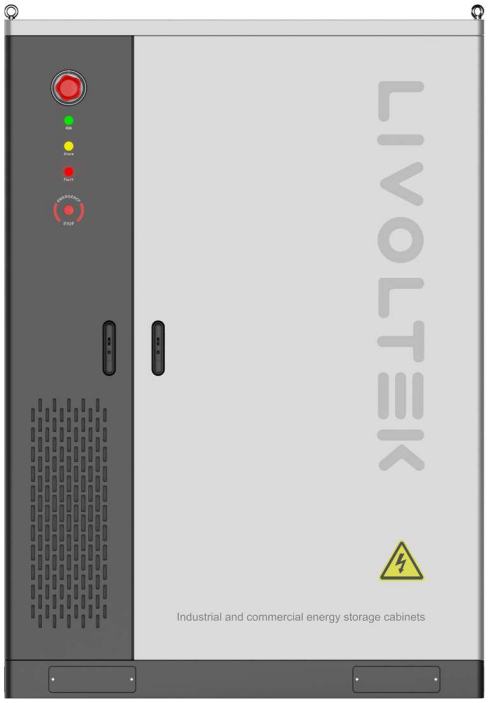
LIVOLTEK

User Manual

100kW/225kWh Commercial & Industrial Energy Storage System



Release Notes

Version	Date	Version Update Record	Authorized Strength	Audits
V1.0	2024-03-04	First Edition V1.0	LH	FJJ
V1.1	2024-06-18	Optimize English translation	WY	FJJ

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. In order to ensure the user better use of this product and to protect personal and property safety, the following symbols used to prompt, please read carefully.

 **Dangerous:** Indicates risk of Electric Shock which will result in death or serious injury if not avoided.

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

 **CAUTION:** Indicates a low level of potential hazard that, if not avoided, could result in moderate or minor injury to personnel.

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

1.2. General Safety

 **Description:**

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. Which 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 the provisions in the relevant international, national and regional standards.
- Do not operate under the conditions of use described in this manual.
- Unauthorized disassembly, alteration of products or modification of software code.

- Failure to follow the operating instructions and safety warnings in the product and documentation.
- Damage to 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 shipping and installation requirements.
- Damage caused by storage conditions that do not meet the requirements of the product documentation.
- 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, as well as 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 Seller's reasonable control, including power outages or electrical failures, theft, war, riots, civil commotion, terrorism, willful or malicious damage.

 **Danger:**

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 standardize 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. Any unauthorized alteration of the equipment's structure, installation order, etc. is prohibited.
- Do not use water to clean electrical parts inside the equipment. If liquid is found inside the equipment, press the emergency stop switch immediately 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 is reliably grounded and that there is no danger of electric shock.

- Do not approach the equipment except for the person who will operate it. Do not energize the equipment without completing the installation or without confirmation from a qualified person. Ensure that at least two persons are present when power is first applied or when the main circuit is energized.

Clarification:

- Users in the transportation, handling, installation, wiring and maintenance of the process of operating behavior and operating tools, must meet the country, region, laws and regulations and relevant standards.
- When installing, operating, or maintaining, it is necessary to clean the top of the cabinet of any standing water, ice, snow, or other debris before opening the cabinet door to avoid debris falling into the cabinet.
- Reverse engineering, decompiling, disassembling, adapting, implanting or other derivative operations on the device software is prohibited, as well as researching the internal implementation of the device, obtaining the source code of the device software, stealing intellectual property rights, etc., In any way, or disclosing the results of any device software performance tests.

1.3. Electrical Safety

1.3.1. Cabling 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 it is prohibited to twist or cross lay each other.
- When wiring is completed or you leave for a short period of time during the wiring process, you need to immediately seal the cable opening and close the cabinet door to avoid small animals from entering.
- The cables used in the energy storage system shall be firmly connected, well insulated, and in accordance with the specifications. The location of the cable through the pipe or

over the hole, must be protected to avoid the cable by sharp edges, burrs and other damage.

- Cable wiring is completed, you need to use the cable bracket and cable clamps for reliable fixing, backfill the soil area of the cable to ensure that the ground is closely adhered to, to prevent backfilling soil, cable deformation or damage caused by force.
- Cables used in high temperature environments may cause the insulation to deteriorate and break, the distance between the cable and the periphery of the heat generating device or heat source area is at least 30mm.
- In order to ensure construction safety, all cables should be laid and installed above 0°C. When handling cables, especially when constructing in low-temperature environments, they 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, check the electrical connections of the equipment to ensure that it is reliably grounded.
- The equipment grounding impedance meets the requirements of national standard GB 50054 and local electrical standards.
- Do not operate equipment without a grounding conductor. When installing equipment that requires grounding, install the protective earth conductor first; when removing equipment, remove the protective earth conductor 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 verify that it is not energized and to ensure that the equipment has been completely de-energized.
- If there is an electrically charged body nearby, cover or wrap it with an insulating board or tape.

- Use a grounding wire to reliably connect the circuit to be serviced to the grounding circuit before performing O&M.

Description:

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

1.4. Mechanical safety

Attention:

- The bottom board must be removed for fork transportation without wooden crate bottom bracket. Lifting and lowering should be carried gently and put down gently, avoiding impact or vibration.
- The center of gravity of the box should fall in the middle of the two forks of the forklift during transportation. It is prohibited to carry the box for long distance or invert or tilt it.
- When transporting the equipment, the operator's view may be blocked due to the large size of the equipment, so it is necessary to arrange for auxiliary personnel to assist in the completion of the task.
- In order 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 equipment by hand, you should be prepared to bear the weight and should wear protective gloves, anti-smash shoes and other safety gear.
- The equipment must be moved carefully during handling to avoid impact or dropping. Avoid scratching the surface of the equipment, damaging parts or cables.

1.5. Battery Safety

Clarification:

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 the customer, resulting in overdue storage, loss of capacity or irreversible damage.
- Mechanical damage from dropping, liquid leakage, rupture, etc. caused by improper handling or failure to connect the battery as required.
- The customer or a third party may change the usage of the battery without informing us. This includes, but is not limited to, connecting additional loads to the battery, mixing it with other brands of batteries, mixing it with batteries of different rated capacities, etc.
- Due to the field equipment operating environment or external power parameters can not meet the environmental requirements of normal operation, the battery caused by direct damage. Including the actual operating temperature of the battery is too high or too low, poor power grid conditions and frequent power outages.
- Customers do not correctly set the battery operation and management parameters or improper maintenance caused by frequent over-discharge of the battery, the customer site expansion or long-term failure to fully charge.
- The customer has not properly maintained the battery in accordance with the operation manual of the supporting equipment, including but not limited to: not regularly checking whether the battery terminal screws are tightened.
- Batteries are lost by theft.
- Batteries that have exceeded the warranty period.

Danger:

- Do not expose the battery to high temperatures or around heat generating equipment, such as sunlight, fire, 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.
- Battery thermal runaway generates flammable gases, as well as harmful gases such as CO and HF. The accumulation of flammable gases after thermal runaway of the battery poses a risk of deflagration and explosion, which may cause personal injury and property damage.
- When installing and maintaining the battery, it is necessary to wrap the exposed cable terminals on the battery with insulating tape. At the same time, avoid foreign objects (e.g. conductive objects, screws, liquids, etc.) from entering the interior of the battery and causing a short circuit.

Warning:

- Batteries must be stored in a separate warehouse, and stored in the outer packaging, avoiding mixed storage with other materials, avoiding open storage, and avoiding stacking batteries too high. The site must be equipped with fire-fighting facilities that meet the requirements, such as fire sand and fire extinguishers.
- Batteries should be protected from 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 internal short-circuiting of the battery due to crystallization that occurs with low temperature charging.
- Please dispose of used batteries in accordance with local laws and regulations, and do not dispose of batteries as household waste.
- If it has been more than 8 months since the battery was last charged, the battery needs to be recharged. Failure to recharge the battery as required may affect the performance and service life of the battery.

Battery Abnormal Handling Measures

Danger:

- When an electrolyte leak occurs or there is an unusual odor, avoid contact with the leaking liquid or gas. Non-professionals should stay away and contact a professional immediately to handle the situation.
- Electrolyte is corrosive and contact may cause skin irritation and chemical burns. If contact with battery electrolyte occurs, the contact area needs to be washed immediately with plenty of water and soap and medical help sought immediately.
- After dropping the battery (no matter with or without package), it is forbidden to continue to use it. If there is no obvious deformation or damage in appearance and there is no obvious odor, smoke or fire, transfer the battery to an open and safe place for 1h under the premise of ensuring safety, and contact our service engineer.
- When there is obvious odor, breakage, smoke or fire after the battery falls, evacuate people immediately and call the police in time. By professional personnel in the protection of safety, the use of fire fighting facilities to extinguish the fire.

1.6. Maintenance and Replacement

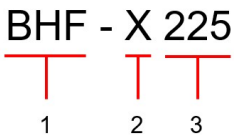
Warnings:

- It is prohibited to open the cabinet door in rain, snow, lightning, dust, fog, etc.
- Before parts are removed from the cabinet, make sure that other parts on the cabinet are not loose.
- During equipment maintenance, nearby energized parts should be covered with insulating material.
- Prohibit any object from touching the operating fan (e.g., fingers, parts, screws, etc.) until the fan is powered off and stops rotating.
- Do not power up the unit before troubleshooting.
- When inspecting the system with electricity, 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 unpowered before operating the equipment.
- Manual wiring inspection is required to avoid abnormal system operation after power components of the energy storage system are replaced or wiring is changed.

- 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



Identifiers	Meaning	Note
1	High voltage LFP energy storage system	/
2	Outdoor cabinet series	/
3	Energy	225kWh

2.2. Product Features

BHF-X series outdoor energy storage cabinet integrates energy storage battery, modular PCS, local management and monitoring system, power distribution system, environmental control system and fire control system. Adopting modularized PCS, it is easy to maintain and expand capacity, featuring safety and reliability, rapid deployment, low cost, high energy efficiency and intelligent management.

The operation strategy of the energy storage system for common application scenarios is as follows:

Peak Shaving and Valley Filling: During off-peak hours as per time-of-use tariffs, the energy storage cabinet automatically initiates charging and remains on standby once fully charged. Conversely, during peak hours, it discharges automatically, capitalizing on tariff differentials for arbitrage, thereby enhancing the economic efficiency of the solar storage and charging system.

PV (Photovoltaic) and Storage Integration: The system dynamically monitors local load demand, giving priority to using photovoltaic-generated power for self-consumption, with excess energy stored. In instances where photovoltaic output is inadequate to meet the immediate local load requirements, the stored energy in the battery is then utilized as a primary supplement.

2.3. Electrical Wiring Diagrams

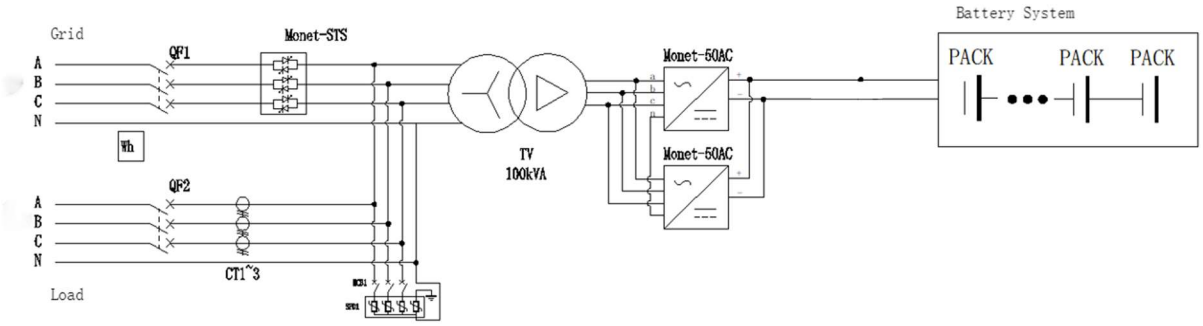


Figure 2.1 Electrical primary diagram

Note: Figure 2.1 for the system program with parallel off-grid, with isolation transformer, with photovoltaic input, different projects with different configurations, the line is slightly different, the actual shipping attached drawings shall prevail.

2.4. Product Features

- System productization, integrating energy storage battery, PCS, energy management monitoring system, power distribution system, environmental control system and fire control system, etc., to fully control the system operation status and risk;
- Configuration of rack-type modular PCS, support for multiple parallel connection, good scalability; according to the system capacity requirements of micro-grid and other scenarios to select the number of PCS modules and the total battery power, the typical configuration is: 100kW/225kWh.
- With protection class IP55, it can perfectly cope with all types of weather outdoors;
- Door-mounted embedded integrated air conditioners are used, which do not take up cabinet space and improve the available space in outdoor cabinets, with better structural integrity at the top and good waterproofing;
- Built-in smoke sensing, temperature sensing, gas sensing, fire extinguishing system, real-time monitoring of the state of the electric cabinet, to ensure the safety of product operation;
- Intelligent air-cooled temperature control, better system temperature field consistency, better performance and longer service life;
- The local control panel can realize diversified functions such as system operation monitoring, energy management strategy formulation, and equipment remote upgrade.

2.5. Product Parameters

The following are the typical configuration parameters of BHF-X series outdoor cabinet energy storage system, the actual supply is subject to the technical agreement.

Table 2.1 Parameters of the energy storage system

Items		Specifications	Note
Cell	Cell Capacity	280Ah@25℃, 0.5C/0.5C	
	Cell System	LFP, Power type	
	Nominal Voltage	3.2V	
	Energy Density	165.9Wh/kg	
Module	Format	CTP Module 1P9S	
Battery Pack	Nominal Energy	16.128kwh	
	Module Composition	1P18S	2 Modules
	Communication Method	Daisy Chain Communication	Daisy Chain Newsletter
PCS Module (AC Side)	Rated power	50kW	Single Cabinet Configuration With 2 Modules
	Output Voltage	400Vac	3W+N+PE/3W+PE
	Full Load Voltage Range	500 - 1000V	
	Rated Frequency	50/60Hz (±5)	
Battery System	Nominal Voltage	806.4V	
	Total Energy	225.8kWh	25°C, 0.5C/0.5C
	Operating Voltage	630~919.8V	
	Number Of Battery Packs	14	Maximum Number Of Packs
	System Components	1P252S	
	Rated power	100kW	
	Depth Of Discharge	100% DOD	
	Operating Temperature	Charge: 0~55℃ Discharge: -20℃~55℃	
	Number Of Parallel Connections On DC Side	5	Maximum Number Of Parallel Connections
	Communication Method	RS485/Ethernet	
	Thermal Management Methods	Air Conditioning Air-Cooled + Air-Heated	
	Fire Fighting Methods	Aerosol	
	Sizes	1500*2120*1200mm	
	Weights	2600kg	

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

2.6. Components

2.6.1. Battery system

Table 2.2 Battery system parameters

Cell Parameters			
Battery Type	Lithium Iron Phosphate (LFP)		
Nominal Voltage	3.2v		
Voltage Range	2.5~3.65V		
Nominal Capacity	280Ah		
Maximum Operating Temperature Range, Charging	0~55℃		
Maximum Operating Temperature Range, Discharge	-20~55℃		
Pack Parameters			
Series-Parallel Connection Method	1P18S		
Rated Energy	16.128kWh		
Nominal Voltage	57.6V		
Voltage Range	48.6V~64.8V		
Weight (Approx.)	125kg		
Dimension(W*D*H)	800*420*230mm		
Battery Cabinet Parameters			
Model	BHF-X225	BHF-X209	BHF-X193
Rated Energy	225.8kWh	209.7kWh	193.5kWh
Rated Voltage	806.4V	748.8V	691.2V
System Voltage Range	680.4~907.2V	631.8~842.4V	583.2~777.6V
Series-Parallel Connection	1P*252S	1P*234S	1P*216S
Number Of Battery Packs	14	13	12
Weight (Approx.)	2470kg	2340kg	2200kg

2.6.2. Battery Management System

The Battery Management System (BMS) operates on a dual-layer structure comprising the Battery Management Unit (BMU) and the Battery Control Unit (BCU). The BMU, situated within the battery enclosure, is responsible for acquiring data pertaining to individual battery cells, relaying this data to the BCU, and executing cell balancing within the enclosure based on directives from the BCU.

Meanwhile, the BCU, housed in the main control cabinet, oversees battery cabinet management. It receives detailed data uploaded by the BMUs, samples the voltage and current of

the entire battery cabinet, conducts State of Charge (SOC) calculations and calibrations, manages pre-charging and charging/discharging operations of the cabinet, and transmits relevant data to the Human Machine Interface (HMI).

Note: BMU, BCU is the name of two-class BMS by some battery manufacturers, which is different for different manufacturers.

2.6.3. Electrical System

The outdoor cabinet energy storage system adopts the modular PCS solution, and users can configure 50kW and 100kW power modules according to the project requirements.The basic parameters of PCS power modules are as follows:

Table 2.3 Parameters of the converter module

Model Number	Monet-50AC
Rated Power	50kW
Maximum Power	55kW
DC Operating Voltage Range	500V~1000V
DC Side Full Load Voltage Range	500V~1000V
Maximum DC Current	110A
Rated AC Voltage	400Vac, 3W+N+PE/3W+N
Rated Frequency	50/60Hz, (±5Hz)
Rated AC Current	72A
Overload Capacity	110%, normal operation; 120%, 1 minute; 150%, 10 seconds
Current Distortion	<3% (rated power)
Power Factor Adjustment Range	-1 Leading ~ +1 Lagging
Ability To Carry Unbalanced Loads	100%
Adaptive Battery	Lithium/lead acid/photovoltaic modules
Charging Method	By BMS Command/Three-Stage/MPPT
Operating Mode	Constant Voltage, Constant Current, Constant Power, MPPT, AC Voltage Source, DC Voltage Source, VSG
Maximum Efficiency	98.2%
Dimensions (W*D*H)	483*600*150mm (444mm without mounting lugs)
Weight (Approx.)	25kg
Isolation Method	non-isolated
Protection Class	IP21
Operating Temperature	-25℃~+60℃ (>45℃ derating)
Relative Humidity	0~95% (non-condensing)
Cooling Method	Forced air cooling
Static (In A Signal)	<70dB

Altitude	3000m (>3000m derating)
Communication Interface	RS485/CAN (optional)

2.6.4. Environmental control systems

The energy storage system is equipped with comprehensive environmental monitoring and fire suppression systems, including devices like smoke detectors, temperature sensors, combustible gas detectors, water sensors, and fire extinguishers. These components collectively ensure full control over the system's operational status and immediate response to environmental anomalies. A schematic diagram illustrating the environmental control system is provided for reference.

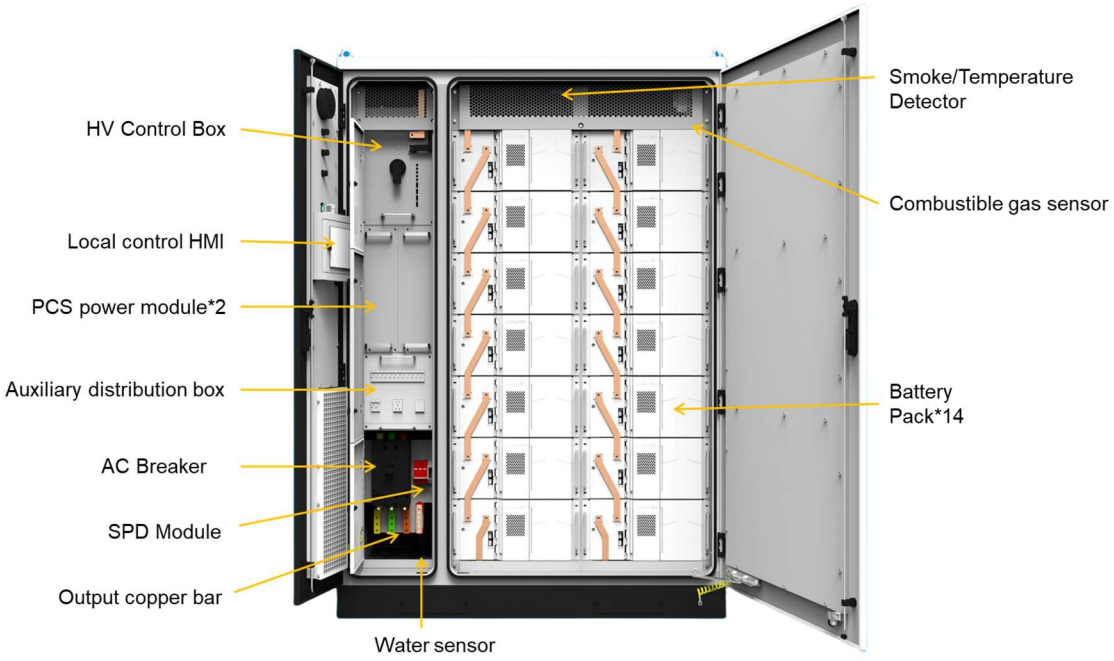


Figure 2.2 Cabinet Internal Structure

2.6.4.1 Air conditioning parameters

Table 2.5 Air-conditioning parameters

Model number	HDC050AS
Electrical parameters	
Rated Working Voltage	220Vac
Rated cooling current	8.6A
Maximum operating current	15A
Rated operating frequency	50Hz
Size (H*W*D)	1350×650×300mm
Weights	100kg
Protection class	IP55
Cooling capacity	5000W
Heating capacity	3000W

Air volume	1250m³/h
Refrigeration	
Cooling point	15°C~50°C (settable)
Return differential (e.g. of farmland)	Default 5°C (settable)
Heater	
Heating point	-15℃~25℃ (settable)
Return differential (e.g. of farmland)	Default 10°C (settable)
Dehumidify	
Dehumidification point	40%~90% (settable)
Return differential (e.g. of farmland)	Default 10% (configurable)
Warning function	
Cabinet high temperature alarm	25°C~80°C (settable)
Cabinet low temperature alarm	-20℃~15℃ (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 Water detection device

The water detection device detects whether there is water ingress, leakage, etc. in the energy storage system.

Table 2.7 Parameters of the flood sensor

Name (of a thing)	Parameters
Operating temperature	-40℃~70℃
Operating humidity	0~100%RH (non-condensing)
Supply voltage	DC 9~30V, DC 12V power supply recommended
Power wastage	≤1W
Contact type	Dry contact, 1 set, supports normally open (NO)/normally closed (NC)
Load capacity	120VAC/2A, 24VDC/2A
Electrostatic protection	Contact discharge ±8KV, air discharge ±15KV
(Electrical) surge	±4KV
EFT	±4KV
Protection class	IP68
Explosion-proof grade	Ex ic mc IIB T6 Gc (Ui=12VDC, Ii=45mA, Ci=0, Li=0)
Weight	240g

2.6.4.3 Smoke detector

Smoke detectors are used to detect smoke concentrations in the cabinet environment.

Table 2.8 Smoke detector parameters

Name (of a thing)	Parameters
Operating voltage	DC24V (allowable range 9V~33Vdc)
Operating current	Monitoring status: <1mA@DC24V Fire alarm: <52mA@DC24V
Relay output	Normally open, contact capacity 1A 30VDC
Work instruction	Monitor status red light blinks about once every 6 seconds.

	Alarm status red light is always on Fault status red light blinks continuously about 2 times every 6S.
Operating environment	Temperature: -10℃~+65℃ Relative humidity < 95% RH (no condensation)

2.6.4.4 Temperature detector

Temperature detectors are used to detect temperature concentrations in the cabinet environment.

Table 2.8 Temperature detector parameters

Name (of a thing)	Parameters
Operating voltage	DC24V (allowable range 9V~33Vdc)
Operating current	Monitoring status: <1mA@DC24V Fire alarm: <42mA@DC24V
Relay output	Normally open, contact capacity 1A 30VDC
Work instruction	Monitor status red light blinks about once every 6 seconds. Alarm status red light is always on Fault status red light blinks continuously about 2 times every 6S.
Operating environment	Temperature: -10℃~+65℃ Relative humidity < 95% RH (no condensation)

2.6.5. Fire Protection System

The firefighting system employs an aerosol fire suppression device, a cutting-edge, eco-friendly solution for fire protection. Its operating principle is as follows: In the event that the environmental monitoring system identifies a fire emergency or the BMS detects thermal runaway in a battery cell, an electric signal is initiated by the system. Upon receiving this activation signal, the aerosol extinguisher activates its internal extinguishing agent, promptly generating and dispersing nano-aerosol particles to swiftly extinguish fires.

Table 2.9 Firefighting aerosol parameters

Name (of a thing)	Technical Parameters
Model specification	JAD300-U01
Activation method	Electric start
Feedback signal	Passive switching signals
Validity period	15 years
Overall dimensions	Φ76×192mm
Operating environment	-40℃ ~ + 55℃
Protection of space	5m³

2.6.6. Local Control System

The microgrid management system (Lotus-ESS) is an intelligent energy management system that is mainly used in applications of energy storage power plants of various capacities and integrated photovoltaic storage and charging power plants.

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:

Table 2.10 Local controller parameters

Product model	Lotus - ESS
Power input	DC 12V
Output control	3 Isolated Output Switches
Input control	6 Isolated Input Switches
Serial port communication	2-channel isolated RS232, 4-channel isolated RS485
Fieldbus	2 CAN bus interfaces
Ethernet port	1 10/100M Ethernet port (RJ45)
Extended storage	1 USB flash drive port, 1 SD card port
Audible alarm	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:

Table 2.11 Overall configuration list of 100kW/225kWh outdoor cabinet energy storage system

Name	Model number	Unit	Quantities	Note
Battery system	BHF-X225	set	1	14 battery boxes, one high-voltage control box
Energy storage converter	Monet-50AC	PCS	2	Modular converters
Air conditioning system	HDC050AS	set	1	Precision air conditioning
Environmental monitoring system	Smoke sensing, temperature sensing, combustible gas detection, flooding, etc.	set	1	Environmental monitoring
Fire protection system	JAD300-U01	set	1	Electric start
Power distribution system	Power distribution box	PCS	1	Auxiliary equipment
Local management system	Lotus-Ess	set	1	

3. Installation with wiring

3.1. Transportation and handling

3.1.1. Product Transportation

- For better protection of the equipment, transportation with packaging is recommended;
- Transportation of equipment should be carried out in accordance with the marking requirements on the packaging to prevent personal injury and equipment damage;
- Energy storage batteries are not recommended for railroad transportation and air transportation. Speed limit requirements for land transportation: 80km/h on flat roads, 60km/h on rugged roads, in case of conflict, please refer to local traffic regulations.

3.1.2. Product Handling

- When using a forklift to move to ensure that the forklift has enough load capacity, and pay attention to the center of gravity of the equipment needs to fall between the feet of the forklift to prevent personal injury and equipment damage;
- Forklifts with batteries need to have a load capacity of ≥3t; forklifts without batteries need to have a load capacity of ≥1.5t;
- Recommended fork knife length ≥1.3m, width 80cm~160cm, thickness 25mm~60mm.

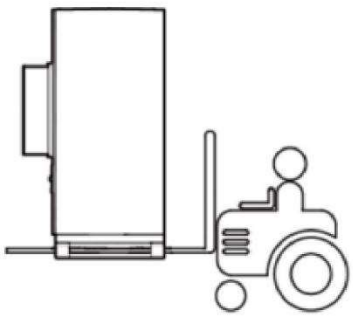


Figure 3.1 Schematic diagram of handling

3.2. Packaging and storage

3.2.1. Product Packaging

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

Table 3.1 Table of packaging parameters

parameters	clarification
model number	Product Model
sizes	Product size after packing
weights	Total weight of the product after packing
markings	Face up, careful placement, center of gravity, etc.

3.2.2. Product Storage

The product shall not be stored in an exposed outdoor location if the product is not immediately transported or installed for use in a storage location that complies with the following conditions:

Table 3.2 Requirements for product storage conditions

parameters	request
Storage temperature (without battery)	-25℃~+60℃
battery	10℃ ~ 30℃
Storage relative humidity	<95% (no condensation)
Height above sea level	<4000m

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 a total of no more than 6 months (counting time from shipment). Beyond 6 months a recharge and SOC calibration is required, at a minimum to 50% SOC. failure to recharge as required may affect the performance and service life of the battery.

3.3. Installation Environmental Requirements

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

- 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 the ventilation openings and heat dissipation system while the equipment is in operation to prevent fire from high temperatures. Installation space is sufficient to ensure that the surrounding equipment will not be affected by the heat generated by the product; install in a location that ensures sufficient space for external wiring. Equipment with convenient transportation conditions and reliable fire suppression systems.
- Keep the installation location away from sources of ignition and do not place flammable or explosive materials around the equipment. If the equipment is installed in a place with lush vegetation, in addition to routine weeding, the ground underneath the equipment needs to be hardened to prevent overgrowth of weeds.
- Do not install the energy storage system outdoors in salt-affected areas to prevent equipment corrosion and fire. Salt-hazardous areas are defined as areas within 2km from the coast or affected by sea breezes.
- The energy storage system must be equipped with protective measures such as fences and walls, and safety warning signs must be erected for isolation to avoid entry of unauthorized personnel during the operation of the equipment, which may result in personal injury or property damage.
- The equipment is installed in an area away from liquids, and should not be installed below water pipes, air outlets and other locations that are prone to condensation; it should not be installed below 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 circuits in the equipment.

Clarification

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

- Strong vibrations, strong noise sources and strong electromagnetic field interference areas.
- Places that generate or have dust, fumes, harmful gases, corrosive gases, etc.

- Places where corrosive, flammable and explosive substances are produced or stored. Within the range of blasting hazards.
- Places where underground facilities are already in place. Densely populated places, high-rise buildings, underground buildings.
- Undesirable geologic conditions such as rubbery and weak soils, ground prone to waterlogging and subsidence.
- Within the boundaries of a mining trap (stagger) area. Areas that could be inundated by a dam or levee failure.
- Earthquake faults and seismic zones with a defense intensity higher than nine degrees. Sections with direct hazards such as mudslides, landslides, quicksand and caves.
- Important sanitary protection areas for water supply sources.
- Historic Monuments and Sites Conservation Area.

If there is no more suitable site, it is recommended to install a firewall of not less than 3h fire resistance 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, please inspect it for any signs of damage. If you detect any evidence of damage, retain the evidence and promptly contact Hangzhou Livoltek Power Co., Ltd.
2) If you confirm that the product is in good condition, please proceed to check against the delivery list to verify the completeness of all components.

Table 3.3 Delivery list

No	Name	Quantities	Note
1	Outdoor cabinet energy storage system	1 set	Includes cabinet door key
2	User manual	1 PCS	Electronic file
3	Certificate of conformity	1 PCS	
4	Factory inspection report	1 PCS	

3) The user is required to prepare the relevant installation tools before installation.

Table 3.4 List of installation tools

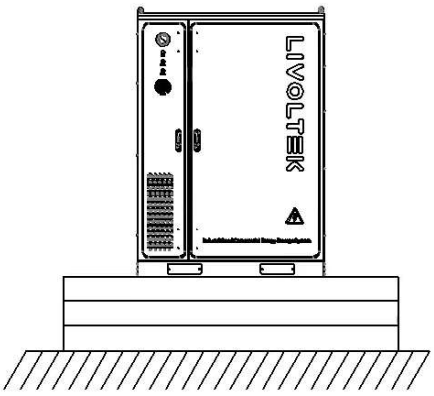
No	Name	Quantities	Note

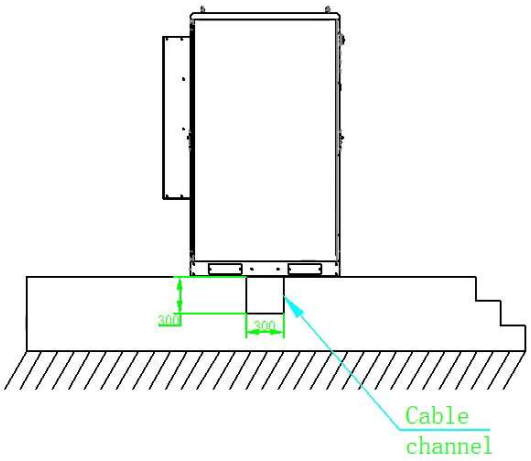
1	Screwdriver set	1 set	
2	A tube for wrapping	1 set	
3	Multimeter	1 unit	
4	Forklift trucks	1 vehicle	
5	Screws, nuts, spacers	certain	

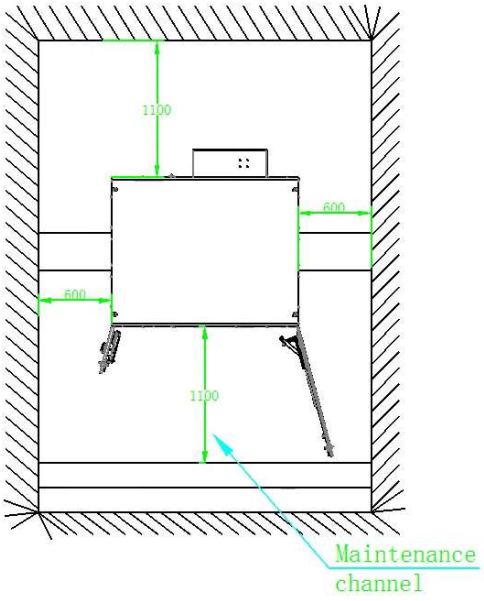
3.5. Mechanical Installation

1) After making sure that there is no abnormality in the product and all accessories are complete, you can refer to the following suggestions for mechanical installation:

- According to the product size in advance to select the equipment installation location, good positioning and fixing; recommended foundation as shown in Figure 3.2.
- Referring to the weight of the product, the selected mounting location needs to have sufficient load-bearing strength;
- Reliable grounding point, ensure that the grounding resistance is less than 4Ω.







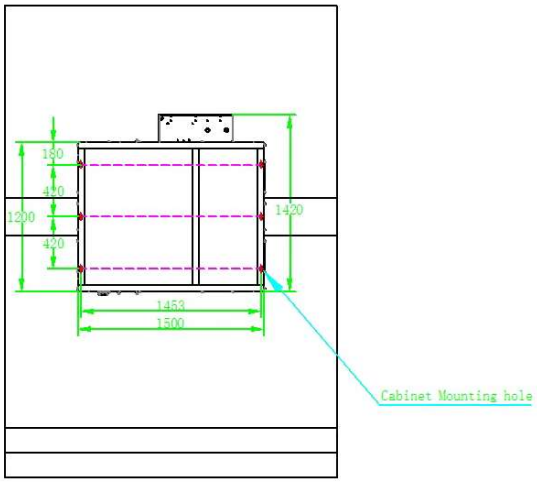


Figure 3.2 Base reference drawing (actual external dimensions of the equipment are subject to shipment)

2) After removing the packing crate, first remove the bottom enclosure of the equipment. The removed boards and screws should be put away and put back after the equipment is put into position.

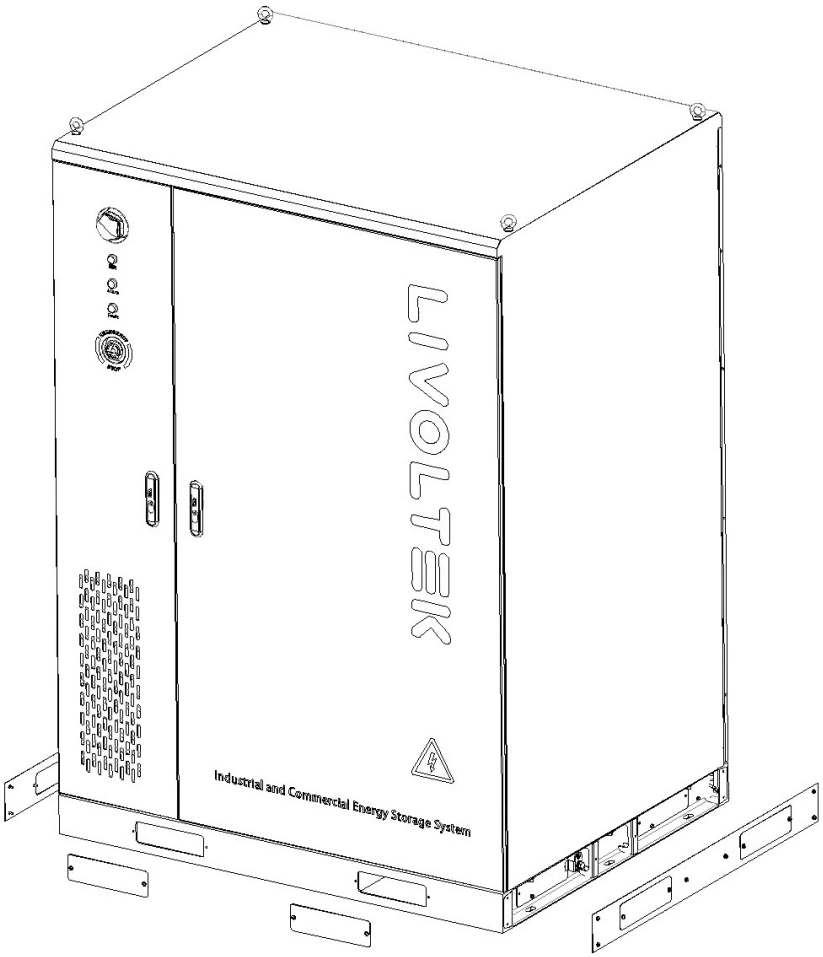


Figure 3.3 Schematic of the bottom enclosure of the device

3) Drill holes (φ13mm) with reference to the hole distances shown in Fig. 3.2, then nail expansion bolts (M12X120) into the drilled holes, remove the nuts on the expansion bolts, and position the equipment on the foundation with a forklift truck so that the equipment fixing holes are aligned with the pre-buried expansion bolts on the foundation, and tighten the nuts.

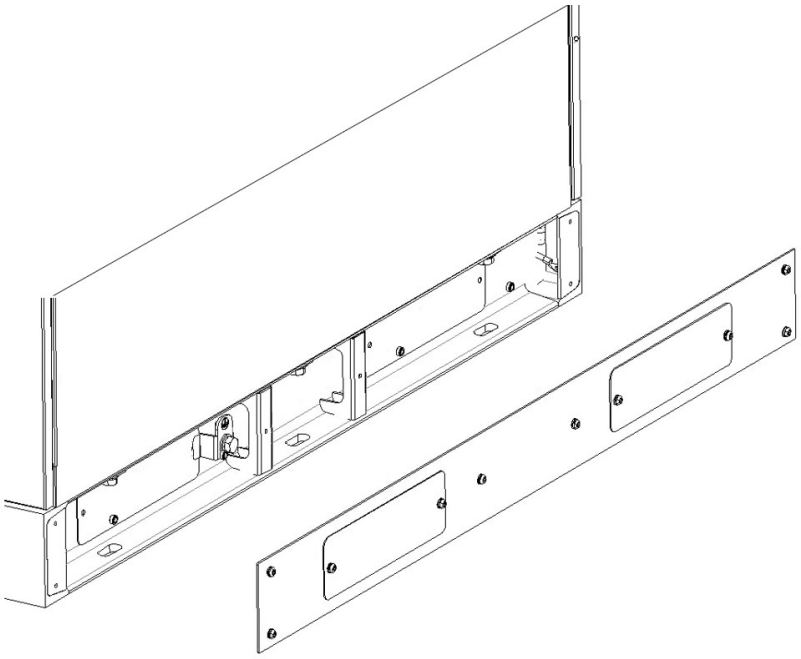


Figure 3.4 Schematic of bolt fastening at the bottom of the unit

3.6. Electrical Cable Installation

This product adopts the structure of all-in-one machine, the internal wiring of 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 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.

Table 3.5 Cable Size Comparison Table

Capacity	AC cable	N cable	PE cable
50kW	≥3*35mm²	≥35mm²	≥25mm²
100kW	≥3*70mm²	≥70mm²	≥50mm²

Danger:

When performing an electrical installation, 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 and make sure the cable is not energized;

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

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

(5) Lay communication and power cables as separately as possible, and ensure that the cable insulation is not damaged during the laying process;

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

(7) All AC cables should be connected to the appropriate phase sequence after entering the device through the access holes on the bottom of the device;

(8) After the wiring is completed, use fireproof mud to seal the wiring leaks to prevent external insects and rodents from entering and damaging the equipment or cables.

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

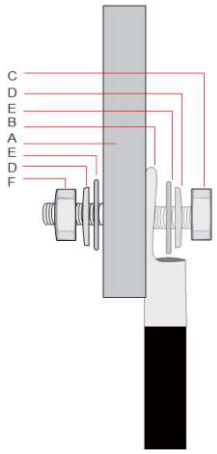
Table 3.6 Wiring torque requirements

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 lower inlet and outlet, after opening the baffle as shown in Fig. 3.5, the A/B/C/N copper rows at the lower end of the switch reserve φ8mm openings for customers' wiring, or according to the customer's requirements for the size of the openings; the protective ground wire is connected to PE copper rows, and the equipment ground impedance meets the requirements of national standard GB 50054 and the local electrical standards.

Figure 3.5 Output Terminal Block

The installation of the terminals and fixing screws and other parts used for system power cable wiring is shown below:



Serial No.	Name
A	Copper Bar
B	Terminal Block
C	Screw
D	Spring Pad
E	Large Flat Washer
F	Nut

Terminal Block Installation　　Terminal Block Component Names

Figure 3.6 Set Screw Installation Schematic

Attention:

● When using copper core cables or copper-clad aluminum cables, use copper terminal blocks.

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

● At least one large flat washer is required on one side of the screw to ensure a tight and reliable connection.

3.7. Communication cable installation

When installing external communication cables, it is essential to segregate them from power cables to minimize interference. The recommended minimum distance between communication lines and power cables is 300mm. Where the communication line must cross a power cable, endeavor to ensure the angle of intersection is 90° between the two cable types. This helps to mitigate electromagnetic interference from the power cable affecting the communication line. Ideally, the communication line should run as close to the ground surface as feasible, utilizing supports like cable trays or metal conduits. If such supports are unavailable, secure the cables with basic fixtures to maintain their position.

For backend system monitoring, the system employs RS485 communication mode with the Modbus RTU communication protocol. Use double-shielded wires or Ethernet cables to connect to the designated locations.

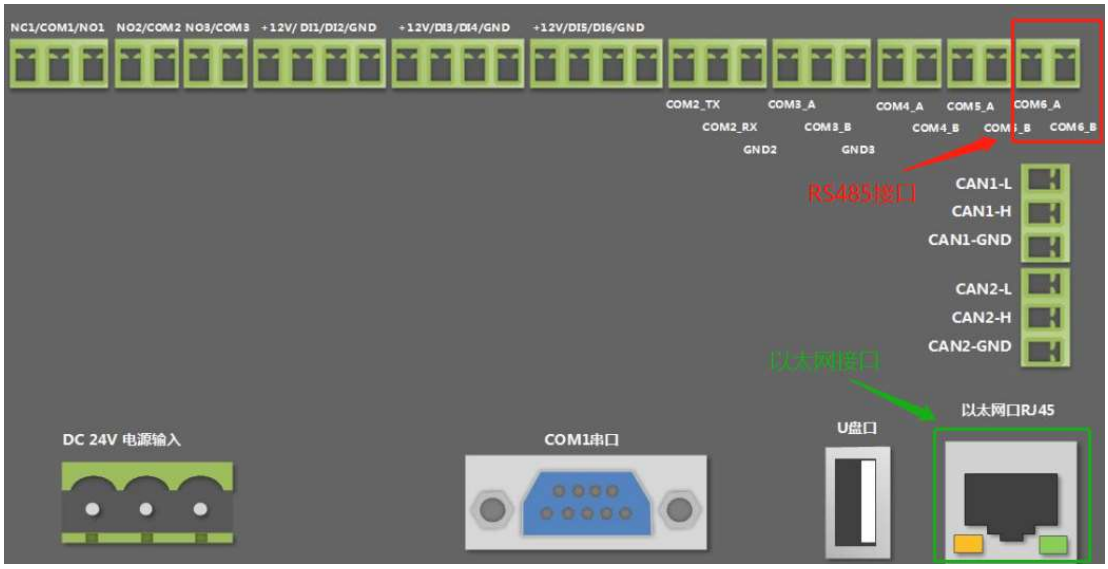


Figure 3.7 Communication cable wiring location diagram

4. Start-up and Commissioning

4.1. Pre-opening check

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 check:

a、 Appearance of the equipment is intact, no damage, no rust and no paint loss. If there is any paint loss, please carry out the paint refinishing operation;

b、 Equipment labels are clearly visible and damaged labels should be replaced promptly.

2) **Grounding check:** the box has a grounding point, and grounding is secure; the box grounding conductor is reliably connected to the box grounding copper row.

3) Cable check:

a、 The cable protection layer is well wrapped with no visible damage;

b、 The terminals are made in accordance with specifications, and the connection is firm and reliable;

c、 Each cable is clearly labeled at both ends, and the alignment meets the principle of separation of strong and weak power, leaving a margin at the turn, and shall not be strained;

d、 Cable mounting bolts have been tightened, cable pulling without loosening; cable crossing hole blocking has been completed.

4) **Copper row inspection:** no obvious cracks or deformation of copper rows, fastening of screws at the lap joints, no misalignment of scribed markings, no debris on the copper rows.

5) **Component Check:** Referring to Figure 4.1, the circuit breakers are all in the open position; the lightning protector indicator mark is green.

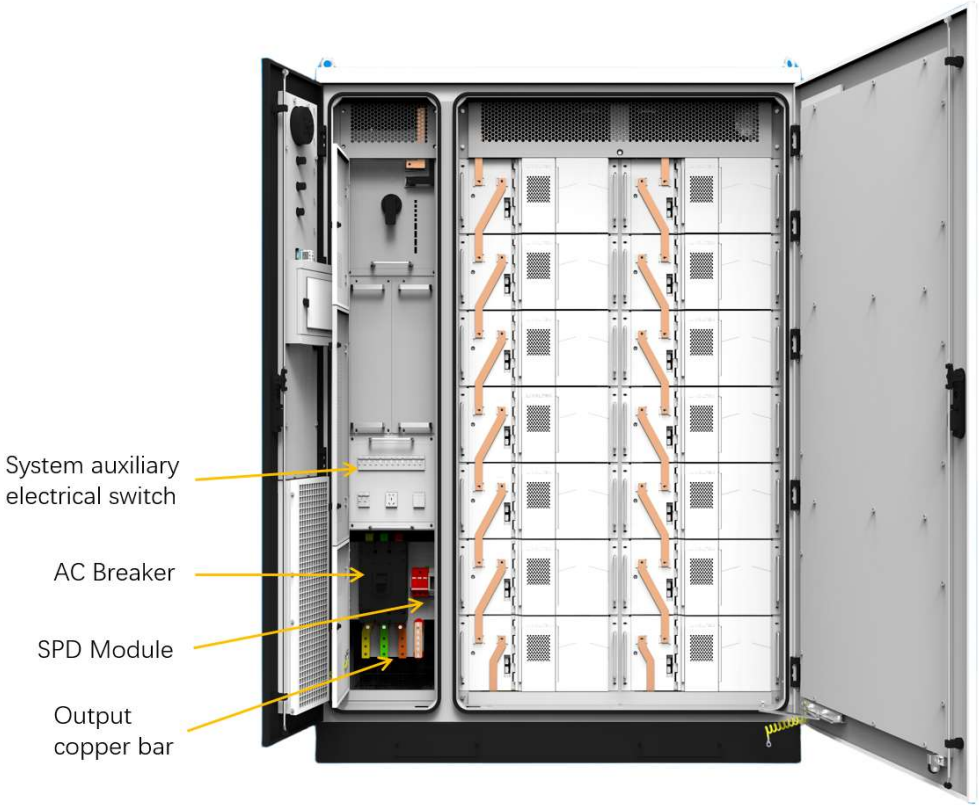


Figure 4.1 Distribution switch location diagram

4.2. Switch-on Operation

The product switch on and operating procedure is as follows:

1) Use a multimeter to confirm that the grid voltage is within the predetermined range (400V±10%);
2) Close the battery high voltage control box DC load switch;
3) Referring to Figure 4.1, close all auxiliary power switches on the system;
4) Wait for the touch panel to start up (about 30 seconds) and confirm that the display is normal and there are no fault alarms;
5) Touch screen battery page click battery start, battery start normally and no fault alarm;
6) Close the main AC circuit breaker;
7) Click "UPM On" on the touch panel system page and wait for about 2 minutes to finish powering on the system.

4.3. Trial Operation

After the equipment's electrical structure installation is complete and startup conditions are met, to ensure the reliable and stable operation of the energy storage system, initial commissioning

must be conducted by professional electrical engineers and technicians. Configure the operation mode and relevant parameters in accordance with project specifications:

1) Set the device control mode to "Manual Mode" and set the active power to 5%;
2) Observe the parameters of the screen PCS and battery during operation, and stop the machine in time for testing if there is any abnormality;
3) Runs for 0.5 hours;
4) Set the active power to -5%, at which point the battery is charged at 5% of the system's rated power, the
5) Observe the parameters of the screen PCS and battery during operation, and stop the machine in time for testing if there is any abnormality;
6) Runs for 0.5 hours;
7) After completing the 1-hour test run without any abnormality, turn off the system in the "Switch" interface;
8) According to the project background and demand, you can choose the local manual power control mode or automatic peak shaving mode to put into operation formally, and then click "system power on" in the system interface.

4.4. Switch-off Operation

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

1) Click the touch screen switch interface click "system shutdown", wait for the system to stop running, in the "data" -> "battery data" to turn off the battery, check the real-time data page battery voltage is 0V, system shutdown;
2) Disconnect the battery high voltage control box DC load switch;
3) Breaks the main AC circuit breaker;
4) Referring to Figure 4.1, disconnect all auxiliary power switches of the system, the touch screen goes out, and the unit completes shutdown.

4.5. Emergency Stop

When the product is malfunctioning or a critical situation requires emergency shutdown, you can perform the following emergency shutdown operations:

1) Press the emergency power-off button "EPO";
2) Referring to Figure 4.1, break out all auxiliary power switches of the system;
3) Reset the EPO button after determining that the fault or hazard is cleared and operation is required.

5. Operation and handling

This chapter mainly introduces the LCD touch screen display interface and the corresponding operation control through the human-machine interface. Users can execute various operation commands through the LCD display interface, conveniently browse the 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 touch screen 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 Fig. 5.1, the homepage interface displays the real-time power, voltage, current, power generation, operation mode, working status and other information of the system.

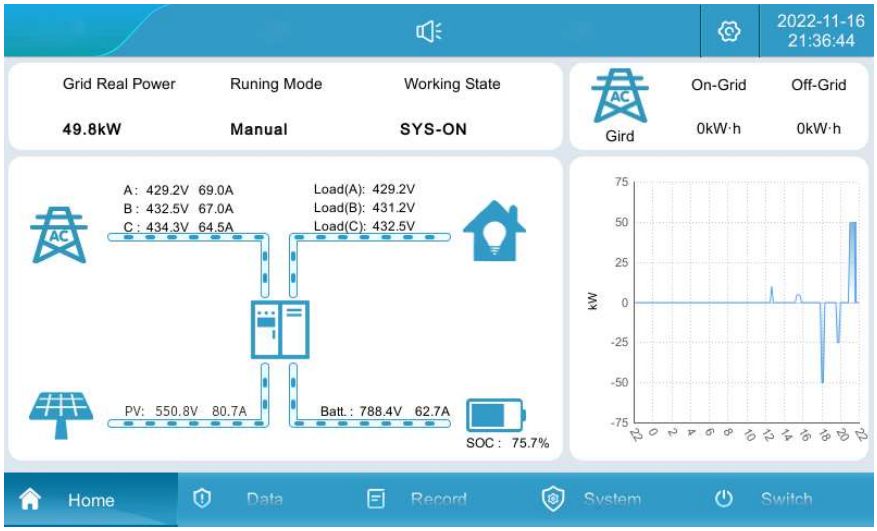


Figure 5.1 Main Page

Each menu expands the item:

No.	Menu name	Menu items	Parameter function
1	Homepage	/	Display the operation status of the system and the charging/discharging curve of the day.
2	Digital	Real time data	Display of all analog data of the converter
		Real time status	Converter operating status and switching status display
		Real-time alarms	Current system alarm messages
		Battery data	Battery data display and battery on/off setting

		Environmental monitoring	Dynamic loop monitoring display and air conditioning parameterization
3	Record (in sports etc.)	Historical alarms	Display historical alarm records
		Operation log	Displaying the operation log
		Data sheet	Export History
4	Systems	System information	Displaying system information
		Operating mode	System operation mode setting
		Parameterization	Converter and battery parameterization
		Manufacturer Settings	Equipment Manufacturer Settings
		System upgrade	System software upgrade
		Communication settings	Perform communication settings
5	Switchgear	System switch	System boot and shutdown

5.2. Switching Operation

1、 System open: first check the whole machine on the power, close the DC load switch, refer to Figure 4.1 to close the system auxiliary power switch, observe the touch screen without fault alarm (screen startup takes about 30 seconds);

2、 Turn on the battery in "Data"->"Battery Data", the green light of the battery operation indicator lights up, check the fault alarm machine is no problem;

3、 Wait for the PCS to establish communication with the touch screen, close the main AC circuit breaker and the screen shows normal mains voltage;

4、 Click "Switch" to enter the current switching interface, select all the modules/UPM to enable (you can also turn on some of the modules according to the actual need), click the "UPM ON" button, the normal turn-on time of about 2 minutes, as shown in Figure 5.2.

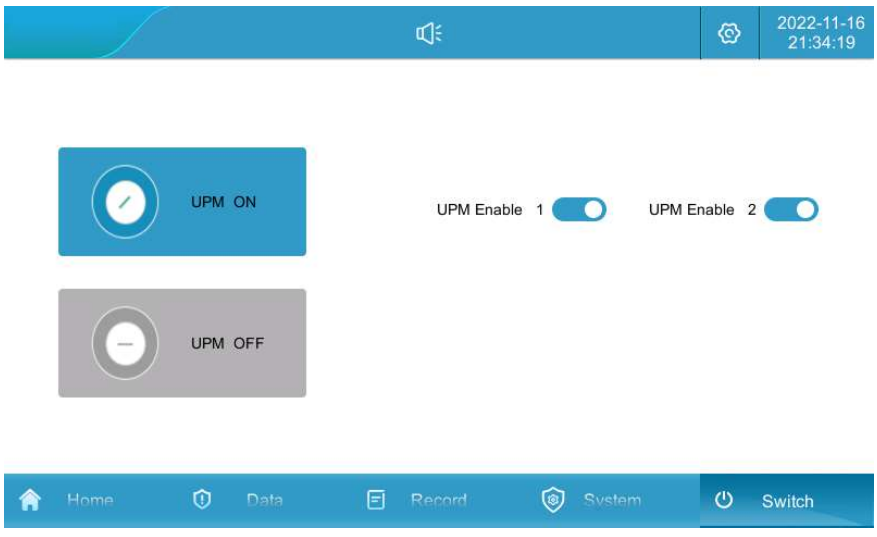


Figure 5.2 Switching Interface

5、 If it is not opened successfully, the interface will pop up the startup failure prompt interface, according to the failure to query the cause of the failure; Failure: "System Failure" "PCS Failure" (go to the failure list to query); "Cannot be discharged "(Battery power reaches the lower limit value of SOC) "Cannot charge" (Battery power reaches the upper limit value of SOC).

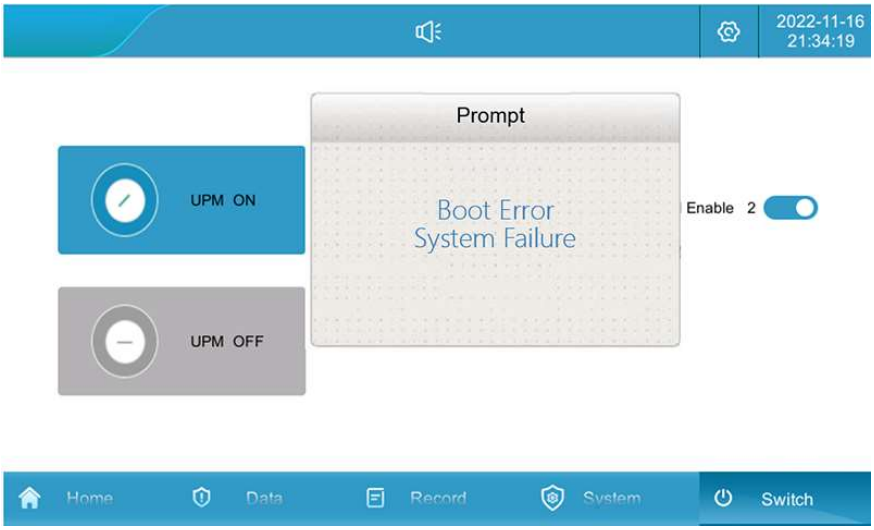


Figure 5.3 System Open Failure Screen

6、 System shutdown: When the system is running, click "System Shutdown", turn off the battery in "Data"->"Battery Data", and the battery voltage on the real-time data page becomes 0. If the system environment temperature and humidity is too high (too low), the air conditioner will stop working until the temperature and humidity return to the normal range (16~27℃);

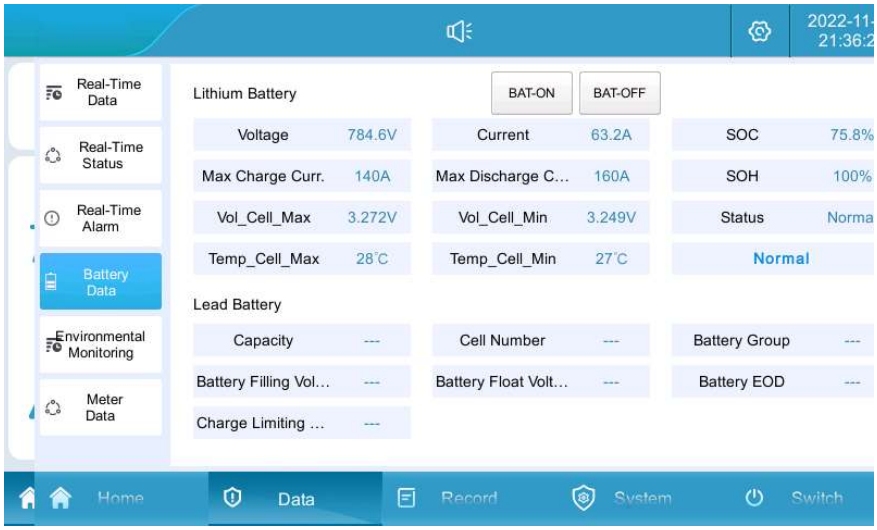


Figure 5.4 Battery shutdown screen

7、 Disconnect the battery high voltage control box DC load switch;

8、 Breaks the main AC circuit breaker;

9、 Disconnect all auxiliary power switches of the system, the touch screen goes out, and the device completes shutdown.

5.3. Communication settings

Explanation: Communication setting refers to the communication protocol setting between LCD touch panel and battery BMS, LCD touch panel and EMS backend.

1、 Check that the battery BMS communication cable is connected to the touch panel back terminals CAN2_H, CAN2_L;

2、 Check that the backstage EMS communication cable has been connected to terminal COM6_A, COM6_B on the back of the touch panel or to the network port position;

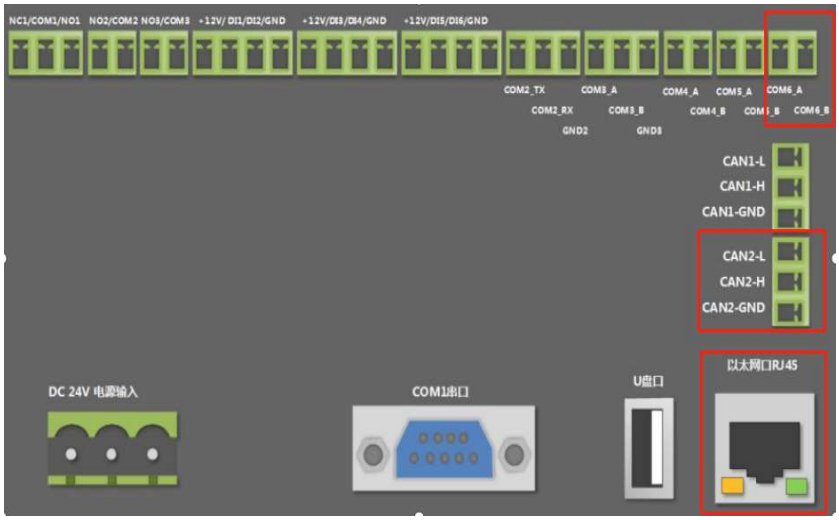


Figure 5.5 Communication wiring check

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

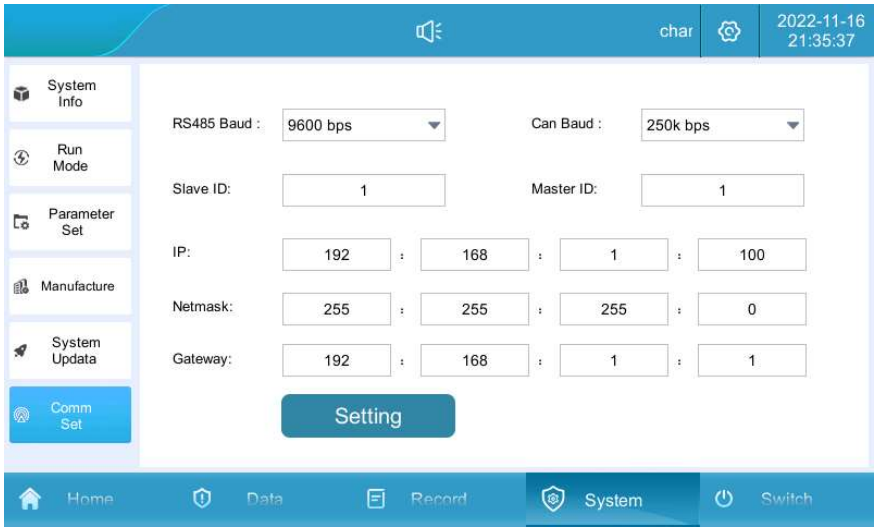


Figure 5.6 Communication Setting Screen

4、Battery BMS communication setting: set CAN baud rate to 250k bps;

5、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;

6、Background EMS communication settings 2: If you use Ethernet communication, the energy storage system local as a server, the host set the default address: 192.168.1.100, set the communication panel corresponds to the local address of 1, the server port is 502, if more than one energy storage system to access the background IP address can not be duplicated, modify the IP address and then click on the Settings button to configure the IP address.

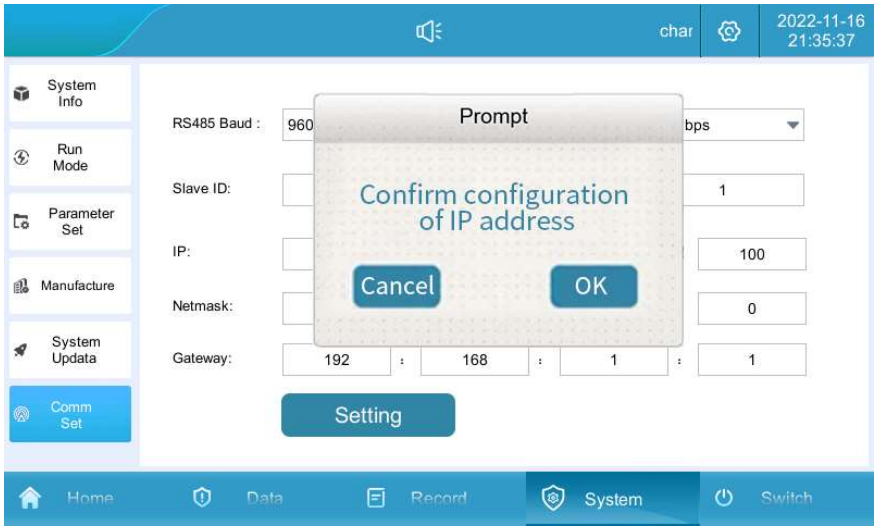


Figure 5.7 IP Address Configuration Screen

5.4. Operation Mode Setting

5.4.1. Introduction to the model

The operation modes of energy storage systems can be categorized into three: grid-connected automatic mode, grid-connected manual mode, and off-grid manual mode.

1、Grid-connected automatic mode: For peak shaving and valley filling application scenarios, the energy storage system automatically connects to the grid according to the pre-set time-sharing charging and discharging power.

2、Grid-connected manual mode: The energy storage system operates in the grid-connected mode, but system startup or shutdown must be manually operated by the user on the LCD touch screen. The charging and discharging active power, reactive power and power factor of the energy storage system can be set in "Parameter Setting".

3、Off-grid manual mode: the energy storage system runs in off-grid mode, the system can output stable 400V/50Hz three-phase AC voltage, but the startup or shutdown of the energy storage must be manually operated by the user on the LCD touch screen.

5.4.2. On-Grid manual mode

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

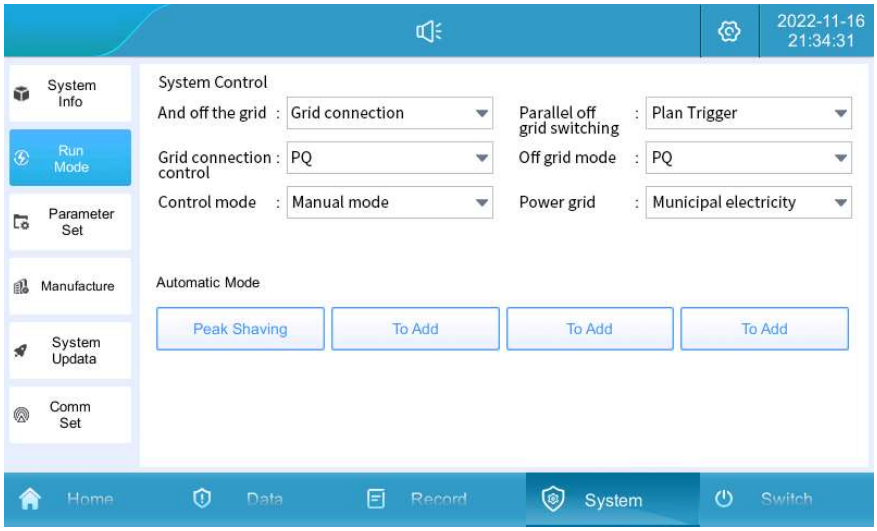


Figure 5.8 Grid-connected manual mode setting

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 values. The power setting interface is shown in Figure 5.9.

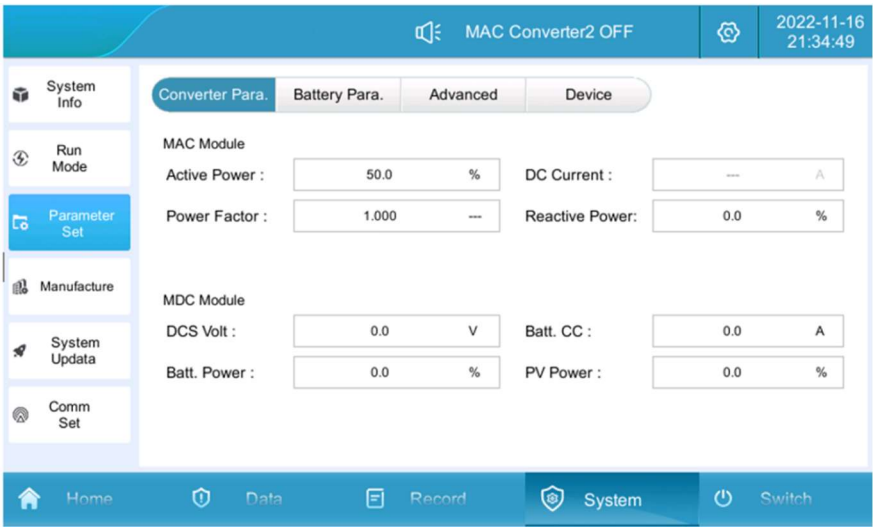


Figure 5.9 Power Setting Screen

5.4.3. Grid-connected automatic mode

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

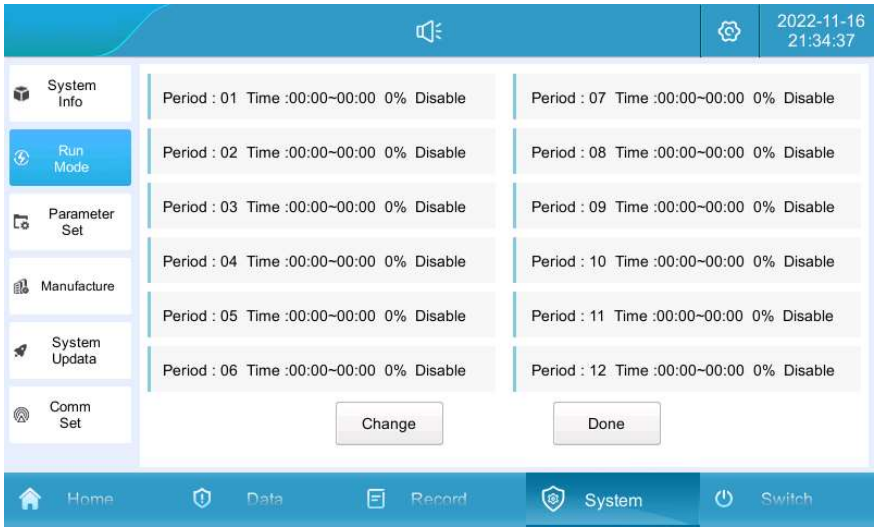


Figure 5.10 Peak Shaving Operation Setting Screen

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 time period 2 setting, and save and exit after completing all the time period settings;

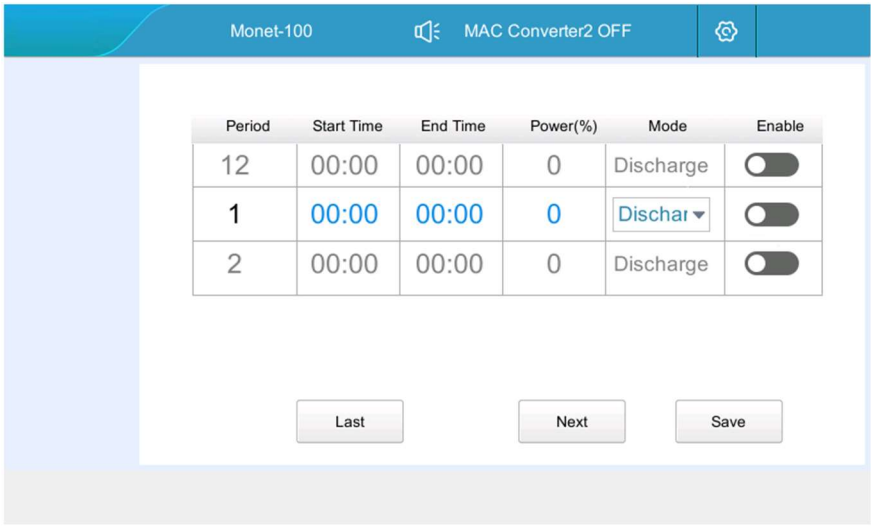


Figure 5.11 Charge and Discharge Time Setting Interface for Peak Shaving

3、Automatically jump to the following screen, click the Finish button;

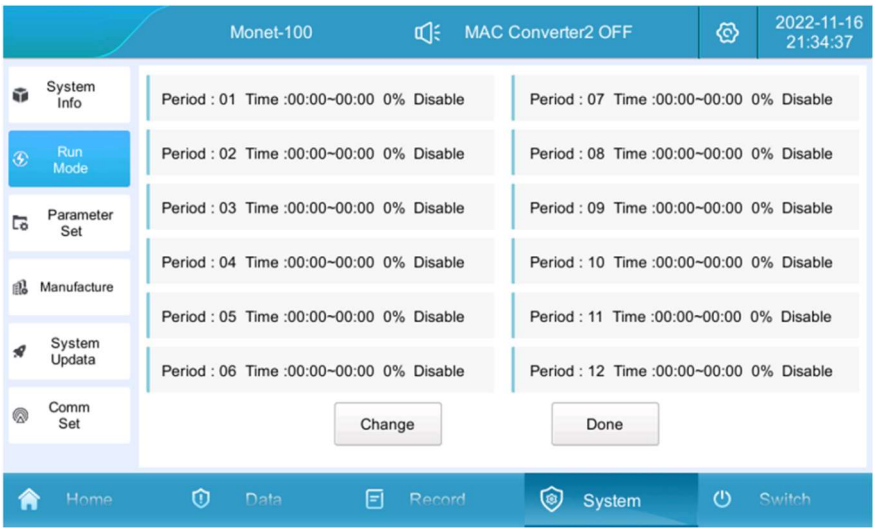


Figure 5.12 Peak reduction charge/discharge setting interface

4、"Control Mode" is changed to "Peak Load shifting";

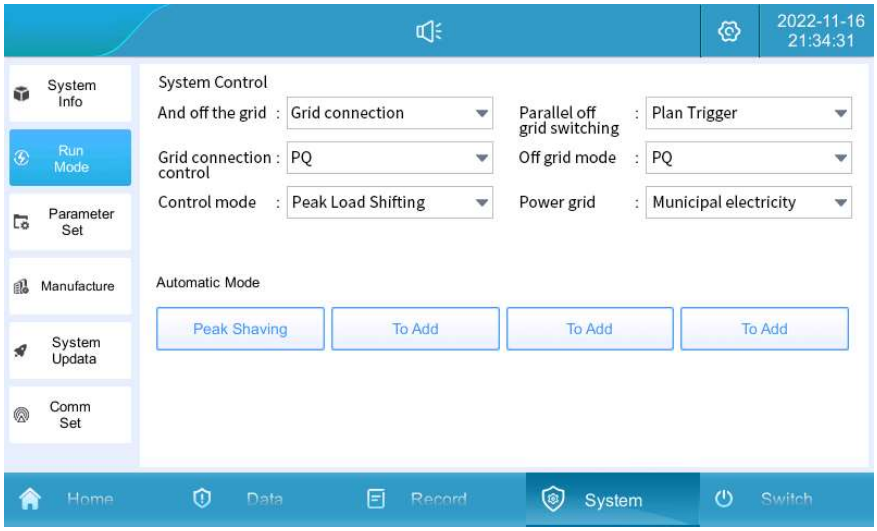


Figure 5.13 Peak shaving control mode

5、This is the automatic mode: Pause, click "Switch" -> "UPM On" to complete the local automatic control mode setting.

Figure 5.14 Local control run mode on

5.4.4. Off-Grid mode

When it is desired for the energy storage system to supply power only to important local loads, the public grid or diesel engine can be disconnected and the energy storage system can be selected to supply power to important loads off-grid. The specific setup method is as follows:

1、Manually cut off-grid mode: when running in the grid-connected state of power grid loss, PCS islanding protection shutdown, at this time manually switch off the utility switch, need to set the energy storage system to off-grid mode, click on the "system" -> "operation mode" to enter the current page. Click "System"->"Operation Mode" to enter the current page. Then select "Off-grid Mode" in "Control Mode".

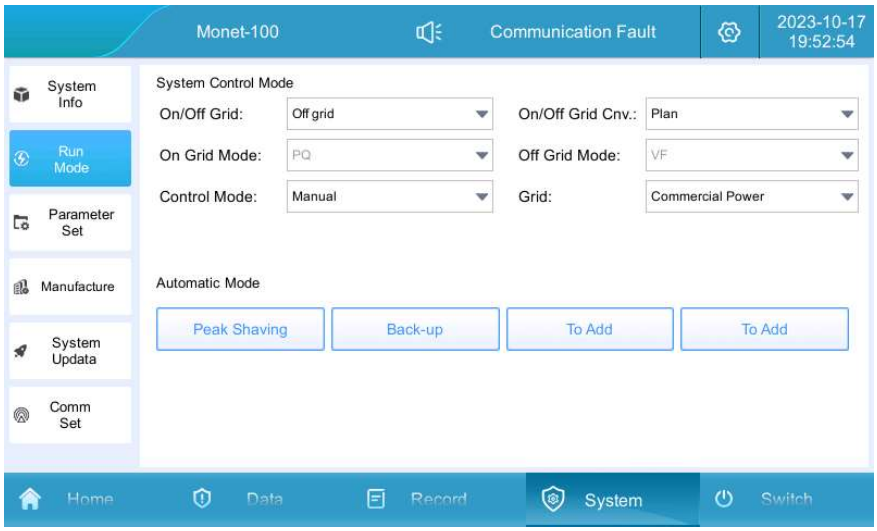


Figure 5.15 Offline Mode Setting Screen

2、Enter the "Switch" page to "enable" the power modules as required (it is recommended to enable all of them), and finally, click "UPM On" to confirm, then the system will run off-grid and output a stable 400V/50Hz AC voltage.

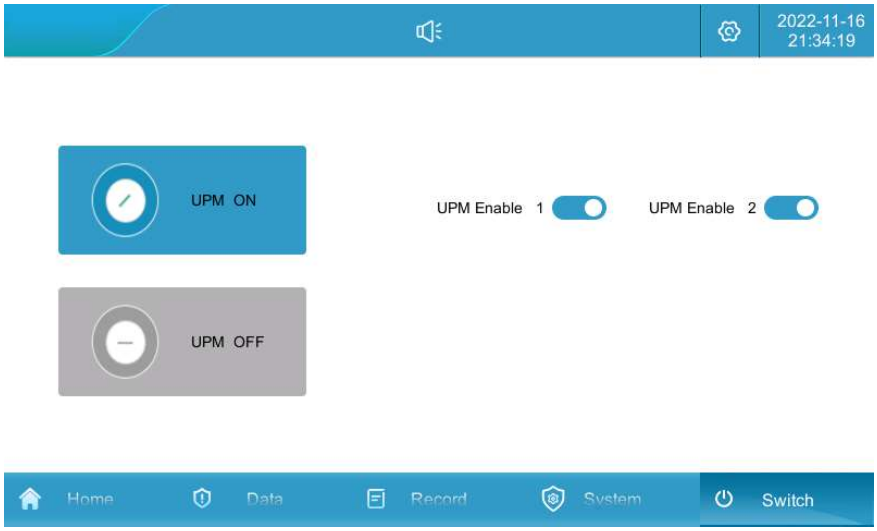


Figure 5.16 Offline Mode Setting Screen

5.5. Battery parameter setting

1、Click "System"->"Parameter Setting" table to enter the current page; customers set the upper and lower limits of SOC according to their own needs; it is recommended that the upper limit of SOC is set to 100%, and the lower limit is set to not less than 5%.

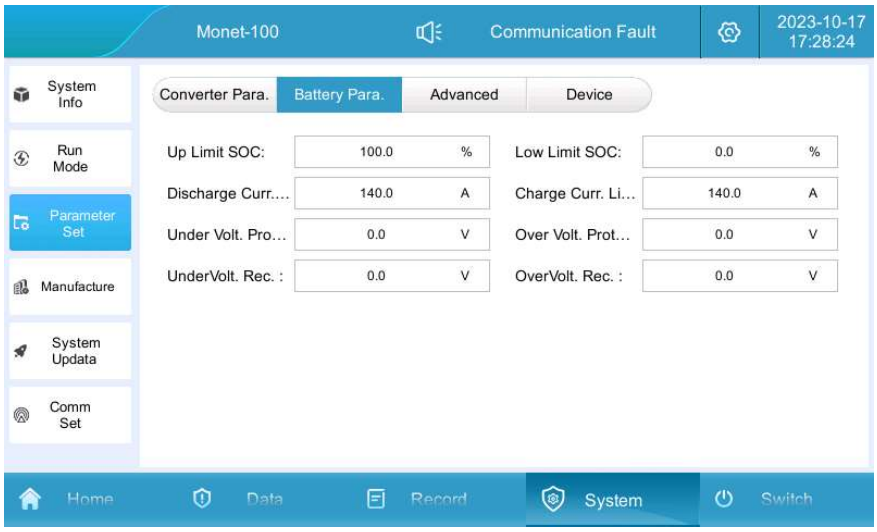


Figure 5.17 Battery Charge and Discharge Setting Interface

3、Set the upper and lower limits of battery charging and discharging voltage and current according to the parameters of the configured battery.

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.

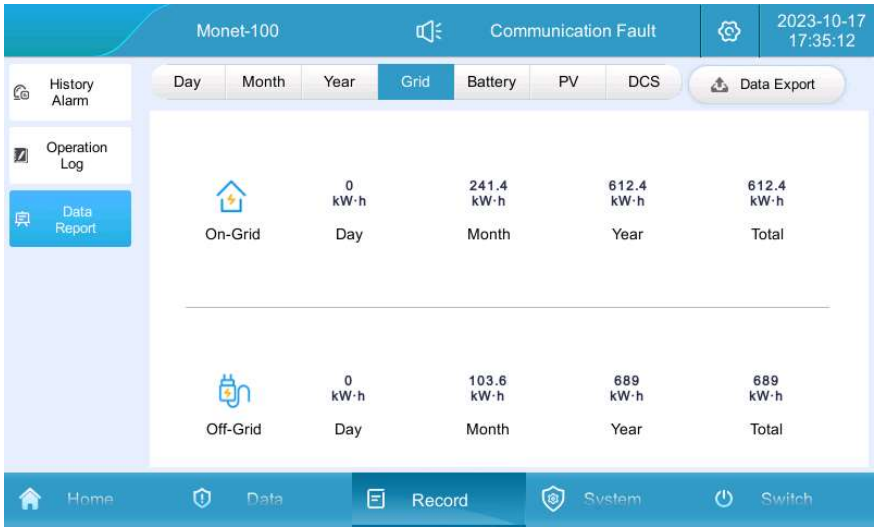


Figure 5.18 Data Report Screen

2、 View the current day, month, year, and total charge/discharge.

3、 Insert the USB flash drive, wait for the USB flash drive to connect, click Data Export and wait for the export to complete.

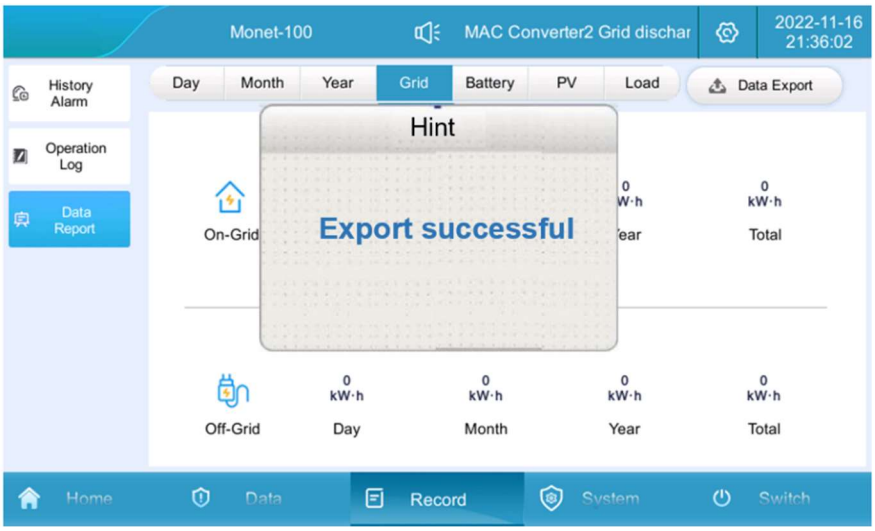


Figure 5.19 Data Export Screen

5.7. Software upgrade

Software upgrade includes: LCD touch screen software, power module DSP software and power module ARM software. 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 USB flash drive and a computer, create a new folder in the USB flash drive and name it "MAC" for storing the burned files;

Figure 5.20 Creating an upgrade software folder

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

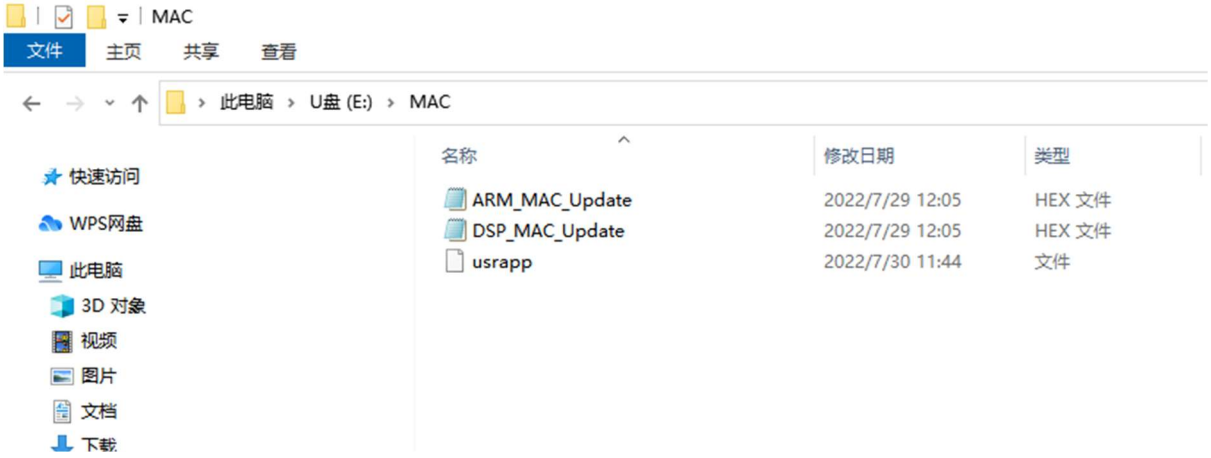


Figure 5.21 Storing the upgrade software

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

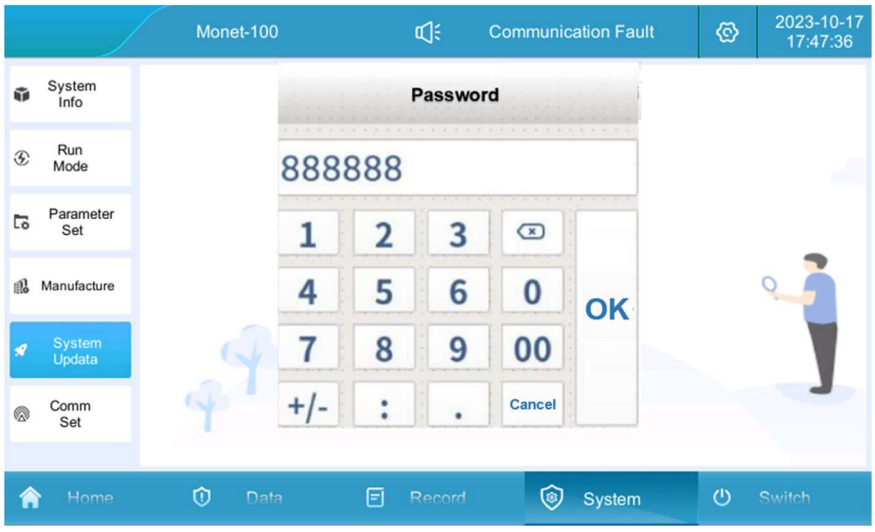


Figure 5.22 Upgrade Software Password Verification

4、 Insert the USB flash drive on the back of the touch screen, the interface shows that the USB flash drive is connected and the upgrade file is detected;

5、 To upgrade the LCD touch screen software, click "LCD Upgrade", wait for about 15 seconds, there will be a prompt to upgrade successfully;

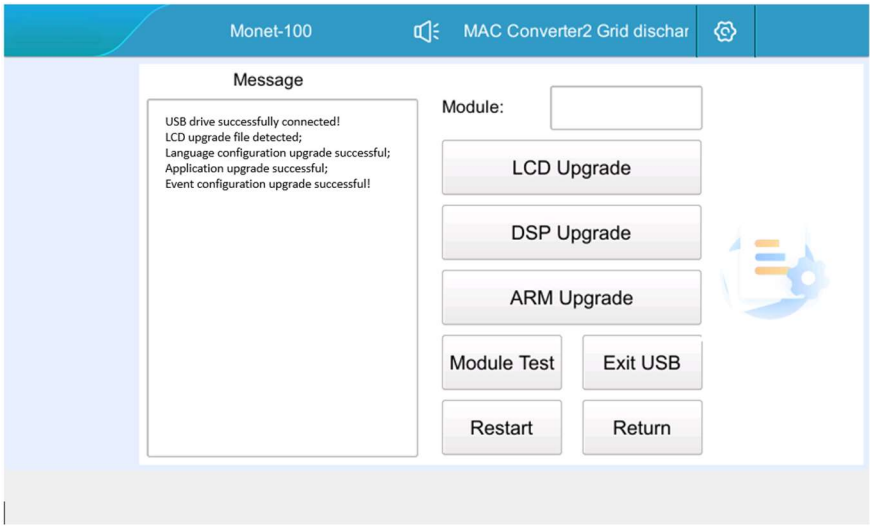


Figure 5.23 LCD Upgrade Software and Reboot Screen

6、LCD touch screen software finished, click the "Restart" button, the version of the refresh to take effect, such as Figure 5.23. Customers can be based on the actual situation of the DSP and ARM upgrade is complete, and then click "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 2 for upgrading after the completion of upgrading until the completion of the upgrade of all modules);

8、Click "DSP/ARM Upgrade", prompt upgrade timeout, click "DSP/ARMA Upgrade" again, and wait for about 5 minutes, prompt upgrade success. The system upgrade is completed.

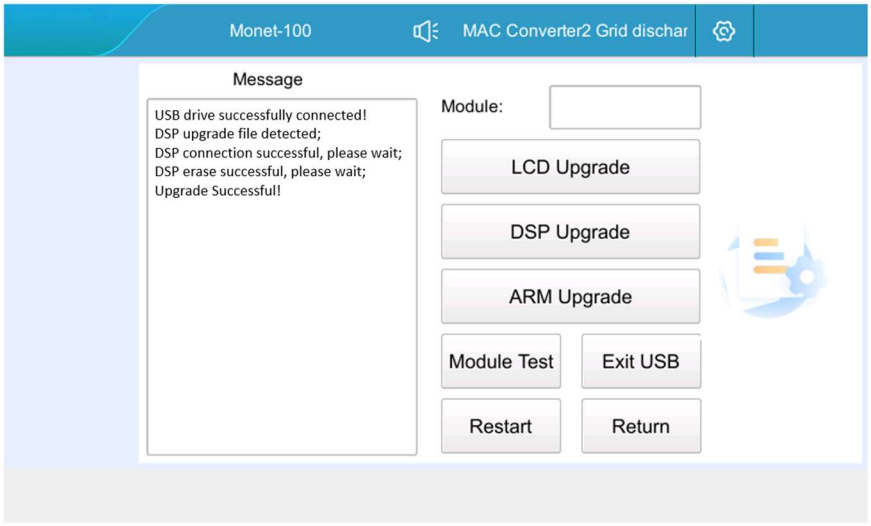


Figure 5.24 DSP/ARM Upgrade Interface

6. Alarms and Maintenance

Alarm levels are defined as follows:

- Failure: The device fails and the system stops operating (charging/discharging).
- Alarm: The device's output power decreases or part of its function fails due to external factors, but it does not affect the system's charging and discharging functions.

6.1. Alarm Handling

Table 6.1 Fault Alarm Handling Methods

Alarms/Faults	Components involved	Cause of the problem	Solutions
Rainstorm Malfunctions	Battery compartment	Flooding of energy storage cabinets	1. Check for water buildup inside the cabinet; 2. Verify that the outdoor cabinet is not leaking and that the equipment inside the cabinet is intact.
Fire-fighting Malfunctions	Battery compartment	Battery overheating or fire	1. Immediately press the EPO button and move away from the energy storage cabinet; 2. Observe continuously for 30 minutes from a safe distance. If there is smoke or fire, call the fire alarm; if neither is abnormal, manually clear this activity alarm and contact the manufacturer.
Lightning protector Warning	Electric silo	Failure of a lightning protector	1. Check for loose lightning arrester signal wire connections; 2. Check for discoloration of the lightning protector indicator; 3. Replacement of AC lightning arresters.
Compactors Warning	Refrigeration	1. Loose wiring 2. Compressor damage	1. Disconnect the power distribution switch and open the air conditioner junction box to check for loose wiring; 2. Observe the appearance of the compressor for visible damage and a burning smell, if so, contact the manufacturer.
Outdoor Fans warning	Refrigeration	1. Loose wiring 2. Damage to wind turbines	1. Disconnect the power distribution switch and open the air conditioner junction box to check for loose wiring; 2. Observe if the fan is visibly damaged and if there is a burning smell, if so, contact the service hotline.
Indoor Fans	Refrigeration	1. Loose wiring	1. Disconnect the power distribution switch

warning		2. Damage to wind turbines	and open the air conditioner junction box to check for loose wiring; 2. Observe if the fan is visibly damaged and if there is a burning smell, if so, contact the service hotline.
Grid overvoltage/undervoltage malfunctions	Grid/oil engine	Abnormal grid voltage	Check for abnormal grid voltage;
Grid overfrequency/underfrequency malfunctions	Grid/oil engine	Abnormal grid voltage	Check for abnormal grid voltage;
Crypto-protection malfunctions	Grid/oil engine	Abnormal grid voltage	Check for abnormal grid voltage;
High/Low Voltage Ride Through warning	Grid/oil engine	Abnormal grid voltage	Check for abnormal grid voltage;
Grid voltage imbalance malfunctions	Grid/oil engine	Abnormal grid voltage	Check for abnormal grid voltage;
Misphasing of the grid malfunctions	Grid/Diesel	Wrong phase sequence in the grid	Counterbalance any two of the three ABC cables
DC voltage high/low malfunctions	Batteries	Abnormal battery voltage	Check for abnormal DC input voltage;
Busbar overvoltage malfunctions	Energy storage converter	1. load imbalance 2. software anomaly	1. Check for loose or abnormal DC wiring; 2. Contact Manufacturer
Busbar half-voltage unbalance malfunctions	Energy storage converter	1. load imbalance 2. software anomaly	1. Check for abnormal loads; 2. Contact Manufacturer
Overheating and derating warning	Energy storage converter	High internal temperature	1. Check the electrical bin inlet and outlet for blockages; 2. Check the internal fan for proper operation; 3. Contact Manufacturer
Power Tube Over Temperature malfunctions	Energy storage converter	High internal temperature	1. Check the electrical bin inlet and outlet for blockages; 2. Check the internal fan for proper operation; 3. Contact Manufacturer
Balance bridge over-temperature malfunctions	Energy storage converter	High internal temperature	1. Check the electrical bin inlet and outlet for blockages; 2. Check the internal fan for proper operation; 3. Contact Manufacturer

DC overcurrent malfunctions	Energy storage converter	DC Current Excess	1. Check for short circuits or broken lines on the DC side; 2. Replace the energy storage converter module or contact the manufacturer.
Balanced Bridge Overcurrent malfunctions	Energy storage converter	Internal current overrun	1. Check for off-grid load overload; 2. Replace the energy storage converter module or contact the manufacturer.
Output overload/overcurrent malfunctions	Energy storage converter	AC side power/current excess	1. Check that the grid voltage is normal; 2. Check for short circuits or broken lines on the DC side; 3. Check for off-grid load overload; 4. Replace the energy storage converter module or contact the manufacturer.
Current limit on a wave-by-wave basis Malfunctions	Energy storage converter	AC side current excess	1. Check that the grid voltage is normal; 2. Check for off-grid load overload; 3. Replace the energy storage converter module or contact the manufacturer.
Communications blackout Malfunctions	Local Controller for Energy Storage Converters	Communications blackout	1. Check whether the communication network cable between modules is loose and abnormal; 2. Check whether the local controller communication network cable is loose and abnormal;
Parallel/Synchronous malfunctions	Energy storage converter	Parallel/Synchronized Signal Interrupt	1. Check the parallel cable for looseness or abnormality; 2. Check that the parallel setting is not abnormal; 3. Hardware circuitry is damaged.
Relay open/short malfunctions	Energy storage converter	1. Internal relay abnormality 2. software anomaly	1. Replacement of energy storage converter modules 2. Contact factory to replace internal boards
Fans 1/2/3 warning	Energy storage converter	Internal fan abnormality	1. Replacement of energy storage converter modules 2. Contact factory to replace internal fan
Leakage current malfunctions	Energy storage converter	1. Excess leakage current 2. software anomaly	1. Check the leakage current hall for loose or abnormal wiring; 2. Check that the ground wire is not disconnected;
Abnormal insulation impedance malfunctions	Energy storage converters/batteries	1. Low insulation to ground 2. software anomaly	1. Check the AC and DC cables for breakage or short circuit to ground; 2. Check for broken battery wiring or a short to ground.
Loss of modules warning	Energy storage converter	Module-to-screen communication	Check whether the communication network cable between modules is loose and

		interruption	abnormal;
Low DC voltage warning	Energy storage converter	Battery not turned on	Check if the battery is on

WARNING: The above alarms and faults are common alarms or faults, **if any faults other than those in Table 6.1 occur, please 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 in a long-term and stable manner, 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. Quarterly maintenance is recommended for systems installed in areas with severe sand and dust, high salt spray or heavy industrial parks, and semi-annual maintenance is recommended for energy storage systems in areas with favorable climatic environments.

Table 6.2 Routine maintenance tasks

Maintaining the image	movements	reference standard
Cabinet	● Check the appearance of the whole machine ● Checking the vents ● Checking the condition of door locks	● No visible coating flaking, scratching or rusting ● No visible signs of water leakage ● No dust buildup in vents ● No damage to door locks
Refrigeration	● Check for noise and vibration ● sweep the filters	● Fan, compressor rotation is normal, no jamming, strange noise ● Filter surfaces are clean and not clogged
Energy storage converter	● Check for noise and vibration ● Check the front panel vents ● Checking the contact surface of the copper row at the rear end	● Front panel fan rotates normally, no jams or rattles ● Front panel vent surfaces are clean and free of clogs ● No corrosion and discoloration of copper rows and contact surfaces, no dust accumulation
Electronic	● Inspection of lightning protectors ● Check cable copper contact surface	● Lightning protector normal ● No loose screw socket connecting wires coming off ● No corrosion and discoloration of copper rows and contact surfaces, no dust accumulation
Battery pack	● Check for noise and vibration ● Check cable copper contact surface	● Battery pack fan rotates without jerks or rattles ● Front panel vent surfaces are clean and free of clogs

		● No loose screw socket connecting wires coming off ● No corrosion and discoloration of copper rows and contact surfaces, no dust accumulation

6.3. Warranty Service

6.3.1. Warranty period

The warranty period agreed in the commercial contract shall prevail in case of correct use of the product.

6.3.2. Warranty Coverage

Within the warranty period, if a product failure arises due to a quality issue inherent to the product, Hangzhou Livoltek Power Co., Ltd. will address the situation, including the replacement of the product. Customers are requested to allow a reasonable timeframe for the company to perform necessary maintenance and execute product replacements. It is essential for customers to present proof of purchase and ensure that the product's trademark is clearly discernible. Failure to do so may result in the company exercising its right to withhold warranty services.

6.3.3. Disclaimer

In the event of the following circumstances, the Company reserves the right not to carry out the warranty, but may still provide repairs for a fee.

- Out of warranty;
- Proof of purchase of the product cannot be provided;
- Damage caused during transportation, loading and unloading;
- Damage caused by incorrect installation, modification or dismantling by unauthorized personnel;
- Damage caused by operation under abnormal conditions of use or environment;
- Malfunction or damage to the machine caused by the use of parts or software other than ours;
- Failure due to irresistible factors such as fire, earthquake, flood, etc.