100KW/215KWh Technical Program of Integrated Cabinet Air-cooled Energy Storage System

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Catalog

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I. Scope of application

This specification is suitable for 100KW/215KWh industrial and commercial energy storage system developed by SY New Energy(shangrao)Co.,Ltd and describes its external dimensions, performance indicators, battery management system parameter settings, the appearance of the battery pack marking, the use of the environment and the storage and transportation requirements, as well as precautions for use.

Battery system design reference technical documents

GB/T 191-2008 Packaging, Storage and Transportation Graphic Marking

GB/T 2423.1-2008 Environmental test for electrical and electronic products Part 2: Test method Test A: Low temperature

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

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

GB/T 2423.2008 Environmental test for electrical and electronic products, Part 2: Test method Db: Alternating humidity and heat (12h+12h cycle) GB/T 2900.33-2004

Electrotechnical terminology Power electronics

GB GB 3859.1-1993 Provisions on basic requirements for semiconductor converters

GB 3859.2-1993 Semiconductor converter application guidelines

GB 3859.3-1993 Semiconductor converter transformers and reactors

GB4208-2008 Enclosure protection level (IP code)

GB 5226.1-2008 Mechanical and electrical safety of mechanical and electrical equipment Part 1: General technical conditions

GB 7947-2006 Human-machine interface marking marking of basic and safety rules conductor color or number marking

GB/T 12325-2008 Electricity quality deviation of supply voltage

GB/T 12326-2008 Power quality voltage fluctuations and flicker

GB/T 13382008 General technical conditions for packaging of electromechanical products

GB/T 13422-2013 Electrical test methods for semiconductor power converters

GB 14048.1-2006 Low-voltage switchgear and controlgear Part 1: General provisions

GB/T 14549-1993 Harmonics in power quality utility grids

GB/T 15543-2008 Permissible unbalance of three-phase voltage of power quality

GB/T 14598.27-2008 Measurement relays and protective devices Part 27: Product safety requirements

GB/T 15543-2008 Power quality	GB/T 15543-2008	Power quality three-phase voltage unbalance
GB/T 15945-2008 Power quality three-phase voltage unbalance	15945-2008 Power quality	Permissible frequency deviation of power system for power quality
GB/T	17626 -2006	Electromagnetic compatibility test and measurement techniques

GB 17799.2012 Electromagnetic compatibility general standard for emissions in industrial environments

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GB/T 50062014 Specification for over-voltage protection and insulation matching design of a.c. electrical installations

GB/T 50065-2011 Design specification for grounding of a.c. electrical installations

GB 51048-2014 Design specification for electrochemical energy storage power station

GB/T-36549-2018 Operation index and evaluation of electrochemical energy storage power station

GB/T-36558-2018 General technical conditions for

electrochemical energy storage systems in power

systems GB/T 36547-2018 Technical provisions for

grid access of electrochemical energy storage

systems

GB/T 34133-2017 Technical specification for testing of energy storage converters

GB/T 34120-2017 Technical Specification for

Energy Storage Converters of Electrochemical

Energy Storage Systems GB/T-36545-2018 Technical

Requirements for Mobile Electrochemical Energy

Storage Systems GB/T-36548-2018 Test

Specification for Electrochemical Energy Storage

Systems for Access to the Grid NB/T-1815-2018

Reliability Evaluation Protocol for

Electrochemical Energy Storage Power Plant

Equipment

Supply list

Sequence	Name	Unit	Quantity	Remarks
1	100KW/215KWh energy storage system	Sets	1	
2	Product Manual	Copies	1	
3	Certificate of Conformity	copies	1	

Product performance and technical indicators

This energy storage product has unique advantages in three aspects: safety and reliability, intelligence and efficiency, and streamlining and flexibility. In terms of safety, the system has six safety designs: ontological safety, design safety, structural safety, system safety, management safety, and fire safety, so that there is no omission of safety precautions. It can accurately locate each abnormal battery, detect faults precisely, and efficiently operate and maintain fire protection; it adopts the design concept of explosion-proof + fire protection, and comprehensively protects the safety of the power station system in multiple dimensions from the cell level, pack level, and cabinet system level; and it realizes triple insulation monitoring and protection, i.e., the DC insulation inside the battery system, and the DC-AC insulation between the batteries and the PCS.

The energy storage system adopts air-cooled thermal management program, the nominal capacity of the energy storage system is 215KWh, and the output power is 100KW; it consists of 15 sets of 51.2V280Ah Li-FePO4 battery packs with certified Li-ion Li-FePO4 batteries, as well as 1 set of BMS, 1 set of EMS, 1 set of management system, 1 set of fire-fighting system, 1 set of 100KW PCS, 1 set of DCDC converter with MPPT interface, and 1 set of BMS, 1 set of EMS, 1 set of management system and 1 set of fire-fighting system. MPPT interface DCDC converter gathered in 1 set of customized cabinet.

4.1 Product Configuration List

Table 5-1 System Configuration List

100KW/215KWh
configuration list

Serial number	Equipment name	Specification	Quantity	Unit	Brand name	Remarks
1	Energy Storage System	100KW/215KWh	1	Sets		Individual set of sub-item details See 1.1～1.9
1.1	Battery module	280-1P16S 14.336kWh	15	Group		
1.2	High Voltage Box	768V high voltage box	1 set	set		
1.3	Single cell	3.2v280A cell	240	piece		
1.4	Thermal management system	3KW industrial air conditioner	1	set		
1.5	Fire fighting system	Hot aerosol fire extinguishing device	1 set	Sets		
1.6	BMS	1 master, 15 slaves	1 set	set		
1.7	EMS	Energy Management System	1 set	Sets		microgrid
1.8	PCS	100KW	1	set		
1.9	Cabinet	Non-standard customization	1 set	Sets		
1.10	DCDC module	DCDC module with MPPT interface	1 set	set		

4.2 Function

(1) Reliable charging and discharging. Efficient charging and discharging through lithium iron phosphate ion battery, long service life and high reliability.

(2) Automatic protection function. Quick response, high precision data sampling, with perfect and reliable protection function:

◇ Over-voltage and under-voltage protection for the battery pack as a whole, over-voltage and under-voltage protection for a single cell of the battery;

◇ Charging and discharging over-current protection;

◇ Charge and discharge temperature over-temperature protection;

◇ Short circuit protection;

◇ Adopt new customized hot aerosol fire extinguishing device;

(3) Protection lifting mode. Battery pack or single unit in the overcharge protection, the voltage returns to the overcharge reset voltage value, automatically release the alarm

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(4) Battery equalization function. Equalization control according to each battery voltage, energy transfer type equalization (reserved).

(5) Charging and discharging with the same port, support charging and discharging 140A, with 485/CAN communication function.

4.3 Technical specifications

Sequence	Item	Indicator		Remarks
Battery single-cell parameters				
1	Battery type	Lithium iron phosphate power battery		LiFePO4 280A
2	Rated Voltage/Capacity	3.2V/280Ah		
3	Single battery voltage range	2.80V-3.60V		
4	Weight of single battery	5.34±0.05kg		
5	Dimension	Width	173.7±0.5mm	
		Thickness	71.7±0.5mm	
		Height (total)	205.1±0.5mm	
		Height (main body)	200.5±0.5mm	
		Pole center distance	90±0.3mm	
6	Working Temperature	Charging temperature	0℃～60℃	
		Discharge temperature	-20℃～60℃	
7	Charge retention capacity	97% (25℃,30days)		
8	Cycle times	More than 7 000 cycles (0.2C cycle, normal temperature, capacity (Capacity retention rate: 80%)		
Battery pack parameters				
1	Rated Voltage	51.2V		16 strings

2	Battery pack voltage range	40～58.4V	According to single cell 2.8V-3.6V
3	Rated capacity	280Ah	
4	Total Energy	14.336KWh	
5	Series-parallel connection	16 series and 1 parallel	
6	SOC Range	20%-100%	
7	Charge/discharge capacity efficiency	≥95%	
8	Maximum continuous charging current (A)	280	
9	Overcurrent protection (A)	300	

10	Maximum continuous discharge current (A)	280	
11	Total weight	104KG (valuation)	
12	Ambient Relative Humidity	10%-90% (valuation)	
13	Water and dust protection standard	IP55	
14	Battery system charging and discharging ambient temperature	Charge and discharge -20℃-60℃	
15	Battery box size	486*766.7*227mm	
Parameters of energy storage system			
1	Rated Voltage	768V	240 series
2	Battery pack voltage range	672～864V	According to single cell 2.8V-3.6V
3	Rated capacity	280Ah	
4	Total Energy	215.04KWh	
5	Series and parallel connection method	240S1P	15 51.2V 280Ah battery packs in series composition
6	Battery box number	15	
7	Inverter	100KW	
8	Cycle life	More than 6000 times (0.2C cycle, room temperature, capacity retention rate: 80%)	
9	Working Temperature	Charging temperature: 0℃～60℃	
		Discharge operating temper: -20℃～60℃	

		ature		
10	Maximum charging power	100KW		
11	Maximum discharge power	100KW		
12	Rated frequency	50/60Hz		
13	Maximum output power	110KW		
14	Shipment of products with power	30%-50% of the power to be shipped		
15	Communication method	CANO/RS485		
16	Cabinet size	1850*1060*2258mm		
17	Battery box waterproof grade	IP55		
18	Battery box weight	2.3 tons (valuation)		
19	Packing material	Wooden trailer		

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4.4 Environmental Characteristics

(Charge according to the standard, fully charged, stand 0.5h to do the following tests)

Environment Temperature	Discharge current	Battery capacity requirement
25℃	1.0I1A	The measured capacity of discharged battery is not less than 100% of the nominal capacity, and the appearance of no deformation and no rupture
0℃	1.0I1A	The measured capacity of discharged battery is not less than 90% of the nominal capacity, and the appearance of no deformation and no rupture
-0℃ 1.0I1A 10℃	1.0I1A	The measured capacity of discharged batteries is not less than 75% of the nominal capacity, and the appearance of no deformation and no bursting
55℃	1.0I1A	The measured capacity of discharged battery is not less than 95% of the nominal capacity, and the appearance of no deformation and no rupture

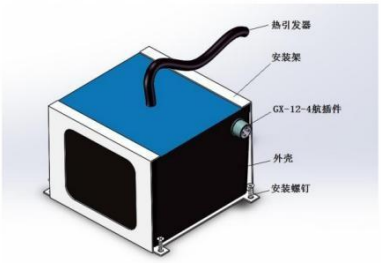
4.5 Safety Characteristics

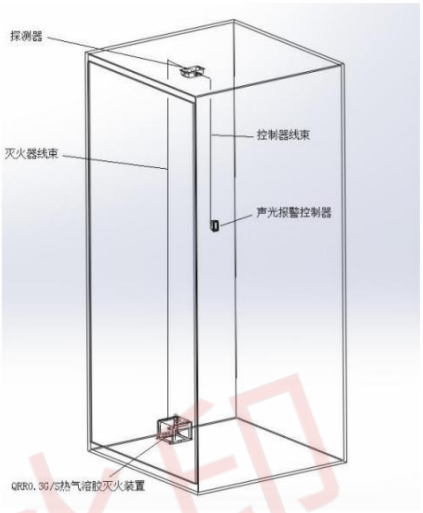
Item	Specification	Remarks
Insulation	≥10MΩ	With the insulation resistance tester DC 500V test voltage, the battery positive and negative terminal interface (terminal) respectively to the battery pack metal shell test, insulation resistance value ≥10MΩ.
Strong insulation	No breakdown, no flying arc phenomenon	Battery positive and negative terminal interfaces respectively on the battery pack metal casing can withstand 50Hz, RMS 500V AC voltage (leakage current ≤ 10mA) or 710V DC voltage for 1min, there should be no breakdown, no flying arc phenomenon.
Anti-submerging	No leakage, no smoke, no fire or no explosion.	Fully charged battery pack immersed in 3.5% NaCl solution, the depth of water should be completely submerged in the battery pack, keep 2h, take out, in the ambient temperature 15 ℃ ~ 35 ℃, relative humidity 25% ~ 85%, atmospheric pressure of 86kPa ~

		106kPa under the placement of 4h.
Drop resistance	No obvious damage, no leakage, shell rupture, fire or explosion, etc., no displacement of the battery pack and each position when shaken up and down. No displacement of the battery pack and each machine position when shaking up and down.	The battery pack is fully charged, choose 6 angles arbitrarily, from the set height of the highest point (0.8 meters to 1.5 meters). (0.8 meters ~ 1.8 meters) at the highest point of free fall to the concrete ground 1 time.
Constant humidity	No obvious deformation, corrosion, smoke or explosion, and its capacity should be not less than 90% of the measured reference capacity.	After the battery pack is fully charged, when there is BMS, put it into 60℃±2℃, relative humidity. ± 2 ℃, relative humidity of 90% ~ 95% of the constant temperature and humidity box after 12h, and then take it out in the ambient temperature of 25 ℃ ± 2 ℃ under the condition of 2h, visual inspection of its appearance, and then with 1.0I1A Then discharge it with 1.0I1A current to the termination voltage.

4.6 Thermal aerosol fire extinguishing device

- Thermal aerosol automatic fire extinguishing device consists of shell, initiator (electric initiator or thermal initiator), insulation system, aerosol generator, cooling system, mounting screws, mounting bracket, GX12-4 four-core navigation plug-in and so on.





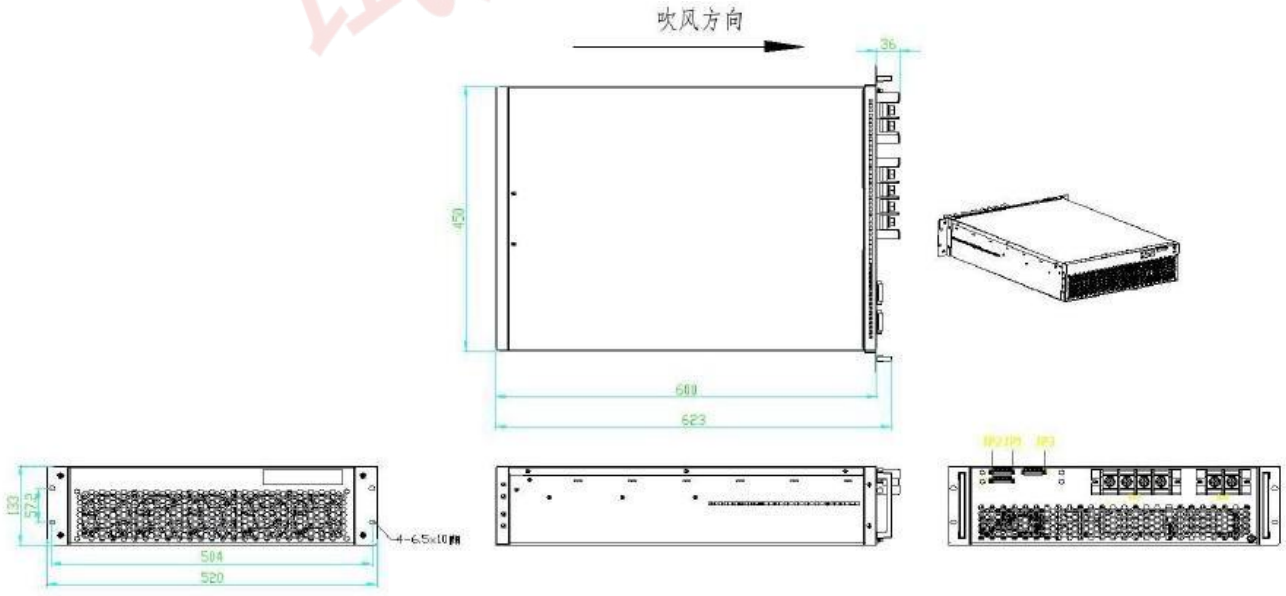
- The controller adopts warping board type switch controller, with sound and light alarm and manual start function, when the temperature of the detector electric detection exceeds 80℃ and the CO concentration exceeds 190PPM, the detector will be triggered to realize sound and light alarm through the controller. When it is confirmed that a fire has occurred, the emergency button on the controller can be manually activated to start the fire extinguishing device, so as to release the aerosol extinguishing gas and extinguish the fire. Controller working voltage: DC12V/24V.

4.7 DCDC Module and PCS

4.7.1 DCDCTechnical Parameters and Outline Diagram

Product name	DC/DC Bidirectional Converter
DC voltage on BAT side (V)	Voltage range 300-900V, full load 300-900V
High voltage side battery voltage (V)	Voltage range 300-900V, full load 500-900V
Rated power (KW)	100kW

Peak power (KW)	110 kW(10min)
Rated current of low voltage side (A)	320A
Rated current on high voltage side (A)	200A
Voltage measurement accuracy	1% of the total voltage
Current Measurement Accuracy	1% of current measurement accuracy
RMS current ripple	≤2%
Maximum efficiency	≥99%
Charge to discharge conversion time	Less than 20ms
MPPT function	Possess
Number of MPPT channels	1 way
Working Mode	LV side constant voltage, LV side constant current, LV side constant power, HV side constant voltage, HV side constant current.



4.7.2 PCSTechnical Parameters and Outline Drawing

DC Side Parameters		
Number of circuits	1	

DC voltage range	DC600V～900V	
Maximum DC current	192A	
Rated DC power	100kW	
Voltage stabilization accuracy	≤±2%	
Accuracy of current stabilization	≤±5%	
Voltage limiting characteristic	Possess	
Current Limit Characteristics	Possess	
AC Grid Parameters		
Rated output power	100kW	
Overload capacity	1.1 times long term, 1.2 times 1min	
Rated Voltage	AC 400V	
Rated output current	145A	
AC access method	Three-phase four-wire	
Isolation method	No	
Grid voltage range	400V(-20%～+15%)	
Grid frequency range	50Hz/60Hz±2.5Hz	
Total harmonic distortion rate of current	≤3% (full load)	
Power factor	-0.99～+0.99	
Current DC component	≤0.5%	
Charge/discharge conversion time	<100ms	
AC off-grid parameters		
AC off-grid voltage	AC400V	
AC Voltage Range	AC400V±3%	
AC Off-grid Frequency	50Hz/60Hz	

Off-grid output THDU	≤3% (linear load)	
Unbalanced load capacity	100%	
Other Parameters		
Maximum conversion efficiency	≥98%	

Allowable ambient temperature	-20℃～50℃(>45℃ need to be reduced)	
Allowable relative humidity	≤95% (℃)	
Noise	≤75dB	
Protection grade	IP20	
Altitude	Greater than 2000 meters need to derate the use of	
Dimension	W480mm×H186mm×D620mm	
Structure and heat dissipation of PCS module	Rear panel of primary terminal, front panel of secondary terminal, front air in and rear air out;	
Ventilation volume of PCS module	467(CFM)	
PCS module air inlet effective minimum Smallest area	43232(mm2)	Effective ventilation area without louvers and with inlet and outlet facing the module
Effective minimum area of the air outlet of the PCS module Effective minimum area of PCS module outlet	69171(mm2)	
Weight of PCS module	50KG	
Cooling Method	Forced air cooling	
Multi-module network	DC side separate - AC side parallel / AC/DC double parallel	
Emergency stop function	The IO of the module receives the emergency stop switch command	
Human-computer interaction	Module does not come with LCD screen, need to be connected to 7-inch configuration screen.	
BMS communication interface	CAN	
EMS communication interface	Network interface	
Inter-module communication	Fiber Optics	
Communication with the screen	Network port	

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4.8 Thermal Management System

4.8.1 Air conditioning product parameters

Item	Unit	Parameter
Working ambient temperature	Temperature	-40 to +55
Rated AC Input Power		220±15%VAC~50Hz
Cooling Capacity(L35/L35)	W	3000
Rated AC Input Power(L35/L35)	W	1375
Rated current (L35/L35)	A	6.4
Heating capacity	W	2000
Dimension of box(H*W*D)	width *depth	1300*500*250
Overall dimensions with flange(H*W*D)	Dimension(H*W*D)	1350*550*250
Weight (kg)	Kg	63
Installation		Door mounting embedded 60mm
Maximum sound pressure noise	dB(A)	70
Waterproof and dustproof grade		IP55
Refrigerant		R134a
Lifespan	Years	>10
Surface treatment		Electrostatic spraying (RAL7035)

4.8.2 Air conditioner external dimension drawing

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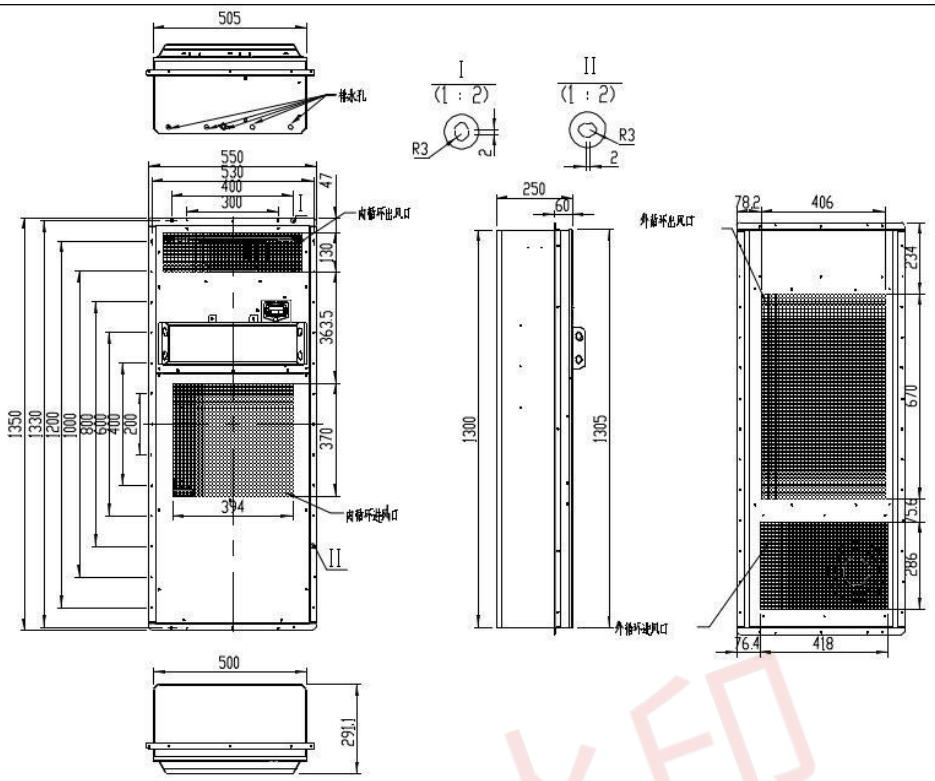

4.8.3 Product Function

- Cooling

The air conditioner can set parameters through the display or background software: cooling set temperature and cooling deviation temperature. When the temperature inside the cabinet is higher than (refrigeration set point + refrigeration deviation), the refrigeration starts; when the temperature inside the cabinet is lower than the refrigeration set temperature, the refrigeration stops.

Refrigeration Parameter Setting Points

Parameter	Default value	Setting range	Unit
Refrigeration set point	29	[16～38]	℃
Cooling deviation temperature point	6	[1～10] ℃	℃

- Heating

The air conditioner can be set by setting the parameters: heating set temperature and heating deviation temperature. When the temperature inside the cabinet is lower than

the heating set temperature, the heating will start; when the temperature inside the cabinet is higher than (heating set temperature + heating deviation temperature), the heating will stop.

Heating Parameter Setting Points

Parameter	Default value	Setting range	Unit
Heating Setting Temperature Point	5	[5～26]	℃
Heating deviation temperature point	10	[0～10]	℃

● Air supply

The air conditioner can realize uniform temperature distribution inside the cabinet by air supply function to avoid local overheating inside the cabinet. When the temperature inside the cabinet

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If the temperature is lower than the refrigeration opening temperature, the air supply function will be opened automatically.

● Dehumidification

When the humidity in the cabinet is greater than the dehumidification opening humidity (default 80%, range 50% to 99%), and the temperature in the cabinet is less than the dehumidification opening temperature (default 25 ℃, range 20 to 40 ℃), turn on the electric heating dehumidification; when the temperature in the cabinet rises to the dehumidification stopping temperature (default 30 ℃, range 25 to 50 ℃), or the humidity drops back to the dehumidification stopping humidity (default 75%, range 50% to 99%) stop heating.

Parameter	Default Value	Setting range	Unit
Dehumidification on temperature	25	20～40℃	℃
Dehumidification stop temperature	30	20～45℃ ℃	℃
Dehumidification open humidity	80	50～99	%
Dehumidification stop humidity	75 to 95	45～95	%

Note: Dehumidifying function and cooling function cannot be turned on at the same time.

4.9 BMS Battery Management System

4.9.1 BCMUSystem Function

BCMU-H mainly controls and manages the information of the whole group of batteries (1500V battery system), collects the total voltage, current and temperature of the whole group of batteries, collects the information of individual batteries, and alarms and protects the abnormalities of the battery group. BCMU-H can protect the battery pack according to the requirements of safety handling rules to ensure the safe and stable operation of the battery system. When the battery is seriously over-voltage, under-

voltage, over-current (short-circuit), leakage (insulation) and other abnormal faults, the battery pack control management unit can control the opening and closing of the whole group of batteries to avoid over-charging, over-discharging and over-current of the batteries. BCMU-H mainly has the following functions:

- Real-time monitoring of group terminal voltage, current, temperature and insulation resistance of the battery pack;
- Real-time calculation of SOC and SOH of the whole battery pack;
- The module has wet contact, dry contact output, switch input detection port, etc.;
- The module has CAN and RS485 communication interfaces to receive and upload data and alarm information in real time to achieve remote monitoring of the battery pack.

4.9.2 BCMUtechnical parameters

Item		Parameter		Remarks
		Technical Parameter	Unit	
Power supply	Power supply voltage	DC24V±10%	Vdc	
	Rated Power Consumption	<3	W	
Group end voltage Acquisition	Acquisition range	0～1500	V	
	Accuracy	0.2%FS		
Current Sampling	Acquisition range	±300	A	Based on shunt & Hall sensor
	Acquisition Accuracy	0.2%FS		Full Scale
	Number of channels	4 channels	Number of channels	

	Collection range	-40～125	Temperature	
	Acquisition accuracy	±1	℃	
DO	Number of channels	8 channels	Number of Channels	6 low-side outputs.
	Output capacity	2A@30VDC		2 dry contact outputs
DI	Number of channels	6	Number of channels	Passive feedback signal input
	Switching input	Passive 24VDC		
Insulation Resistance	Acquisition range	0 to 100	MΩ	
	Acquisition Accuracy	10%FS		
CAN	CAN0	1	Path	Communication between BCMU-H and BAMS
	CAN1	1 way	Communication between BCMU-H and BMU	Communication between BCMU-H and BMU
	CAN2	1 way	Road	Reserved
	Baud rate	250	Kbps	(default)
RS485	RS485-0	1	Road	Reserved
	RS485-1	1CH	Road	Reserved
	Baud rate	9600	bps	(default)
Dimensions & Weight		220*98*45mm/0.34kg		
Installation		Wall Mount		

4.9.3 BMUsystem function

- Real-time monitoring of voltage and temperature of single cell battery;
- Real-time calculation of SOC, SOH of single battery;
- The module has bi-directional active equalization, which improves the consistency of the battery pack and effectively extends the battery life;
- The module has dry contact output, which can be alarmed on site or controlled remotely;
- Module with CAN communication interface, real-time data and alarm information, to achieve remote monitoring of the battery pack;
- Modular design, easy to install, use and maintain, and the modules are isolated from each other, high reliability.

4.9.4 BMUTechnical Parameters

Technical Parameters	Rated specification	Remarks
Module supply voltage	DC24V±20%	
Module power supply power	<2W	Without equalization power
Battery Monitoring Sections	26 sections	Maximum single support (13+13)
Voltage detection range	0~5V	
Voltage Detection Accuracy	±3mV	
Temperature detection number	28 units	Maximum support for a single unit
Temperature detection range	-40～125℃	
Temperature detection accuracy	±1℃	
Battery equalization	Bidirectional active equalization	
Battery equalization current	2A	

Fan control mode	Start-stop; PWM	Support fan feedback detection
Input insulation resistance	≥50MΩ,2500VDC	
Data communication interface	CAN	
Baud rate	250Kbps (default)	
Dry contact output	1 way, 2A@30VDC	Control fan DC24V power supply
Dimension and weight	185*105*23(mm)/0.5Kg	
Installation	Wall Mount	

4.10 EMS Energy Management System

Microgrid Energy Management Control System (EMCS) Selection and Design

3.3.1 Introduction to Microgrid EMCS System Functions

The microgrid energy management control system is the core component of the whole microgrid system, which provides data management, monitoring, control and optimization for the microgrid dispatching and control center, and guarantees the stable and efficient operation of the energy storage system.

The microgrid energy management control system in this project consists of an energy management system (EMS) and an energy control system (ECS). The former mainly realizes the conventional power collection and monitoring, data processing, and cloud services in the microgrid, while the latter mainly realizes the real-time power control, load balance control, and all kinds of dynamic regulation and control of the energy storage system, PV system, diesel system, loads, and distribution system in the microgrid. The latter mainly realizes real-time power control, load balance control, and all kinds of dynamic regulation and control of the microgrid's internal energy storage system, PV system, diesel system, loads, and distribution

system, so as to ensure that the power demand of all loads in the system is met, the PV system is maximally utilized, the diesel system is started as few times as possible, the storage system is dynamically optimized and balanced, and the system meets the operating agreement with the main grid system, so as to minimize the energy consumption and system loss as much as possible, and to provide the logic and control method for islanding and reclosing in the event of system failure.

The Energy Control System (ECS) is the central key to this project.

The micro network EMCS system has multiple 485 communication ports, multiple CAN communication ports, and multiple Ethernet interfaces. Meters, air conditioners, etc. are accessed by 485 communication, and PCS, BMS, IO port expansion box, etc. are accessed by Ethernet communication. The fire controller, contactor, etc. feed back information and control through IO dry contact signals.

The microgrid EMCS system can upload the energy storage system body, PCS, BMS equipment level information according to the dispatching requirements, and has the function of receiving the curve issued by the dispatching system.

Core modules for microgrid energy control (ECS) systems

3.3.2 Microgrid EMCS Automatic Control Strategy

System operation logic:

When there is light, photovoltaic power generation is used as the main source of electricity for loads, and the overflow electricity is charged into the energy storage battery. When there is no light, the

energy storage serves as the main power supply device for the load.

In the absence of light and with energy storage below the threshold, the diesel engine starts and runs at maximum efficiency for the load and the overflow power is recharged into the battery.

1. The microgrid model

1.1 Chai Fa Control Strategy

Diesel condition: Battery SOC lower than set point, PV power - load power <set value. Off Diesel condition: utility power is normal, or battery SOC is higher than set point.

NOTE: Priority is given to the use of the main engine. If the main diesel engine fails and cannot be started, use the backup diesel engine (if available).

1.2 Photovoltaic Control Strategy

Conditions for turning on the PV inverter: PV cell voltage meets the conditions for turning on the inverter

Conditions for switching off the PV inverter: The PV cell voltage does not meet the operating conditions, the load does not have a power demand and the batteries are full.

The EMS controls the maximum power generated by the PV so that it varies with the maximum permissible charging power of the battery and the load power, thus ensuring that the battery operates within safe limits and that the PV power can be used directly for the load or for recharging the battery.

1.3 PCS control strategy

The PCS operates in grid-connected mode when the diesel engine is on or the utility power is normal, and in off-grid mode when the diesel engine is off and the utility power is off.

Switching cabinets and ATS switches are flexibly switched by the microgrid control system.

2. Diesel hybrid mode: When PV cannot generate electricity in extreme weather and the SOC of energy storage is lower than the threshold value, at this time, the diesel engine will be the power supply, and the diesel engine will have different fuel consumption according to the change of the load, so

in order to minimize the fuel consumption and reduce the environment and noise pollution, at this time, it will automatically run in the "diesel hybrid mode". will control the charging or discharging of the energy storage system according to the peaks and valleys of electric load, and control the power of the diesel engine. According to the peaks and valleys of electric load, the energy storage system is controlled to charge or discharge, and the power of diesel engine is controlled.

When the diesel fuel is used as power supply, the microgrid controller controls the diesel fuel to run at the highest efficiency point, and the whole system not only realizes the priority of photovoltaic, but also extremely reduces the fuel consumption and the cost of electricity.

When the diesel power at the highest efficiency point > load power, the diesel charges the load while charging the storage battery.

When the diesel power at the highest efficiency point is lower than the load power, the diesel and the energy storage will supply power to the load together. If the SOC of the storage battery is too low, the system issues an overload warning in advance.

3.Backflow prevention function

A: If the load power P1 is greater than the PV power, the load power can be supported by both battery discharge and PV power.

B: If the load power P2 is smaller than the PV power, then the battery power SOC is prioritized, and when the SOC is too high, the PV power will be reduced to match the load power to prevent the PV power from impacting the diesel generator. Achieve to the most economical and safest power consumption strategy.

3.3.3 Microgrid EMCS Data Monitoring List

The list of microgrid EMCS monitoring data primarily includes, but is not limited to, the following tables. Table 3.9 Battery System Monitoring Information

serial number	Monitoring content	serial number	Monitoring content
1	Total Battery Pack Voltage	2	Battery pack current
3	SOC	4	SOH
5	Charge cut-off voltage	6	Discharge cutoff voltage
7	Maximum charging current	8	Maximum discharge current
9	Maximum Cell Voltage	10	Minimum Cell Voltage
11	Maximum Single Cell Voltage No.	12	Minimum Single Cell Voltage No.
13	Maximum Single Cell Temperature	14	Minimum cell temperature
15	Maximum Single Cell Temperature No.	16	Minimum Single Cell Temperature No.
17	Battery pack high temperature alarm	18	Battery cell high temperature alarm
19	Battery pack charging high voltage alarm	20	Battery Single Charge High Voltage Alarm
21	Battery Discharge Low	22	Battery Single Discharge

	Voltage Alarm		Low Voltage Alarm
23	Battery pack discharge overcurrent alarm	24	Battery pack charging overcurrent alarm

Table 3.10 PCS and Auxiliary System Monitoring Information

serial number	Monitoring content	serial number	Monitoring content
1	PCS Basic Parameters	2	running normally
3	operational anomaly	4	Fault Alarms
5	Charge and Discharge Status	6	Charging Current
7	discharge current	8	Battery pack voltage

5.1 Appearance diagram and size of energy storage system

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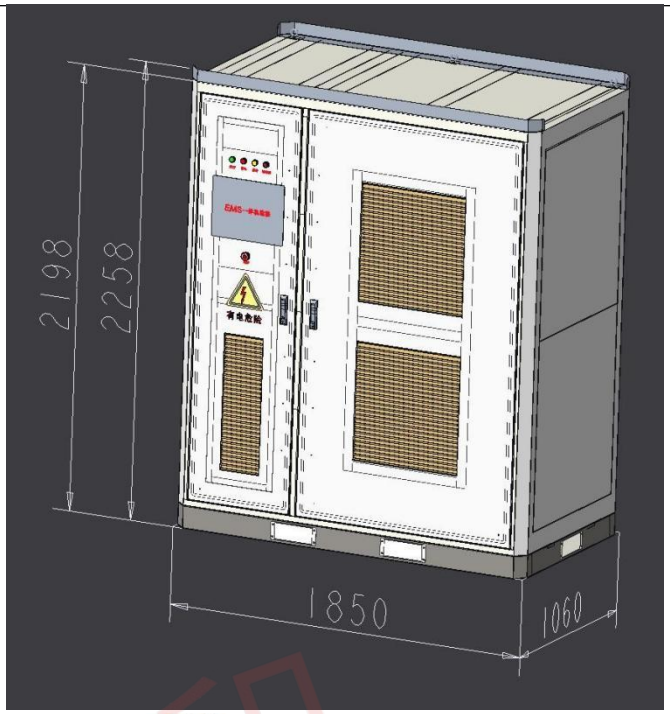

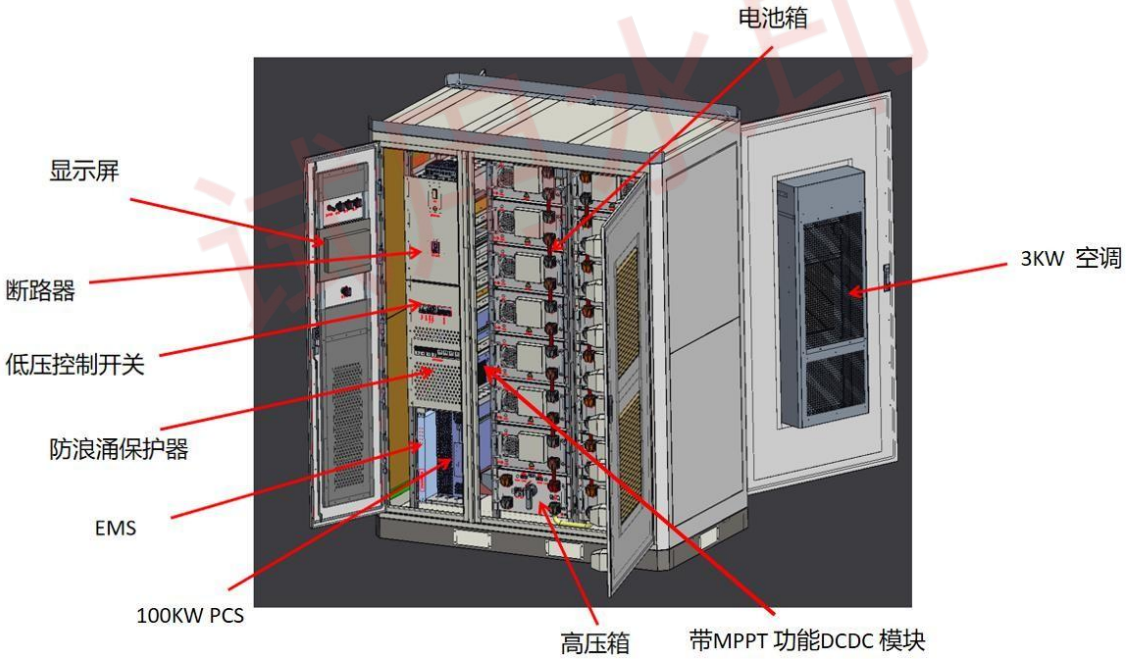

5.2 Battery Module Schematic

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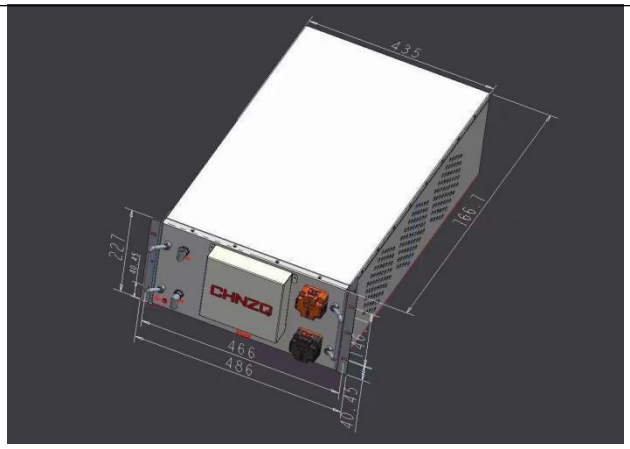
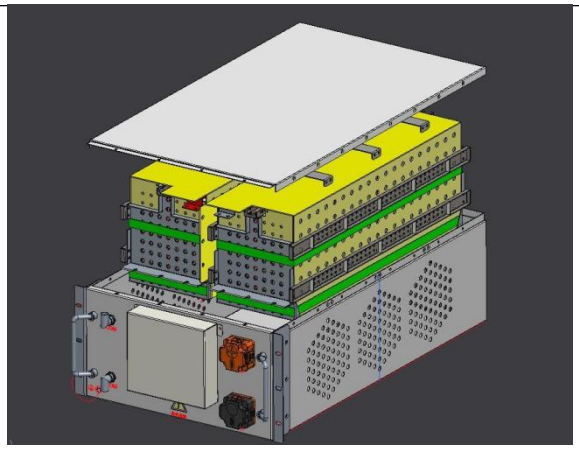
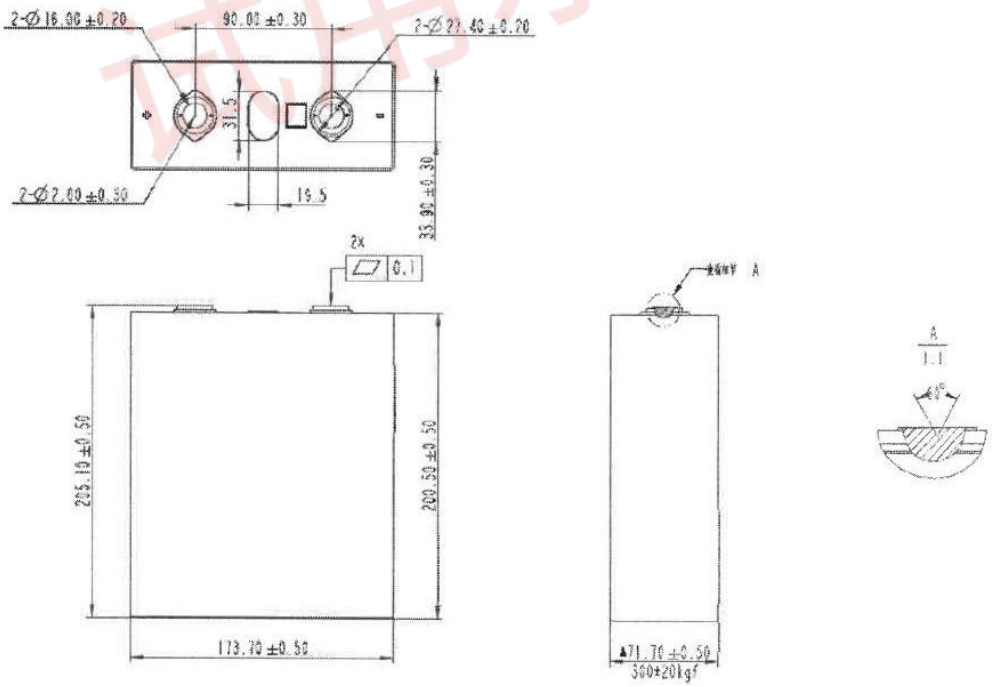




5.3 Battery cell size diagram

- The battery cell adopts a mature standard A-grade 280Ah lithium iron phosphate (LFP) square aluminum cell produced by a fully automated production line. This cell has high continuous power, high cycle life, high storage life and high safety. (As shown in the picture)



Battery Appearance Dimension Diagram

5.4 Schematic diagram of high voltage case

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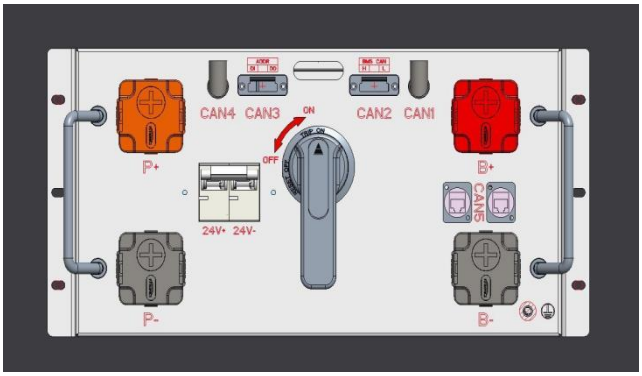
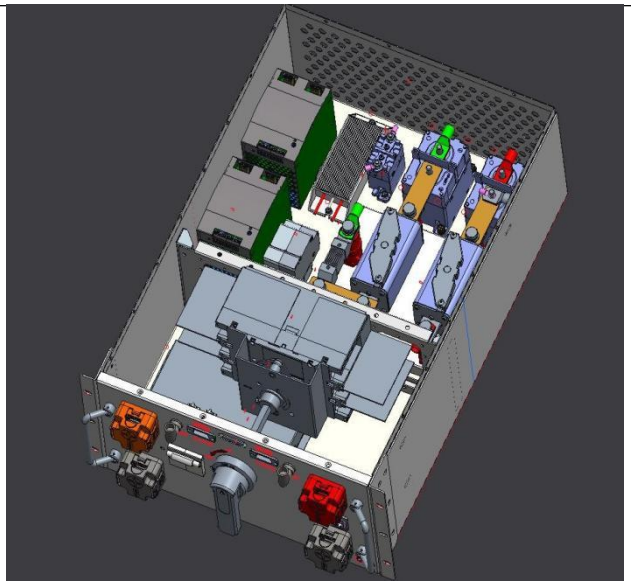
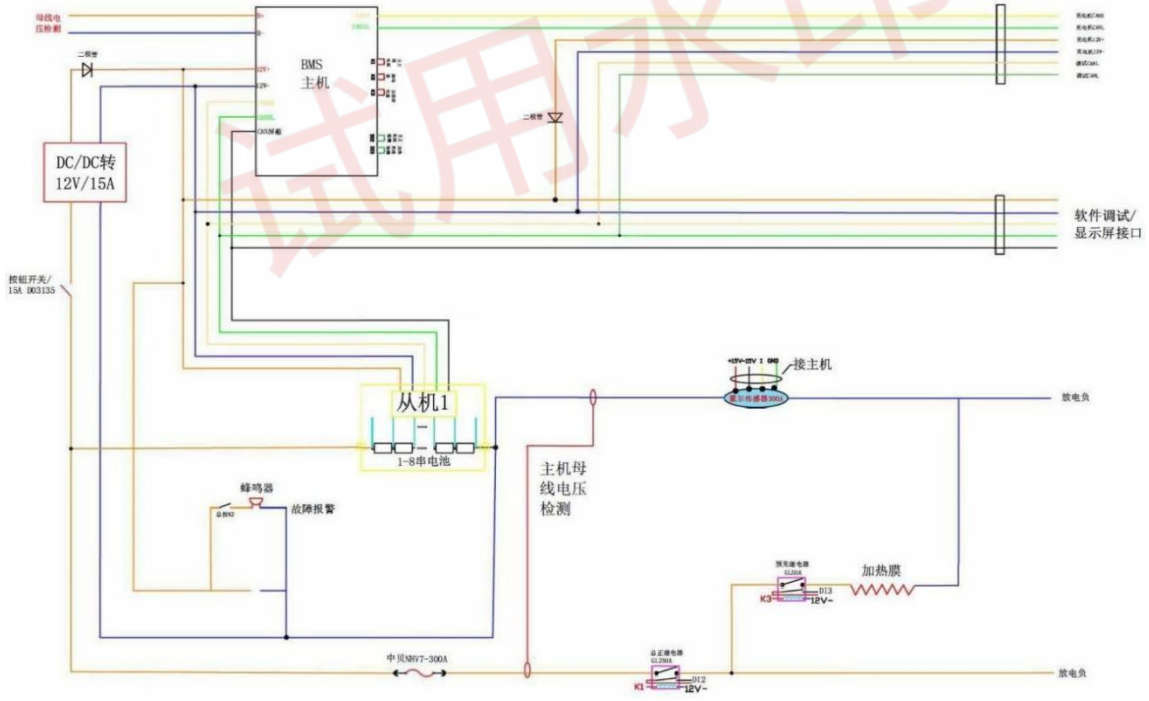




Electrical principle of battery and working principle diagram of energy storage system



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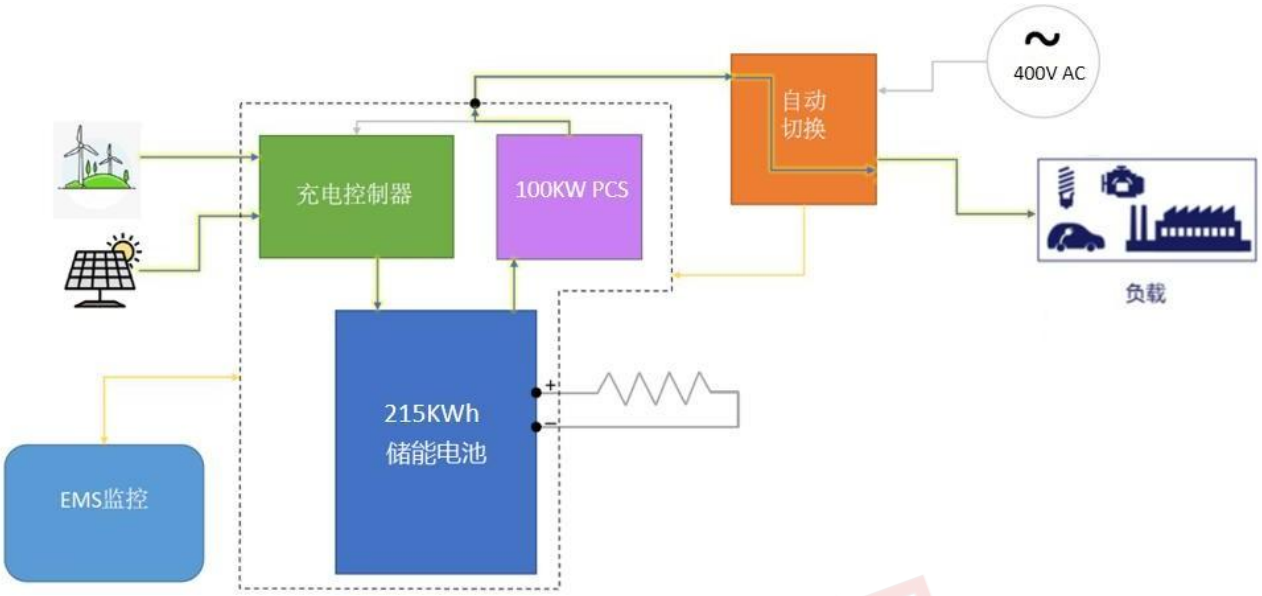

VII. Conditions of use

7.1 Packing

7.1.1 Packing: ☐ Neutral carton (domestic) ☐ Dangerous package carton (export) Wooden pallet (bulk container export).

7.1.2 Each battery pack should have an outer packaging, and should be accompanied by product manuals, certificates. Packaged products should be placed in a dry, dust-proof, moisture-proof box, dangerous goods box should be marked on the outside of the product name, model, voltage, capacity, quantity, gross/net weight, LOGO, battery serial number, etc., neutral container does not contain the above. There should be necessary markings such as "Handle with care", "Fear of moisture", "Upward", "Fear of fire", etc.

7.1.3 Accompanying information: shipping inspection report, product manual, software of the host computer, communication agreement (electronic file), etc.

7.1.4 Anti-vibration and anti-pressure measures: Both sides (top and bottom) of the battery module should be filled with anti-vibration materials.

7.1.5 Waterproof, anti-dispersion, handling: battery module set of nylon bags, packing tape tightening, pallet.

7.2Transportation

Battery packs should be packed into boxes for transportation, and should be prevented

from violent vibration, impact or extrusion during transportation, and prevented from sunshine and rain, and can be transported by cars, trains, ships, airplanes and other means of transportation.

7.3Storage

7.3.1 Batteries should be stored in a clean place with an ambient temperature of -5℃~35℃ and a relative humidity of not more than 75% at a charge state of 20%~40%,

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Dry, ventilated and protected from rain and snow indoor, and should be placed flat and cushioned, not less than 100MM from the ground;

7.3.2 Batteries should not be stored with active chemicals or dusty items;

7.3.3 The battery should not be subjected to any mechanical shock or heavy pressure;

7.3.4 Batteries should be kept out of direct sunlight, away from sources of ignition, and not less than 2M away from sources of heat;

7.3.5 From the date of manufacture, every 3 months of storage should be 0.2 ~ 0.5C current replenishment 30 ~ 60min, the temperature range of 25 ℃ ± 5 ℃.

8, the use of responsibility

Users must use the battery according to the instructions on the battery label or this battery specification of SY New Energy(shangrao)Co.,Ltd The company will not be responsible for any damage caused by overheating, fire or explosion of the power system due to improper use.

Danger

Failure to read the following may result in battery leakage, explosion or fire.

(1) Do not put the battery into water or get it wet;

(2) Do not use or store batteries near sources of heat (such as fire or heaters);

(3) Do not reverse the positive and negative terminals;

(4) Do not connect the battery directly to a wall outlet or vehicle cigarette lighter outlet;

(5) Do not put the battery into a fire or heat it;

(6) Do not short-circuit the positive and negative terminals of the battery with wires or other metal objects, and do not transport or store the battery with necklaces, hairpins or other metal objects;

(7) Do not hit, throw or subject the battery to mechanical shock;

(8) Do not pierce the battery case with nails or other sharp objects, hammer or step on the battery;

(9) Do not disassemble the battery in any way;

(10) Prohibit charging the battery under fire or extreme heat.

(11) Do not place the battery in a microwave oven or pressure vessel;

(12) It is prohibited to use the battery in combination with primary batteries (e.g. dry cell batteries) or batteries of different capacities, models and varieties;

(13) Do not use the battery if it emits strange odor, heat, deformation, discoloration or any other abnormal phenomenon; if the battery is in use or charging, it should be immediately removed from the appliance or charging equipment and stop using it;

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(14) Batteries should be kept out of the reach of children;

(15) If the battery leaks or emits a strange odor, it should be immediately removed from close to open flames; the leaking electrolyte may cause a fire or explosion;

(16) If the electrolyte gets into your eyes after the battery leaks, do not rub it, flush it with water, and seek medical assistance immediately. If not treated in time, the eyes will be harmed.

X. Precautions

- Please use the lithium battery pack in strict accordance with the instruction manual. If the battery leaks and the electrolyte gets on the skin or clothes, immediately wash the affected area with running water, otherwise it may lead to skin inflammation.
- Read the instruction manual of the battery pack and install and remove the battery correctly.
- If the terminals of the battery pack become dirty, wipe them with a dry cloth before use. Otherwise, the battery pack may not make good contact, resulting in energy loss or failure to charge.
- It is strictly prohibited to disassemble or repair the battery system without professional handling.
- The battery system must be charged with a charger specifically designed for this battery system.
- It is strictly prohibited to immerse the power system in water or salt water, when not in use, please keep the battery in a cool and dry environment.
- If during charging or discharging the power system emits a strange odor, becomes hot, discolored or deformed, or appears abnormal in any way, stop the operation immediately and seek professional treatment.
- When the battery catches fire, dry sand or nitrogen extinguisher should be used to extinguish the fire.
- It is strictly prohibited to put the battery system into fire or heat source.
- When installing or using the battery, please remove metal jewelry or other metal objects, and be careful when placing the battery, especially when putting it into

metal containers.