short circuit protection		have	
19	AC overvoltage/undervoltage protection		have	
20	AC over/under frequency protection		have	
21	AC line phase sequence error protection		have	
22	DC overcurrent/short circuit protection		have	
23	DC overvoltage/undervoltage protection		have	
24	DC polarity reverse protection		have	
25	Over temperature protection		have	
26	Communication failure protection		have	
27	Cooling system fault protection		have	
28	Fault recording		No less than 5 weeks, 200 points per week	
4. System				
29	Maximum conversion efficiency		≥0.99	
30	Power response speed		<100ms	
31	Charge-discharge conversion time		<100ms	Conversion time from 100% rated power charging to 100% rated power discharging.
32	Dimensions (width*depth)		1110*827mm	
33	weight		1100kg	
34	Protection level		IP30	
35	noise		≤80dB	1m away from the device
36	cooling method		air cooling	
37	Communication Interface		RS485, Ethernet	IEC61850，ModbusRTU
38	Wiring		bottom in and bottom out	
39	Working temperature		-25℃~+55℃	
40	Storage environment temperature		-20℃~+70℃	
41	allowed relative humidity		0～95%, no condensation	
42	Altitude		No derating at altitude ≤ 2000m	
43	Earthquake resistance	horizontal acceleration	0.2g	Tested according to IEC 61166, safety factor 1.67

		vertical acceleration	0.1g	

5.6 Fire Safety System

Equipped with combustible gas detectors, fire detectors, gas fire extinguishing devices, combustible gas emission devices, intelligent detection and active exhaust before firefighting, the exhaust ventilation volume of the energy storage container meets the requirements of "Design Code for Electrical Equipment in Explosive Hazardous Environments" GB50058-2014 , to avoid the accumulation of flammable gases, and remotely control the exhaust after firefighting to avoid explosions;

It has flood detection and linkage protection functions. It can cut off the power circuit immediately after flooding to avoid disasters such as electric shock, high-voltage short circuit and short circuit spread.

>One-button emergency stop function: It has a one-button emergency stop function (EPO function), which can manually and quickly cut off the main circuit of the energy storage system in case of accidents such as short circuit, electric shock, fire, etc. to avoid the spread of the accident.

>Combustible composite gas detection system:

>A gas detector is installed in the container, which can detect the concentration values of combustible gases such as H2 and CO.

>The gas volume range is below 10% of the lower explosion limit (LEL), and two-level flammable gas concentration action thresholds and two-level protective actions are set;

>The first-level threshold of the gas detector is set between 0.1% LEL and 5% LEL. When the combustible gas concentration is at this threshold, the first-level protection action is initiated and the combiner cabinet is shut down;

>The second-level threshold of the gas detector is set between 5% LEL and 10% LEL and above. When the combustible gas concentration is at this threshold, the

second-level protection action is initiated, that is, the exhaust fan is turned on based on the first-level protection action;

>The gas detection and fire alarm output signals are simultaneously connected to the battery management system to ensure real-time monitoring and fire warning;

>Other requirements comply with the relevant gas detection regulations of GB15322 "Combustible Gas Detector".

>Intelligent detection fire protection system: Equipped with a centralized fire protection system, the energy storage container fire protection system consists of gas fire extinguishing agent cylinders, pipelines, nozzles, signal feedback components, fire detectors and controllers, emergency start and stop buttons, audible and visual alarms, and discharge Gas indicator light, etc.

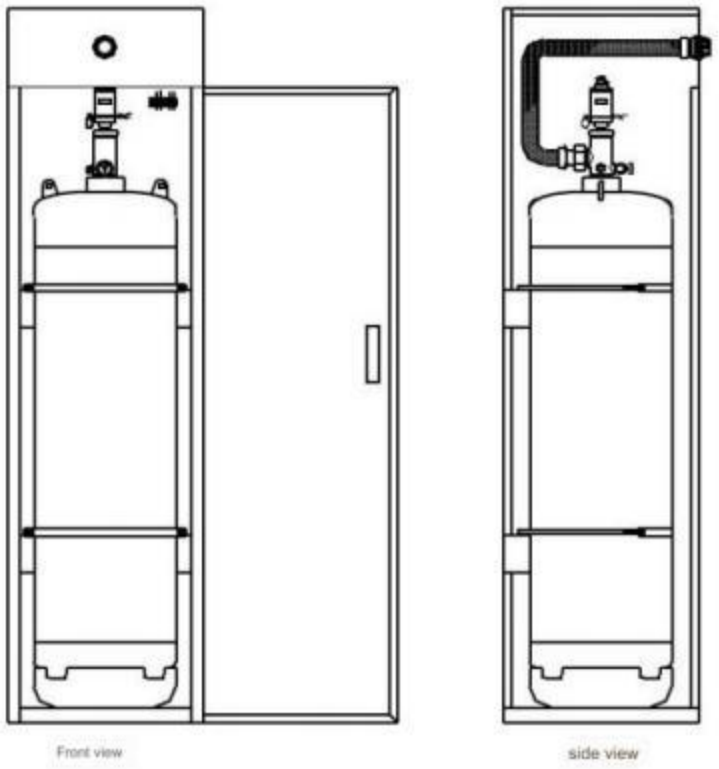


Figure 5.6 a

Schematic diagram of installation structure of cabinet fire extinguishing device

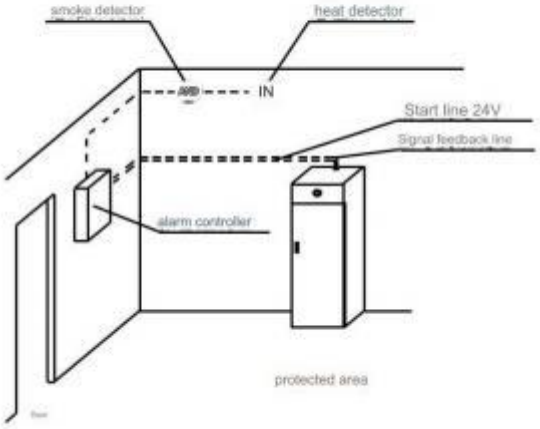


Figure 5.6 (b)

Schematic diagram of single bottle group of cabinet fire extinguishing device

5.7 Cooling System

The energy storage system adopts a constant temperature and humidity design.

It has two built-in industrial air conditioning refrigeration and heating systems with a cooling capacity of 15KW. It adopts a distributed temperature control design and uses door-mounted air conditioners instead of traditional centralized air conditioners to avoid differences in heat dissipation effects caused by differences in physical locations within the container.

The air duct design adopts an internal circulation upward air supply design. The air outlet pressure of the air conditioner and the suction force of the fan in the battery pack push the cold air through the battery pack, and the hot air then enters the air inlet of the air conditioner on the door to prevent external dust from entering the container

and causing the inside of the container to The ambient temperature should be constant at 23±5℃(to ensure optimal working condition).

Due to the low outlet air temperature, PEF insulation cotton is affixed to the top of the container to avoid condensation.

5.8 Energy Management System EMS

>Self-developed microgrid intelligent monitoring and energy management system with completely independent intellectual property rights

>Based on hierarchical distributed technology and time series database technology, it can easily accommodate massive data of large-scale microgrids.

>It adopts a product architecture of local control + cloud management to carry out real-time control, centralized monitoring, intelligent operation and maintenance, and data analysis of the microgrid system. It can be applied to different application scenarios such as wind and solar storage, solar storage and charging, and solar and diesel storage.

>Distributed control and centralized management can be applied to mixed application scenarios of different types of batteries