BSLBATT®

Best Solution Lithium Battery

BSLBATT C&I ESS

User Manual

500kW / 1MWh

Version: V1.0.0

Release Notes

Version	Date	Version Update Record	Approved
V1.0.0	2024-07-08	V1.0.0	

Catalogs

1. Safety Instructions

1.1. Description of Safety Symbols

When installing, operating, and maintaining the equipment, please read this manual first and follow all the safety precautions marked on the equipment and in the manual. To ensure the user's better use of this product and to protect personal and property safety, the following symbols are used to prompt, please read carefully.

Distress: Indicates a highly potentially hazardous situation which, if not avoided, will result in death or serious injury.

Warnings: Indicates a situation of moderate potential hazard that could result in death or serious injury if not avoided.

Note: Indicates a situation with a low potential hazard that, if not avoided, could result in moderate or minor injury to personnel.

Instructions: Emphasis and additions to the content may also provide tips for optimizing the use of the product.

1.2. General security

Instructions:

This equipment should be used in an environment that meets the design specifications, otherwise, it may cause equipment failure, and the resulting abnormal equipment function or damage to parts, personal safety accidents, property damage, etc. are not covered by the equipment quality warranty. Local laws, regulations, and codes should be observed when installing, operating, and maintaining the equipment. The safety precautions in this manual are only supplementary to local laws, regulations, and codes. The Company shall not be liable in the event of any of the following occurrences.

- The installation and use environment exceeds that specified in the relevant international, national, and regional standards.
- Does not operate in the conditions of use described in this manual.
- Unauthorized disassembly, alteration of the product, or modification of the software code.
- Failure to follow the operating instructions and safety warnings in the product and documentation.
- Damage to the equipment caused by abnormal natural circumstances (force majeure, such as earthquakes, fires, windstorms, floods, mudslides, etc.).

- Damage caused by the customer's failure to follow transportation and installation requirements.
- Damage caused by storage conditions that do not meet product documentation requirements.
- Damage to the hardware or data of the device due to customer negligence, incorrect operation, or intentional damage.
- Damage to the system caused by a third party or the customer, including damage caused by relocating and installing the system in a manner that does not comply with the requirements of this manual, and adjusting, altering, or removing identifying marks in a manner that does not comply with the requirements of this manual.
- Defects, failures, or damages caused by acts, events, negligence, or accidents beyond the reasonable control of Seller, including power outages or electrical failures, theft, war, riots, civil commotion, terrorism, willful or malicious damage.

 **Distress:**

- The equipment is subject to high voltages, and unregulated operation may cause electric shock or fire, resulting in death, serious personal injury, or severe property damage. Please follow the operating sequence and safety precautions given in this manual and other related documents to regulate the operation:
- Check that the device's pre-installed cable connections are tight. Check the device for damage, such as holes, dents, or other signs of possible internal damage. Check that the internal parts of the equipment are not displaced. It is prohibited to change the structure, installation order, etc. of the equipment without authorization.
- It is prohibited to clean the electrical parts inside the equipment with water. If liquid is found inside the equipment, immediately press the emergency stop switch and notify the site manager.
- Do not carry out installation, wiring, maintenance, and replacement operations with electricity. Measure the voltage at the point of contact before touching any conductor surface or terminal, and make sure that the protective earth wire of the equipment or parts to be serviced has been reliably grounded and that there is no danger of electric shock.
- Do not approach the equipment except for the person who is to operate the equipment. Do not energize the equipment without completing the installation or confirming by a qualified person. When powering up the unit for the first time or when the main circuit is energized, ensure that at least two persons are present.

 **Instructions:**

- The user's operating behavior and operating tools during transportation, handling, installation, wiring, and maintenance must meet the laws, regulations, and relevant standard requirements of the country or region where they are located.
- When installing, operating, and maintaining, it is necessary to clean the top of the cabinet of accumulated water, ice snow, or other debris before opening the cabinet door to avoid debris falling into the cabinet.
- It is prohibited to reverse engineer, decompile, disassemble, adapts, implant, or other derivative operations of the equipment software, to study the internal implementation of the equipment in any way, to obtain the source code of the equipment software, to steal intellectual property rights, etc., or to disclose the results of any equipment software performance tests.

1.3. Electric Safety

1.3.1. Wiring requirements

- Please choose cables that meet the requirements of local laws and regulations. Cables of the same type should be tied together, and cables of different types should be laid separately, and mutual winding or cross-laying is prohibited.
- When the wiring is completed or when you leave for a short time during the wiring process, you need to immediately seal the cable opening and close the cabinet door to prevent small animals from entering.
- The cables used in the energy storage system must be firmly connected, and well insulated, and the specifications meet the requirements. Cable through the pipe or the hole location, there must be protection to avoid cable damage by sharp edges, burrs, and so on.
- Cable wiring is completed, you need to use the cable bracket and cable clamps for reliable fixing and backfill the soil area of the cable to ensure that the ground is closely affixed to prevent backfilling soil, cable deformation, or damage caused by the force.
- Cables used in high-temperature environments may cause aging and breakage of the insulation layer, and the distance between the cable and the periphery of the heat-generating device or heat source area is at least 30mm.
- To ensure construction safety, all cables should be laid and installed above 0℃. When handling the cables, especially when constructing in a low-temperature environment, the cables should be gently held and placed.

1.3.2. Grounding requirements

- Tampering with the grounding conductor is prohibited. The grounding body of the equipment should be permanently connected to the protective grounding grid.

Before operating the equipment, the electrical connection of the equipment should be checked to ensure that the equipment has been reliably grounded.

- The equipment grounding impedance meets the requirements of national standard GB 50054 and local electrical standards.
- It is prohibited to operate the equipment when no grounding conductor is installed. When installing the equipment that needs to be grounded, the protective earth conductor shall be installed first; when removing the equipment, the protective earth conductor shall be removed last.

1.3.3. Inspection Requirements

- Before connecting or removing cables, disconnect the protective switch of the corresponding circuit.
- Use a multimeter of the corresponding voltage level to check for electrical charges and make sure that the equipment is completely de-energized.
- If there is an energized body in the vicinity, use an insulating board or insulating tape to cover or wrap it.
- Use a grounding wire to reliably connect the circuit to be serviced to the grounding circuit before carrying out operation and maintenance.

Instructions:

- Before connecting the cables, make sure that the cable labels are correctly identified before connecting.
- If the equipment has multiple inputs, disconnect all inputs to the equipment and wait until the equipment is completely powered down before operating the equipment.
- After maintenance is complete, remove the grounding wire between the maintenance circuit and the grounding circuit.

1.4. Mechanical Safety

Note:

- The bottom enclosure must be removed for forklift transportation without wooden crates. Lifting and lowering should be carried gently and put down lightly to avoid impact or vibration.
- The center of gravity of the crate during transportation should fall in the middle of the two forks on the forklift. It is forbidden to carry the equipment for a long distance or invert or tilt it.

- When transporting the equipment, the operator's vision may be blocked due to the large size of the equipment, and it is necessary to arrange auxiliary personnel to assist in the completion.
- To ensure the safety of drilling holes outside the body of the equipment, a suitable location should be selected before drilling to ensure that it will not cause short circuits and other effects. During the drilling process, the equipment should be covered to prevent debris from falling into the equipment, and the debris should be cleaned up in time after drilling.
- When carrying the equipment by hand, you should be prepared to bear the weight, and you should wear protective gloves, anti-smash shoes, and other safety gear.
- Move the equipment carefully during handling to avoid impact or falling. Avoid scratching the surface of the equipment, damaging parts or cables.

1.5. Battery Safety

Instructions:

We are not responsible for damage to the batteries supplied by us caused by the following reasons:

- Failure to charge and accept the battery in time due to customer reasons, resulting in battery overstorage, loss of capacity irreversible damage, etc.
- Mechanical damage, liquid leakage, rupture, etc. caused by dropping the battery due to improper operation or not connecting the battery as required.
- The customer or a third party does not know the Company and change the battery use scenarios by themselves. This includes but is not limited to connecting additional loads to the battery, mixing with other brands of batteries, mixing with batteries of different rated capacities, etc.
- Direct damage to the battery is caused by the operating environment of on-site equipment or external power parameters that do not meet the environmental requirements for normal operation. Including the actual operating temperature of the battery is too high or too low, poor power grid conditions, and frequent power outages.
- The customer did not set the battery operation and management parameters correctly or improper maintenance was caused by frequent over-discharge of the battery, the customer's site expansion, or long-term inability to fully charge.
- The customer does not carry out proper maintenance of the battery according to the operation manual of the supporting equipment, including but not limited to not regularly checking whether the battery terminal screws are tightened.
- The battery is lost by theft.

- Batteries that have exceeded the warranty period.

 **Distress:**

- Do not expose the battery to high-temperature environments or around heat-generating devices such as sunlight, fire sources, transformers, heaters, etc. Overheating of the battery may cause fire or explosion.
- It is prohibited to disassemble, modify, or damage the battery (e.g., inserting foreign objects, immersing in water or other liquids, etc.), which may cause the battery to leak, overheat, catch fire, or explode.
- The thermal runaway of the battery will produce combustible gases, as well as harmful gases such as CO and HF. There is a risk of deflagration and explosion due to the accumulation of flammable gases after the thermal runaway of the battery, which may cause personal injury and property damage.
- When installing and maintaining the battery, use insulating tape to wrap the exposed cable terminals on the battery. At the same time, to avoid foreign objects (such as conductive objects, screws, liquids, etc.) into the battery's internal short circuit.

 **Warnings:**

- Batteries must be stored in a separate warehouse and the outer packaging, avoiding mixed storage with other materials, open storage, and avoiding stacking the batteries too high. The site must be equipped with fire-fighting facilities that meet the requirements, such as fire sand, fire extinguishers, and so on.
- Batteries should avoid impact. When handling the battery, it should be carried in the direction required by the battery, and inverted and tilted are prohibited.
- Please use the battery within the temperature range specified in this manual. When the ambient temperature of the battery is lower than the lower limit of the operating temperature, charging is prohibited to avoid the internal short circuit of the battery due to crystallization from low-temperature charging.
- Please dispose of used batteries according to local laws and regulations, and do not dispose of batteries as household garbage.
- If the battery has been charged for more than 8 months since the last time, the battery needs to be recharged. Failure to do so may affect the performance and service life of the battery.

1.6. Battery Abnormal Handling Measures

Distress:

- Avoid contact with the leaking liquid or gas when an electrolyte leak occurs or there is an unusual odor. Non-professionals should stay away and contact a professional immediately.
- The electrolyte is corrosive and contact may cause skin irritation and chemical burns. If contact is made with the battery electrolyte, the contact area needs to be washed immediately with plenty of water and soap, and medical help is sought immediately.
- batteries are prohibited from further use after being dropped (with or without a pack). If there is no obvious deformation or breakage in appearance and no obvious odor, smoke, or fire, transfer the battery to an open and safe place to stand for 1h under the premise of ensuring safety and then dispose of it, and contact our service engineers.
- When obvious odor, breakage, smoke, and fire appear after the battery falls, evacuate people immediately and report to the police in time. Use fire-fighting facilities to extinguish the fire by professional personnel while guaranteeing safety.

1.7. Maintenance and replacement

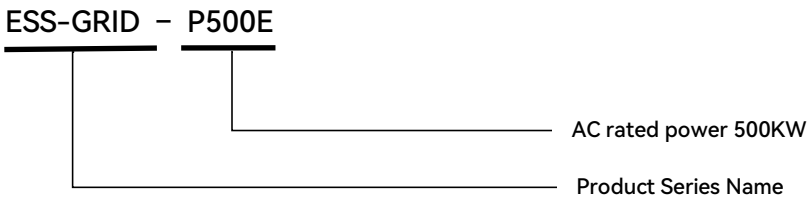
Warnings:

- It is prohibited to open the cabinet door in rain, snow, lightning, sand, dust, fog, or other weather.
- Before parts are removed from the cabinet, make sure that other parts on the cabinet are not loose.
- During equipment maintenance, cover nearby energized parts with insulating material.
- Prohibit any objects from touching the running fan (e.g., fingers, parts, bolts, etc.) until the fan is de-energized and stops rotating.
- Do not energize the unit before troubleshooting.
- When inspecting the system with power, pay attention to the hazard warning signs on the equipment and avoid standing at the cabinet door.
- Equipment other than battery packs must wait 15 minutes after powering down to ensure that the equipment is not powered before operating the equipment.
- After the energy storage system power components are replaced or wiring is changed, manual wiring inspection is required to avoid abnormal system operation.

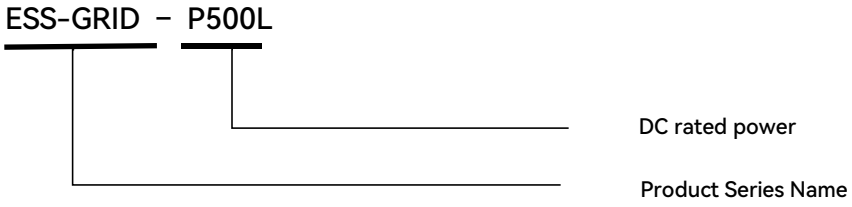
- After completing the operation related to maintenance and replacement, lock the cabinet door in time and keep the key properly.

2. Products

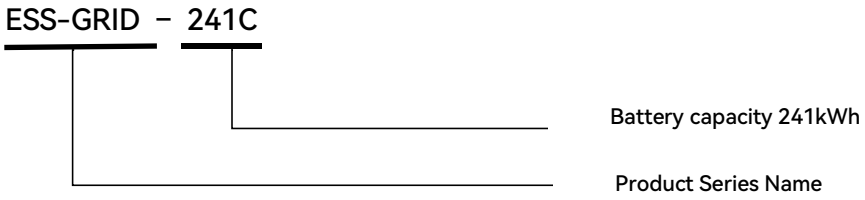
2.1. Model Description



AC Energy Storage Cabinet Model Description



DC Photovoltaic Cabinet Model Description



Battery Cabinet Model Description

Description: Isolation transformer, STS parallel off-grid switching, DC power module are optional parts. Rated output power and battery capacity can be flexibly configured according to project requirements.

2.2. Product Functions

Optical storage outdoor energy storage cabinet integrates an energy storage battery, modular STS, modular PCS, modular DC/DC DC converter, energy management monitoring system, power distribution system, environmental control system, and fire control system. Adopting modularized PCS, it is easy to maintain and expand capacity. Optical storage outdoor energy storage cabinet adopts front maintenance, which can reduce floor space and maintenance access, and is characterized by safety and reliability, rapid deployment, low cost, high energy efficiency, and intelligent management.

The operation strategies of the energy storage system in common application scenarios are as follows:

Cutting the peaks and filling the valleys: Time-sharing tariffs in the valley: the energy storage cabinet is automatically charged, full standby; time-sharing tariffs in the peak: the energy storage cabinet is automatically discharged, realizing the arbitrage of tariff difference, and improving the economic efficiency of the optical storage charging system.

Optical Storage Joint: Real-time access to local load power, photovoltaic power generation is prioritized for self-generation and self-consumption, and surplus power is stored; if photovoltaic power generation is insufficient to provide local loads, battery storage power is prioritized.

2.3. Electrical Wiring Diagrams

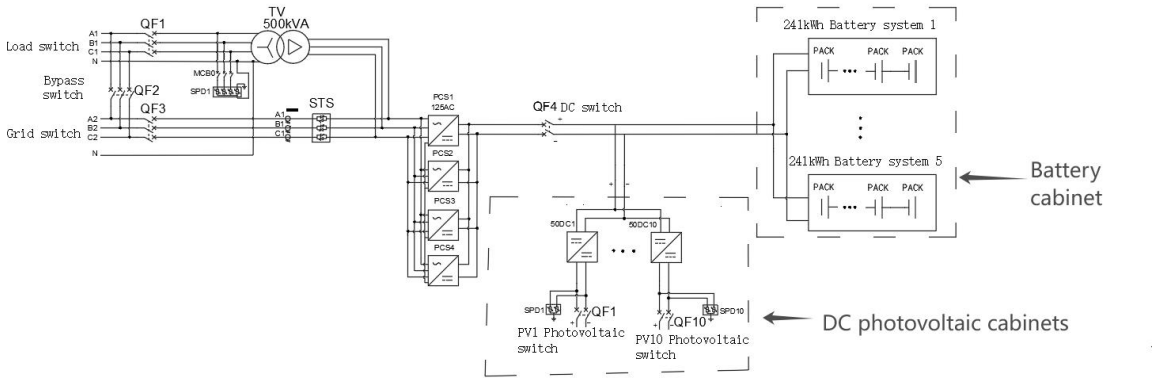


Figure 2.1 Electrical primary diagram

Instructions: Figure 2.1 shows the system scheme with off-grid connection, isolation transformer, and photovoltaic input, the configuration of different projects is different, the line is slightly different, and the actual shipment of the attached drawings shall prevail.

2.4. Product Characteristics

- The system is productized, integrating energy storage battery, modular PCS, modular STS, modular DC/DC DC converter, energy management monitoring system, power distribution system, environmental control system and fire control system, etc., which can comprehensively control the system operation status and risk;
- Is configured with rack-mounted modular PCS, supporting parallel connection of multiple machines with good scalability; the number of PCS modules and total battery power can be selected according to the system capacity requirements of microgrids and other scenarios, with typical configurations of 500TS (1.125MWh) and 500TS (1.204MWh).
- The protection class IP54 can perfectly cope with all types of outdoor weather;

- Adopts a door-mounted embedded integrated air conditioner, which does not take up cabinet space and improves the available space for outdoor cabinets, with better structural integrity at the top and a good waterproof effect;
- Local control panel can realize diversified functions such as system operation monitoring, energy management strategy development, and equipment remote upgrade.

2.5. Product Parameters

The following are the typical configuration parameters of the integrated outdoor energy storage cabinet, the actual supply is subject to the technical agreement.

Figure 2.1 Parameters of AC energy storage cabinets

Model	ESS-GRID P500E
AC (grid-connected)	
PCS Rated AC Power	500kW
PCS Maximum AC Power	550kW
PCS Rated AC Current	720A
PCS Maximum AC Current	790A
PCS Rated AC Voltage	400V，3W+PE/3W+N+PE
PCS rated AC frequency	50/60±5Hz
Total harmonic distortion of current THDI	<3% (rated power)
Power factor	-1 overrun ~ +1 hysteresis
Voltage total harmonic distortion rate THDU	<3% (linear load)
AC (off-grid load side)	
Load Voltage Rating	400Vac，3W+PE/3W+N+PE
Load Voltage Frequency	50/60Hz
Overload capacity	110% long term operation; 120% 1 minute
Off-grid output THDu	≤ 2% (linear load)
DC side	
PCS DC side voltage range	625~950V (three-phase three-wire) / 670~950V (three-phase four-wire)
PCS DC side maximum current	880A
System parameters	
Protection class	IP54
Protection grade	I
Isolation mode	Transformer isolation: 500kVA
Self-consumption	<100W (without transformer)

Display	Touch LCD touch screen
Relative humidity	0~95% (non-condensing)
Noise level	Less than 78dB
Ambient Temperature	-25℃~60℃ (Derating above 45℃)
Cooling method	Intelligent air cooling
Altitude	2000m (over 2000m derating)
BMS Communication	CAN
EMS Communication	Ethernet / 485
Dimension (W*D*H)	1450*1000*2300mm
Weight	1700kg

Figure 2.2 Parameters of DC PV Cabinet

Model	ESS-GRID P500L
Photovoltaic (DC/DC) Power Rating	500kW
PV (Low Voltage Side) DC Voltage Range	312V~500V
PV Maximum DC Current	1600A
Number of PV MPPT circuits	10
Protection Rating	IP54
Protection Rating	I
Display	Touch LCD touch screen
Relative Humidity	0~95% (non-condensing)
Noise level	Less than 78dB
Ambient Temperature	-25℃~60℃ (Derating above 45℃)
Cooling Method	Intelligent air cooling
EMS Communication	Ethernet / 485
Dimension (W*D*H)	1300*1000*2300mm
Weight	500kg

Figure 2.3 Battery Cabinet Parameters

Model number	ESS-GRID 241C
Rated Battery Capacity	241kWh
Rated System Voltage	768V
System Voltage Range	672V~852V
Cell Capacity	314Ah
Battery Type	LiFePO4 battery（LFP）
Battery series-parallel connection	1P*16S*15S
Maximum charge/discharge current	157A
Protection Grade	IP54
Protection Grade	I
Cooling and heating air conditioning	3kW
Noise level	Less than 78dB
Cooling Method	Intelligent air-cooling
BMS Communication	CAN
Dimension (W*D*H)	1150*1100*2300mm
Weight	1800kg
The system uses 5 clusters of 241kWh batteries for a total of 1.205MWh	

Note: The actual parameters have been set at the factory according to customer requirements.

2.6. Components

2.6.1. Battery system

Figure 2.2 Battery System Parameters

Battery Parameters		
Cell	Battery Type	LiFePO4 battery（LFP）
	Nominal Voltage	3.2V
	Voltage Range	2.8V~3.55V
	Nominal Capacity	314Ah

	Maximum Operating Temperature Range, Charging	0~60℃
	Maximum Operating Temperature Range, Discharge	-30~60℃
Module	Series-parallel connection	1P16S
	Nominal energy	16.076kWh
	Nominal Voltage	51.2V
	Voltage range	44.8~56.8V
	Weight (Approx.)	91 kg
	Overall Dimension(W*D*H)	480*750*226±2mm
Battery clusters	Rated energy storage energy	241kWh
	Nominal System Voltage	768V
	System Voltage Range	672~852V
	Series and parallel connection mode	1P*16S*15S
	Number of electric boxes included	15 个
	Weight (approx.)	1400kg

2.6.2. Battery Management Systems

An energy storage management system consists of a battery management system (BMS) and an energy management system (EMS). The battery we chose comes with its own BMS system, which is divided into two levels: BMU and BCU.

BMU is located in the battery box, completes the data acquisition of single-cell information inside the battery box, uploads the data to BCU, and completes the equalization between single cells in the battery box according to the instructions issued by BCU.

BCU is located in the main control box and is responsible for the management of the battery cabinet, accepting the detailed data uploaded by the BMU inside the battery, sampling the voltage and current of the battery cabinet, calculating and correcting the SOC, and managing the pre-charging and standby charging, charging and discharging of the battery cabinet, as well as uploading the relevant data to the EMS.

2.6.3. Electrical Systems

2.6.3.1 Power Converter Storage (PCS) Modules

Light storage integrated outdoor energy storage cabinet adopts modularization scheme, users can configure different number of power modules according to the project requirements. The parameters of the power module of the energy storage converter are as follows:

Figure 2.3 Parameters of the converter module

Model	BSL-125AC
Rated Power	125kW
Maximum power	137kW

DC working voltage range	580~1000V (three-phase three-wire) / 670~1000V (three-phase four-wire)
DC side full load voltage range	625~950V (three-phase three-wire) / 670~950V (three-phase four-wire)
Maximum DC current	200A
Rated AC Voltage	400Vac, 3W+ PE/3W+N+PE
Rated frequency	50/60Hz, (±5Hz)
Rated AC current	181A
Overload capacity	110%, normal operation; 120%, 1 minute
Current distortion	<5% (rated power)
Power factor adjustment range	-1 Overrun ~ +1 Lag
Unbalanced load capacity	100%
Battery	Lithium/Lead Acid/Photovoltaic Module
Charging mode	By BMS command / Tri-Stage / MPPT
Operating Mode	Constant Current, Constant Power, MPPT, AC Voltage Source, DC Voltage Source
Maximum efficiency	98.2%
Dimension (W*D*H)	520*750*265mm
Weight (approx.)	68kg
Isolation mode	Non-isolated
Protection Grade	IP21
Working Temperature	-25℃~+60℃(>45℃ derating)
Relative Humidity	0~95% (non-condensing dew)
Cooling method	Intelligent air-cooled
Noise level	<78dB
Altitude	3000m (>3000m derating)
Communication Interface	CAN

2.6.3.2 DC Converter Power (DC/DC) Modules

For islands, mountains, border posts, and other remote areas or areas with unstable power supply, or new zero-carbon science and technology parks of the photovoltaic storage system. Users can configure DC converter power modules according to project requirements, charging batteries through DC coupling,

realizing the integrated power supply system of PV and energy storage. The parameters of the DC converter power module are as follows:

Figure 2.4 DC Converter Module Parameters

Model	BSL-50DC
Rated DC Power	50kW
Maximum DC power	55kW
DC operating voltage range	200V~1000V
Low voltage side full load voltage range	312V~850V
Maximum current on low voltage side	80A*2
Number of input channels on the LV side	2 (can be 2 independent, can be connected in parallel as 1)
HV side full load voltage range	500V~900V
Maximum DC on HV side	110A
Number of input channels on the HV side	1
Operating mode	Constant Voltage, Constant Current, Constant Power, MPPT
Maximum conversion efficiency	98.80% of the time
Dimension (W*D*H)	483(without mounting lugs 444)*600*150mm
Weight (approx.)	25kg
Isolation mode	Non-isolated
Protection Grade	IP21
Operating Temperature	-25℃~+60℃(>45℃ derating)
Relative Humidity	0~95% (no condensation)
Cooling method	Forced air cooling
Noise level	<70dB
Altitude	3000m (>3000m derating)
Communication Interface	RS485/CAN (optional)

2.6.3.3 STS parallel off-grid switching module

For areas where the power grid is unstable and power cuts occur frequently, users can configure the STS module according to the project requirements, and realize seamless switching automatic control of grid connection and disconnection through STS. The parameters of the STS module are as follows:

Figure 2.5 Parameters of STS Parallel and Off-grid Modules

Model	BSL-500STS
Rated power	500kW
Maximum power	550kW
Rated AC Voltage	400Vac，3W+N
Rated frequency	50/60Hz(±5Hz)
Rated AC Current	720A
Switching time	<10ms
Maximum efficiency	99%
Dimension(W*D*H)	520*750*150mm
Weight(approx.)	40kg
Protection Rating	IP21
Operating Temperature	-25℃℃~+60℃(>45℃ derating)
Relative Humidity	0~95%(non-condensing)
Cooling method	Intelligent air-cooled
Noise level	<70dB
Altitude	3000m(>3000m derating)
Communication Interface	CAN

2.6.3.4 Three-phase isolation transformers

For off-grid application scenarios, a three-phase isolation transformer is configured to completely disconnect and isolate the output terminal from the input terminal to realize harmonic filtering and prevent inrush current. The isolation transformer module parameters are as follows:

Figure 2.6 Three-Phase Isolation Transformer Module Parameters

Model	T-500
Rated power	500kVA
Dimension (W*D*H)	975*530*980mm
No-load loss	≤2100W
Insulation grade	H
Connection group	Dyn11
Primary input voltage	400V
Primary input current	721.7A
Rated frequency	50Hz
Secondary output voltage	400V
Secondary output current	721.7A
Overload capacity	110%
Cooling method	Dry self-cooling
Efficiency	> 98%
Noise level	≤65dB

2.6.4. Environmental Control Systems

The energy storage system is equipped with environmental control units such as smoke detectors, emergency stops, door magnetic sensors, and fire protection, which can fully control the system operation status. Schematic diagram of environmental control system:

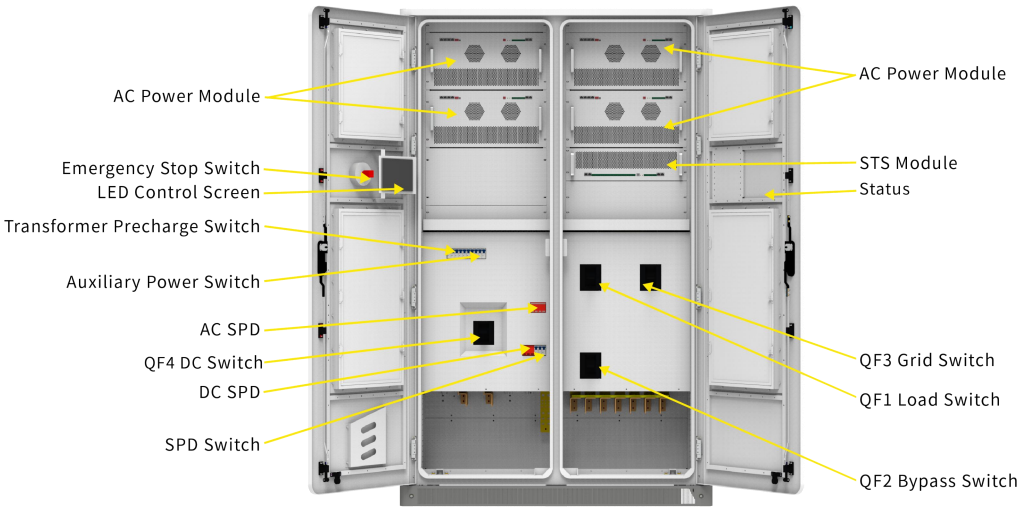


Figure 2.2 Internal structure of AC energy storage cabinet ESS-GRID P500E

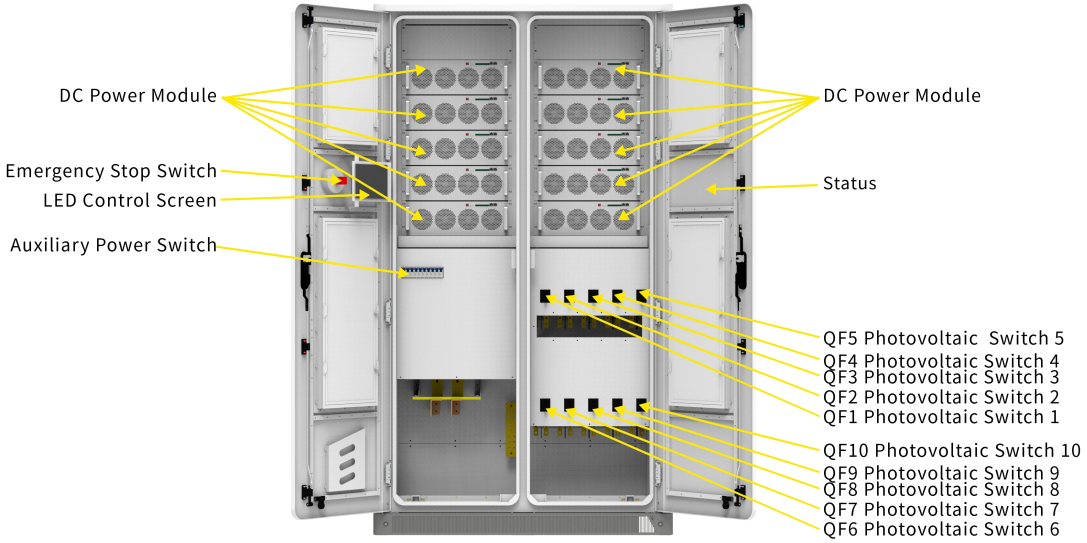


Figure 2.3 Internal structure of DC PV cabinet ESS-GRID P500L

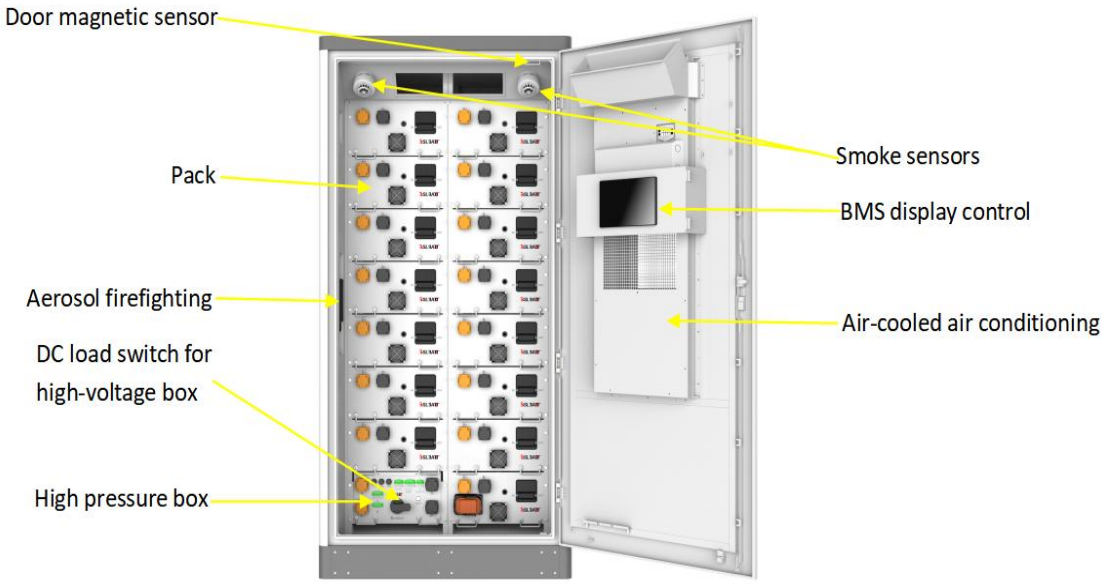


Figure 2.4 Internal structure of the battery cabinet ESS-GRID 241C

2.6.4.1 Precision air conditioning parameters

Operation Principle:

① **Refrigeration:** when the temperature inside the cabinet is higher than the refrigeration set point plus refrigeration deviation, it starts refrigeration; when the temperature inside the cabinet is lower than the refrigeration set point, it stops refrigeration.

② **heating:** when the cabinet temperature is lower than the heating set point, start heating; when the cabinet temperature is higher than the heating set point plus heating deviation, stop heating.

③ **Dehumidification:** when the humidity inside the cabinet is greater than the dehumidification open humidity (default 80%, range 50~99%), and the temperature inside the cabinet is less than the dehumidification open temperature (default 25 ℃, range 20~40 ℃), turn on the electric heating dehumidification; when the temperature inside the cabinet rises to

the dehumidification stop temperature (default 30 ℃, range 25~50 ℃), or humidity fall back to the dehumidification stop humidity (default 75%, range 50~99%), stop heating.

Figure 2.7 Precision air-conditioning parameters

Model	AC3000P
Electrical parameters	
Rated Working Voltage	220Vac±15%
Rated current	5A
Rated working frequency	50Hz
Dimension (H*W*D)	1350×550×250mm
Weight (H*W*D)	63kg
Protection grade	IP54
Cooling capacity	3000W
Heating capacity	2000W
Airflow	850m^3/h
Noise level	< 70dB
Refrigeration	
Refrigeration opening point	Default 25℃ (Setting range: 16~38)
Refrigeration Deviation	Default 6℃ (Setting range: 1~10)
Heat production	
Heating opening point	Default 5℃ (Setting range: 5~26)
Heating deviation	Default 10℃ (Setting range: 1~10)
Dehumidify	
Dehumidification on temperature	Default 25℃ (Setting range: 20~40)
Dehumidification stop temperature	Default 30℃ (Setting range: 25~45)
Dehumidification on humidity	Default 80% (Setting range: 50~99)
Dehumidification stop humidity	Default 75% (Setting range: 45~95)
Warning function	
Cabinet high temperature alarm	30℃~60℃ (Settable)
Low temperature alarm	-45℃~10℃ (settable)
Cabinet high humidity alarm	0%~100% (Settable)
Note: The actual parameters are set at the factory according to customer requirements.	

2.6.4.2 Access switches

Door switch detects the open status of the device.

Figure 2.8 Door Switch Parameters

Type	Parameters
Rated Voltage	AC-15: 380V DC-13: 220V
Rated current	AC-15: 0.79A DC-13: 0.14A
Rated insulation voltage	415V

Rated impulse withstand voltage	2.5kV
Operating frequency	Mechanical/Electrical: 20 times/min
Name	Temperature: -5℃~+40℃ Relative humidity < 90% RH (no condensation)

2.6.4.3 Smoke Detectors

Smoke detectors are used to detect the smoke concentration in the current environment.

Figure 2.9 Smoke Detector Parameters

Name	Parameter
Working Voltage	DC12/24V (allowable range 9V~33V)
Working Current	Monitoring status: <4mA@DC12V Fire alarm: 28mA@DC28V 52mA@DC24V 18mA@DC10V
Relay Output	Normally open, contact capacity 1A 30VDC
Working Indication	Monitoring status red light flashes about 1 time every 3s. The alarm status red light is always on
Environment	Temperature: -20℃~+60℃ Relative humidity < 95% RH (no condensation)

2.6.5. Fire protection systems

The fire extinguishing system adopts aerosol fire extinguishing device which is a new type of environmentally friendly fire fighting product with advanced level in the world. Working Principle: When a fire occurs, the fire extinguishing device receives an electric start signal or an open flame ignites the heat-sensitive line, the electric initiator or the heat-sensitive line burns to activate the aerosol generator in the fire extinguishing device, and the heat released by the aerosol generator through the redox reaction causes the chemical coolant to decompose, thus realizing that the aerosol generator and the coolant participate in the fire extinguishing together.

Figure 2.10 Firefighting Aerosol Parameters

Model	QRR0.3G/S-Q
Technical Parameters	
Weight of agent	300g
Equipment weight	860±30g
Spraying time	≤14s
Dimension	46*68.5*255mm

Nozzle temperature	400℃、200℃、75℃ the thermal spacing of is respectively 0.05m、0.12m、0.3m
Actual fire extinguishing efficiency	100g/m^3~130g/m^3
Ambient temperature range	-50℃~+90℃
Relative humidity	≤95%
Parameters of TH type (thermal wire) starting mode	
Starting temperature	170℃
Valid period of use	10 year

2.6.6. Local Management Systems

BSL-ESS is an intelligent energy management system developed for microgrid systems, mainly used in various capacities of energy storage power stations, and photovoltaic storage and charging integrated power station applications.

The product integrates the functions of HMI, port control and communication, system parameters, and operation strategy setting to realize the monitoring and management of the energy storage system. The hardware resources and parameters of the product are as follows:

Figure 2.11 Local Controller Parameters

Product Model	BSL- ESS
Power Input	DC 12V
Output Control	3 Isolated Output Switches
Input Control	6 isolated input switch
Serial Communication	2 isolated RS232, 4 isolated RS485
Fieldbus	2 CAN bus interfaces
Ethernet port	1 10/100M Ethernet port (RJ45)
Extended storage	1 USB flash disk port, 1 SD card port
Audible alarms	1 Controllable Buzzer
Program Characterization	1 Run Indicator, 1 Status Indicator, 1 Alarm Indicator
Abnormal Characterization	1 hardware watchdog timer
Real Time Clock	1 RTC Real Time Clock

2.7. Configuration List

In summary, the overall configuration list of the energy storage system in a typical configuration is as follows:

Figure 2.12 ESS-GRID P500E Overall Configuration Checklist

Name	Model number	UNIT (of measure)	Quantity	Remarks
Energy Storage Converter	BSL-125AC	unit	4	Modularization
STS on/off grid switching module	BSL-500STS	Unit(s)	1	Modularization
Three-phase isolation transformer	T-500	Unit	1	Dyn11
Auxiliary System	Lightning protection, auxiliary power switch, etc.	Sets	1	Auxiliary equipment
Management System	BSL-ESS	Sets	1	Composed of BMS and EMS

Figure 2.13 ESS-GRID P500L Overall Configuration Checklist

Name	Model	unit (of measure)	Quantity	Remarks
DC Converter Power Module	BSL-50DC	unit	10	Modularization
Auxiliary System	Lightning protection, auxiliary switch, etc.	Sets	1	Auxiliary supporting equipment
Management System	Lotus-ESS	Sets	1	Composed of BMS and EMS

Figure 2.14 ESS-GRID 241C Overall Configuration Checklist

Name	Model	unit (of measure)	Quantity	Remarks
Battery System	314Ah，225kWh	Sets	1	With control box
Air Conditioning System	AC3000P 220±15%VAC~50Hz	Sets	1	Precision air conditioner
Fire Fighting System	QRR0.3G/S-Q	Sets	1	Thermal line start type

Actuals are based on the supplied configuration.

3. Installation & Wiring

3.1. Transportation and Handling

3.1.1. Product Transportation

- To keep the equipment in a better state of protection, it is recommended to use transportation with packaging;
- Equipment transportation needs to be transported according to the requirements of marking on the packaging to prevent personal injury and equipment damage;
- Energy storage batteries are not recommended for rail transportation, or air transportation. Land transportation speed limit requirements: flat road speed limit 80km/h, rugged road speed limit 60km/h, if there is any conflict, please refer to the local traffic regulations.

3.1.2. Product Handling

- Ensure that the forklift has enough load capacity when using the forklift to move, and pay attention to the center of gravity of the equipment to fall between the forklift feet to prevent personal injury and equipment damage;
- With battery transfer, forklift load capacity needs to be ≥3t; without battery transfer, forklift load capacity needs to be ≥1.5t;
- Recommended fork knife length ≥1.5m, width 80cm~160cm, thickness 25mm~70mm.

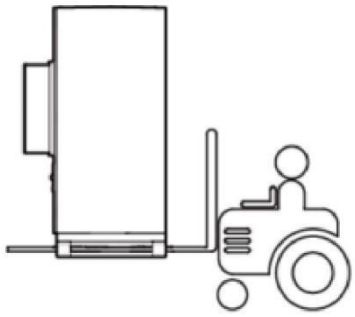


Figure 3.1 Schematic diagram of handling

3.2. Packaging and Storage

3.2.1. Product packaging

In order to keep the product in a better state of protection during transportation, specific wooden crates are used for packaging. The following basic parameters (including but not limited to) are included on the equipment package, which need to be carefully checked according to the project needs:

Figure 3.1 Table of Packing Parameters

Parameter	Description
Model	Product Model
Dimension	Dimension after packing
Weight	Total weight of the product after packing
Marking	Face up, careful placement, center of gravity, etc.

3.2.2. Product storage

If the product is not to be transported or installed for use immediately, it must be stored indoors in a place that meets the following conditions:

Figure 3.2 Requirements for product storage conditions

Parameters	Requirement
Storage temperature (without battery)	-25℃~+60℃
Battery	20℃~30℃
Storage Relative Humidity	<95% (no condensation)
Altitude	<3000m

Note: Long-term storage of batteries is not recommended. There will be capacity loss in long-term storage of lithium batteries, the general irreversible capacity loss of lithium batteries is 3%~10% after 12 months of storage at the recommended storage temperature. Battery packs should be stored and shipped for no more than 8 months (counting time from shipment). Beyond 8 months a recharge and SOC calibration is required, at least 50% SOC. Failure to recharge as required may affect the performance and service life of the battery.

3.3. Installation environmental requirements

The installation layout of the energy storage system must meet the fire distance or firewall requirements specified by local standards, including but not limited to GB 51048-2014 Design Code for Electrochemical Energy Storage Power Stations, NFPA 855 Standard for the installation of Stationary Energy Storage Systems. The energy storage system is only applicable to outdoor scenarios requires an outdoor arrangement and does not support indoor arrangements. General requirements for siting are listed below:

- The level of the installation location should be above the highest historical water level in the area. The distance to airports, buried waste disposal sites, river banks, or dams should be ≥ 2km.
- Select a well-ventilated area. Do not block vents and cooling systems to prevent fires from high temperatures when the equipment is in operation. Installation space is sufficient to ensure that the

surrounding equipment will not be affected by the heat generated by the product; installation location ensures sufficient space for external wiring. Have convenient transportation conditions and reliable fire suppression system equipment.

- Installation location away from fire sources, do not place flammable or explosive items around the equipment. If the equipment is installed in a site with lush vegetation, in addition to routine weeding, the ground underneath the equipment needs to be hardened to prevent the overgrowth of weeds.
- Do not install the energy storage system outdoors in salt-hazardous areas to prevent the equipment from corrosion and fire. Salt-hazardous areas are defined as areas within 2km of the coast or affected by sea breezes.
- The energy storage system must be protected by fences, walls, and other protective measures, and safety warning signs must be erected for isolation to prevent unauthorized personnel from entering during the operation of the equipment, which may cause personal injury or property damage.
- The equipment is installed in an area away from liquids, and should not be installed underwater pipes, air vents, and other locations that are prone to condensation; it should not be installed under air conditioning outlets, vents, server room outlet windows, and other locations that are prone to water leakage, to prevent liquids from entering the interior and causing short-circuiting of the equipment.

Instructions

Re-siting is recommended when the site cannot be safely spaced to meet the relevant state standards. Site selection should avoid scenarios that are not recommended by industry standards and regulations, including but not limited to the following lots, areas, and places:

- Areas of strong vibration, strong noise sources, and strong electromagnetic field interference.
- Sites that produce or have dust, fumes, hazardous gases, corrosive gases, etc.
- Places that produce or store corrosive, flammable, or explosive substances. Blasting hazard range.
- Places with existing underground facilities. Densely populated places, high-rise buildings, underground buildings.
- There is rubber soil, a weak soil layer, and other adverse geological conditions, easy to accumulate water and easy to sink the ground.
- Within the boundaries of mining subsidence (misalignment) zones. Areas that may be flooded after a dam or dike breaks.
- Earthquake faults and seismic zones with an intensity of defense higher than nine degrees. Sections with direct hazards such as mudslides, landslides, quicksand, and caves.
- Important sanitary protection areas for water supply sources.
- Historical relics and monuments protection zone.

If there is no more suitable site, it is recommended to add a firewall of not less than 3h fire-resistant for safety protection, while considering the space requirements for equipment transportation, installation, and maintenance. It is recommended to refer to T/CEC 373-2020: the length and height of the fireproof wall should exceed the outer contour of the energy storage cabinet by 1m each.

3.4. Pre-installation

1) Before installing the product, you need to check whether the product is intact or not. If you find any signs of damage, please keep the evidence and contact the equipment manufacturer.

2) If you are sure that there is no abnormality in the product, please check according to the delivery list to see if the accessories are complete.

Figure 3.3 Delivery list

Serial No.	Name	Quantities	Note
1	Outdoor Energy Storage Cabinet	1 set	Includes cabinet door key
2	User Manual	1 book	
3	Certificate of Conformity	1 copy	
4	Factory inspection report	1 copy	
5	Packing list	1 copy	

Before installation, users need to prepare relevant installation tools.

Table 3.4 List of installation tools

Serial No.	Name	Quantities	Note
1	Screwdriver Sets	1 set	
2	Socket	1 set	
3	Multimeter	1 set	
4	Forklift	1 vehicle	
5	Screws, Nuts, Spacers	Several	

3.5. Mechanical Installations

After making sure that there are no abnormalities in the product and that all accessories are complete, you can refer to the following recommendations for mechanical installation:

- Select the equipment installation position in advance according to the product dimensions, and do a good job of positioning and fixing; the recommended foundation is shown in Figure 3.2.
- Referring to the weight of the product, the selected installation position needs to have sufficient load-bearing strength;
- Reliable grounding point, ensure that the grounding resistance is less than 4Ω.

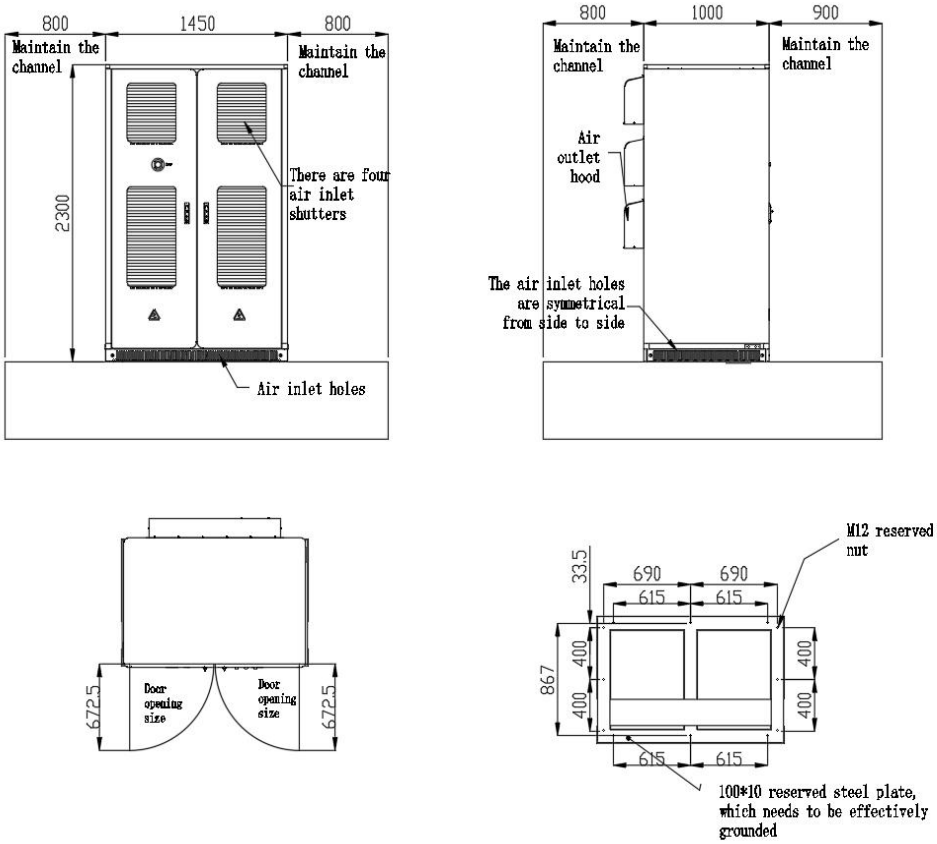


Figure 3.2 AC Energy Storage Cabinet ESS-GIRD P500E

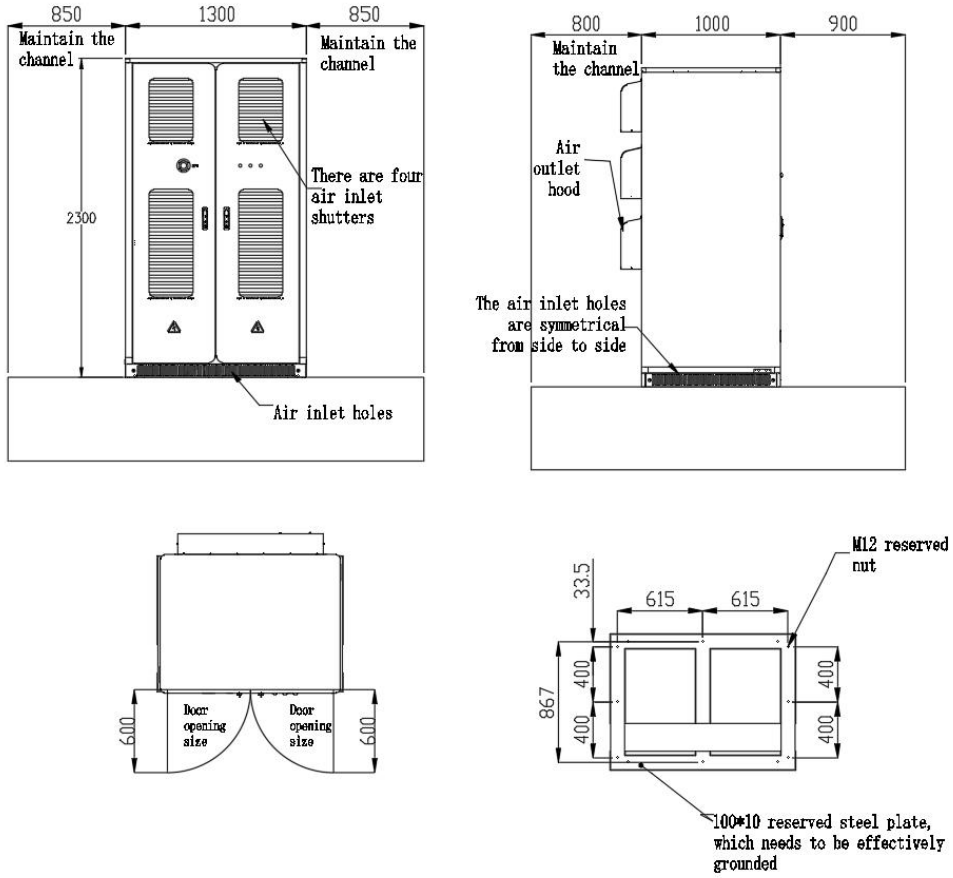


Figure 3.3 DC PV Cabinet ESS-GIRD P500L

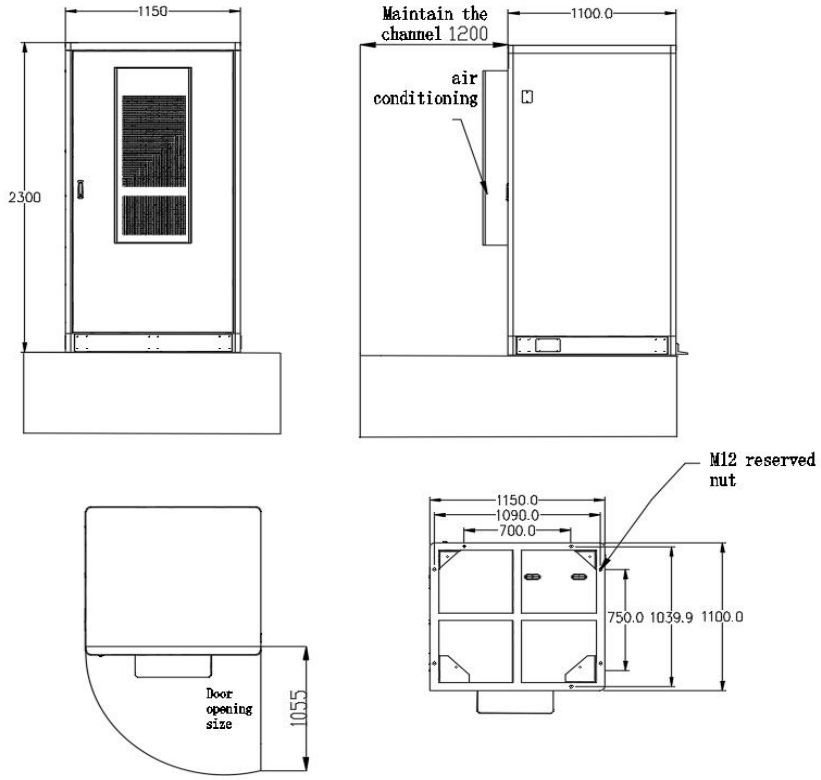


Figure 3.4 Battery Cabinet ESS-GIRD 241C

(1) After removing the packing crate, remove the enclosure at the bottom of the equipment first. The removed board and screws should be put away, and the equipment should be put back after it has been put into position.

Figure 3.5 Schematic of the bottom enclosure of the device

(2) Use a forklift to position the equipment on the foundation, align the fixing holes of the equipment with the pre-embedded nuts of the foundation, and fasten them with M16X40 bolts.

Figure 3.6 Illustration of bolt fastening at the bottom of the unit

3.6. Electrical Cable Installation

This product adopts the structure of an all-in-one machine, the internal wiring of the DC side has been completed, and only the AC side and external communication need to be installed on site with electrical cables. According to the power of the product, cable specifications are provided in Table 3.5 wiring reference. Cable diameter selection should be in line with local cable standards. Factors affecting cable selection include: rated current, cable type, laying method, ambient temperature, and maximum acceptable line loss.

Figure 3.5 Comparison of Cable Diameters

Capacity	AC cable	Zero line	Earth (wire)	Positive and negative DC input (female)
50kW	≥3*35mm²	≥35mm²	≥25mm²	≥2*35mm2
100kW	≥3*70mm²	≥70mm²	≥50mm²	≥2*70mm2
150kW	≥3*95mm²	≥95mm²	≥95mm²	≥2*95mm2
200kW	≥3*120mm²	≥120mm²	≥120mm²	≥2*120mm2
500kW	≥3*(150*2)mm²	≥(150*2)mm²	≥(150*2)mm²	≥2*(150*2)mm2

Distress: When performing an electrical installation, you can refer to the following recommendations for electrical installation:

（1）Check that all switches in the equipment are disconnected before wiring to ensure that the equipment is not energized;

（2）Disconnect the grid switch before wiring to ensure that the cable is not electrically charged;

（3）To determine the correct phase sequence of the cable, you can add yellow, green, red, and black different colors of insulation sheath or logo to differentiate, to prevent phase sequence errors;

（4）Cable terminals and copper row connections need to be pressed, and screws to choose the right length, so as not to affect the insulation and fastening;

（5）Communication and power cables should be laid separately as far as possible, and the cable insulation should be ensured not to be damaged during the laying process;

（6）The grounding cable must be reliably connected to the grounding copper row, and cable cross-section area to meet the design requirements;

（7）All AC cables need to enter the equipment through the bottom of the equipment access hole into the corresponding phase sequence;

（8）After the wiring is completed, use fire clay to seal the wiring leakage, to prevent external insects and rodents from entering the equipment or cable damage.

In order to prevent the terminals from loosening under force and causing poor contact, resulting in increased contact resistance and heat, etc., make sure that the bolts used to fasten the terminals meet the torque requirements listed in Figure 3.6.:

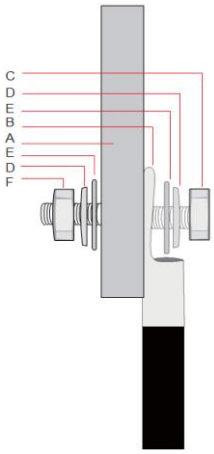
Figure 3.6 Wiring Torque Requirements

Screw Size	M4	M5	M6	M8	M10	M12	M14	M16
Torque (N*m)	1.8~2.4	4~4.8	7~8	22~29	44~58	76~102	121~162	189~252

The inlet and outlet of the energy storage system is under the inlet and outlet, after removing the switch plate, as shown in Fig. 3.5, the A/B/C/N copper rows at the lower end of the switch are reserved for ϕ11mm and ϕ13mm holes to be opened for the customers to connect the wires or according to the customer's requirements for the size of the holes; the protective ground wire is connected to PE copper rows, and the grounding impedance of the equipment meets the national standards of GB 50054 and the requirements of the local electrical standards.

Figure 3.7 Wiring Diagram

The installation of terminals and fixing screws for system power cable wiring is shown below.:



序号	名称
A	Copper wire
B	Wiring terminal
C	Screws
D	Spring pads
E	Large flat pads
F	Nuts

Terminal Block Installation

Terminal block part names

Figure 3.6 Set Screw Installation Schematic

Attention:

- When using copper core cables or copper-clad aluminum cables, use copper terminals.
- When aluminum alloy cables are used, use copper-aluminum transition terminals or aluminum terminals with copper-aluminum transition spacers.

4. Start-up and Commissioning

4.1. Pre-start-up Inspection

Before running the product, please make sure that the product has been installed in accordance with the specifications, and carry out a comprehensive and detailed inspection of the machine to ensure that all indicators are in line with the requirements before starting the machine.

1) Appearance inspection:

a. The appearance of the equipment is intact, no damage, no rust and no paint dropping. If there is paint falling off, please carry out the operation of replacing the paint;

b. equipment labels are clearly visible, damaged labels should be replaced in time.

2) Grounding check:

the box with grounding point, and grounded firmly; box grounding conductor reliably connected to the box grounding copper row.

3) Cable check:

a. Cable protection layer is well wrapped without obvious damage;

b. The terminal production in line with the specifications, the connection is firm and reliable;

c. The cable ends of the label is clear, the alignment to meet the principle of separation of strong and weak power, leaving a margin at the turn, shall not be pulled tight;

d. Cable installation bolts have been tightened, cable pulling no loosening; cable over the hole blocking has been completed.

4) Copper row check:

No obvious cracks or deformation of the copper row, the lap screws are tight, no misalignment of the scribe marking, no debris on the copper row.

5) Component inspection:

Refer to Fig. 4.1, the circuit breakers are all in the open position; the indicator mark of the lightning protector is green.

Note: In order to transport safety, we will disconnect one section of the battery module DC cable, the whole cluster of batteries in the open circuit state, the DC cable needs to be connected before powering up, pay attention to the need to bring insulated gloves to operate, inserted into the connector to hear the sound of "card" indicates that it has been inserted into place.

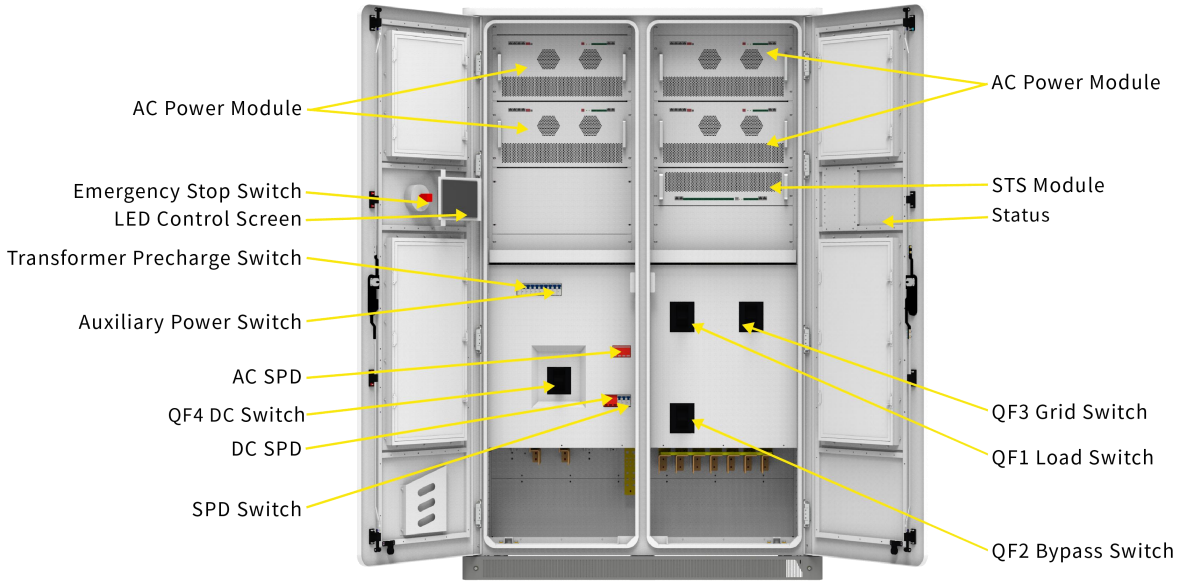


Figure 4.1 AC Energy Storage Cabinet ESS-GRID P500E Distribution Switch Location Diagram

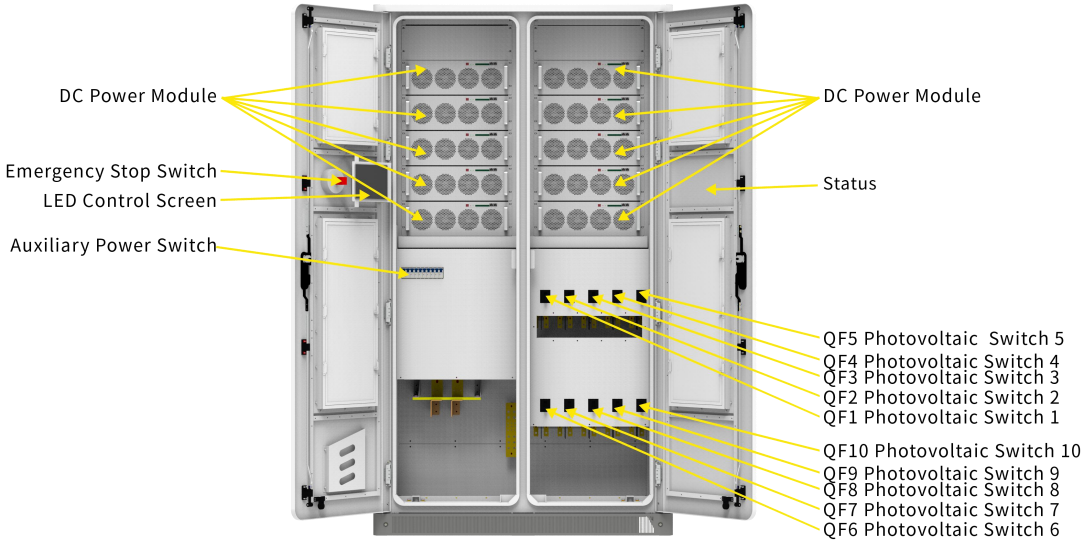


Figure 4.2 DC PV Cabinet ESS-GRID P500L Distribution Switch Location Map

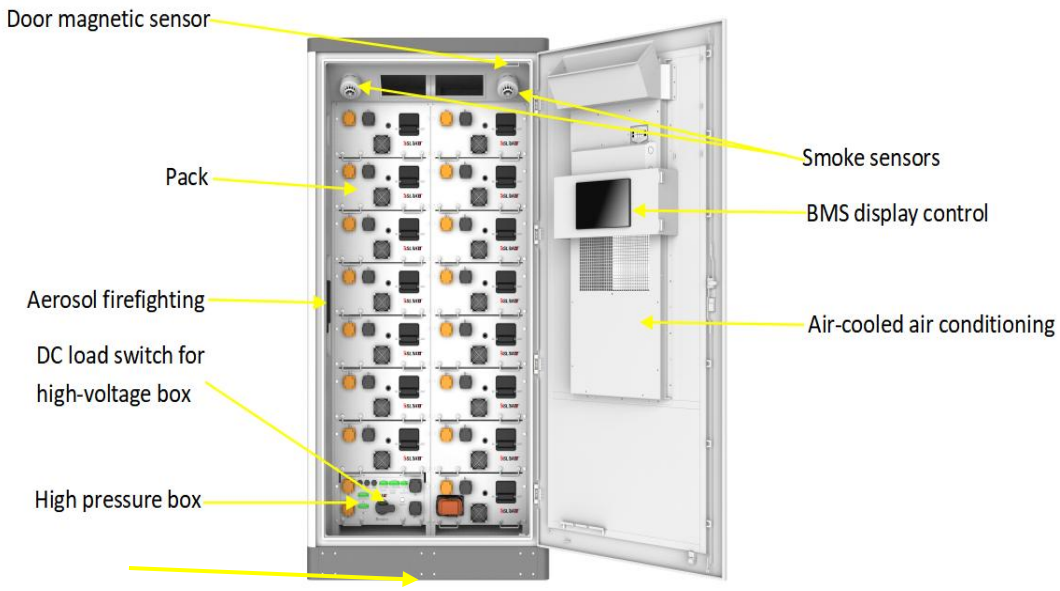


Figure 4.3 Battery Cabinet ESS-GRID 241C Distribution Switch Location Map

4.2. Booting Operation

The operation procedure of product power-on operation is as follows:

1) Confirm that the grid voltage is within the predetermined range (400V±10%) with a multimeter;
2) Referring to Fig. 4.1, close the transformer pre-charging switch MCB2 and auxiliary power switch MCB3~4, close the QF3 utility switch, complete the transformer soft start, close the QF1 load switch, and close the QF4 DC switch (when using the QF2 bypass switch for equipment maintenance, remember to disconnect the QF1 load switch first).
3) Referring to 4.2, close the QF1-10 PV switch and the auxiliary power switch.
4) Referring to 4.3, close the battery auxiliary switch and the high voltage box load switch (rotate to ON position), MCB1 air conditioning switch.
5) In the HMI touch screen of the DC PV cabinet click on the switch to enable all modules and click on System On. In the HMI touch screen of the AC energy storage cabinet, click "System"->"Parameter Setting" interface to set converter parameters, and in "System"->"Operation Mode" interface, select the required converter parameters. In the "System"->"Operation Mode" interface, select the required operation mode (Manual Mode, Peak Shaving and Valley Filling, Backup Mode);
6) Enable all the modules in the "Switch" page of the touch screen, and click "Converter On" to complete the power-on.

4.3. Test run

After the equipment completes the installation of all electrical structures to meet the start-up conditions, to ensure the reliable and stable operation of the energy storage system, the initial operation must be powered up by professional electrical engineers and technicians, and set the operation mode and related parameters according to the project requirements:

1) Set the equipment control mode to "manual mode" and set the active power to 5%;

2) Turn on the air conditioner in "Data"->"Environment Monitoring", enable all the modules in the "Switch" interface, and then click "System On". Click "System On";
3) Observe the parameters of PCS, battery, and air-conditioner during operation, and stop the machine in time for testing if there is any abnormality;
4) Run for 0.5 hours;
5) Set the active power to -5%, at this time the battery is charged at 5% of the rated power of the system.
6) Observe the parameters of the screen PCS, battery, and air conditioner during the running period, and stop the machine in time for testing if there is any abnormality;
7) Run for 0.5 hours;
8) After completing 1-hour trial run without any abnormality, turn off the system in the "switch" interface;
9) According to the project background and demand, you can choose the local manual power control mode, automatic peak shaving mode, or backup mode to put into operation formally and click "system on" in the system interface.

4.4. Shutdown Operation

When the product needs daily maintenance, the shutdown operation is required. The normal shutdown operation of the product is as follows:

1) Click on "System Shutdown" in the touch screen switching interface;
2) Referring to Fig. 4.1, disconnect the system transformer pre-charge switch MCB2, auxiliary power switch MCB3~4, split QF1 load switch, and split QF4 DC switch;
3) Referring to Figure 4.2, breaking QF1~10 PV switch, breaking auxiliary power switch MCB1; and
4) Referring to Fig. 4.3, break the DC load switch of the battery high-voltage control box and break the auxiliary power switch MCB1;
5) Wait for the end of the busbar discharge, the touch screen goes out, and the equipment is shut down.

4.5. Emergency Shutdown

When there is a malfunction or critical situation that requires an emergency shutdown of the product, the following emergency shutdown operations can be performed:

1) Press the emergency shutdown button "EPO";
2) Referring to Figure 4.1~3, disconnect all auxiliary power switches, AC and DC molded case switches, and battery DC load switches of the system;
3) Reset the EPO button after determining that the fault or danger is removed and operation is required.

Description:

After pressing "EPO" emergency shutdown, you need to refer to Fig. 4.1~3 to turn off all auxiliary power switches, AC/DC molded case switches, and battery DC load switches, and wait for the HMI touch panel to be powered down for 10min before powering on!

5. Operation and Handling

This chapter mainly introduces the LCD touchscreen display interface and the corresponding operation control through the human-machine interface. Users can execute various operation commands through the LCD interface, conveniently browse DC, AC, and system operation-related parameters and data, timely access to the current equipment status, and real-time alarm information to provide a reliable basis for fault diagnosis. In addition, the LCD touchscreen can also display the system software version information and upgrade the software of each component through the U disk.

5.1. Introduction to Human Machine Interface

After the system is powered on, the LCD touch screen enters the startup interface, and after 30s, the startup interface disappears and the system enters the "home" interface. As shown in Figure 5.1, the home page interface displays the real-time power, voltage, current, power generation, operation mode, working status and other information.

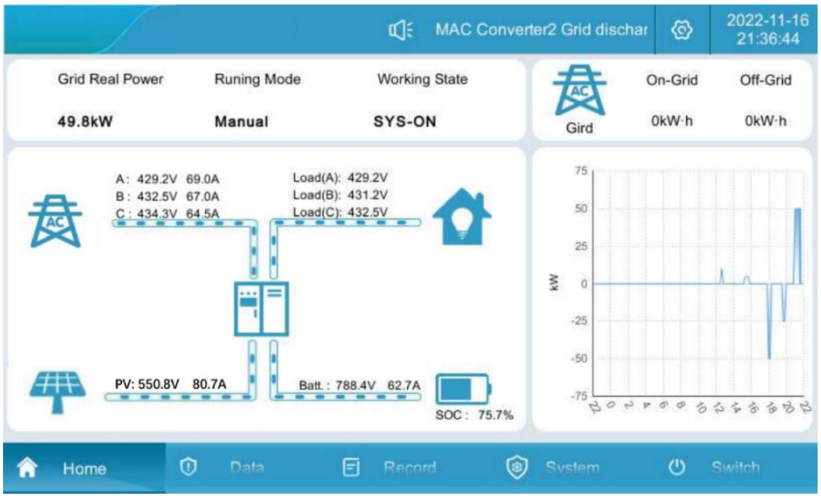


Figure 5.1 Main Page

Each menu expands items:

Serial No.	Menu Name	Menu items	Parameter Function
1	Main Page	None	Display the operation status of the system and the charging/discharging curve of the day
2	Data	Real-time data	Display of all analog data of converter
		Real-time status	Display of converter operating status and switching status
		Real-time Alarms	Alarm information of the current system
		Battery Data	Battery data display and battery on/off setting
		Environmental Monitoring	Display of dynamic loop monitoring and setting of air conditioning parameters
3	Records	Historical Alarms	Display of alarm history

		Operation Log	Display of operation log
		Data Report	Export history records
4	SYSTEMS	System Information	Display of system information
		Operation Mode	System operation mode setting
		Parameter Setting	Setting of converter and battery parameters
		Manufacturer Settings	Setting of equipment manufacturers
		System Upgrade	System software upgrade
		Communication Setting	Perform communication settings
5	Switches	System Switch	System startup and shutdown
6	HMI Lights	HMI left indicator	① the first from top to bottom for the power indicator: HMI touch screen power supply is normal, the green light blinks; (blinking frequency of 1s once) ② from the top down the second for the status indicator: the system has a fault, the green indicator does not light up; system without a fault, the green indicator is always on; ③ from the top down the third for the fault indicator: when the system has a fault, the red indicator light flashes; system without a fault, the red indicator light does not light (blinking frequency of 1s once)
7	System Lights	Status indicator	① When the system is on standby and there is a fault, the system lamp lights red. ② when the system is running, and there is no fault, the system light is green ③When the system is running and there is a fault, the system lamp lights yellow. ④ When the system is in standby and there is no fault, the system lamp does not light up.

5.2. Switching operations

Switching operation:

1. Referring to Figure 4.1, close the transformer pre-charging switch MCB2 and the auxiliary power switches MCB3~4, close the QF3 utility switch, complete the transformer soft start, close the QF1 load switch, and close the QF4 DC switch (when using the QF2 bypass switch for equipment maintenance, remember to disconnect the QF1 load switch first).
2. Referring to 4.2, close the QF1-10 PV switch and the auxiliary power switch.
3、Referring to 4.3, close the battery auxiliary switch and the high voltage box load switch (rotate to ON position), MCB1 air conditioning switch.
4. It takes about 30 seconds for the screen to start.

5. Set the converter parameters in "System"->"Parameter Setting" interface, and select the required operation mode in "System"->"Operation Mode" interface. In "System"->"Parameter Setting" interface, select the required operation mode, select grid connection and control mode manual, peak shaving and valley filling and backup mode.

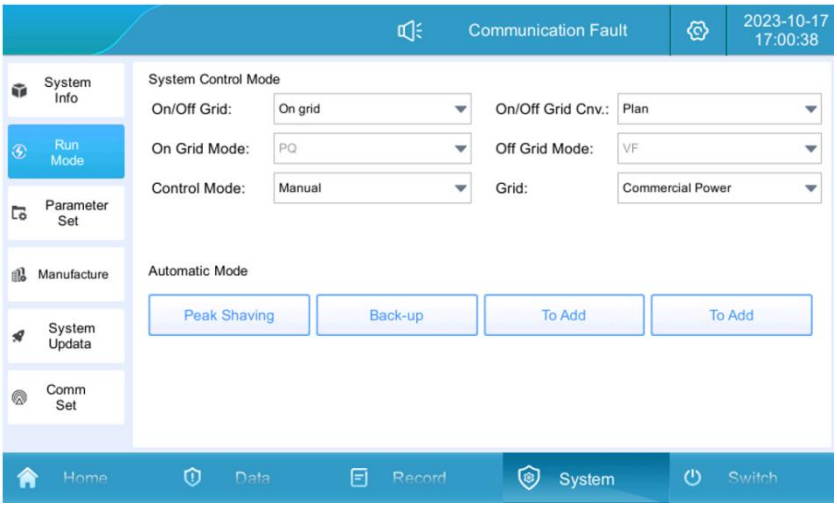


Figure 5.2 Run mode screen

6. Enable all modules in the "Switch" page of the touch screen (you can also turn on some of the modules according to the actual need), click "System On", the normal opening time is about 30 seconds, as shown in Figure 5.3.

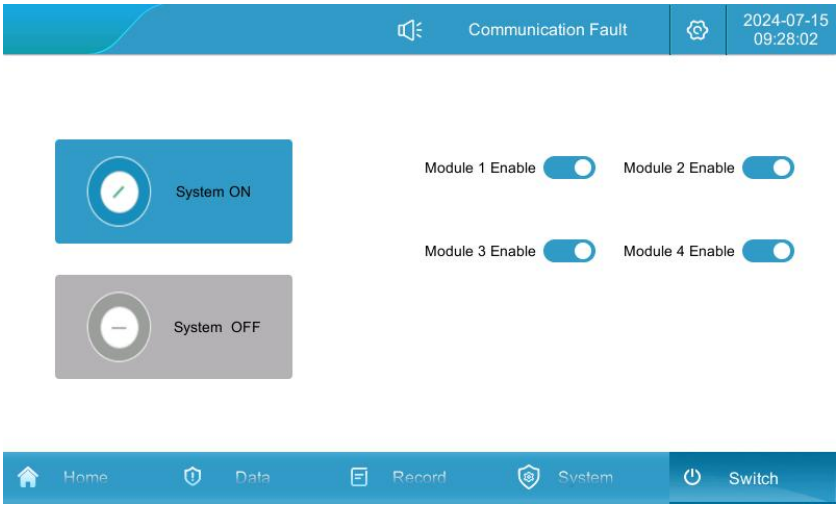


Figure 5.3 Switching Interface

7. Converter shutdown: When the converter is in operation, click "Converter Shutdown" as in Figure 5.3;
8. Disconnect all AC and DC switches and auxiliary power switches of AC energy storage cabinet, DC PV cabinet and battery cabinet.

5.3. Communication Settings

Description: Communication setting refers to the communication protocol setting between LCD touch screen and battery BMS, LCD touch screen and EMS background.

1. Check that the communication line of battery BMS has been connected to the terminals CAN2_H and CAN2_L on the back of the touch panel;
2. check the background EMS communication line has been connected to the back terminal COM6_A, COM6_B of the touch screen or to the position of the network port;

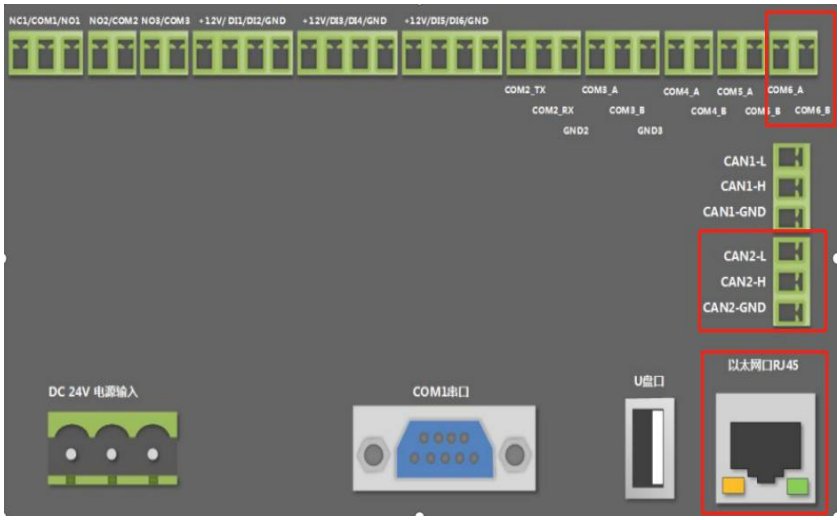


Figure 5.4 Communication wiring check

1. Click "System"->"Communication Setting" on the LCD touch panel to enter the communication setting interface.

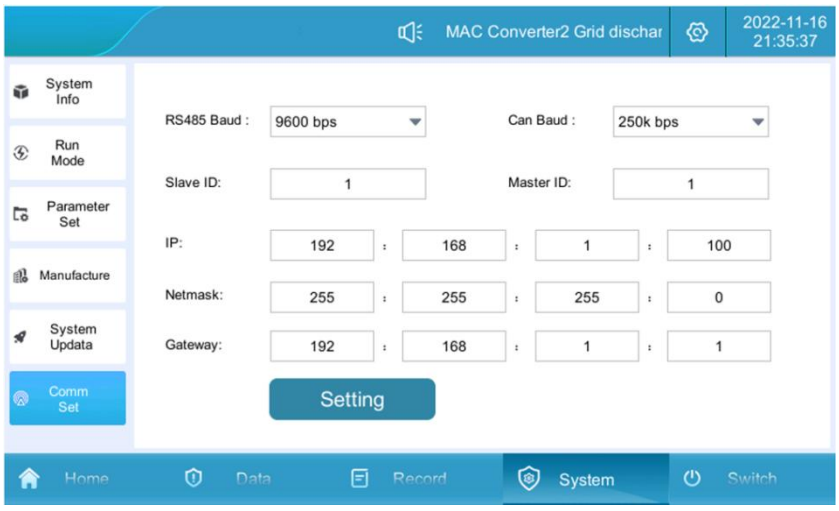


Figure 5.5 Communication Setting Screen

2. Battery BMS communication setting: set CAN baud rate to 250k bps;
3. Background EMS communication setting 1: If RS485 communication is used, set the local address corresponding to the communication panel to 1, if more than one energy storage system access to the background from the address can not be repeated;

1. Background EMS communication setting

2. If Ethernet communication is used, the local energy storage system acts as a server, the host sets the default address to 192.168.1.100, sets the local address corresponding to the communication panel to 1, and the server port to 502, and if more than one energy storage system is accessed to the background IP address can not be duplicated, modify the IP address and then click on the Setup button to configure the IP address.

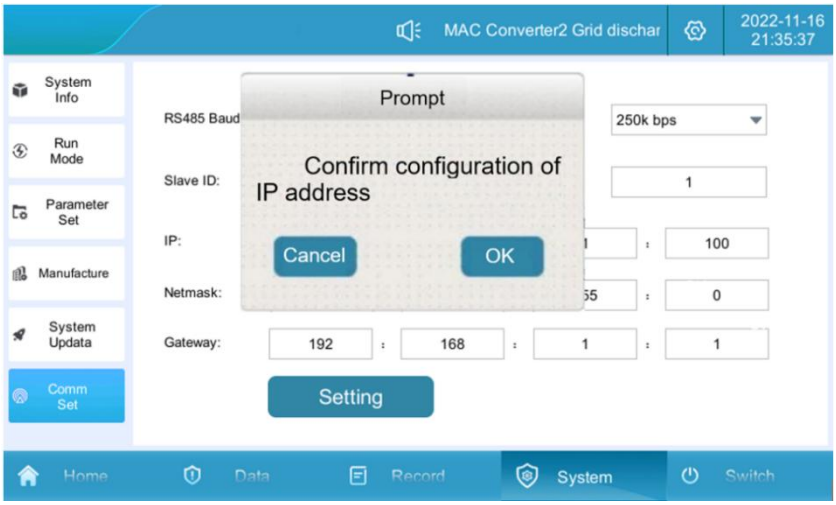


Figure 5.6 IP Address Configuration Screen

5.4. Operating Mode Settings

5.4.1. Introduction to Operation Modes

Optical storage of outdoor energy storage cabinets can be divided into three modes of operation: grid-connected manual mode, grid-connected automatic mode, and off-grid automatic switching.

1. Grid-connected manual mode: the energy storage system runs in grid-connected mode, but the system startup or shutdown must be manually operated by the user LCD touch screen. The charging and discharging active power, reactive power, and power factor of the energy storage system can be set in "Parameter Settings". When the PV power is greater than the load power, the excess power is stored in the battery, and the PV output power is limited when the battery is full; when the PV power is less than the load power, the PV+storage power supply is combined, and if it is not enough, the utility will be supplemented; at night when there is no light, the storage power supply is prioritized, and the utility power supply is supplied when the storage power is lower than the set value.
2. Grid-connected automatic mode: For peak shaving and valley filling application scenarios, the energy storage system will be automatically connected to the grid according to the pre-set time-charging and discharging power. For backup mode application scenarios, PV gives priority to battery charging, load power provided by the grid, when the battery is charged to the set SOC upper limit of 100% time Volt shutdown, battery SOC discharge to 96% PV power on, at this time the battery is not charging or discharging, when the PV power is greater than the load power, PV tracking the load power, when the PV power is less than the load power, the PV + battery power supply to the load jointly.
3. Automatic switching between grid and off-grid: When the grid suddenly cuts off when running in a grid-connected state, the storage converter automatically switches from grid-connected to off-grid mode, and the system can output a stable 400V/50Hz three-phase AC voltage; when the grid suddenly calls when running in the off-grid state, the storage converter automatically switches from off-grid to grid-connected mode.

Explanation: a. Switching between grid-connected and off-grid can be set to be triggered by plan or non-plan, set to be triggered by non-plan: when the utility power is cut off, it will automatically switch to off-grid operation, and the system can output stable three-phase AC voltage of 400V/50Hz; when the utility power comes back to the grid, it will automatically switch to the grid-connected mode of operation. Setting as schedule trigger: running in grid-connected mode can be manually switched to off-grid mode, set "and off-grid" to "off-grid", running in off-grid mode can be manually switched to grid-connected mode (provided that utility exists), set "and off-grid" to "off-grid", set Set "Off-grid" to "On-grid". The setting interface is as follows:

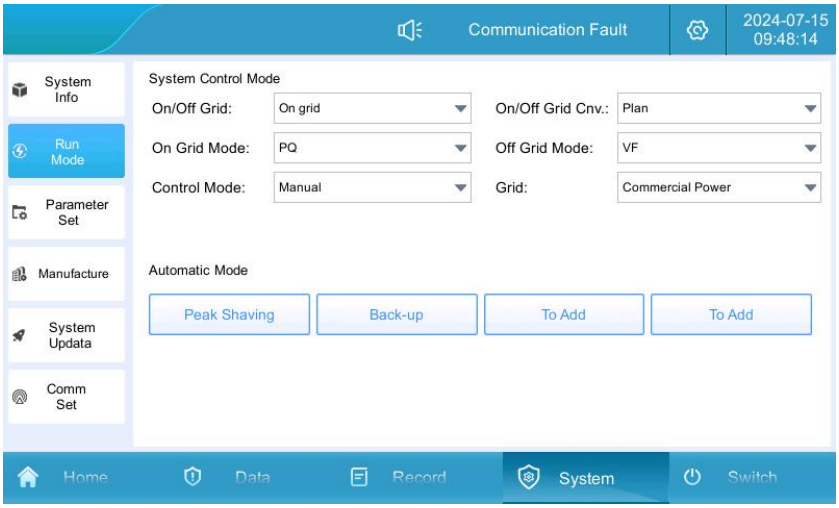


Figure 5.6 Parallel Off-grid Setting Interface

b. In grid-connected mode, the anti-reverse current function can be set to disable or enable, set to enable: the power of the energy storage system will not be supplied back to the grid. Set to disable: the power of energy storage system can flow into the grid. In the system "System"->"Parameter Settings"->"Advanced Settings (Password 888888)"->"MSTS Parameter "->"Anti-reverse current enable" setting interface is as follows:

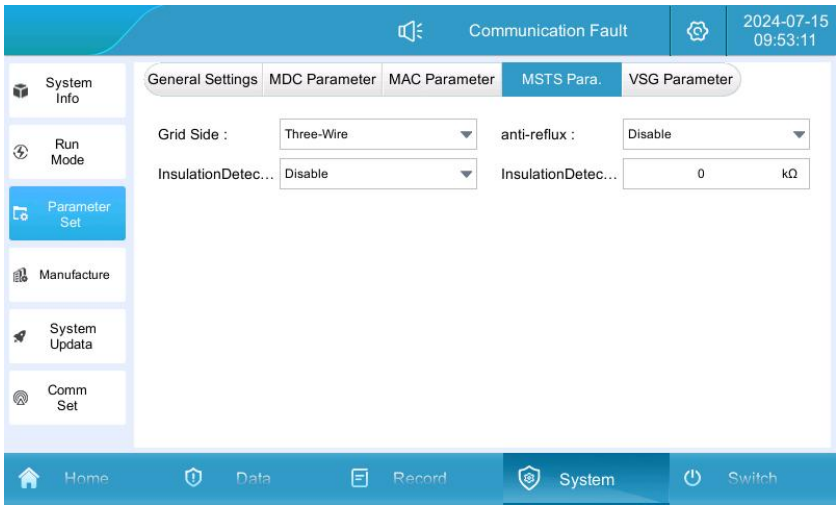


Figure 5.7 Anti-reverse flow setting interface

5.4.2. Grid-connected Manual Mode

1. Click "System" -> "Operation Mode" mode to enter Figure 5.8.

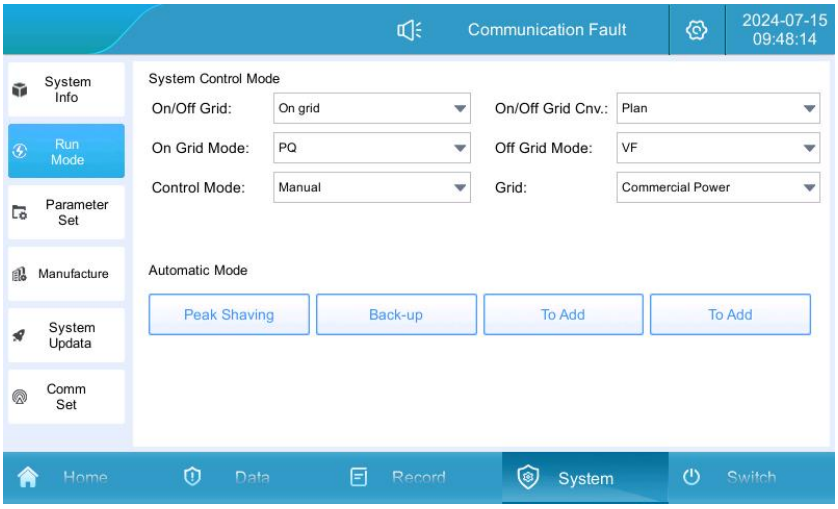


Figure 5.8 Grid-connected manual mode setting

2. Set the control mode to "Manual Mode", set the corresponding active power, power factor, and reactive power in the "Parameter Setting" page, and the machine will run according to the set value (positive value is for discharging, a negative value is for charging). The power setting interface is shown in Figure 5.9.

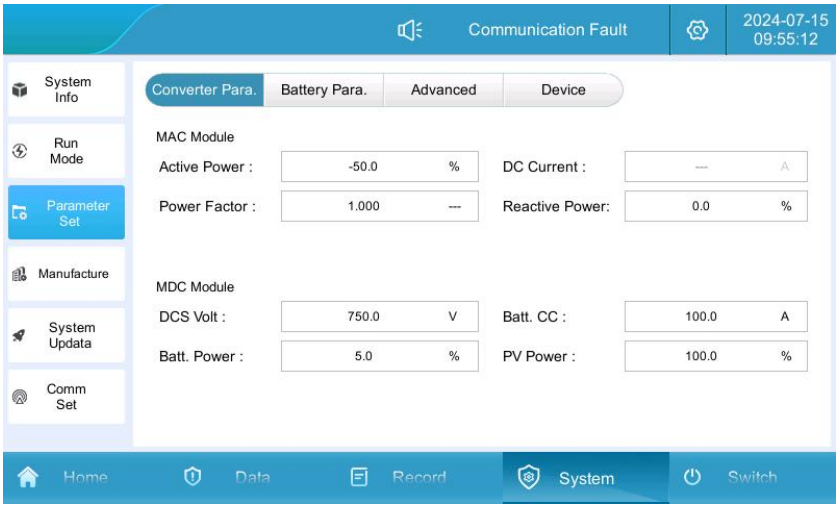


Figure 5.9 Power Setting Screen

3. Go to the "Switch" page and "Enable" the power modules as needed (it is recommended to enable all of them), and finally, click "System On" to confirm.

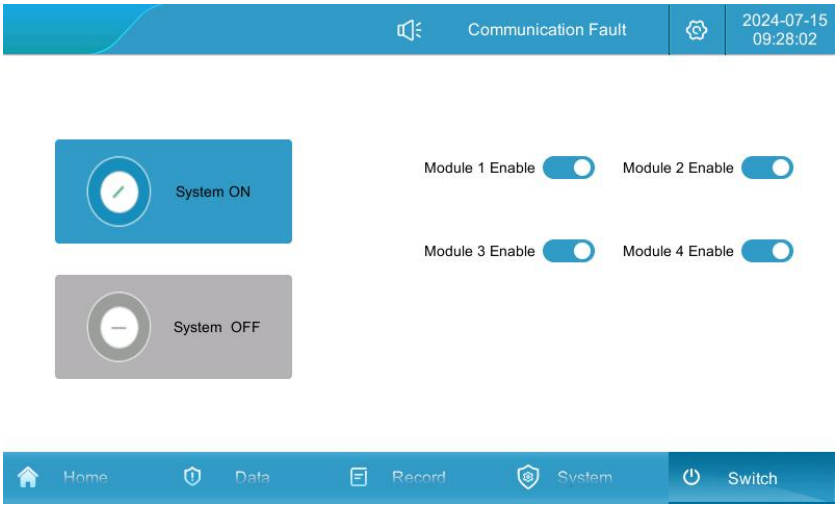


Figure 5.10 Switchboard Interface

5.4.3. Grid-connected Automatic Mode

Peak Trimming Mode:

1. Click "System" -> "Operation Mode", click "Peak Shaving" button to enter the setting page;

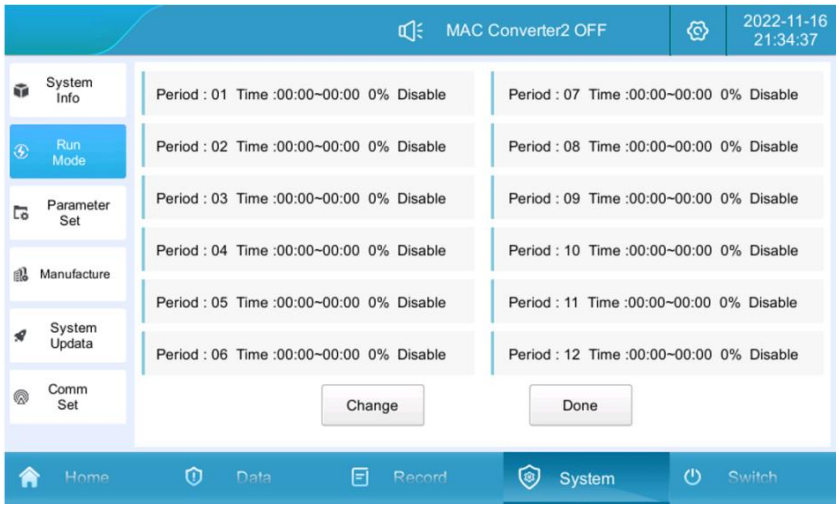


Figure 5.11 Peak Shaving Operation Setting Screen

2. Click "Modify" to set the peak shaving and valley filling operation time and power: set the start and end time, charging and discharging power, and whether to enable or not in time period 1; click the next entry to enter the time period 2 settings, and save and exit after completing all the time period settings;

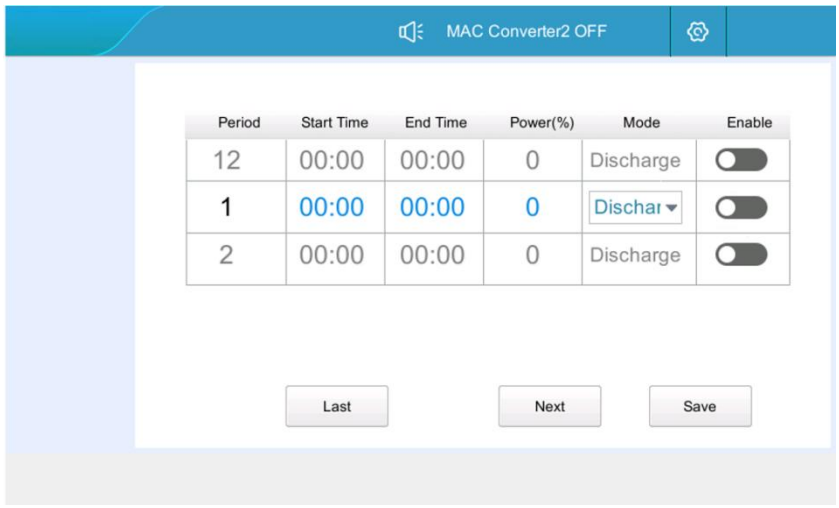


Figure 5.12 Peak shaving charging and discharging time setting interface

3. Automatically jump to the following interface, click Finish button;

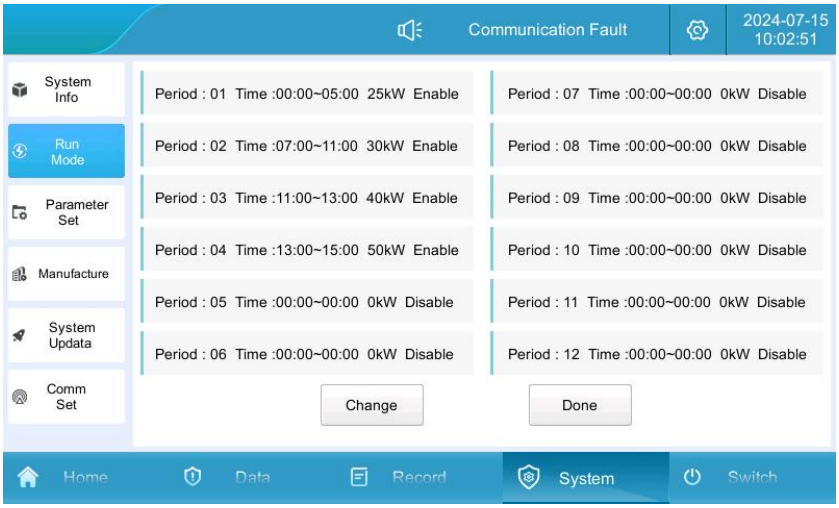


Figure 5.13 Peak reduction charging and discharging setting interface

4. Modify the "control mode" to "peak shaving and valley filling";

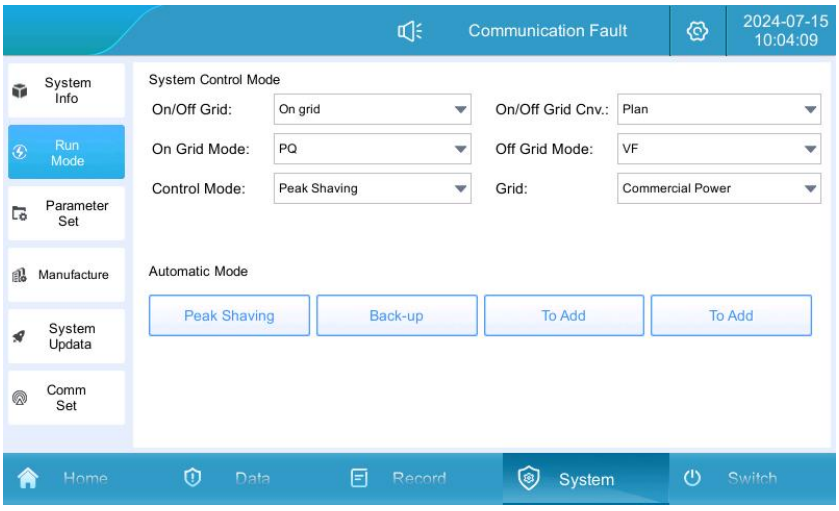


Figure 5.14 Peak shaving control mode

5. This is the automatic mode: pause, click "switch"->"system on" to complete the local automatic control mode setting.

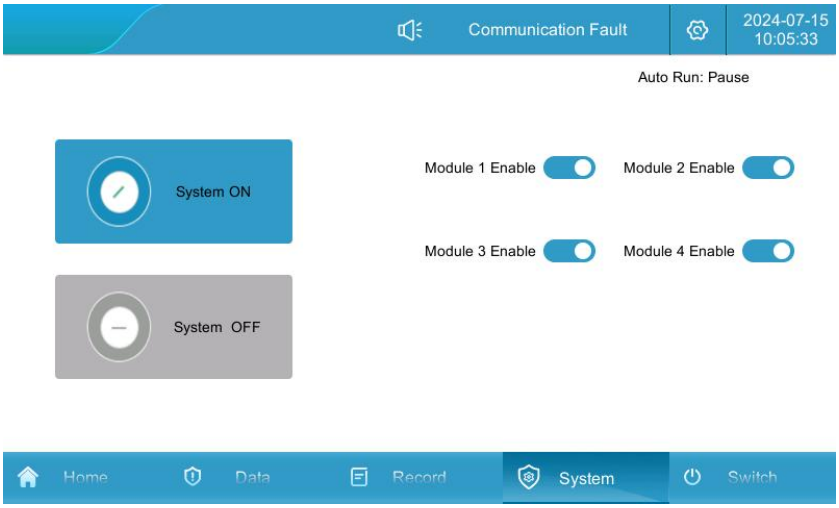


Figure 5.15 Local control run mode on

Backup Mode:

1. Click "System"->"Operation Mode", click "Backup Mode" button to enter the setting page; **Set Utility Charge Enable:** allow utility to charge the battery; **Battery Charge Power:** set the desired battery charge power value; **Set Utility Charge Disable**: do not allow utility to charge the battery. Battery charging power: set the required battery charging power value; when utility charging is disabled: utility power is not allowed to charge the battery. **Generator:** when set to enable, the generator is allowed to supply power to the load; when set to disable, the generator is not allowed to supply power to the load. **Generator Charging:** when set to prohibit, the generator is not allowed to charge the battery; when set to enable, the generator is allowed to charge the utility (provided that the generator is enabled first). **Backup Power to Maintain SOC:** When the battery SOC discharges to the set value of Backup Power to Maintain SOC, the battery will not be discharged and the load will be supplied by the utility or oil engine.

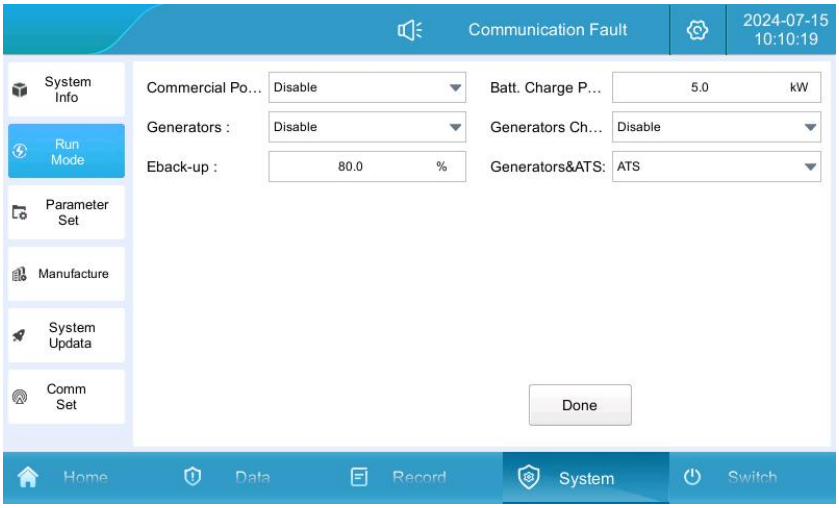


Figure 5.16 Backup Mode Setting Screen

2. When the tanker is running in reverse mode, disconnect the grid switch, close the tanker switch and close the load switch; click "System"->"Operation Mode"->"Grid" and set "Generator"; click "Backup Mode" button to enter the setting page, set "Generator" as enable, set "Generator Charge" as enable, set "Generator Charge" as enable, and set "Generator Charge" as "Generator Charge". Click "Backup Mode" button to enter the setting page, set "Generator" as enable, "Generator Charge" as enable, and "Battery Charge Power" as enable. Set "Battery Charging Power" to the power value of battery charging. After the generator is turned on, the generator will supply power to the load and at the same time charge the battery to maintain the SOC of the backup power, and the system will automatically switch to off-grid operation to supply power to the load. When the utility power is restored, you need to manually disconnect the oil switch, close the utility switch, set the "Grid" to utility power, run the backup mode, and execute the logic of the backup mode, which will not charge the battery when the utility power is charging the battery up to the SOC of the backup power.

3. Modify "Control Mode" to "Backup Mode";

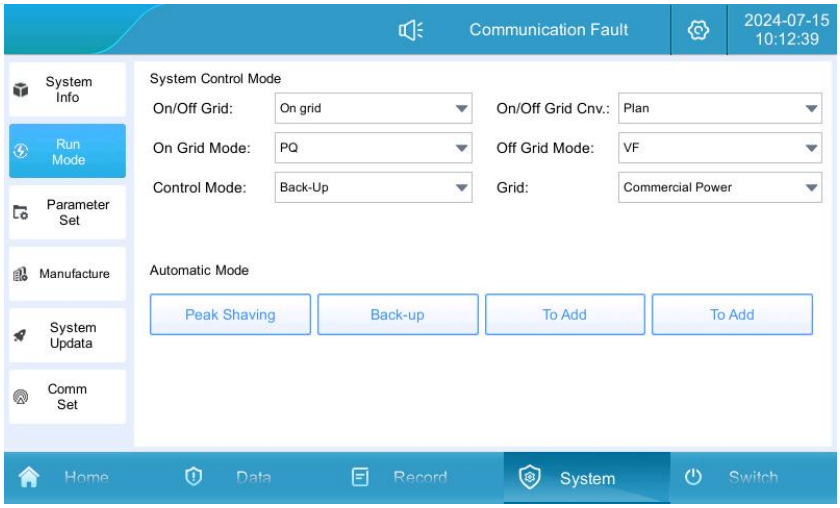


Figure 5.17 Automatic Control Operation Mode On

4. At this time, it is automatic mode: pause, click "switch"->"system on" to complete the local automatic control mode setting.

5.4.4. Automatic Switching On and Off the Grid

Grid-connected to off-grid: when the system is running in grid-connected state with sudden power failure of the grid, STS detects the power failure of the grid, transmits the information of power failure of the grid to PCS and performs the switching, and at the same time, PCS receives the signal of STS and switches from grid-connected mode to off-grid mode automatically, and the system outputs a stable three-phase AC voltage of 400V/50Hz;

Off-grid to grid-connected: when the system is running in off-grid state with grid incoming, STS detects the grid incoming call, transmits the grid incoming call information to PCS, and when STS tracks the synchronization of grid phase and amplitude with the PCS running off-grid, PCS notifies STS to issue a closing command, and at the same time, PCS automatically switches from off-grid mode to grid-connected mode, and the system executes grid-connected strategy.

The specific settings are as follows:

1. Manual switching mode: Click "System"->"Operation Mode" to enter the current page. Select "Schedule Trigger" in "Switching to Off-grid" and set it as Schedule Trigger: running in grid-connected mode can be manually switched to off-grid mode, and set "Switching to Off-grid" to "Off-grid". "Off-grid", running in off-grid mode can be manually switched to grid-connected mode (provided that utility power exists), set "on-grid" to "grid-connected".

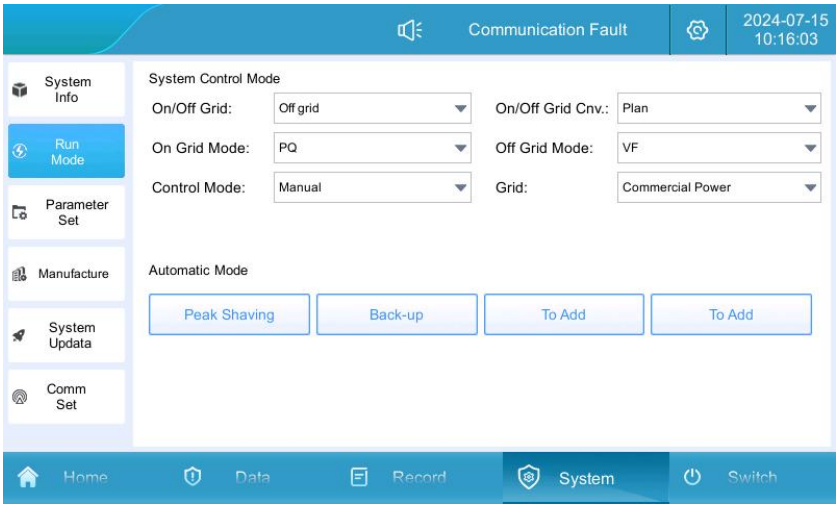


Figure 5.18 Manual parallel off-grid switching mode setting interface

2. Automatically cut off-grid mode: Click "System"->"Operation Mode" to enter the current page, and set "Off-grid Switching" to "Unscheduled Trigger", and set it to "Unscheduled Trigger". Set as "Unscheduled Trigger": when the power grid suddenly cuts off under the grid-connected state, the ESC automatically switches from grid-connected mode to off-grid mode, and the system can output stable 400V/50Hz three-phase AC voltage; when the power grid suddenly calls in the off-grid mode, the ESC automatically switches from off-grid mode to grid-connected mode.

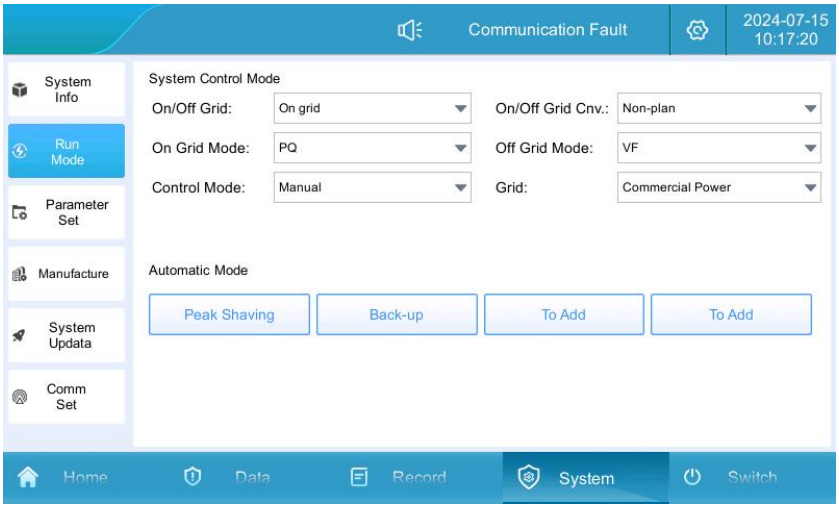


Figure 5.19 Automatic parallel and off-grid switching mode setting interface

5.5. Battery Parameter Setting

Click "System"->"Parameter Setting" to enter the current page; customers set the upper and lower limits of SOC according to their own needs; it is recommended that the lower limit of SOC is set at a value of not less than 5%.

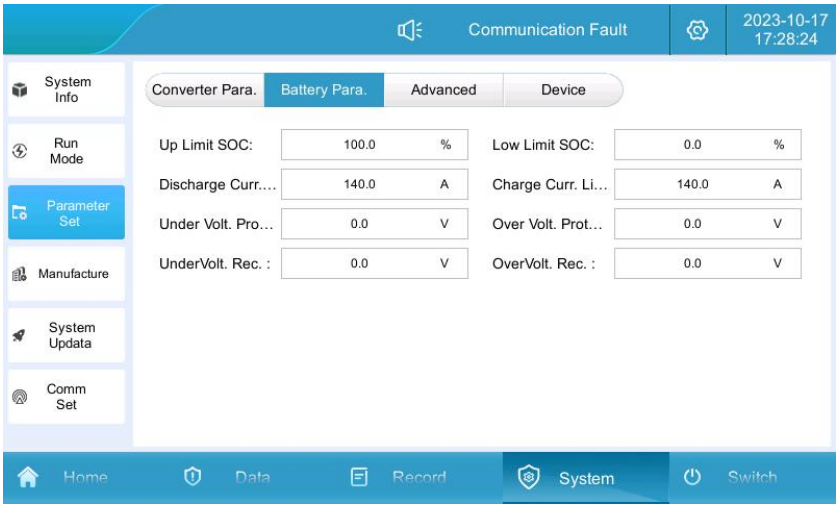


Figure 5.20 Battery Charge and Discharge Setting Interface

Note: Battery parameters are set before the energy storage system is shipped from the factory, and it is not recommended to modify them by yourself.

5.6. Data Viewing and Exporting

1. Click "Records" -> "Data Report" to enter the current page.

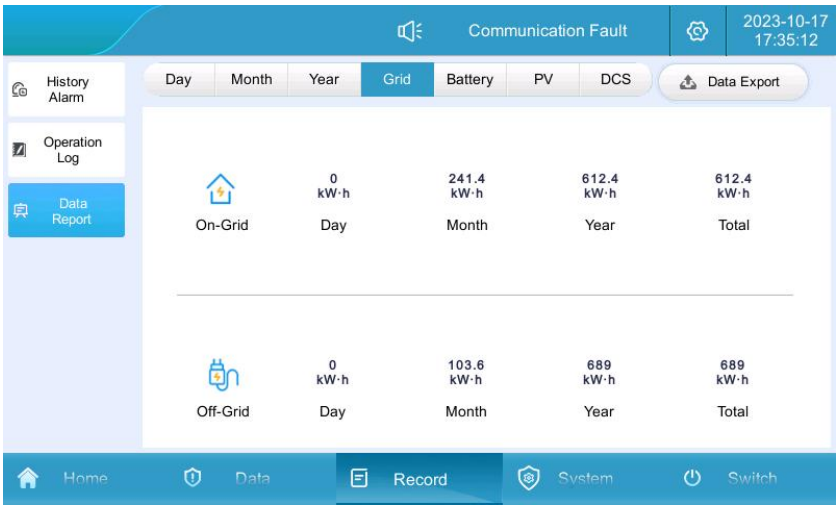


Figure 5.21 Data report screen

2. View the current day, month, year and total charge/discharge amount.
3. Insert the U disk, wait for the U disk to be connected, click data export, wait for the export to be completed.

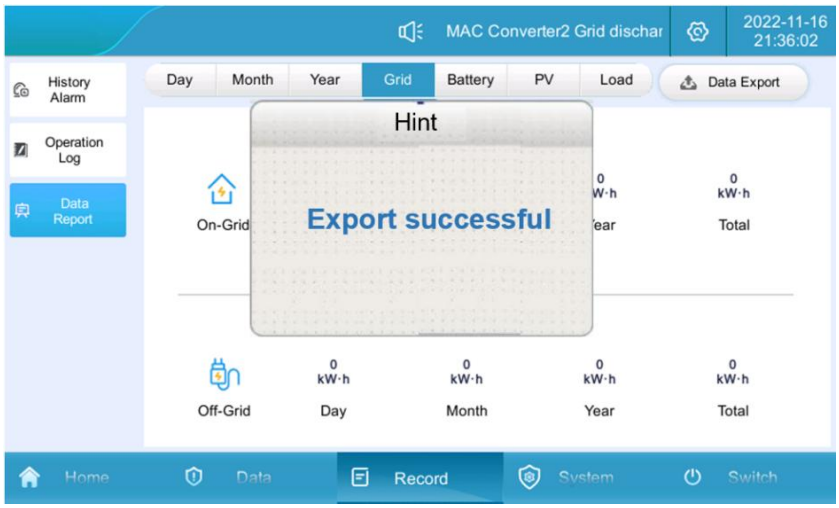


Figure 5.22 Data Export Interface

5.7. Software Upgrade

Software upgrade includes: LCD touch screen software, power module DSP software, power module ARM software three kinds of software upgrade. Before upgrading in the touch screen "switch" page to shut down the system, that is, the system must be stopped in the process of upgrading the software.

1. first of all, prepare a U disk, a computer, in the U disk, a new folder, named "UPDATE" for the storage of burn files;

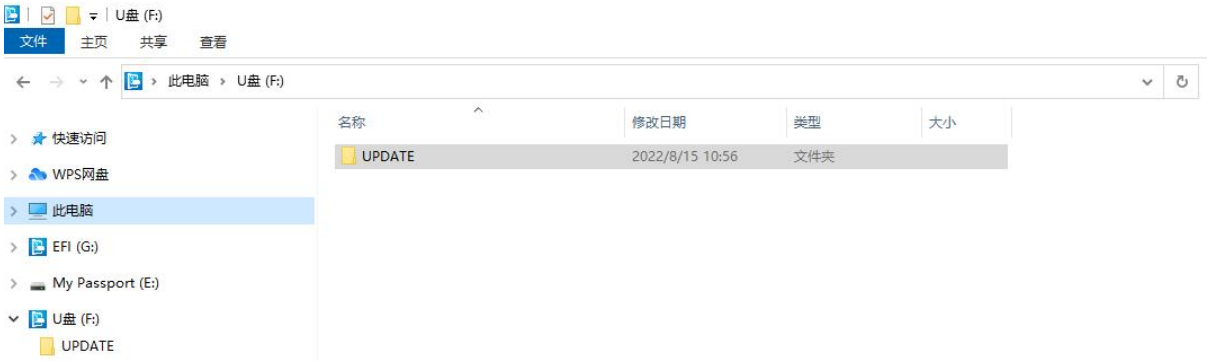


Figure 5.23 Creating an upgrade software folder

2. Copy the DSP, LCD and ARM firmware required for system upgrade to the UPDATE folder;

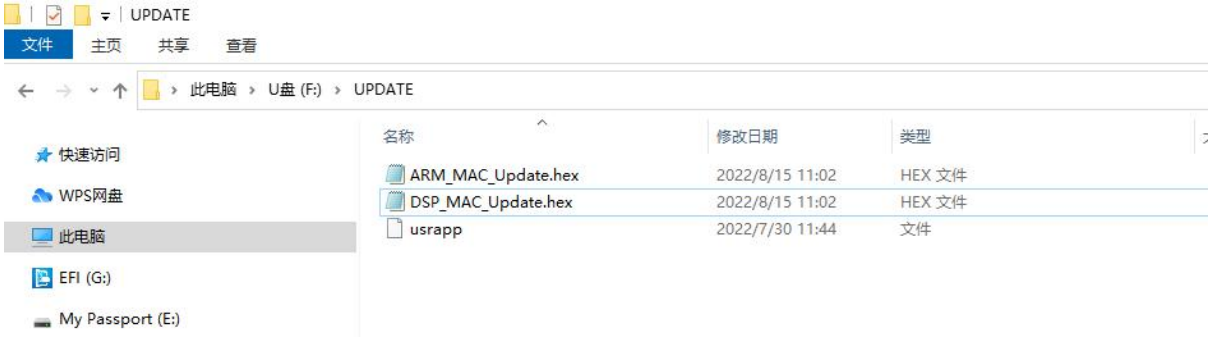


Figure 5.24 Storing the upgrade software

3. Click "System"->"System Upgrade", enter the password "888888" to enter the upgrade page;

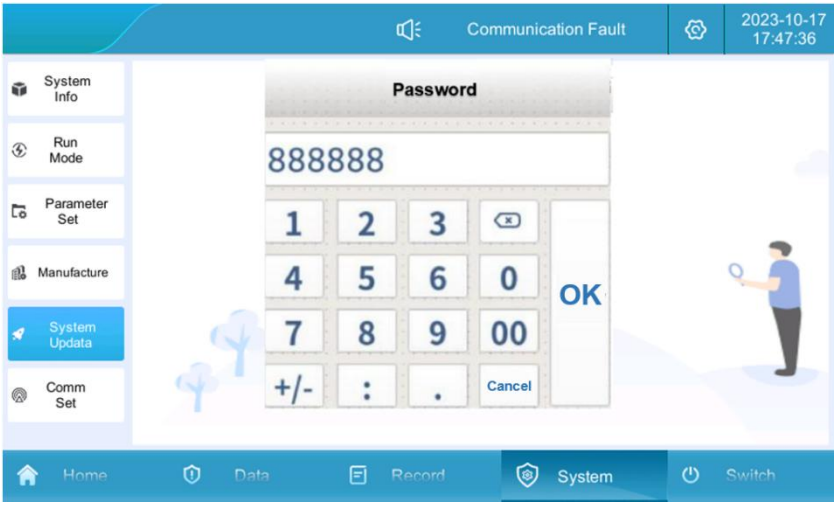


Figure 5.25 Upgrade Software Password Verification

4. Insert the USB flash disk into the back of the touch screen, the interface shows that the USB flash disk is connected and the upgrade file is detected;
5. Upgrade the LCD touch screen software, click "LCD upgrade", wait for about 15 seconds, there will be a prompt to upgrade successfully;

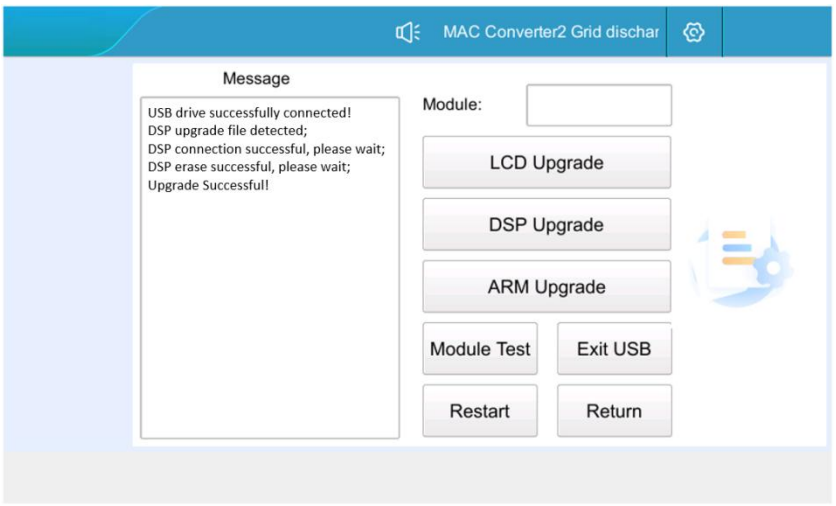


Figure 5.26 LCD Upgrade Software and Reboot Screen

5. LCD touch screen software is completed, click on the "Restart" button, the version of the refresh to take effect, as shown in Figure 5.24. Customers can be based on the actual situation of the DSP and ARM upgrade is completed, and then click on the "Restart.
7. Power module DSP/ARM upgrade, you need to select the module to be upgraded in the module box of the "System Upgrade" interface (when the system has more than one module, it is recommended to upgrade from module 1 first, and then set up module 3 after completion of upgrading until the completion of the upgrade of all modules);
8. Click "DSP/ARM Upgrade", and wait for about 5 minutes to prompt the upgrade success. Complete the system upgrade.

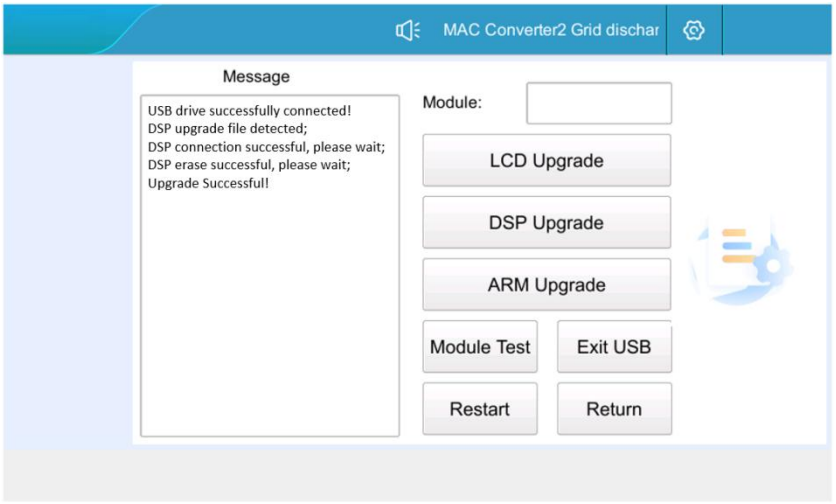


Figure 5.27 DSP/ARM Upgrade Interface

5.8. Environment Monitoring Interface Introduction

Click "Data"->"Environment Monitoring" to enter the following interface; you can view the real-time environmental status of the system, air conditioning parameter settings and air conditioning on and off in the interface.

Cooling Mode: When the temperature is greater than or equal to the set cooling point, the air conditioner is turned on, when the temperature is lower than the cooling point, the air conditioner is turned off, and the return value is 5℃ by default (1~10℃ adjustable);

Heating mode: when the temperature is lower than the heating point, the air conditioner turns on the heating, when the temperature reaches the heating point plus the return difference value, the return difference value is 5℃ by default (1~10℃ adjustable);

Figure 5.28 Environment Monitoring Screen

6. Alarms and Maintenance

Alarm levels are defined as follows::

- Failure: The equipment fails and the system stops running (charging/discharging).
- Alarm: the device has lost output power or part of its function has failed due to external factors, but it does not affect the charging/discharging function of the system.

6.1. Alarm Handling

Figure 6.1 Fault Alarm Handling Methods

Alarms/Faults	Components	Problem Cause	Approach
Flooding	Battery compartment	Water in the energy storage cabinet	1. Check whether there is water inside the cabinet; 2. Confirm that the distributed energy storage cabinet is not leaking and that the equipment inside the cabinet is intact.
Fault	Battery compartment	Cabinet door open	1. Check that the cabinet door is fully closed; 2. Check that the cable on the door magnetic sensor is not disconnected; 3. Check whether the door magnetic sensor position is offset.
Door Magnetic	Battery compartment	Battery overheating or fire	1. Immediately press the EPO button and move away from the energy storage cabinet; 2. Observe for 30 minutes from a safe distance. If there is smoke or fire, call the fire alarm; if there is no abnormality, manually clear the active alarm and contact the manufacturer.
Alarm	Electrical Compartment	Surge Protector Failure	1. Check whether the lightning protector signal line connection is loose; 2. check for discoloration of the lightning protector indicator; 3. Replace the AC lightning protector.
Fire	Air Conditioning	1. Loose wiring 2. Damaged compressor	1. Disconnect the power distribution switch, open the air conditioner junction box, and check 0 see if the wiring is loose; 2. Observe the appearance of the compressor to see if there is obvious damage, whether there is a burning smell, if so, contact the manufacturer.
Fault	Air conditioning	1. Loose wire 2. Damaged fan	1. Disconnect the power distribution switch, open the air conditioner junction box and check whether the wiring is loose; 2. Observe whether the fan is visibly damaged and

			whether there is a burning smell, if so, please contact the service hotline.
Lightning Protector	Air conditioning	1. Loose wire 2. Fan damage	1. Disconnect the power distribution switch, open the air conditioner junction box and check whether the wiring is loose; 2. Observe whether the fan is visibly damaged and whether there is a burning smell, if so, please contact the service hotline.
Alarm	Grid/oiler	Abnormal grid-side voltage	Checking for abnormalities in the voltage on the grid-connected side;
Compressor	Grid/Oil engine	Abnormal grid-side frequency	Checking whether the frequency on the grid-connected side is abnormal;
Alarm	Grid/Oil engine	Abnormal grid-side voltage	Checking whether the voltage on the grid-connected side is abnormal;
Outdoor fan	Grid / Oil Machine	Abnormal grid-side voltage	Checking whether the voltage on the grid-connected side is abnormal;
Alarm	Grid / Oiler	Abnormal grid-side voltage	Checking whether the voltage on the grid-connected side is abnormal;
Grid Misphase	Grid/Diesel	Wrong phase sequence on grid-connected side	Align any two of the three ABC cables
DC voltage high/low	Batteries	Abnormal battery voltage	Check for abnormal DC input voltage;
Fault	Energy Storage Converters	1. Load imbalance 2. Software anomaly	1. Check for loose or abnormal DC wiring; 2. Contact the manufacturer
Bus overvoltage	Energy Storage Converters	1. Load imbalance 2. Software anomaly	1. Check if the load is abnormal; 2. Contact the manufacturer
Fault	Energy storage converters	High internal temperature	1. Check whether the air inlet and outlet of the electrical compartment are blocked; 2. Check whether the internal fan is operating normally; 3. Contact the manufacturer
Half-voltage unbalance at busbar	Energy storage converters	High internal temperature	1. Check whether the air inlet and outlet of the electrical compartment are blocked; 2. Check whether the internal fan is operating normally; 3. Contact the manufacturer
Fault	Energy storage converter	Internal temperature too high	1. Check whether the air inlet and outlet of the electrical compartment are blocked; 2. Check whether the internal fan is operating normally; 3. Contact the manufacturer
Over Temperature Derating	Energy storage converter	DC current overrun	1. Check for short circuits or broken wiring on the DC side; 2. replace the energy storage converter module or

			contact the manufacturer.
Alarm	Energy storage converter	Internal current overrun	1. Check for off-grid load overload; 2. Replace the energy storage converter module or contact the manufacturer.
Power tube over temperature	Energy storage converter	AC side power/current overrun	1. check whether the grid voltage is normal; 2. check whether there is a short circuit or line breakage on the DC side; 3. check whether the off-grid load is overloaded; 4. Replace the energy storage converter module or contact the manufacturer.
Wave-by-wave current limiting	Energy Storage Converters	AC side current overrun	1. check whether the grid voltage is normal; 2. check whether the off-grid load is excessive; 3. replace the energy storage converter module or contact the manufacturer.
Fault	Local Controller for Energy Storage Converters	Communication interruption	1. Check whether the communication network cable between modules is loose and abnormal; 2. Check whether the communication network cable of the local controller is loose and abnormal;
Communication Interruption	Energy Storage Converters	Parallel/ Synchronous Signal Interrupt	1. Check whether the parallel cable is loose or abnormal; 2. Check whether the parallel setting is abnormal; 3. Damaged hardware circuits
Fault	Energy storage converter	1. Internal relay abnormality 2.Software abnormality	1. Replacement of the energy storage converter module 2.Contact manufacturer to replace internal boards
Parallel Synchronization	Energy storage converter	Internal fan abnormality	1. Replacement of the energy storage converter module 2. Contact the manufacturer to replace the internal fan
Fault	Energy storage converter	1.Leakage Current Excess 2.Software abnormality	1. Check leakage current hall for loose or abnormal wiring; 2. Check if the ground wire is disconnected;
Relay open short circuit	Energy storage converter/battery	1. Low insulation to ground 2.Software abnormality	1. Check the AC and DC cables for breakage or short circuit to ground; 2. Check whether the battery line is broken or shorted to ground.
Fault	Energy Storage Converter	Module-to-screen communication interrupted	Check whether the communication network cable between modules is loose and abnormal;
Fan 1/2/3	Energy Storage Converters	Battery not turned on	Check that the battery is turned on;
Low voltage on the low voltage	Photovoltaic DC converters	PV voltage open circuit voltage below	Measure the positive and negative DC voltages of the PV switch with a multimeter to see if they are

side one way and two ways		250V	greater than 250V.

WARNING: The above alarms and faults are common alarms or faults, **If a malfunction other than those in Table 6.1 occurs, contact the manufacturer directly.**

6.2. Routine Maintenance

Affected by ambient temperature, humidity, dust, vibration and aging of internal components of the inverter, the system may have some potential problems during operation. In order to enable the energy storage system to operate stably for a long period of time, it is necessary to arrange regular inspections by maintenance personnel according to Table 6.2, so that problems can be found and dealt with in a timely manner. Maintenance is recommended once a month for systems installed in sandy, dusty, salt-sprayed or heavy industrial parks, and once every 3 months for energy storage systems in areas with favorable climatic conditions.

Figure 6.2 Routine Maintenance Tasks

Maintenance Objects	Movements	Reference standard
Box	●Check the whole appearance of the machine ●Checking the vents ●Check door lock condition	●No obvious coating peeling, scratches, or corrosion ●No obvious signs of water leakage ●No dust buildup in vents ●No damage to door locks
Air conditioners	●Check for noise and vibration ●Clean the filter	● Fan and compressor rotate normally, without jamming or abnormal noise. • Clean filter surface, no clogging
Energy storage converters	● Check for noise and vibration ●Check front panel vents ●Check the rear copper contact surface	● The front panel fan rotates normally, without stuttering or rattling. ● The surface of the front panel vents is clean and not clogged. ● No corrosion and discoloration of copper rows and contact surfaces, and no accumulation of dust.
Electrical	●Check the lightning arrestor ●Check cable copper contact surfaces	●Surge arrester is normal ●Screw socket connecting wires are not loosened or detached ●No corrosion and discoloration of copper rows and contact surfaces, and no accumulation of dust.
Battery packs	●Check noise and vibration ●Check cable copper contact surfaces	● Battery pack fan rotates without jams or rattles ● The surface of the front panel vents is clean

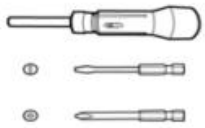
		and not clogged. ● Screws and sockets connecting wires are not loosened. ● Copper rows and contact surfaces are free of corrosion and discoloration, and free of dust accumulation.

6.3. Dust Removal Operating Instructions

6.3.1. Pre-maintenance Preparation

Attention:

Please prepare at least the following tools, if there are not enough tools may not be able to complete the maintenance; the use of tools, Phillips screwdriver, etc., the handle needs to be insulated, or the use of insulated tools.

 Cross screwdriver	 Multimeter	 Rubber hammer	 Insulated ladder
 Vacuum cleaner	 High pressure water gun		

Personal Protection Tools:

 Safety gloves	 Protective goggles	 Dust mask	 Safety shoes
 Reflective Vest	 Safety helmet	 Medical kit	

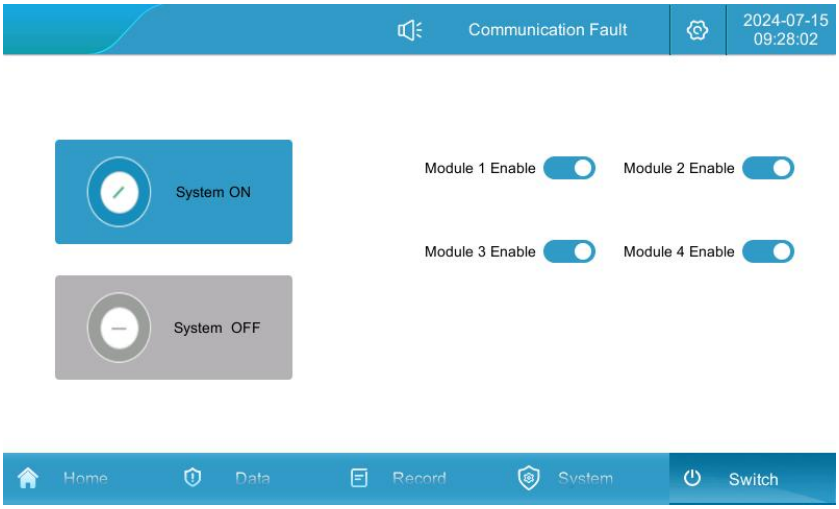
6.3.2. Monthly Maintenance

Maintenance Category	Maintenance actions	Reference standard	Is the system powered down
Box	• Cleaning of vents • Clean the dustproof cotton • Rinse the exterior	• No accumulation of dust in the ventilation openings • No entry of insects, rats, snakes and other animals • No visible discoloration or debris on dustproof cotton.	Yes
Air Conditioning	• Clean radiators	• The fan rotates normally without any stuttering or rattling. • The radiator surface is clean and not clogged	Yes
Distribution area	• Check for foreign objects in the distribution area	• Area is clean and free of foreign objects	Yes
Note: Sandy areas are recommended to be cleaned once for every sandstorm; cleaning is recommended once before entering the summer; other areas are based on the actual situation, to ensure that the filter or condenser is not clogged; the statute of limitations for the use of dust cotton is up to 2 years. Recommended tools: high-pressure water gun.			

6.3.3. Procedure

Step 1: The system powers down and shuts down;

1) Click on the touch screen switch screen and click on "System Shutdown";



2) Breaking system auxiliary power switch MCB4~5 and battery auxiliary power switch;

3) Breaking QF1 oil engine switch, QF2 utility switch, breaking QF4 load switch, QF5~6 photovoltaic switch;

4) Breaking the battery high voltage control box DC load switch;

5) Waiting for the end of busbar discharge, the touch screen goes out and the equipment finishes shutting down;

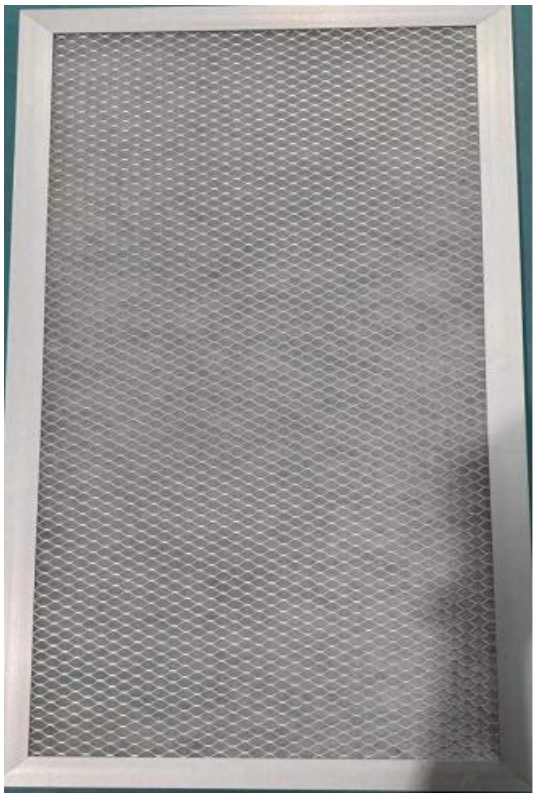
6) Close the distribution switch on the upper level of the energy storage equipment and put up the "No Closing" maintenance signage.

Step 2: Use special tools and keys to open the system cabinet door;

Step 3: Disconnect the circuit breaker of the upper distribution box of the utility circuit breaker, and hang the "no closing" maintenance signboard. Use a multimeter to measure whether the equipment is still charged, until the equipment is no longer charged before the next operation;

Step 4: Open the cabinet door, loosen the snap of the dustproof cotton frame, remove the dustproof cotton, put the aluminum alloy frame and the dustproof cotton flat on the safe placing area;

Step 5: Use a high-pressure water gun to rinse the dust wadding, or use a cleaning agent if it is excessively dirty;



Step 6: Put the cleaned dustproof cotton into the aluminum alloy dustproof cotton frame to dry, and then use the clips to fix it;

Step 7: Reboot is detailed in operation 5.2.

6.4. Warranty Service

6.4.1. Warranty Period

The warranty period agreed upon in the commercial contract is subject to the correct use of the product.

6.4.2. Warranty Coverage

Products in the warranty period, where the quality of the product itself and lead to failure, the company for the customer to carry out free maintenance or replacement products. Customers should reserve a reasonable response time for the Company's maintenance, the replacement of the product by the Company to deal with. Customers need to show proof of purchase of the product, and ensure that the product logo is clearly visible, otherwise the Division has the right not to be warranted.

6.4.3. Disclaimer of Liability

In the following cases, we have the right not to carry out quality assurance but still can provide paid repair services.

- Is out of warranty;

- Cannot provide proof of purchase related to the product;
- Damage caused during transportation, loading, and unloading;
- Damage caused by incorrect installation, modification, or dismantling by unauthorized personnel;
- Damage caused by the operation under abnormal conditions of use or environment;
- Malfunction or damage to the machine caused by the use of non-Natone components or software;
- Failure caused by fire, earthquake, flood, and other irresistible factors