SP30HBG2、SP25HBG2、SP30HBPS、SP25HBPS hybrid energy storage converter user manual

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Contents

1 Manual Description

This document mainly introduces the product information, installation and wiring, configuration and testing, troubleshooting and maintenance of the hybrid converter. Before installing or using the product, please read this manual carefully to understand the product safety information and familiarise yourself with the functions and features of the product. The document may be updated from time to time, please get the latest version of the material and more information about the product from the official website.

1.1 Applicable products

This document applies to the following models of hybrid converters:

SP30HBG2, SP25HBG2, SP15HBG2

1.2 Applicable personnel

Only for professionals who are familiar with local codes, standards and electrical systems, and who have been professionally trained and are Only for professionals who are familiar with local codes standards and electrical systems, and who have been professionally trained and are knowledgeable about this product.

1.3 Symbol Definition

For better use of this manual, the following symbols are used to highlight important information, so please read the symbols and descriptions carefully.

⚠ Dangerous
● Indicates a situation with high potential danger that, if not avoided, will result in death or serious injury to personnel.
⚠ Warnings
● Indicates a situation with moderate potential danger that, if not avoided, could result in death or serious injury to personnel.
⚠ Take care
● Indicates a situation with a low potential danger that, if not avoided, could result in moderate or minor injury to personnel.
Note

- Highlighting and supplementing content may also provide tips or tricks to optimize the use of a product, help you solve a problem, or save you time.

2 Security matters

The safety precautionary information contained in this document must always be observed when operating the converter.

Note
● The converter involved in this document has been designed and tested in accordance with strict safety regulations, however, as electrical equipment, it is important to follow the relevant safety instructions before carrying out any operation on the converter, as improper operation may result in serious injury or property damage. The following is a summary of the safety instructions for the converter.

2.1 General instructions General instructions

Note
● The contents of this document may be updated from time to time due to converter version upgrades or for other reasons. If not otherwise agreed, the contents of this document do not replace the safety precautions on the product label. The contents of this document may be updated from time to time due to converter version upgrades or for other reasons. ● Please read this document carefully to understand the converter and precautions before installing the converter. ● All operations of the converter must be carried out by professional, qualified electrical technicians who are familiar with the relevant standards and safety codes of the project site. All operations of the converter must be carried out by professional, qualified electrical technicians who are familiar with the relevant standards and safety codes of the project site. ● Damage to the converter or injury to personnel resulting from failure to install, use, or configure the converter in accordance with this document or the corresponding user manual is not the responsibility of the converter manufacturer. Damage to the converter or injury to personnel resulting from failure to install, use, or configure the converter in accordance with this document or the corresponding user manual is not the responsibility of the converter manufacturer.

2.2 PV String Safety

⚠ Warnings
● Ensure that the module bezel and bracket system are well grounded. ● After the PV input cable is connected, please ensure that the cable is fastened and not loose. ● Use a multimeter to measure the positive and negative poles of the PV input cable to ensure that the PV input cable is connected with the correct polarity; and the voltage is within the allowable range. And the voltage is within the allowable range. ● Do not connect the same PV to more than one converter, otherwise it may lead to the converter damage.

2.3 Hybrid converter safety

⚠ Warnings
● Ensure that the voltage and frequency of the grid connection point comply with the grid connection specifications of the converter. ● It is recommended to add protective devices such as circuit breakers or fuses on the AC side of the converter. The current capacity of the protective device should be greater than 1 5 times the rated AC output current of the converter. It is recommended to add protective devices such as circuit breakers or fuses on the AC side of the converter. ● The protective ground wire of the converter must be firmly connected to ensure that the resistance between the zero line and the ground wire is less than 10 Ω. . ● Copper core cables are recommended for AC output lines. If aluminium wires are needed, please use aluminium to copper connectors to connect to the converter . ● When the converter triggers overload protection for a single time, the converter can automatically restart.

⚠ Dangerous
● When installing the converter, please avoid the connector at the bottom of the converter bearing weight, otherwise it may cause damage to the connector. ● After the installation of the converter, the labels and warning signs on the converter must be clear and visible, and it is prohibited to obstruct, alter, or damage it. The labels and warning signs on the converter must be clear and visible, and it is prohibited to obstruct, alter, or damage it. ● The identification on the inverter is as follows.

	High voltage hazard. The converter operates with high voltage, make sure that the converter is de-energised when operating the converter.		Delayed discharge. After the converter is powered down, wait 15 minutes until the converter is fully discharged.
	Before operating the converter, please read the relevant instructions for the converter in detail.		The converter is potentially dangerous when operated. Please take precautions when operating.
	High temperatures are present on the surface of the converter, and touching it while the converter is in operation is prohibited, as this may result in burns.		Protective earth wire connection point.
	CE marking		The converter is not to be disposed of as household waste, please dispose of the converter according to local laws and regulations or send it back to the converter manufacturer.
	Australia RCM certification.		

2.4 Battery Safety

Warnings

- Before installing the battery pack, please carefully read the user manual of the battery pack to understand the product and precautions. Please strictly Please strictly follow the requirements in the user manual of the battery pack for operation.
- If the battery pack has been fully discharged, please strictly follow the requirements of the user manual of the battery pack to charge the battery pack.
- The output capacity of the battery pack may be affected by some environmental factors, such as temperature, humidity, weather conditions, etc., which may limit the output capacity of the battery pack, thereby limiting the output capacity of the hybrid converter.
- If the battery pack cannot start, please contact after-sales as soon as possible. Otherwise, it may cause permanent damage to the battery pack.
- Use a multimeter to measure the positive and negative poles of the battery pack output cable, ensuring that the positive and negative poles of the battery pack output cable are correctly

connected to the positive and negative poles of the battery input interface of the hybrid converter; And the output pack output cable are correctly connected to the positive and negative poles of the battery input interface of the hybrid converter; And the output voltage of the battery pack is within the allowable range of the battery input voltage of the hybrid converter.

2.5 Conditions required for operators

Note
● The personnel responsible for installing or maintaining the hybrid converter must undergo strict training, be familiar with various safety precautions, and master the correct operating methods of the hybrid converter. The personnel responsible for installing or maintaining the hybrid converter must undergo strict training, be familiar with various safety precautions, and master the correct operating methods of the hybrid converter. ● Only qualified professionals or trained personnel are allowed to install, operate, maintain, and repair the hybrid converter.

2.6 Operational safety

When operating the converter, operators need to use insulated tools and wear safety protective equipment to ensure their personal safety.

3 Products

3.1 Product Characteristics

3.1.1 product positioning

Mainly for small and medium-sized energy storage microgrid development of a high-efficiency, high-reliability energy storage inverter, support for photovoltaic access, and off-grid switching device, support for multiple parallel operation, support for oil-machine hybrid operation, support for fast switching work on and off the grid. It is suitable for backup power, load smoothing, peak shaving and valley filling, small island microgrids, farms, villas, battery ladder utilisation and other scenarios to meet the needs of different users.

Product Advantage

3.1.2 Enclosure Installation Key Points

Installation Environment

- For outdoor use, the cabinet must meet IP54; for indoor use, the cabinet must meet IP20.
- Reserved space inside the cabinet.:
  - ✓ At least 10cm on both sides
  - ✓ At least 20cm above and below

Heat Dissipation Requirements

- The cabinet must have ventilation holes.
- Avoid direct sunlight or high-temperature areas

Mounting Method

- Vertically fix inverter to enclosure backplate using screws
- Ensure the device is stable and vibration-free

3.1.3 Product Advantage

Efficient and highly reliable:

(1) Low power consumption: low standby power consumption ≤ 15W, no-load operation loss less than 160W (off-grid);

(2) High efficiency: maximum conversion efficiency of 97.8 per cent;

(3) High protection: The core unit has IP5X protection level, which can work stably in harsh environments, such as sand, dust and high salt spray;

(4) Duct isolation design: Adopt isolation duct design to improve the safety and reliability of the product;

(5) High overload capacity: with a short time 150% overload capacity, which enhances the adaptability and durability of the system;

(6) Seamless switching function: supports seamless switching on and off the grid, ensuring the continuity and stability of power supply.

Function:

(1) Oil-engine hybrid mode: Supports oil-engine hybrid operation, which provides flexible energy combination methods and improves energy utilisation efficiency;

(2) Three-phase Independent Grid Connection Control Technology: It achieves independent control of the three phases, optimizes power distribution, and improves the system's flexibility and efficiency.

(3) Seamless switching: Seamless switching between parallel and off-grid (less than 10ms);

(4) Grid adaptability: perfect high and low voltage ride-through function, islanding protection, black start and other functions;

(5) Parallel function: AC side supports 15 sets of parallel parallel operation or off-grid operation (built-in STS function supports up to 3 sets of parallel connection), while the DC side also supports the parallel use of multiple machines;

(6) Flexible application scenarios: suitable for small industrial and commercial, small island microgrids, farms, villas and other scenarios to meet the specific needs of different users.

Convenience:

(1) Communication and monitoring: support a variety of communication protocols, support mainstream BMS, easy to remote monitoring and management;

(2) High maintainability: front wiring, front maintenance;

(3) Fault protection: perfect fault protection and fault record function;

(4) Efficient energy management: Built-in EMS (Energy Management System) supports

parallel operation of multiple devices, which improves the intelligent level of energy management, self-generation and self-consumption, economic mode, and grid-connection priority;

(5) Wide Voltage Range: Voltage input for a wide range of battery configurations, adaptable to meet energy needs for different capacity requirements. Better battery adaptability and cost-effectiveness down to 200V, e.g. 30kW/20-70kWh(100AH), 30kW/(60-215)kWh(280AH).

3.1.4 Specification

(1) Product Parameter

Parametric	SP30HBG2	SP25HBG2
Battery parameters		
Maximum Battery Voltage	850V	
Minimum Battery Voltage	200V	
Supported Battery Types	Lead-acid batteries, lithium batteries, solid-state batteries, etc.	
Rated Battery Voltage Range	320V-850V	320V-850V
Maximum battery current	100A	80A
PV parameters		
Maximum power	19.2kW+19.2kW	15kW+15kW
Maximum PV Voltage	850V	
PV starting voltage	250V	
MPPT voltage range	200V-800V	
Overvoltage rating	Class II	
Maximum feedback current	0A	
Maximum PV Current	32A+32A	25A+25A
AC side (grid-connected)		
Rating	30kVA	25kVA
Rated current	43.5A	36.2A
Rated grid voltage	400V/230V	
Grid voltage range	-20%~15%	
Starting inrush current	8.5A	
Grid frequency range	50Hz (47Hz~52Hz) or 60Hz (57Hz~62Hz)	
Current harmonic	<5% (>30% load)	
Power factor	-0.8 to 0.8 (see below)	
Overvoltage rating	Class II	
Protection level	Class I	
AC side (off-grid)		
Rated output power	30kVA	25kVA
Maximum output power	33kVA	27.5kVA
Rated output current	43.5A	36.2A

Maximum output current	48A	40A
Rated voltage	400V/230V	
Output voltage harmonics	<3% (resistive load)	
Disequilibrium	100%	
Frequency range	50/60Hz	
Maximum fault current	472A/20ms	
Maximum overcurrent protection value	48A	39.8A
Output overload (current)	48A<I_{load} ≤54A/100s 54A<I_{load} ≤65A/100ms	39.8A<I_{load} ≤45A/100s 45A<I_{load} ≤54A/100ms
System parameter		
Communications port	EMS: RS485 Battery: CAN or RS485	
DIDO	DI: 2-way; DO: 2-way	
Maximum efficiency	97.8 per cent	
Installation	frame	
Dilapidation	Standby <10W, no-load power <150W	
Weights	35kg	
Sizes	W*L*H: 440*560*183mm	
Protect	IP20	
Temperature range	-25 - 60°C (>45°C derated use)	
Humidity range	5-95 per cent	
Cooling method	Intelligent forced air cooling	
Contamination level	Class II	
Height above sea level	4000m (2000m or more used at a reduced rate)	
Accreditation	ce, iec62019, iec62477, iec6100, en50549	
Grid support	LVRT, HVRT, SVG	

Parametric	SP30HBPS	SP25HBPS
Battery parameters		
Maximum Battery Voltage	850V	
Minimum Battery Voltage	200V	
Supported Battery Types	Lead-acid batteries, lithium batteries, solid-state batteries, etc.	

Rated Battery Voltage Range	320V-850V	320V-850V
Maximum battery current	100A	80A
AC side (grid-connected)		
Rating	30kVA	25kVA
Rated current	43.5A	36.2A
Rated grid voltage	400V/230V	
Grid voltage range	-20%~15%	
Starting inrush current	8.5A	
Grid frequency range	50Hz (47Hz~52Hz) or 60Hz (57Hz~62Hz)	
Current harmonic	<5% (>30% load)	
Power factor	-0.8 to 0.8 (see below)	
Overvoltage rating	Class II	
Protection level	Class I	
AC side (off-grid)		
Rated output power	30kVA	25kVA
Maximum output power	33kVA	27.5kVA
Rated output current	43.5A	36.2A
Maximum output current	48A	40A
Rated voltage	400V/230V	
Output voltage harmonics	<3% (resistive load)	
Disequilibrium	100%	
Output frequency	50/60Hz	
Maximum fault current	472A/20ms	
Maximum overcurrent protection value	48A	39.8A
Output overload (current)	$48A<I_{load}\leq54A/100s$ $54A<I_{load}\leq65A/100ms$	$39.8A<I_{load}\leq45A/100s$ $45A<I_{load}\leq54A/100ms$
System parameter		

Communications port	EMS: RS485 Battery: CAN or RS485
DIDO	DI: 2-way; DO: 2-way
Maximum efficiency	97.8 per cent
Installation	Frame
Dilapidation	Standby <10W, no-load power <150W
Weights	35kg
Sizes	W*L*H: 440*560*183mm
Protect	IP20
Temperature range	-25 - 60°C (>45°C derated use)
Humidity range	5-95 per cent
Cooling method	Intelligent forced air cooling
Contamination level	Class II
Height above sea level	4000m (2000m or more used at a reduced rate)
Accreditation	ce, iec62019, iec62477, iec6100, en50549
Grid support	LVRT, HVRT, SVG

3.1.5 Product Operating Characteristic Curve

(2) Power curve

The power curve is shown in Figure 1 is shown:

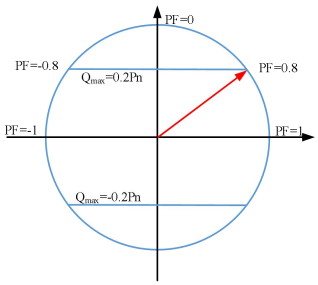


Figure 1 Power Curve

(3) Battery Voltage Derating Curve

The relationship between battery voltage and battery discharge power is shown in Figure 2 shows the relationship between

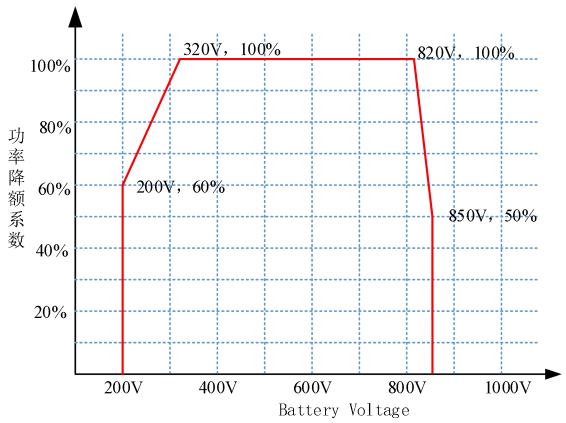


Figure 2 Battery voltage versus discharge power

The relationship between battery voltage and battery charging power is shown in Figure 3 shows the relationship between

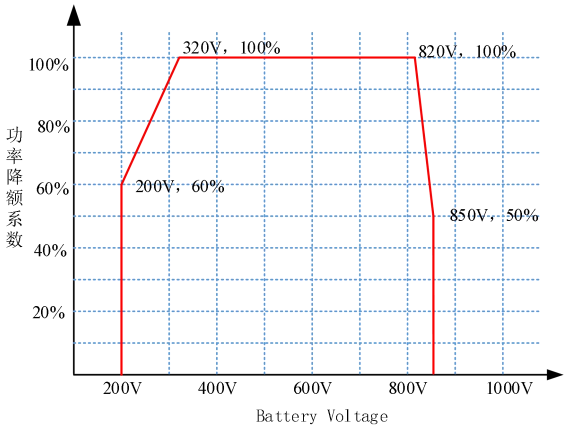


Figure 3 Battery voltage versus AC charging power

(4) Grid voltage derating curves

The relationship between AC charging and discharging power and grid voltage is shown in Figure 4 shows the relationship between

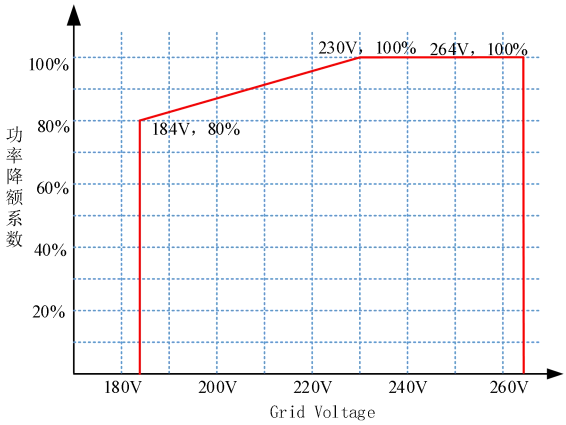


Figure 4 AC charging and discharging power versus grid voltage

(5) Operating Ambient Temperature Derating Curve

The relationship between AC charge/discharge power and ambient temperature is shown in Figure 5 is shown in Figure 5

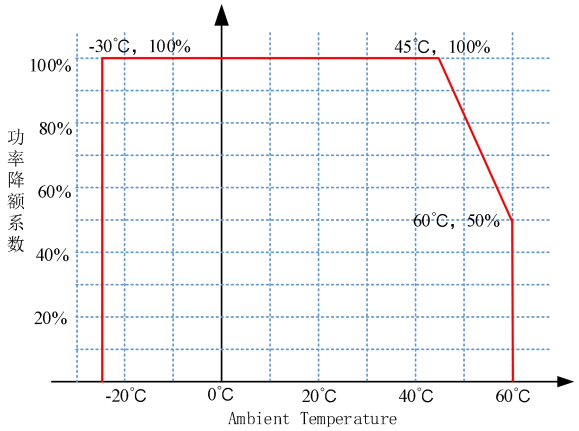


Figure 5 AC charge/discharge power versus ambient temperature

3.2 Product Classic Applications

The classic application is shown below:

(1) **Small industrial and commercial**: Suitable for small factories, commercial buildings, office buildings, etc. It is used to optimise energy consumption, realise peak and valley tariff management and reduce electricity expenditure, while providing emergency power back-up functions to ensure that key equipment can still operate normally when the power grid is unstable;

(2) **Small island microgrid**: In remote islands or areas without stable grid coverage, the SP30HBG2 can be combined with renewable energy sources such as solar photovoltaic panels and wind turbines to build independent microgrids to provide stable power supply;

(3) **Farms and Agricultural Facilities**: In the agricultural sector, the inverter can be combined with solar and storage systems to power irrigation, greenhouse control, automation equipment, etc. It also supports oil-engine hybrid modes to ensure that operations can be maintained in times of energy shortage;

(4) **Villas and houses**: Provide energy solutions for high-end houses, realising the combination of solar power generation and energy storage to increase the rate of energy

self-sufficiency, as well as providing home emergency power supply to ensure that home electricity consumption is not affected in case of grid failure;

(5) **Temporary power and construction sites**: In construction sites, outdoor activities, temporary facilities and other scenarios, the SP30HBG2 can be used as a mobile power supply to provide the necessary power support, while supporting oil-engine hybrids to ensure the continuity of power supply;

(6) **Remote areas and emergency rescue:** In remote areas or emergency rescue scenarios, the SP30HBG2 is lightweight, highly integrated, and allinone can be quickly deployed to provide a stable power supply to support the operation of critical facilities such as communication equipment and medical equipment;

(7) **Battery laddering**: Participate in national or regional energy optimisation projects, such as the wind and diesel storage island demonstration project, to demonstrate the performance and benefits of SP30HBG2 in practical applications.

3.2.1 Small commercial and industrial energy storage

Main application scenes: home, villa, supermarket, farm, field construction and other scenes.

Main functions: PV self-generation and self-consumption, emergency power backup, etc.

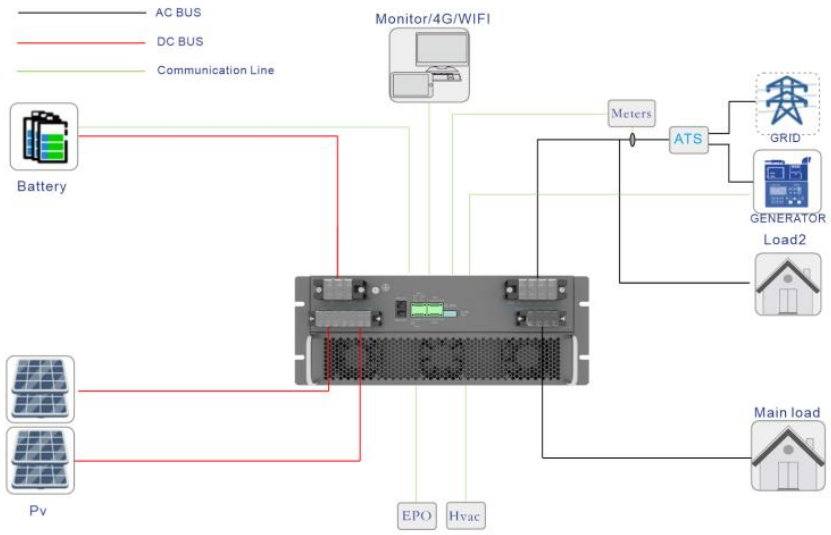


Figure 6

3.2.2 Off-grid microgrid solutions

Main application scenes: unstable power areas, villas, farms, islands, oil extraction, and other powerless areas.

Main functions: self-generation and self-consumption, emergency power reserve, oil machine management, wind turbine management, etc.

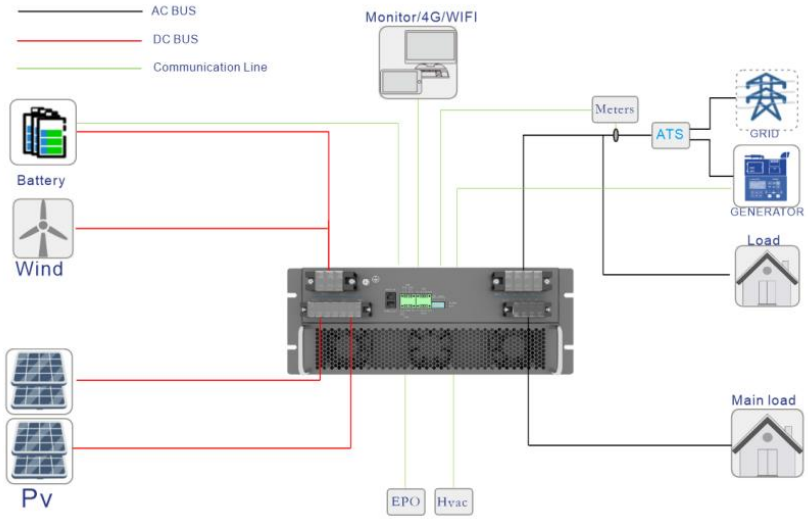


Figure 7

3.2.3 Three-phase unbalance and low voltage control

Main application scenarios: high-voltage, low-voltage and unbalance of terminal grid voltage due to new energy access or load fluctuation, line impedance and other reasons.

Main functions: three-phase independent grid-connected independent control, to achieve energy balance, maximum compensation of 150%.

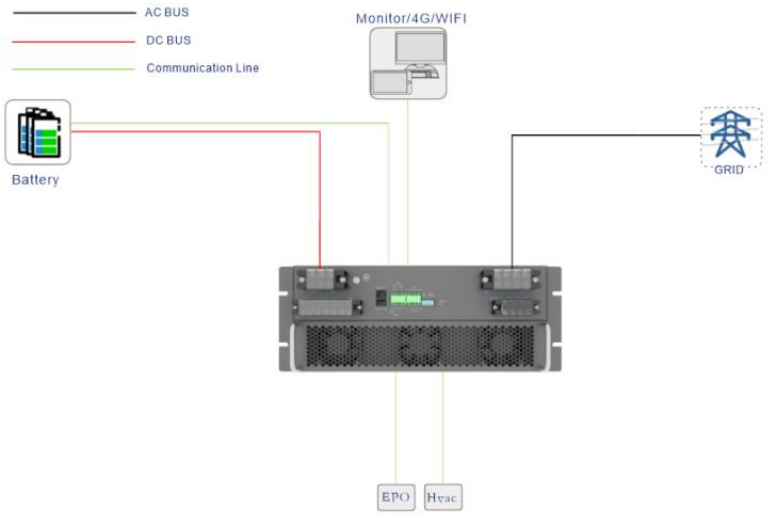


Figure 8

3.2.4 Energy storage + emergency power backup

Main application scenarios: EPS replacement, mobile power, battery secondary utilisation, sodium ion batteries, fuel cells, etc.

Main features: support single-phase charging function, wide range of battery power full load (320V-820V), maximum current 100A.

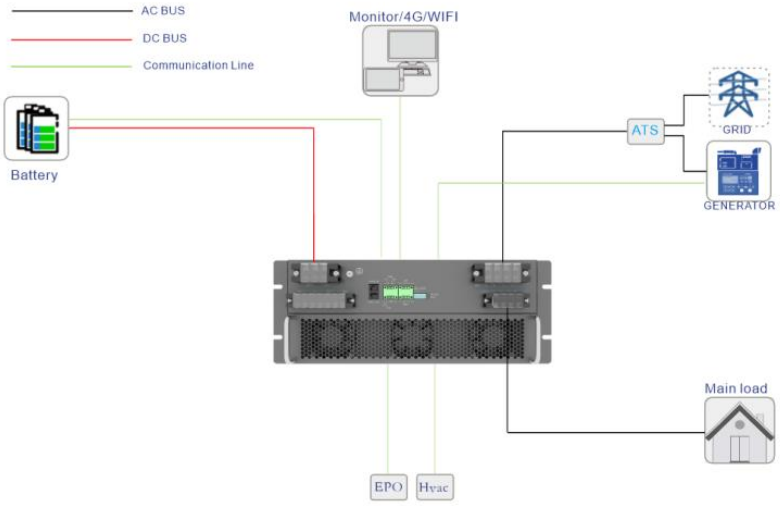


Figure 9

3.2.5 Multi-unit parallel programme

Main functions: support multiple parallel machines, support transformerless output, support transformer start.

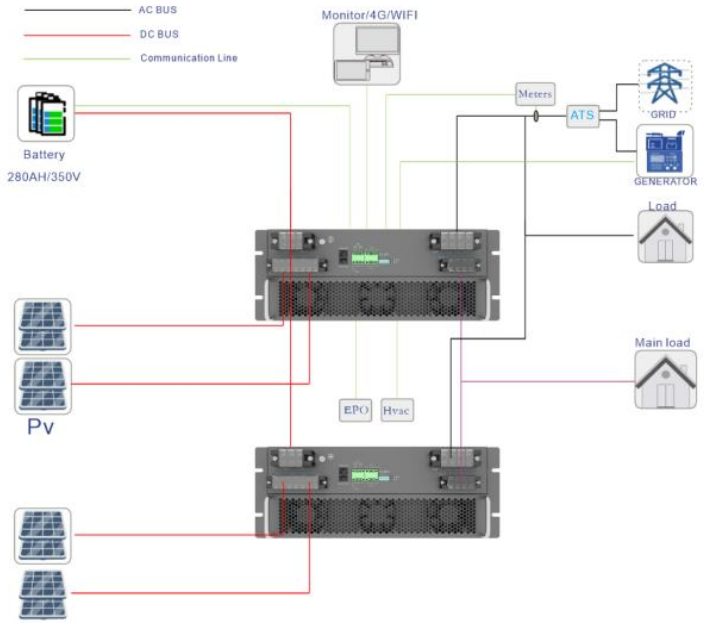


Figure 10

3.3 Description of model rules

This document applies to the type description of SP**HB** series converter

Serial number	Coding	Hidden meaning
1	Company identification	SP: Sino Soar Hybrid
2	AC power rating	30: AC rated output power 30kW 25: AC rated output power 25kW 15: AC rated output power 15kW
3	DC Voltage Rating	H: DC side input voltage within 200~1000V
4	Protection class	B: Insertion of frames
5	Module Classification	G2: Hybrid energy storage converter PS: Energy Storage Converters DC: Direct Current Converter PV: DC MPPT IV: Inverters

3.4 Product Circuit Introduction

3.4.1 Introduction to Power Circuits

The power circuit schematic is shown in Figure 11 The converter already contains a bus capacitor soft-start circuit, so the BMS does not need a corresponding bus capacitor soft-start circuit.

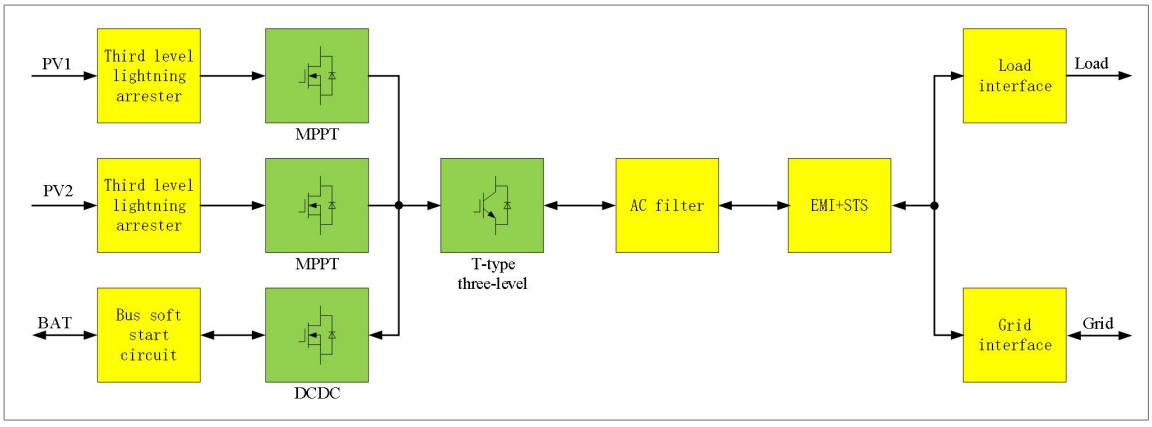


Figure 11 Schematic diagram of power circuit

3.4.2 Introduction to working modes

The converter has a total of three basic operating modes, i.e. self-generation, economic mode and priority grid connection, which require an additional SAEMS100 controller, please contact our sales staff if required.

（1）Provide for one's own use

This mode is suitable for regions with relatively high electricity prices and low or no subsidies for electricity back to the grid. The control logic of this mode is mainly to store excess PV power generation in the battery, and when there is insufficient PV power generation or no PV power generation at night, the battery is discharged for load power consumption, which improves the reasonable utilisation rate of the PV system and the rate of self-sufficiency of the household energy, and reduces the amount of the household's use of the grid energy, thus saving the expenditure of the household electricity bill.

For example: a) when the PV light is sufficient, for example, the PV output power is 35kW, at this time the power of the load is 10kW, the remaining 25kW of the PV will charge the battery without feeding energy back to the grid; b) when the PV light becomes weak, for example, the PV output power is only 10kW, at this time the load's power is 20kW, the PV power shortfall of 10kW needs to be replenished by the battery, thus satisfy the energy required by the load and does not consume energy from the grid.

（2）Economic model

This mode is suitable for scenarios where the difference between peak and valley electricity prices is large, to achieve peak and valley arbitrage, such as setting the converter to charging state during the time when the price of electricity is relatively low, and setting the converter to grid-connected discharging state during the time when the price of electricity sold is relatively high. This mode is achieved by manually setting the charging and discharging time periods of the converter to achieve automatic switching of the converter's operating state at different time periods.

（3）Priority Internet access

This mode is applicable to the grid-connected scenario of full feed-in, which maximises the PV power generation to the grid, such as when the PV power generation exceeds the rated output

capacity of the AC side of the converter, the converter will charge the batteries for the exceeding portion; when the PV power generation is less than the rated output capacity of the AC side of the converter, the insufficient portion will be made up by the batteries, which ensures that the converter will maximise the output of energy to the power grid.

For example: a) When the PV light is sufficient, for example, the PV output power is 35kW, the power fed back to the grid at this time is 30kW, and the remaining 5kW of the PV will charge the battery. b) When the PV light becomes weak, for example, the PV output power is only 10kW, the power fed back to the grid at this time is 30kW, and the insufficient 20kW of the PV power needs to be replenished by the battery to meet the power fed back to the grid. c) When the PV output power is only 10kW, the power fed back to the grid is 30kW, and the insufficient 20kW of PV power needs to be replenished by the battery to meet the power maximisation. Power maximisation.

3.5 Product mix

3.5.1 Product Appearance

Figure 12 Schematic diagram of 45° angle of the product

Figure 13 Front view of product

3.5.2 Product Size

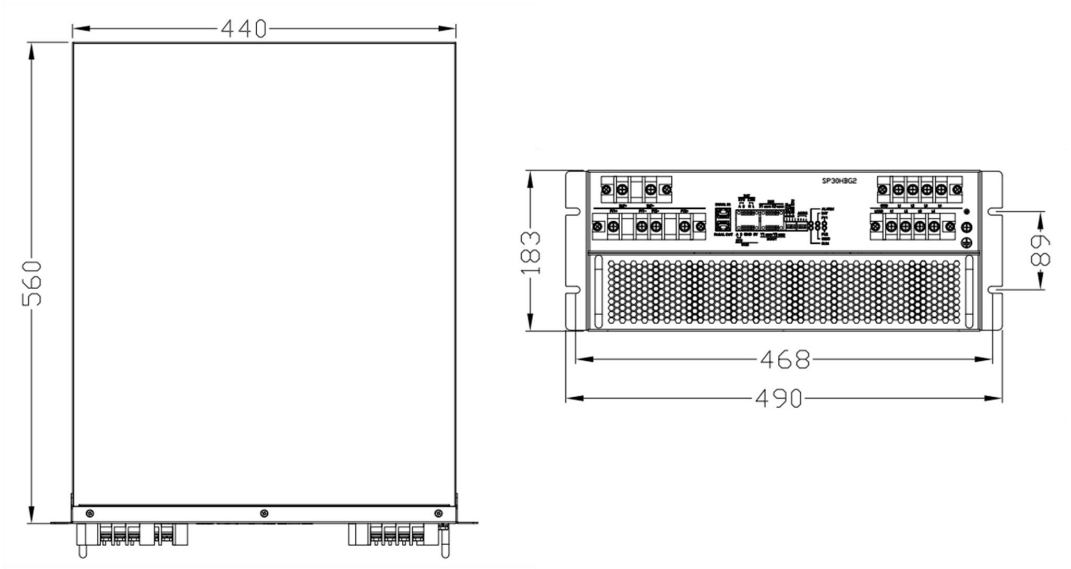


Figure 14 Product Dimensions

4 Transport and, storage and installation

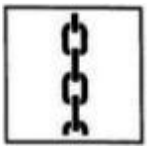
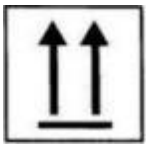
4.1 Transport and storage

When transporting and storing the converter module, please pay attention to the marking on the packing box, and the following requirements should be met during transport and storage:

⚠ Take care

- Ensure that the outer packaging of the converter is not removed during storage and transport;
- Ensure that the storage environment is free of corrosive and toxic gases;
- Ensure that the storage temperature is maintained between -45°C and 70°C and the relative humidity is maintained between 5%RH and 95%RH;
- Ensure that storage is in stacks of up to 4 layers and that there is no risk of the stacks tipping over;
- Regular inspections are required during storage, and packaging materials need to be replaced in a timely manner if insect and rodent bites are found;
- Ensure that means of transport and storage warehouses comply with fire protection requirements;
- If the storage time exceeds six months, the converter needs to be checked and tested by a professional before it is put into use;
- Avoid transporting the converter in rainy or inclement weather conditions, and if this is unavoidable, always take the necessary protective measures;
- For long term storage, it must be guaranteed to be energised once a year for a period of not less than 6 hours from the date of purchase.

The graphic description of the package marking is shown in the table below

Icon	Instructions
	A centre of gravity marking indicating where the centre of gravity of the energy storage converter is located.
	Lifting marks indicating the position of the chain or rope when lifting the storage converter.
	Upward markings indicating the manner in which the energy storage converter is to be handled and placed are to be placed in such a way that it is not permitted to place it upside down, horizontally or at an angle.
	Lightly place the markings and avoid violent friction or collision during transport and placement.
	Fear of humidity marking, during transport and storage should be avoided energy storage converter subjected to rain or moisture.

4.2 Unpacking and Inspection

The following checks are required when the converter is unpacked:

⚠ Warnings
● Check whether the outer packaging of the converter is damaged before opening the box, if it is damaged, please contact the relevant personnel for confirmation and replacement in time; ● Place the converter on a level surface with the front facing up and remove the sealing tape from the outer packaging; ● Take out the shipping attachments and confirm whether there is any omission or misdelivery of the attachments, if there is any omission or misdelivery, please contact the relevant personnel in time to confirm and reissue the relevant attachments; ● The cushioning will be taken out, and then two or more people will need to assist each other to take out the converter module, to prevent the converter from falling when taking out the converter module, resulting in a threat to the safety of life and property; ● Check whether the plastic film packing bag of the converter module is damaged, if it is damaged, please contact the relevant personnel for confirmation and replacement in time; ● Remove the plastic film from the module and check the appearance of the module for more obvious scratches or defects, if there are more obvious scratches or defects, please contact the relevant personnel for confirmation and replacement; ● Check whether the nameplate parameters of the converter module are consistent with the ordering contract, such as model number, rated power, voltage range and other key parameters. If the nameplate parameters of the converter module are not consistent with the ordering contract, please contact the relevant personnel for confirmation and replacement; ● Dispose of converter-related packaging materials appropriately in accordance with local laws and regulations.

4.3 Handling and installation

4.3.1 Installation and Handling Precautions

The transport, storage or installation of the converter shall meet the requirements of the laws and regulations and relevant standards of the country and region where it is located. Before

installation, the hybrid converter needs to be transported to the installation site. To avoid personnel injury or equipment damage during transport, please pay attention to the following matters:

⚠ Warnings
● Please staff the hybrid converter according to its weight to avoid injury due to its weight being beyond the range of human handling. ● Wear safety gloves when installing or handling the hybrid converter to avoid injury. ● Please ensure that the converter is balanced during handling and avoid dropping it.

4.3.2 mounting tool

Artifact		
Forklift trucks	Torque spanner	Screwdrivers
 When moving equipment over short distances, a forklift is required to avoid falls during handling, which may result in injury or equipment damage.	 When connecting power cables, a torque spanner should be used to fix them in accordance with the relevant torque size, so as to prevent too small a torque from causing the power cables to be connected to the terminals insecurely or too large a torque from causing damage to the terminals.	 Phillips screwdriver M6 screws for fixing the module in the cabinet

4.3.3 Installation environment

The installation environment of the converter needs to meet the following conditions:

⚠ Take care
● It is important that the converter is installed in a location with a shelter from the sun; ● The converter should be installed in a well-ventilated area to prevent its performance from being affected by poor heat dissipation;

- The surface of the machine is hot during operation of the converter, so be sure to install it in a location where it cannot be easily touched;
- It is important that the converter is kept away from children and special populations;
- The installation area of the converter should be far away from flammable and explosive materials, and needs to be far away from strong interference equipment;
- The mounting frame or wall of the converter should be fire resistant;
- Installation of the converter near relatively noise-sensitive office areas or residential premises should be avoided.

To ensure the life safety of the installer, relevant safety precautions must be in place when performing electrical installation or maintenance on this product. The following protocols must be followed when performing electrical installation:

⚠ Distress

- All power supplies connected to the converter must be disconnected to ensure that the converter is in a non-powered state.
- A warning sign must be left at the disconnected location to prevent it from being re-energised during installation.
- Necessary grounding and short-circuit connections are required.
- Electrically charged parts need to be treated as necessary and isolated with insulating material to avoid injury to personnel.
- The converter must only be installed and operated by specialised personnel, and the installation process is carried out in strict accordance with the instructions in the user manual.
- The installer must comply with the relevant electrical operating regulations of the country or region in which he is working.
- The installer needs to know the voltage level of the supply area and judge the voltage suitability.

The environmental requirements of the converter are as follows:

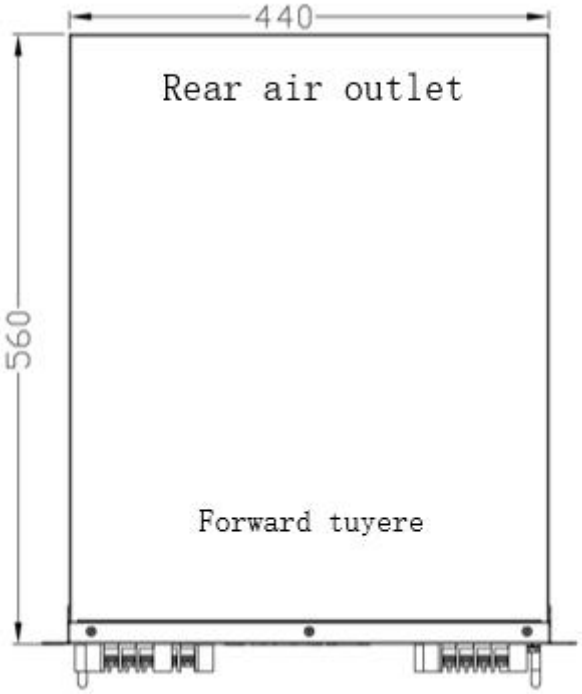
⚠ Take care

- This product is in-cabinet mounted and needs to be installed for use in the final system;
- Installation and use of the altitude is not higher than 4000m, if more than 2000m need to be reduced use;

- The working ambient temperature of the converter is -30 ℃ ~+60 ℃ , when the ambient temperature is >45℃, the converter needs to be derated;
- The working environment of the converter has a humidity of 5%RH~95%RH and no condensation;
- When the converter works in a high dust environment, it is necessary to increase the dust filtering device according to the site conditions, but it does not affect the inlet and outlet air volume of the converter;

4.3.4 Duct Requirements

The cooling method of the converter module is forced air-cooling, the front panel is the air inlet, the rear panel is the air outlet, the rated air inlet of the converter module is 350CFM (10m3 /min), when installed in the integrated system, the air inlet of the cabinet should be directly opposite to the module's air inlet on the front panel, and the distance between the converter module's air inlet and cabinet should be more than 110mm; the corresponding air ducts and air outlets need to be added to the cabinet, which should directly send hot air outside the cabinet to avoid hot air in the cabinet and outlets of the module and to avoid hot air in the cabinet. The air duct should be directly opposite to the module air outlet and the cabinet air outlet, and the distance between the converter module air outlet and the cabinet should be greater than 110mm, so that the hot air is sent directly to the cabinet, to avoid the hot air backflow in the cabinet. If there is no relevant air outlet duct, the exhaust fan should be added at the cabinet air outlet, and the air volume of the fan should be 2 times of the module air intake requirements. Considering that the air inlet should be increased with dustproof cotton, the air inlet area of the cabinet should be more than 3 times of the inlet area of the converter module, and the dustproof cotton is recommended to be polyurethane mesh foam with 40PPI density, and the flame retardant level should be satisfied with 94V0. The air outlet area of the cabinet should be 2 times of the outlet area of the converter module, and it is also recommended to adopt the 10-mesh anti-insect steel mesh in the air outlet. The air inlet reference is shown below.


440
Rear air outlet
590
Forward tuyere

5 Cable Connection Instructions

5.1 Port Definition

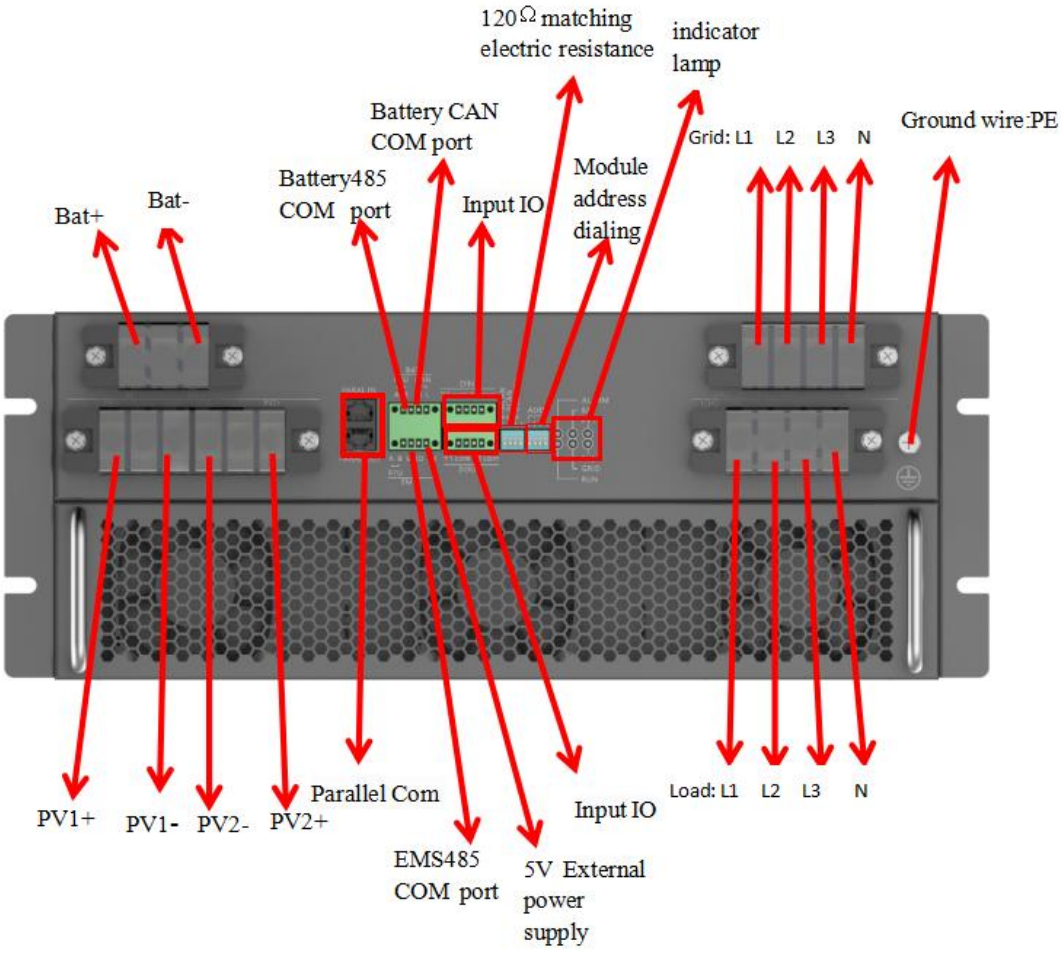


Figure 15 Port Definition Schematic

Power Port Definition:

Name(of a thing)	Functionality	Note
BAT+/BAT-	Battery input terminal	OT terminal (RNB22-6S), recommended for 25mm² cable
LOAD (L1/L2/L3/N)	AC load terminal block	OT terminal (RNB22-6S), 16mm² cable
GRID (L1/L2/L3/N)	AC grid-side terminals	OT terminal (RNB22-6S), recommended for 25mm² cable
PV1+/PV1-/PV2V-/PV2+	Photovoltaic Input Terminal	OT terminal (RNB14-6S), recommended for 10mm² cable
PE	ground terminal	OT terminal (RNB14-6S), recommended for 10mm² cable

⚠ Take care
● The power terminals are fixed with M6 screws, please use the screws supplied to fix the power cables, and the torque of the fixing screws is 3N.m (30kgf · m), too big will lead to damage of the terminals, too small will lead to poor contact. ● The module needs to be reliably earthed for operation, poor earthing may result in danger of electric shock and damage to the module, fixing screw torque is 5N.m.

The signal terminal interface is defined in Figure 16 Shown in Figure 16

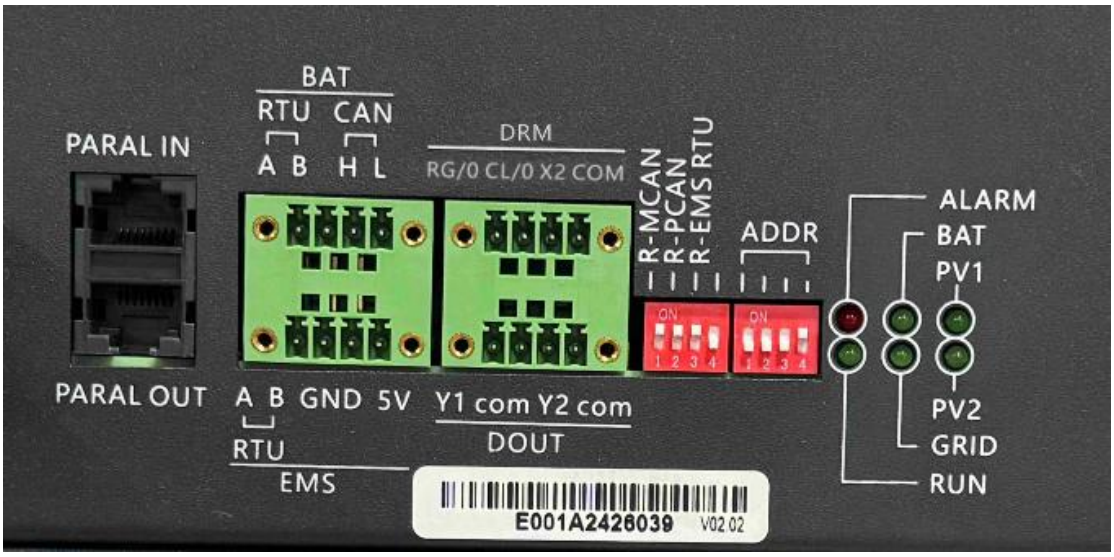


Figure 16 Signal terminal interface definition

Name (of a thing)	Functionality	Note
PARAL IN	Parallel line input	Parallel line
PARAL OUT	Parallel line output	Parallel line
BAT_RTU	Battery RS485 interface	BAT communication interface
BAT_CAN	Battery CAN interface	
RTU (A-B)	Communication interface with EMS	Upper computer or EMS or SAEMS100 (optional) coordinated control system
5V-GND	SAEMS power supply port	Output capacity 5V/1A
RG/0	DRM	Disconnecting the short circuit between the RG/0 and CL/0 terminals will cause the PCS system to shut down and stop outputting power. To restore normal operation, the short circuit between these two terminals must be re-established.
CL/0		
X2	Input node	Reserve

X2_com	Input node	Reserve
Y1	Output dry contact	Output capability: Maximum port voltage not higher than 24V, maximum current not more than 200mA
com		
Y2	Output dry contact	
com		
R-MCAN	Parallel Communication Matching Resistor	ON: Indicates communication matching resistor access The 1st module and the last module need to access the parallel communication matching resistor (dial code to ON position), i.e. the first and last module need the parallel communication matching resistor, the rest do not.
R-PCAN	Parallel Communication Matching Resistor	
R-EMS RTU	EMS RTU Communication Matching Resistor	
ADDR	Module address dialling code	ON: indicates 1, and vice versa indicates 0 A binary representation of the module address is used, with the left side being the high bit and the right side being the status, i.e., module 1 is represented as 0001; module 3 is represented as 0011.
ALARM	Fault indicator	Always on when the converter is faulty, always off when there is no fault.
RUN	Status indicator	The converter is always on in normal operation, flashes 1 time per second in standby without fault, and is always off when the converter fails.
BAT	Battery status indicator	Battery terminal circuit function is always on when it is running, blinks 1 time per second when there is no battery abnormality, and is always off when there is a battery abnormality.
GRID	Grid status indicator	Always on when grid-connected operation, blinking 1 time per second when there is no abnormality in the power grid, and always off when there is abnormality in the power grid.
PV1	PV1 status indicator	PV1 is always on when it is running, blinks 1 time per second when PV1 is not abnormal, and is always off when PV1 is abnormal.
PV2	PV2 status indicator	PV2 is always on when it is running, blinks 1 time per second when PV2 is not abnormal, and is always off when PV2 is abnormal.

The internal schematic of the output trunk node is shown in Figure 17 shown:

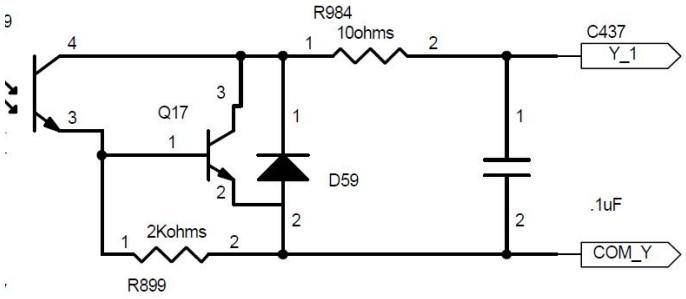


Figure 17 Internal principle of the output trunk node

The maximum voltage of the port is not higher than 24V and the maximum current does not exceed 200mA.

Input Trunk Node Internal Schematic As Figure 18 shown:

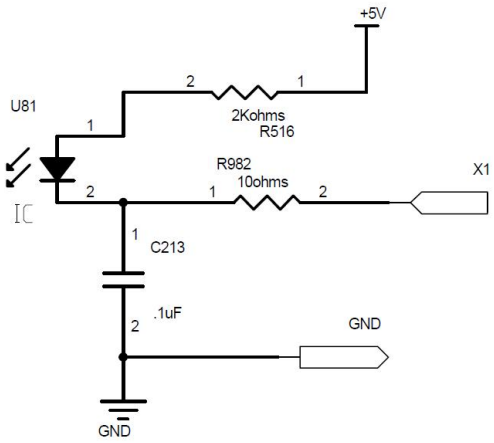


Figure 18 Internal schematic of the input trunk node

The input trunk node has a built-in power supply, the external only need to provide a switch for shorting, the switch shorting impedance and the sum of the line impedance should be less than 0.1Ω.

5.2 Cable Wiring Tool

Tools and instruments		
Multimeter	Torque spanner	Crimper
 Measurement of equipment energisation	 Connection power cord, torque 3N.m (30kgf/m)	 For power cable crimping
Screwdrivers	Wire stripper	Heat guns (or heat exit fans), heat shrink tubing
 Phillips screwdriver for fastening and removing M6 screws	 For power cable processing	 Wrapping the conductive part of the power cable to avoid leakage.

According to the site conditions, appropriately increase the relevant tools to avoid the lack of tools affecting the installation progress.

5.3 DC Side Wiring

⚠ Warnings
● The battery voltage must not be greater than the maximum permissible DC voltage of the converter, 850V, otherwise damage to the device may occur; ● When a ground fault exists in the system, it is necessary to remove the ground fault and wire after the fault; ● The DC power cable screws of the converter are to be fastened according to a mounting torque of 3 N.m. Less than this mounting torque will cause a fire due to poor contact, and more than this mounting torque will result in damage to the power terminals; ● When the wiring of the converter is wrong, it will cause the converter not to work properly and even lead to equipment damage; ● In the installation process, it is necessary to install the cables in strict accordance with the order of

installation to prevent accidents during the installation process.

The battery side cables are installed in the following order:

Step 1 Measure the port voltage of the battery with a multimeter to ensure that its battery voltage is within the input voltage range of the converter;

Step 2 Disconnect the battery switch and measure with a multimeter to confirm that the power cables to be installed to the converter are in an uncharged state;

Step 3 Cut the appropriate length of heat shrink tubing and assemble the heat shrink tubing to the power cable to be crimped;

Step 4 Use wire strippers to strip the insulation of the power cable to the appropriate length, then attach the cold-pressed terminals corresponding to the terminals, and finally use crimping pliers to crimp the terminals;

Step 5 After crimping the terminals, check whether the terminals are crimped reliably. If the crimping is not secure enough, cut off the terminals and repeat step 4;

Step 6 After the terminals are firmly crimped, use a heat gun to shrink the heat shrink tubing and insulate it accordingly;

Step 7 Connect the positive and negative power cables of the battery pack to the "BAT+" and "BAT-" terminals of the converter, and use a torque spanner to calibrate the mounting torque so that the power cables and the power terminals have good contact.

5.4 AC Side Wiring

⚠ Warnings

- The grid voltage must not be greater than the maximum permissible AC voltage of the converter, 264 V, otherwise damage to the equipment may occur;
- When a ground fault exists in the system, the ground fault needs to be removed before wiring;
- The AC power cable screws of the converter are to be tightened according to a mounting torque of 3 N.m. Less than this mounting torque will cause a fire due to poor contact, and more than this mounting torque will result in damage to the power terminals;
- During installation, if the phase sequence is wrong, the converter will not work properly or even the converter will be damaged;
- In the installation process, it is necessary to install the cables in strict accordance with the order of installation to prevent accidents during installation.

The AC side power cable installation sequence is as follows:

Step 1 Measure the port voltage of the grid (phase voltage less than 264V) with a multimeter to ensure that its grid voltage is within the input voltage range of the converter;

Step 2 Disconnect the grid switch and measure the AC side power cables and the converter AC terminals with a multimeter to confirm that the AC power cables and the converter AC terminals to be mounted to the converter are uncharged;

Step 3 Cut the appropriate length of heat shrink tubing and assemble the heat shrink tubing to the power cable to be crimped;

Step 4 Use wire strippers to strip the insulation of the power cable to the appropriate length, then attach the cold-pressed terminals corresponding to the terminals, and finally use crimping pliers to crimp the terminals;

Step 5 After crimping the terminals, check whether the terminals are crimped reliably. If the crimping is not secure enough, cut off the terminals and repeat step 4;

Step 6 After the terminals are firmly crimped, use a heat gun to shrink the heat shrink tubing and insulate it accordingly;

Step 7 Connect the power cables from the grid to the power terminals "L1", "L2", "L3" and "N" on the grid side of the converter. "Use a torque spanner to calibrate the mounting torque so that the power cables make good contact with the power terminals.

Step 8 Connect the power cables of the AC load to the power terminals "L1", "L2", "L3" and "N" on the load side of the converter. "Use a torque spanner to calibrate the mounting torque so that the power cables make good contact with the power terminals.

5.5 Wiring Diagram

This subsection mainly illustrates the wiring diagrams for one cluster and one management single machine, one cluster and one management multiple machines in parallel, and single battery pack multiple machines in parallel.

Note
● Ensure that the address of the battery pack corresponds to the address of the converter one by one to prevent the phenomenon of inaccurate EMS control due to the mismatch between the PCS and the battery pack; ● SAEMS100 or SAEMS200 need to communicate with all the battery packs, its communication with the battery is RTU communication or CAN communication, the two communication methods to choose one of them can be, RTU communication baud rate is 115200, CAN communication baud rate is 125kbps; ● The SAEMS100 or SAEMS200 communicates with the converter by means of RTU communication and CAN communication, both of which need to be connected for use, and the RTU communication cables and CAN communication cables of all parallel-connected converters need to be connected together separately; ● Ensure that the matching resistor for RTU and CAN communication of the last converter module is enabled; ● Ensure that the addresses of all parallel converters are unique (change the address of the converter by dialling the address) and that the baud rate for RTU communication is 115200 and for CAN is 125kbps; ● The communication method between SAEMS100 or SAEMS200 and the meter is RTU communication, and the baud rate of RTU communication is 9600, which is mainly used to enable the external anti-reverse current function; ● SAEMS100 or SAEMS200 are optional products, please contact the relevant staff if you need them; ● STS is an optional product, please contact the relevant staff if you need to purchase it.

5.5.1 One Cluster One Management Standalone Connection Diagram

The wiring diagram for this operating mode is shown in Figure 19 As shown in Figure 19, all power cables connected to the converter need to be connected to an external isolation switch, and the converter can work in the grid-connected or off-grid state, and can automatically switch between the two states.SAEMS100 coordinates and controls the whole system according to the parameters set by the user, so that the system can operate according to the different needs of different users.

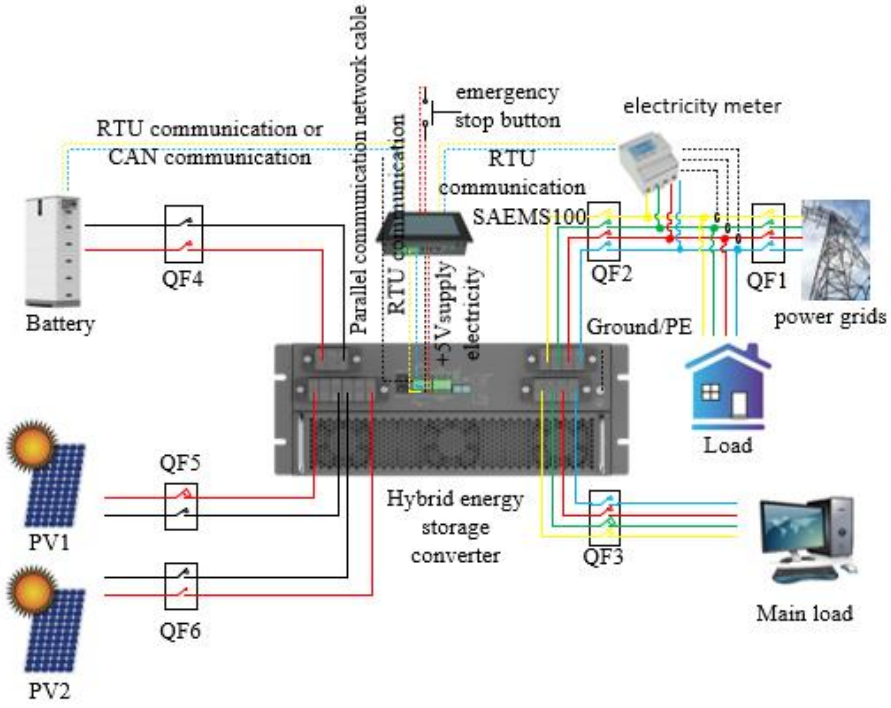


Figure 19 Schematic diagram of one cluster one management wiring

⚠ Warnings
● If a PV simulator or DC power supply is used instead of a solar PV panel for the relevant tests, please close the isolation switches QF5 and QF6 before switching on the PV simulator or DC power supply to output; ● The recommended energy meter is the Anchorage ADL400 model; ● The CT needs to be installed between the load and QF1 or it will not achieve the desired effect; ● If no energy meter is installed, the inverter's internal backflow prevention function can be enabled, in which case the loads are supplied from the grid and the inverter supplies power only to the important loads; ● The converter needs to be reliably earthed, otherwise personal safety and damage to the converter will result.

5.5.2 One cluster, one management of multiple machines in parallel (off-grid)

The wiring diagram for this mode of operation is as follows Figure 20 As shown in Figure 20, all power cables connected to the converter need to be connected to an external isolation switch, and the converter is only allowed to work in the off-grid state, with a maximum of 15 units connected in parallel, and each converter is connected to an independent battery pack on the battery side to realise the one-to-one management of the converter to the battery pack.The

SAEMS200 carries out the co-ordinated control of the whole system according to the parameters set by the user, so that the system can be operated in accordance with the different needs of different users. The SAEMS200 coordinates and controls the whole system according to the parameters set by the user, enabling the system to operate according to the different needs of different users.

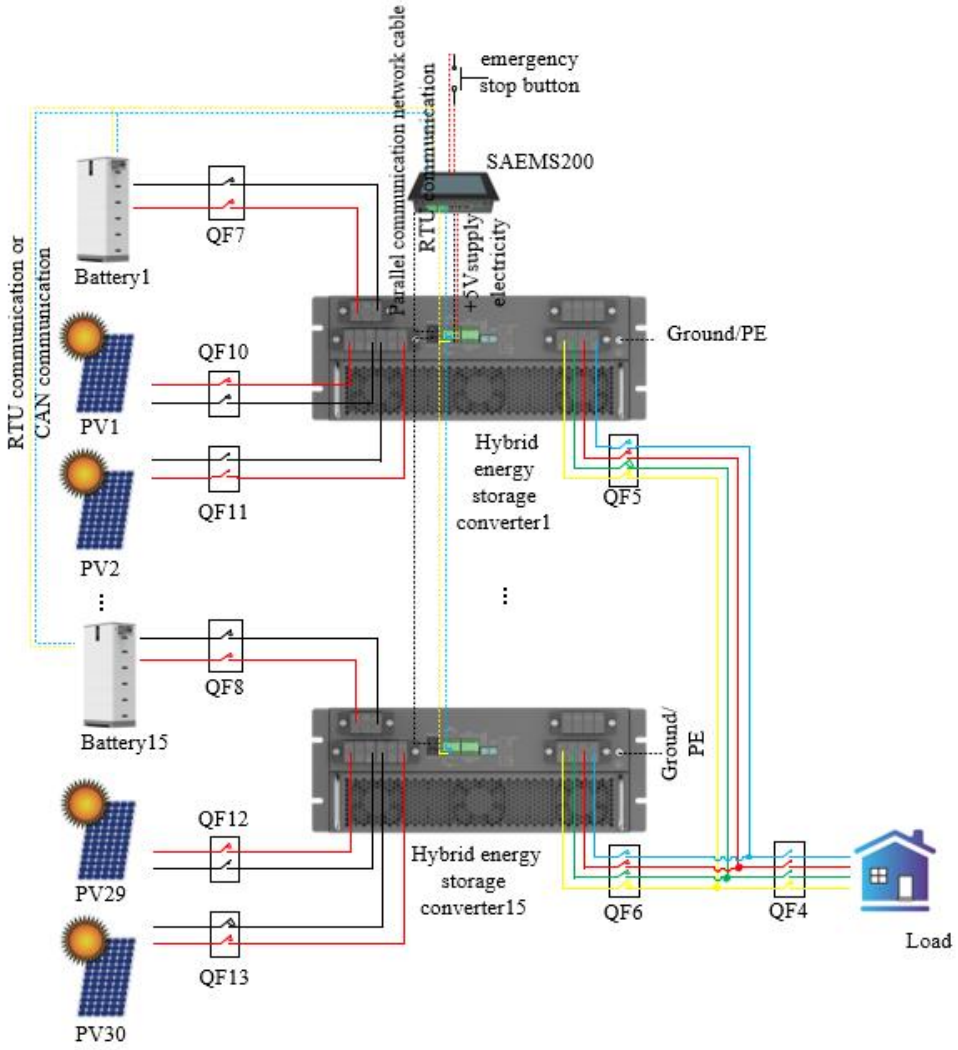


Figure 20 Wiring diagram for parallel connection of multiple machines with one cluster and one manager

⚠ Warnings
● If a PV simulator or DC power supply is used instead of a solar PV panel for the relevant tests, please close the isolation switches QF10, QF11, QF12 and QF13 before switching on the PV simulator or DC power supply to output; ● In this wiring mode, the converter works only in off-grid mode and cannot be operated on-grid; ● All converters need to be reliably earthed, otherwise personal safety and damage to the converter

will result.

5.5.3 One cluster, one management of multiple machines in parallel (and off-grid switching)

(1) Usage scenarios with up to 3 units in parallel

The wiring diagram for this mode of operation is shown in Figure 21 As shown in Figure 21, the converter can achieve the function of switching on and off the grid by itself, the number of converters connected in parallel can not exceed 3, and all power cables connected to the converter need to be connected to an external isolation switch.SAEMS100 coordinates and controls the whole system according to the parameters set by the user, so that the system can be operated according to the different needs of different users.

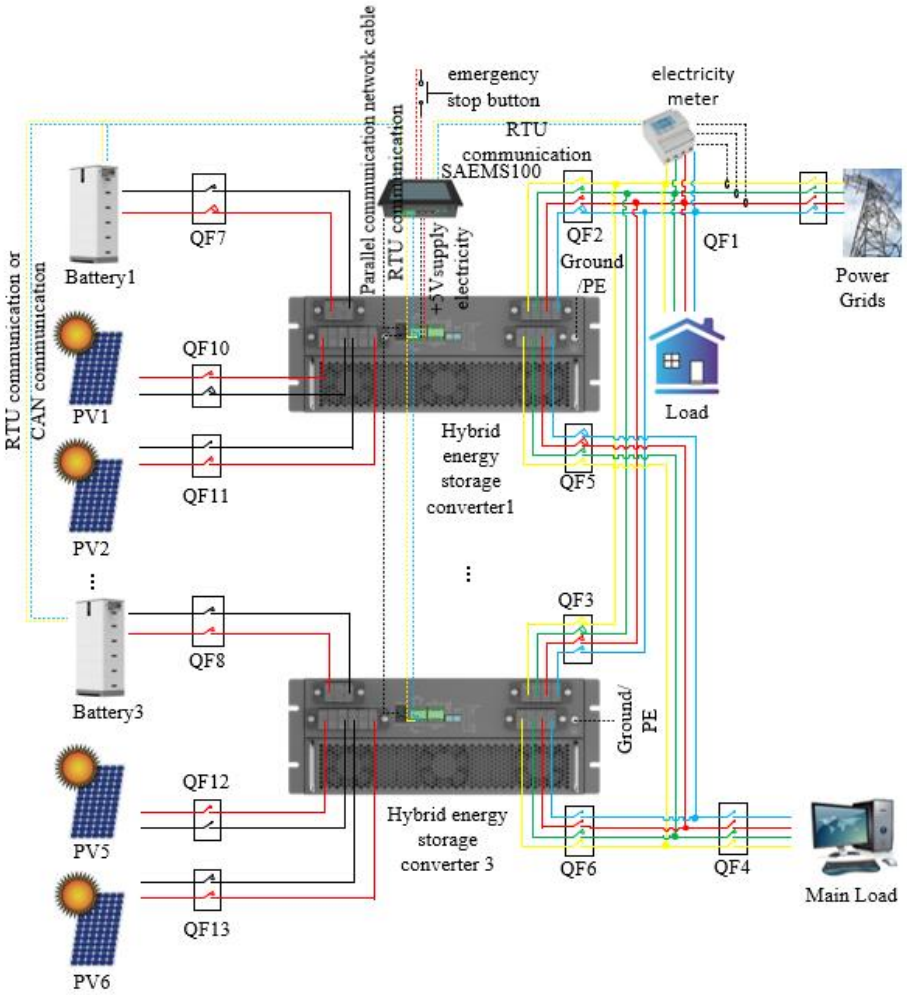


Figure 21 Schematic diagram of parallel wiring of multiple machines with one cluster and one management

Warnings

- If the PV simulator or DC power supply is used to replace the solar PV panel for related tests, please close the isolation switches QF10, QF11, QF12 and QF13 before turning on the PV simulator or DC power supply for output;
- The energy meter is recommended to use Anchoray ADL400 model;
- CT needs to be installed between the load and QF1, otherwise the desired effect cannot be achieved;
- If the energy meter is not installed, you can enable the converter internal anti-reverse current function, at this time the load is supplied by the grid, the converter only supply power to the important loads;
- All converters need to be grounded reliably, otherwise it will lead to personal safety and converter damage.

(2) Usage scenarios with more than 3 units connected in parallel

The wiring diagram of this working mode is shown in Figure 22, at this time, the converter needs to cooperate with the external STS device to realize the function of switching between parallel and off-grid, the number of parallel connection is up to 15, and all the power cables connecting to the converter need to be connected to the external isolation switch.SAEMS200 coordinates the control of the whole system according to the user's parameter, which makes the system able to operate according to the different needs of different users.

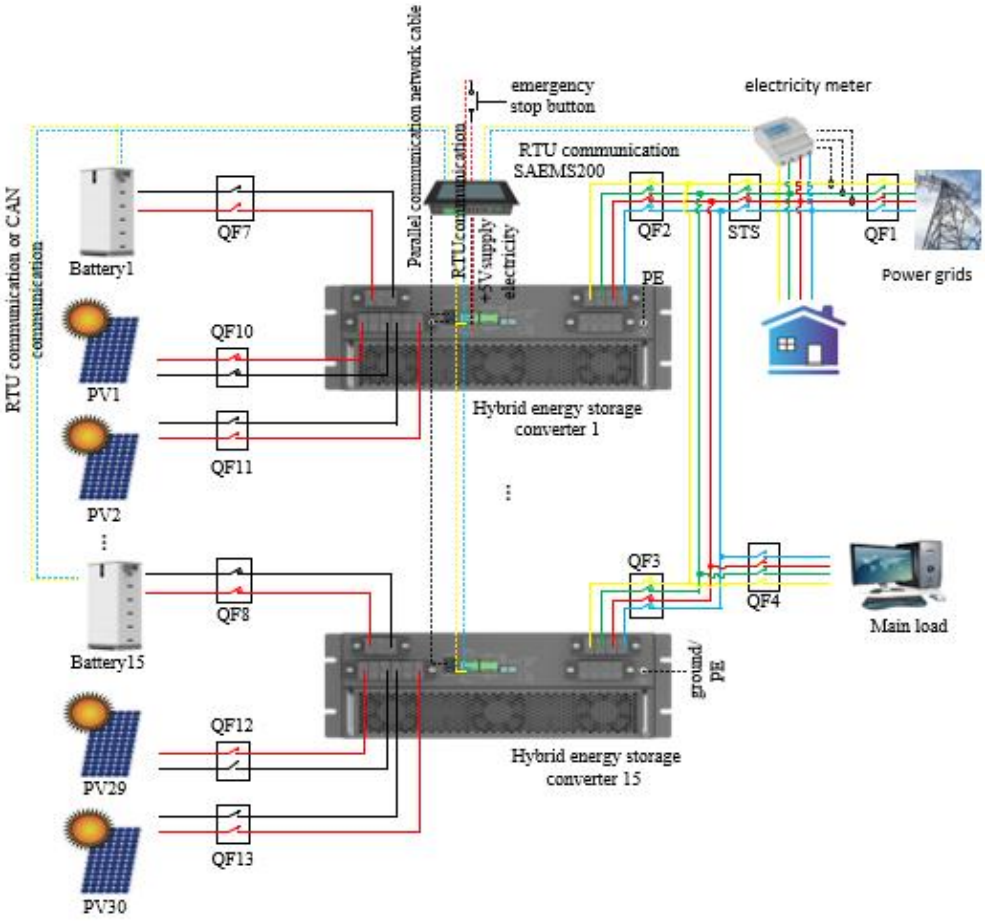


Figure 22 Schematic diagram of parallel connection of multiple machines with one cluster and one management.

⚠ Warnings
● If the PV simulator or DC power supply is used to replace the solar PV panel for related tests, please close the isolation switches QF10, QF11, QF12 and QF13 before turning on the PV simulator or DC power supply for output; ● The energy meter is recommended to use Anchoray ADL400 model; ● CT needs to be installed between the load and QF1, otherwise the desired effect cannot be achieved; ● If the energy meter is not installed, the STS internal anti-reverse current function can be enabled, at this time, the load is supplied by the power grid, and the converter only supplies power to the important load; ● All converters and STS need to be reliably grounded, otherwise it will lead to personal safety and converter damage.

5.5.4 Schematic diagram of a single battery pack with multiple parallel connections (off-grid).

The wiring diagram of this mode is shown in Figure 23, the number of converters in parallel is up to 15, the converters are only allowed to work in off-grid state, and all the power cables connected to the converters need to be connected to external isolation switches.SAEMS200 coordinates and controls the whole system according to the parameters set by the user, so that the system can operate according to the different needs of different users.

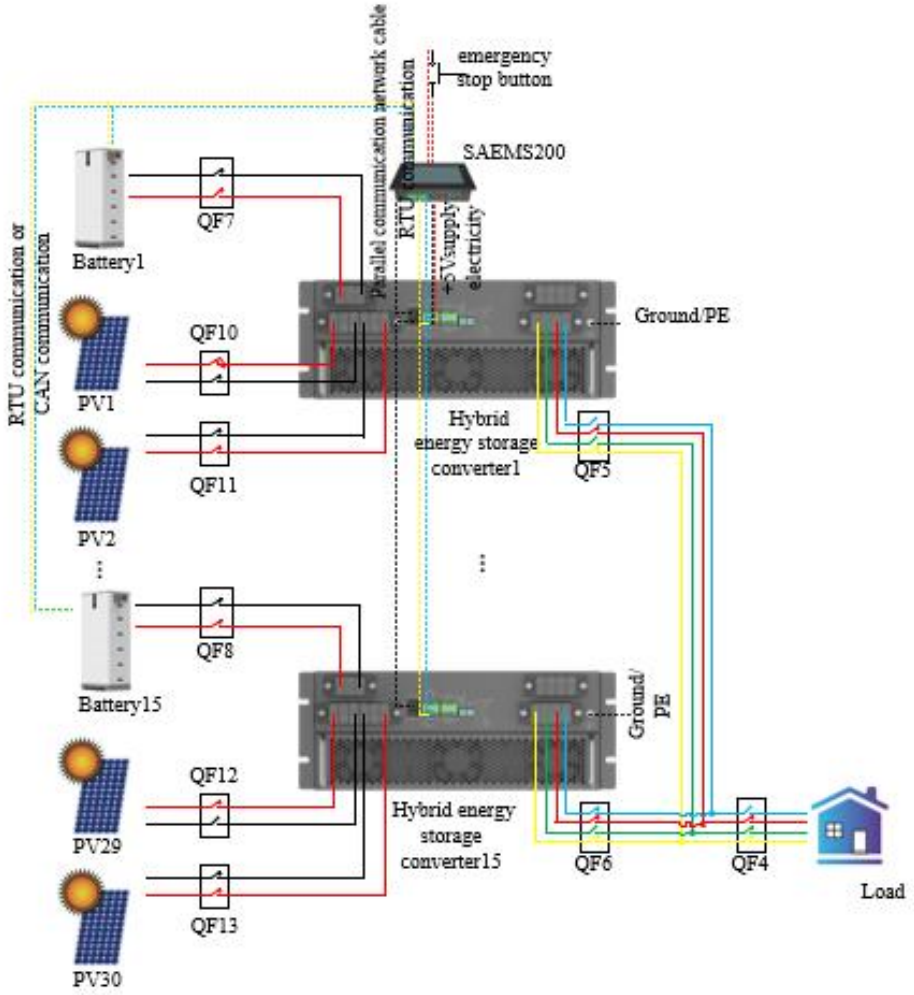


Figure 23 Schematic diagram of parallel connection of single battery packs and multiple machines

⚠ Warnings
● If the PV simulator or DC power supply is used to replace the solar PV panel for related tests, please close the isolation switches QF10, QF11, QF12 and QF13 before turning on the PV simulator or DC power supply for output;

- This wiring method only works in off-grid mode and cannot be operated in grid-connected mode;
- All converters need to be reliably grounded, otherwise it leads to personal safety and converter damage.

5.5.5 Schematic diagram of single battery pack with multiple parallel connections (switching between parallel and off-grid).

(1) Usage scenarios where the number of parallel connections is less than 3 units

The wiring diagram of this working mode is shown in Figure 24. This parallel connection method comes with the function of switching between parallel and off-grid, the number of parallel connections is up to 3, and all power cables connected to the converter need to be connected to an external isolation switch. the SAEMS100 coordinates and controls the whole system according to the parameters set by the user, so that the system can be operated in accordance with the different needs of different users.

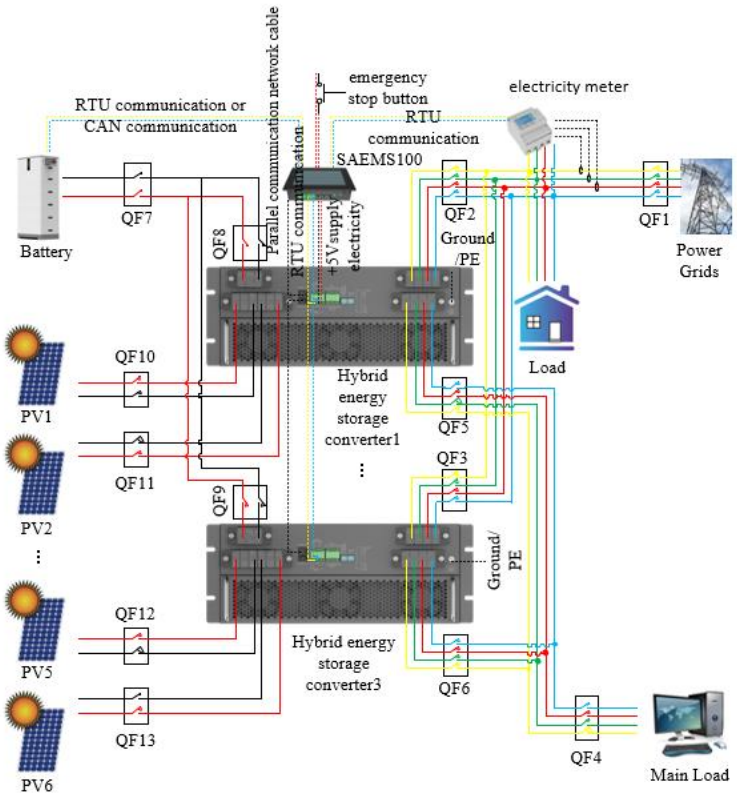


Figure 24 Schematic diagram of parallel connection of single battery packs and multiple machines

⚠ Warnings
● If the PV simulator or DC power supply is used to replace the solar PV panel for related tests, please close the isolation switches QF10, QF11, QF12 and QF13 before turning on the PV simulator or DC power supply for output; ● The energy meter is recommended to use Anchoray ADL400 model; ● The CT of the energy meter needs to be installed between the load and QF1, otherwise the desired effect cannot be achieved; ● If the energy meter is not installed, the converter can be enabled with internal anti-reverse current function, at this time, the load is supplied by the power grid, and the converter only supplies power to the important loads; ● All converters should be grounded reliably, otherwise it will lead to personal safety and converter damage.

(2) Usage scenarios with more than 3 units connected in parallel

The wiring diagram of this working mode is shown in Figure 25, the parallel mode requires external STS device to realize the switching function between parallel and off-grid, and the number of parallel connection is up to 15, and all the power cables connected to the converter need to be connected to an external isolation switch.SAEMS200 coordinates and controls the system according to the parameters set by the user, so that the system can be operated in accordance with the different needs of different users.

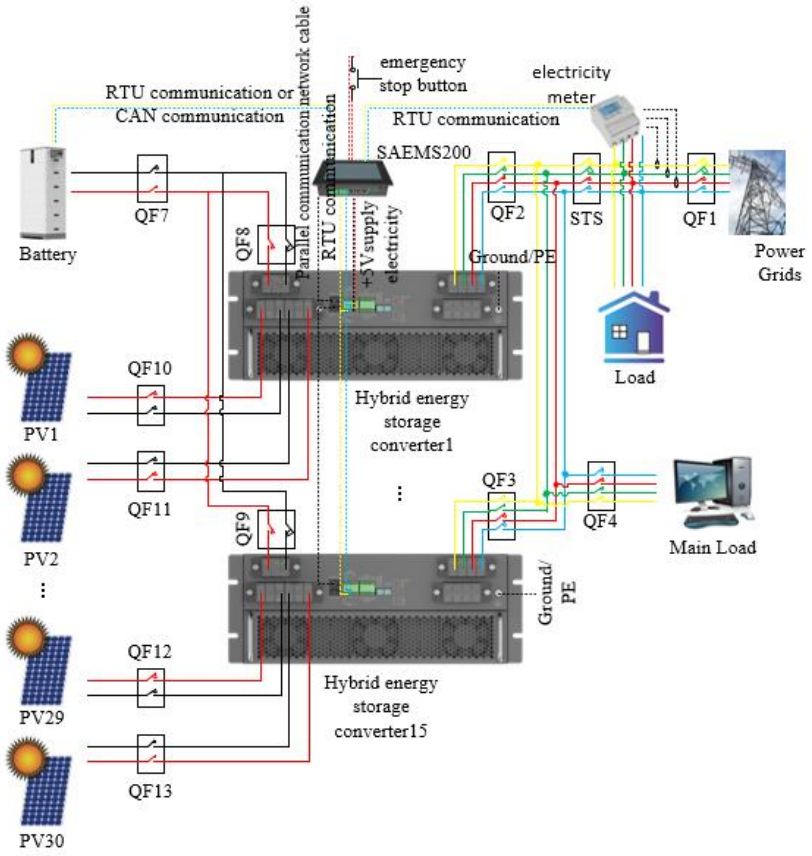


Figure 25 Schematic diagram of parallel connection of single battery packs and multiple machines

⚠ Warnings
● If the PV simulator or DC power supply is used to replace the solar PV panel for related tests, please close the isolation switches QF10, QF11, QF12 and QF13 before turning on the PV simulator or DC power supply for output; ● The energy meter is recommended to use Anchoray ADL400 model; ● CT needs to be installed between the load and QF1, otherwise the desired effect cannot be achieved; ● If the energy meter is not installed, the STS internal anti-reverse current function can be enabled, at this time, the load is supplied by the power grid, and the converter only supplies power to the important load; ● All converters and STS need to be reliably grounded, otherwise it will lead to personal safety and converter damage.

6 Power-on/off operation and fault diagnosis

6.1 Power-on and off operation

6.1.1 Steps for initial power-on and power-on after maintenance

(1) Off-grid with PV power-on

Step 1: Check whether the power cable and communication cable are connected correctly and securely, whether the module address is correct, whether the communication matching resistor is enabled correctly, and so on.If the power cable and communication cable are connected correctly and securely, and if the module address is correct, and if the communication matching resistor is enabled correctly, etc., please refer to the wiring diagram in subsection 5.5 for checking;

Step 2: Use the multimeter's buzzer gear to test the battery port between positive and negative, between positive and negative PV1 port, between positive and negative PV2 port, and between L1, L2, L3 and N of the load port whether short-circuited, if the multimeter's buzzer sounds and the multimeter shows that the impedance is less than 2 Ω, then the two ends of the test short-circuit occurs, and it is necessary to check the corresponding power cables to see whether there is damage to the insulation or the cable is connected to the wrong phenomenon. The power cables should be checked to see if there is any insulation damage or misconnection of the cables, on the contrary, there is no short-circuit situation;

Step 3: Use the beeper of the multimeter to test whether there is a short circuit between the positive and negative battery ports, the L1, L2, L3 and N of the load port, the positive and negative terminals of PV1 and PV2, and the PE (ground terminal), if the beeper of the multimeter sounds and the impedance shown on the multimeter is less than 2 Ω, then the tested port is short-circuited to the ground, and it is necessary to check whether there is damage of insulation layer or misconnection of cables in the corresponding power cables. It is necessary to check whether the corresponding power cable is damaged or connected incorrectly, on the contrary, there is no short-circuit situation;

Step 4: Test the battery voltage with a multimeter at DC voltage level, check whether the battery voltage is within the range of battery voltage required by the converter, if the battery voltage

is not within the range of battery voltage required by the converter, please replace the battery pack so that the battery voltage is within the range of battery voltage required by the converter;

Step 5: Close the circuit breaker at the battery side of the converter and wait for 10 seconds, observe whether the fault indicator and battery status indicator at the front panel of the converter are always on, if the indicator is not on, then use a multimeter to check whether the voltage at the battery port of the converter is within the battery voltage range required by the converter, and if it is not within the battery voltage range required by the converter, check whether the relevant power cables are correctly connected and whether there is any reverse connection of the cables to the battery port, and whether the battery voltage is within the battery voltage range required by the converter. If there is no reverse connection of cables after checking and the voltage at the battery port of the converter is within the range of battery voltage required by the converter, then contact the relevant staff of the converter to handle the problem (if there is a parallel situation in the converter, the circuit breaker connected to the load port of the converter needs to be closed at this time, and the main circuit breaker connected to the important loads should be disconnected);

Step 6: Wait for the converter fault indicator to change from normally lit to normally extinguished and the status indicator to flash at a frequency of 1 second each time, then issue the converter inverter power-on command, and wait for 20 seconds for the converter status indicator to change from flashing at a frequency of 1 second each time to a normally lit state, and if the status indicator does not change to a normally lit state, then check whether the power-on command has been issued successfully, and whether the communication protocol is matched;

Step 7: Use the AC voltage test gear of the multimeter to test whether the RMS value of the voltage between L1, L2, L3 and N of the load port of the converter is 230 ± 2V. If the measured RMS value is greater or less than this value, please check whether the corresponding gear of the multimeter matches the AC voltage test requirements. If the measurement position of the multimeter is AC voltage test position and within the corresponding range, the measured RMS value is still greater or less than the value, please contact the relevant personnel of the converter for processing;

Step 8: Close the main circuit breaker of the important load side, check whether the important load can work normally, if the important load can work normally, then the converter completes the power-on, if the important load can not work normally, use the AC voltage test gear of the multimeter to check whether the AC voltage at the important load is normal, if there is an abnormality in the AC voltage at the important load, then check whether the voltage at the output port of the converter is normal, if the AC output voltage of the converter is normal, then the AC output voltage of the converter is normal, then contact the relevant personnel of the converter to deal with it. If the AC output voltage of the converter is normal, there is a problem with the cable connection between the converter and the important loads. If the AC output voltage of the converter is abnormal, please contact the relevant personnel of the converter in time for processing.

Step 9: Test the PV voltage with a multimeter at DC voltage level and check whether the PV voltage is within the PV voltage range required by the converter. If the PV voltage is greater than the PV voltage range required by the converter, reduce the number of series connection of the corresponding PV modules, so that the PV voltage is within the PV voltage range required by the converter; if the PV voltage is less than the PV voltage range required by the converter (when the lighting conditions are better), increase the number of the corresponding PV modules. If the PV voltage is less than the PV voltage range required by the converter (when the light conditions are better), then increase the number of series connections of the corresponding PV modules so that the PV voltage is within the PV voltage range required by the converter;

Step 10: Close the circuit breaker of the PV side of the converter and wait for 10 seconds, observe whether the PV status indicator on the front panel of the converter is blinking, if the PV status indicator is not blinking, use a multimeter to check the DC voltage level to measure whether the voltage of the PV port of the converter is in the range of PV voltage required by the converter, and if it is not in the range of the PV voltage required by the converter, then check whether the relevant power cable is connected correctly, and whether there is any reverse connection of the PV port cable. If the cable is not within the range of PV voltage required by the converter, check whether the relevant power cable is correctly connected and

whether there is any reverse connection of the PV port cable;

Step 11: Issue the converter PV power-on command, wait for 20 seconds, the converter PV status indicator is converted from blinking at a frequency of 1 second each time to a constant state, if the status indicator does not change to a constant state, check whether the power-on command has been issued successfully, and whether the communication protocol is matched (it can be configured to automatically turn on the power after the PV meets the power-on conditions).

(2) Grid-connected with PV power-on

Step 1 : Check whether the power cable and communication cable are connected correctly and securely, whether the module address is correct, whether the communication matching resistor is enabled correctly, and other items, which can be checked by referring to the wiring schematic in subsection 5.5;

Step 2: Use the buzzer of the multimeter to test whether there is a short circuit between the positive and negative of the battery port, between the positive and negative of the PV1 port, between the positive and negative of the PV2 port, between the L1, L2, L3 and N of the load port, and between the L1, L2, L3 and N of the grid port. If the buzzer of the multimeter sounds and the impedance shown on the multimeter is less than 2 Ω, then there is a short circuit in the two ends being tested, and a short circuit is required. Check whether the corresponding power cable is damaged in the insulation layer or the cable is connected wrongly, if there is no abnormality in the cable after checking, please contact the relevant personnel of the converter to deal with it, on the contrary, there is no short-circuit situation;

Step 3: Use the buzzer of the multimeter to test whether there is a short-circuit between the positive and negative battery ports, the L1, L2, L3 and N of the load ports, the positive and negative terminals of the PV1, the positive and negative terminals of the PV2, the L1, L2, L3 and N of the grid ports, and the PE (ground terminal). If the buzzer of the multimeter beeps and the impedance shown on the multimeter is less than 2 Ω, then the port being tested is short-circuited to the ground, and it is necessary to check whether there is short-circuiting of the corresponding power cable. If the buzzer of the multimeter sounds and the impedance on the multimeter is less than 2Ω, the tested port is short-circuited to ground, and it is necessary

to check whether the corresponding power cable is damaged in the insulation layer or the cable is connected incorrectly, and vice versa;

Step 4: Test the battery voltage with the DC voltage of the multimeter, check whether the battery voltage is within the range of the battery voltage required by the converter, if the battery voltage is not within the range of the battery voltage required by the converter, please replace the battery pack so that the battery voltage is within the range of the battery voltage required by the converter;

Step 5: Test the grid voltage using the AC voltage gear of multimeter, check whether the phase voltage of the grid is within the range of grid voltage required by the converter, if the phase voltage of the grid is not within the range of grid voltage required by the converter accordingly, check whether the phase sequence of the grid is correct, and whether the connection of the grid cables is normal, if the phase sequence of the grid is normal, and there is no abnormality in the connection of the cables, the converter will only work in the off-grid mode, and after the grid voltage returns to normal, the converter automatically connects with the grid, and then the converter will work in the off-grid mode. After the grid voltage returns to normal, the converter will be automatically connected to the grid;

Step 6: Close the circuit breaker at the battery side of the converter and wait for 10 seconds, observe whether the fault indicator and battery status indicator at the front panel of the converter are always on, if the indicator is not on, then use a multimeter with a DC measuring gear to check whether the voltage at the battery port of the converter is within the battery voltage range required by the converter, and if it is not within the battery voltage range required by the converter, check whether the relevant power cables are correctly connected and whether the battery port cables are reversed. If the power cables are connected correctly, check whether there is reverse connection of the battery port cables. If no reverse connection of the cables is found after checking and the voltage of the converter's battery port is within the range of the converter's required battery voltage, then contact the relevant converter staff to deal with the problem (if there is a case of parallel operation in the converter, the circuit breaker connected to the converter's load port needs to be closed at this time, and the main circuit breaker connected to the important loads should be disconnected);

Step 7: Close the circuit breaker on the grid side of the converter and wait for 10 seconds, observe whether the grid status indicator on the front panel of the converter is blinking, if the grid status indicator is not blinking, use a multimeter with AC detection gear to check whether the voltage at the grid port of the converter is within the range of the grid voltage required by the converter, and if it is not within the range of the grid voltage required by the converter, whether the relevant power cable is correctly connected and whether the grid port cable is connected in the wrong phase sequence. If the cable is not in the range of the required grid voltage of the converter, whether the relevant power cable is correctly connected and whether the phase sequence of the power grid port is connected wrongly, if no reverse connection of the cable is found after checking, then there is an abnormality in the power grid at this time;

Step 8: Wait for the converter fault indicator to change from always on to always off and the status indicator to flash at a frequency of 1 second each time, then issue the converter inverter power-on command, and wait for 20 seconds for the converter operation status indicator, battery status indicator and grid status indicator to change from flashing at a frequency of 1 second each time to a normally illuminated state, and check whether the power-on command has been issued successfully or not, and then check whether the converter power-on command has been issued successfully or not. If the operation status indicator and the battery status indicator do not change to the normal light state, check whether the power-on command is issued successfully and whether the communication protocol is matched; if the grid status indicator does not change from blinking to normal light state, please contact the relevant staff of the converter to deal with the problem;

Step 9: Use the AC voltage test gear of the multimeter to test whether the difference between the RMS value of the voltage between L1, L2, L3 and N of the load port of the converter and the RMS value of the phase voltage of the power grid is more than 2 V. If the difference of the measured RMS value is larger than this value, please check whether the corresponding gear of the multimeter matches the AC voltage test requirements. If the measured RMS value of the multimeter is in the AC voltage test position and within the corresponding range, and the difference between the measured RMS value and the grid phase voltage is still more than 2V, please contact the relevant personnel of the converter for processing;

Step 10: Close the main circuit breaker on the side of important loads and check whether the important loads can work normally, if the important loads can work normally, then the converter completes the power-on, if the important loads can not work normally, use the AC voltage test gear of the multimeter to check whether the AC voltage at the important loads is normal, if there is an abnormality in the AC voltage at the important loads, then there is a problem in the cable connection between the converter and the important loads. If the AC voltage at the important load is abnormal, the cable connection between the converter and the important load is faulty; if the AC voltage at the important load is normal, the important load is damaged;

Step 11: Test the PV voltage using a multimeter at DC voltage level and check whether the PV voltage is within the PV voltage range required by the converter. If the PV voltage is greater than the PV voltage range required by the converter, reduce the number of series connection of the corresponding PV modules, so that the PV voltage is within the PV voltage range required by the converter, and if the PV voltage is less than the PV voltage range (when the light conditions are better), then increase the number of the corresponding PV modules. If the PV voltage is less than the PV voltage range required by the converter (when the lighting conditions are better), then increase the number of series connections of the corresponding PV modules so that the PV voltage is within the PV voltage range required by the converter;

Step 12: Close the circuit breaker of the PV side of the converter and wait for 10 seconds, observe whether the PV status indicator on the front panel of the converter is blinking, if the PV status indicator is not blinking, use a multimeter to check whether the voltage of the PV port of the converter is in the range of PV voltage required by the converter, and if it is not in the range of the PV voltage required by the converter, then check whether the relevant power cable is correctly connected and whether there is reverse connection of the PV port cable. If the cable is not within the range of PV voltage required by the converter, check whether the relevant power cable is connected correctly and whether there is any reverse connection of the PV port cable;

Step 13 : Issue the converter PV power-on command, wait for 20 seconds, the converter PV status indicator is converted from blinking at a frequency of 1 second each time to a constant state,

if the status indicator does not change to a constant state, check whether the power-on command is issued successfully and whether the communication protocol is matched (it can be configured to automatically turn on the power after the PV meets the power-on conditions).

(3) Grid-connected without PV power-on

Step 1 : Check whether the power cable and communication cable are connected correctly and securely, whether the module address is correct, whether the communication matching resistor is enabled correctly, and other items, which can be checked by referring to the wiring schematic in subsection 5.5;

Step 2: Use the buzzer of the multimeter to test whether there is a short circuit between the positive and negative of the battery port, between the positive and negative of the PV1 port, between the positive and negative of the PV2 port, between the L1, L2, L3 and N of the load port, and between the L1, L2, L3 and N of the grid port. If the buzzer of the multimeter sounds and the impedance shown on the multimeter is less than 2 Ω, then there is a short circuit in the two ends being tested, and a short circuit is required. Check whether the corresponding power cable is damaged in the insulation layer or the cable is connected wrongly, if there is no abnormality in the cable after checking, please contact the relevant personnel of the converter to deal with it, on the contrary, there is no short-circuit situation;

Step 3: Use the buzzer of the multimeter to test whether there is a short-circuit between the positive and negative battery ports, the L1, L2, L3 and N of the load ports, the positive and negative terminals of the PV1, the positive and negative terminals of the PV2, the L1, L2, L3 and N of the grid ports, and the PE (ground terminal). If the buzzer of the multimeter beeps and the impedance shown on the multimeter is less than 2 Ω, then the port being tested is short-circuited to the ground, and it is necessary to check whether there is short-circuiting of the corresponding power cable. If the buzzer of the multimeter sounds and the impedance on the multimeter is less than 2Ω, the tested port is short-circuited to ground, and it is necessary to check whether the corresponding power cable is damaged in the insulation layer or the cable is connected incorrectly, and vice versa;

Step 4: Test the battery voltage with the DC voltage of the multimeter, check whether the battery

voltage is within the range of the battery voltage required by the converter, if the battery voltage is not within the range of the battery voltage required by the converter, please replace the battery pack so that the battery voltage is within the range of the battery voltage required by the converter;

Step 5: Test the grid voltage using the AC voltage gear of multimeter, check whether the phase voltage of the grid is within the range of grid voltage required by the converter, if the phase voltage of the grid is not within the range of grid voltage required by the converter accordingly, check whether the phase sequence of the grid is correct, and whether the connection of the grid cables is normal, if the phase sequence of the grid is normal, and there is no abnormality in the connection of the cables, the converter will only work in the off-grid mode, and after the grid voltage returns to normal, the converter automatically connects with the grid, and then the converter will work in the off-grid mode. After the grid voltage returns to normal, the converter will be automatically connected to the grid;

Step 6: Close the circuit breaker at the battery side of the converter and wait for 10 seconds, observe whether the fault indicator and battery status indicator at the front panel of the converter are always on, if the indicator is not on, then use a multimeter with a DC measuring gear to check whether the voltage at the battery port of the converter is within the battery voltage range required by the converter, and if it is not within the battery voltage range required by the converter, check whether the relevant power cables are correctly connected and whether the battery port cables are reversed. If the power cables are connected correctly, check whether there is reverse connection of the battery port cables. If no reverse connection of the cables is found after checking and the voltage of the converter's battery port is within the range of the converter's required battery voltage, then contact the relevant converter staff to deal with the problem (if there is a case of parallel operation in the converter, the circuit breaker connected to the converter's load port needs to be closed at this time, and the main circuit breaker connected to the important loads should be disconnected);

Step 7: Close the circuit breaker on the grid side of the converter and wait for 10 seconds, observe whether the grid status indicator on the front panel of the converter is blinking, if the grid status indicator is not blinking, use a multimeter with AC detection gear to check whether the

voltage at the grid port of the converter is within the range of the grid voltage required by the converter, and if it is not within the range of the grid voltage required by the converter, whether the relevant power cable is correctly connected and whether the grid port cable is connected in the wrong phase sequence. If the cable is not in the range of the required grid voltage of the converter, whether the relevant power cable is correctly connected and whether the phase sequence of the power grid port is connected wrongly, if no reverse connection of the cable is found after checking, then there is an abnormality in the power grid at this time;

Step 8: Wait for the converter fault indicator to change from normally lit to normally extinguished and the status indicator to flash at a frequency of 1 second each time, then issue the converter inverter power-on command, and wait for 20 seconds for the converter operation status indicator, battery status indicator and grid status indicator to change from flashing to normally lit at a frequency of 1 second each time, and check whether the power-on command has been issued successfully and whether the communication protocol matches. If the operation status indicator and the battery status indicator do not change to the normal light state, check whether the power-on command is issued successfully and whether the communication protocol is matched; if the grid status indicator does not change from blinking to normal light state, please contact the relevant staff of the converter for processing;

Step 9: Use the AC voltage test gear of the multimeter to test whether the difference between the RMS value of the voltage between L1, L2, L3 and N of the load port of the converter and the RMS value of the phase voltage of the power grid is more than 2 V. If the difference of the measured RMS value is larger than this value, please check whether the corresponding gear of the multimeter matches the AC voltage test requirements. If the measured RMS value of the multimeter is in the AC voltage test position and within the corresponding range, and the difference between the measured RMS value and the grid phase voltage is still more than 2V, please contact the relevant personnel of the converter for processing;

Step 10: Close the main circuit breaker on the side of important loads and check whether the important loads can work normally, if the important loads can work normally, then the converter completes the power-on, if the important loads can not work normally, use the AC voltage test gear of the multimeter to check whether the AC voltage at the important loads is

normal, if there is an abnormality in the AC voltage at the important loads, then there is a problem in the cable connection between the converter and the important loads. If the AC voltage at the important load is normal, the important load is damaged.

6.1.2 Steps for power down before maintenance

(1) Grid-connected with photovoltaic light machine

Step 1: Issue a shutdown command and observe whether the operation status indicator, grid status indicator, battery status indicator, PV1 status indicator and PV2 status indicator on the front panel of the converter are in the state of blinking with 1 second each time or in the state of constant extinction; if there is a constant lighting situation of operation status indicator, grid status indicator, battery status indicator and PV2 status indicator, check whether there is any problem in communication protocol with the converter and then shut down the power supply. If the operation status indicator, grid status indicator, battery status indicator and photovoltaic status indicator are always on, check whether the communication protocol with the converter is faulty and whether the shutdown command has been issued successfully;

Step 2: Ensure that the important loads are in a power-off state or the external maintenance bypass switch is closed, otherwise the maintenance of the converter will lead to power-off of the important loads, which will lead to unnecessary losses;

Step 3: Disconnect the grid port circuit breaker, load port circuit breaker, battery port circuit breaker, PV1 port circuit breaker and PV2 port circuit breaker of the converter, and hang a sign at the circuit breaker with the words “under maintenance, no power on”, at this time, the converter fault indicator light is always on, and the grid status indicator, the PV status indicator and the battery status indicator are always off. At this time, the converter fault indicator is always on, and the grid status indicator, PV status indicator and battery status indicator are always off;

Step 4: Measure whether the voltage between PV1 port, PV2 port, battery port, grid port and load port and PE is reduced to below 60V by using the DC voltage test gear and AC voltage test gear of the multimeter respectively, and if it is above 60V, it is necessary to continue to wait until the port voltage is reduced to below 60V before continuing the operation;

Step 5 : Measure whether the voltage between the positive and negative of the PV1 port, the

positive and negative of the PV2 port, the positive and negative of the battery port, the voltage between the grid ports L1, L2, and L3, the voltage between the grid ports L1, L2, L3, and N, the voltage between the load ports L1, L2, and L3, and the voltage between the load ports L1, L2, L3, and N, respectively, with the multimeter in the DC voltage test mode and AC voltage test mode, has dropped below 60V. 60V or less, if it is above 60V, you need to continue to wait until the port voltage drops below 60V before continuing the operation;

Step 6 : Wait for 15 minutes for the inverter to finish discharging;

Step 7: Use a cell phone to take pictures to record the correspondence of the cable connection, to prevent the wrong cable connection after the maintenance is completed;

Step 8 : Remove the power cables and communication cables connected to the converter, and insulate the cables with insulating tape;

Step 9: Two or more people are required to take out the converter for maintenance and overhaul, and it is strictly prohibited for a single person to carry out maintenance and overhaul of the converter.

(2) Grid-connected without PV shutdown

Step 1: Issue the shutdown command, observe whether the operation status indicator, grid status indicator and battery status indicator on the front panel of the converter are in the state of flashing or always off for 1 second each time, if the operation status indicator, grid status indicator and battery status indicator are always on, check whether there is any problem with the communication protocol of the converter and whether the shutdown command is issued successfully, if there is no problem, please contact the relevant personnel of the converter for processing. If there is no problem, please contact the relevant personnel of the converter for processing;

Step 2 : Ensure that the important loads are in a power-off state or the external maintenance bypass switch is closed, otherwise the maintenance of the converter will lead to the power-off of the important loads, which will lead to unnecessary losses;

Step 3: Disconnect the grid port circuit breaker, load port circuit breaker and battery port circuit breaker of the converter, and hang a sign of “maintenance, no power on” at the circuit breaker, at this time, the converter fault indicator light is always on, the grid status indicator

light, and the battery status indicator light is always off;

Step 4: Measure whether the voltage between the battery port, the grid port and the load port and PE is reduced to below 60V by using the DC voltage test gear and AC voltage test gear of the multimeter respectively, and if it is above 60V, it is necessary to wait until the voltage of all the ports is reduced to below 60V before continuing the operation;

Step 5 : Measure whether the voltages between positive and negative of the battery port, between L1, L2 and L3 of the grid port, between L1, L2, L3 and N of the grid port, between L1, L2 and L3 of the load port, and between L1, L2, L3 and N of the load port have dropped below 60V by using a multimeter in the DC voltage test mode and the AC voltage test mode, respectively, and continue to wait until all the port voltages have dropped below 60V, and continue to operate only after all the ports have dropped below 60V. If it is above 60V, you need to continue to wait until the port voltage drops below 60V before you can continue the operation;

Step 6 : Wait for 15 minutes for the internal discharge of the converter to be completed;

Step 7: Use your cell phone to take a picture of the cable connections to prevent misconnecting the cables after maintenance;

Step 8 : Remove the power cables and communication cables connected to the converter, and use insulating tape to insulate and protect the cables;

Step 9 ： Two or more people are required to take out the converter for maintenance and overhaul, and it is strictly prohibited for a single person to carry out maintenance and overhaul of the converter.

(3) Off-grid with PV shutdown

Step 1: Ensure that the important loads are in a power-off state, otherwise the maintenance of the converter will lead to power-off of the important loads, which will lead to unnecessary losses;

Step 2: Issue the shutdown command, observe whether the operation status indicator and battery status indicator on the front panel of the converter are in the state of blinking with 1 second each time or in the state of constant extinction, if the operation status indicator and the battery status indicator are always on, check whether there is any problem with the communication protocol with the converter and whether the shutdown command is issued

successfully, if there is no problem, contact the relevant personnel of the converter to deal with the problem;

Step 3: Disconnect the load port circuit breaker and battery port circuit breaker of the converter, and hang a sign of “under maintenance, no power on” at the circuit breaker, at this time, the converter fault indicator light is always on, and the battery status indicator light is always off;

Step 4: Measure whether the voltage between the battery port and load port and PE is reduced to below 60V by using the DC voltage test gear and AC voltage test gear of the multimeter respectively, and if it is above 60V, continue to wait until the voltage between all the ports and PE is reduced to below 60V before continuing the operation;

Step 5 : Measure whether the voltage between the positive and negative of the battery port, between the load ports L1, L2 and L3, and between the load ports L1, L2, L3 and N is reduced to less than 60V using a multimeter with a DC voltage test gear and an AC voltage test gear respectively, and if it is in the position of more than 60V, it is necessary to continue to wait until the voltage between all the ports is reduced to less than 60V before continuing the operation;

Step 6 : Wait for 15 minutes for the internal discharge of the converter to be completed;

Step 7 : Use your cell phone to take a picture to record the correspondence of the cable connection to prevent the wrong cable from being connected after the maintenance is completed;

Step 8 : Remove the power cables and communication cables connected to the converter, and use insulating tape to insulate and protect the cables;

Step 9: Two or more people are required to take out the converter for maintenance and overhaul, and it is strictly prohibited for a single person to carry out maintenance and overhaul of the converter.

6.1.3 Customer EMS control operation and switching on/off

The converter is controlled by the EMS through the parameters such as switch-on/switch-off command, charging power, discharging power, maximum permissible charging current of the battery and maximum permissible discharging current of the battery, etc. For details, please check the related communication protocol.

6.1.4 Self-contained SAEMS100/SAEMS200 control operation and switch-on/off.

You can control the converter through the physical button of the on/off switch, and set the relevant parameters through the screen to control the converter, users can set the relevant parameters according to their own needs to achieve the user's charging and discharging needs in different time periods, for details of the settings, you can check the user manual of the SAEMS series products.

6.2 Troubleshooting and Solution

6.2.1 Module Alarms or Faults and Solutions

Alarm or fault name	Fault Codes	Shutdown	Fault recovery method	Troubleshooting measures
Soft start failed	1	Shutdown	Self-recovery	1. Power off the module, wait for 1 to 2 minutes, and then restart the module; 2. After the above operations, if the fault still exists, please contact Sino Soar Hybrid Customer Service.
Duplicate address/Invalid address	3	Shutdown	Detection before power on, recovery after power off	1. Power off the module and reselect the module address that is inconsistent with the system address. The address range is #1~#10; 2. The address range is #1~#10. The left side of the DIP switch is the high address and the right side is the low address. It is valid to switch to the "NO" position and calculate in binary format. 3. After the address is reset, power off and restart are required to take effect.
ECAP failure	4	Shutdown	Self-recovery	Check whether the network cable between the parallel machines is not connected properly, and reconnect the parallel network cable; Replace the parallel network cable.

AC relay short circuit	5	Shutdown	Power off recovery	1. Power off the module and check whether the intermediate relay of the inverter is damaged.
CPLD wave-by-wave current limiting fault	6	Shutdown	Self-recovery	1. The machine has overcurrent, check the load or wiring conditions.
Inv output line short circuit	8	Shutdown	Self-recovery	1. Power off the module and check whether there is a short circuit between the phases and lines.
Overload protection shutdown	9	Shutdown	Self-recovery	1. The machine is in overload state for a long time. Please check the load.

6.2.2 Battery failure and solutions

Alarm or fault name	Fault Codes	Shutdown	Fault recovery method	Troubleshooting measures
Bus unbalance	17	Shutdown	Self-recovery	1. Power off the module, wait 1~2 minutes, and then restart the module; 2. Contact customer service to resolve the issue.
Bus overvoltage	18	Shutdown	Self-recovery	1. Check whether the P and N terminals of the busbar are over-voltage. Turn off the power and wait for 1 minute before turning it on again.
Bus undervoltage	19	Shutdown	Self-recovery	1. Check whether the P and N of the busbar are undervoltage and whether the input voltage is too low; 2. Contact customer service to resolve the issue.
Bus sampling error	20	Shutdown	Self-recovery	1. The bus voltage is not equal to P+N, and there is an error in sampling.
DC soft start failed	twenty one	Shutdown	Self-recovery	1. Wait for the bus voltage to rise before restarting
Reverse battery connection	twenty two	Shutdown	Self-recovery	1. Check whether the positive and negative poles of the battery are connected in reverse.
Battery overvoltage	twenty three	Shutdown	Self-recovery	1. Check whether the battery input is overvoltage. Turn off the power and wait for 1 minute before turning it on again.

Battery undervoltage	twenty four	Shutdown	Self-recovery	1. Check if the battery input is undervoltage.
Discharge overcurrent	25	Shutdown	Self-recovery	1. Check whether there is overcurrent during discharge.
Charging overcurrent	26	Shutdown	Self-recovery	1. Check whether there is overcurrent during charging.
DC contactor failure	32	Shutdown	Self-recovery	1.PTC abnormality or DC contactor abnormality.

6.2.3 Power grid failures and solutions

Alarm or fault name	Fault Codes	Shutdown	Fault recovery method	Troubleshooting measures
Low grid frequency	33	Shutdown	Self-recovery	1. Check whether the low-frequency protection point of the power grid is set too high; 2. Check whether the low-frequency protection time of the power grid is too short; 3. Check whether the actual frequency of the power grid is too low.
High grid frequency	34	Shutdown	Self-recovery	1. Check whether the high-frequency protection point of the power grid is set too low; 2. Check whether the high-frequency protection point time of the power grid is too short; 3. Check whether the actual frequency of the power grid is too high.
Low grid voltage	35	Shutdown	Self-recovery	1. Check whether the grid undervoltage protection point is set too high; 2. Check whether the grid undervoltage protection time is too short; 3. Check whether the actual grid voltage is too low.
High grid voltage	36	Shutdown	Self-recovery	1. Check whether the grid overvoltage protection point is set too low; 2. Check whether the grid overvoltage protection time is too

				short; 3. Check whether the actual grid voltage is too high.
Reverse phase sequence	37	Shutdown	Self-recovery	1. Check whether the phase sequence is reversed.
Island failure	40	Shutdown	Self-recovery	
Abnormal output current	41	Shutdown	Self-recovery	1. Check whether the current output is overcurrent; 2. Check if the AC output is short-circuited.
Inverter overcurrent abnormality	43	Do not shut down	Alarm, self-recovery	The machine inductor current does not match the output current.
Abnormal leakage current	47	Do not shut down	Alarm, self-recovery	1. Check whether the leakage current protection point is set too low; 2. Check whether the leakage current protection time is too short; 3. Check whether there is any insulation problem in the power circuit (power off to check).

6.2.4 Module system failures and solutions

Alarm or fault name	Fault Codes	Shutdown	Fault recovery method	Troubleshooting measures
Fan failure	50	Do not shut down	Alarm, self-recovery	1. Check whether the fan is damaged.
Mode Error	52	Shutdown	Self-recovery	1. Phase lock failed in VF mode.
Auxiliary source abnormality	53	Shutdown	Self-recovery	1. Check whether the auxiliary power supply voltage is too low.
SysFault	54	Shutdown	Self-recovery	1. Other faults are reported, causing shutdown. To eliminate this fault, other faults must be eliminated first.
Arm Failure	55	Shutdown	Self-recovery	1. Check whether the address dial is wrong, or the communication is interrupted, or there is an emergency stop failure, etc.
Over temperature fault	57	Shutdown	Self-recovery	1. Check whether the machine environment is too high and strengthen ventilation.
Abnormal IGBT	58	Shutdown	Self-recovery	1. Check whether the

temperature				temperature difference between the three IGBTs is too large.
Flash initialization error	59	Shutdown	Self-recovery	1. EEPROM chip initialization failed
Internal communication failure	61	Shutdown	Self-recovery	1. Check whether the connection between DSP and ARM is unstable or disconnected. 2. Is there no program on DSP or ARM?
CPLD abnormality	64	Shutdown	Self-recovery	1. The CPLD hardware version number is abnormal.

7 The method to check the software and hardware version numbers.

7.1 Homepage interface.

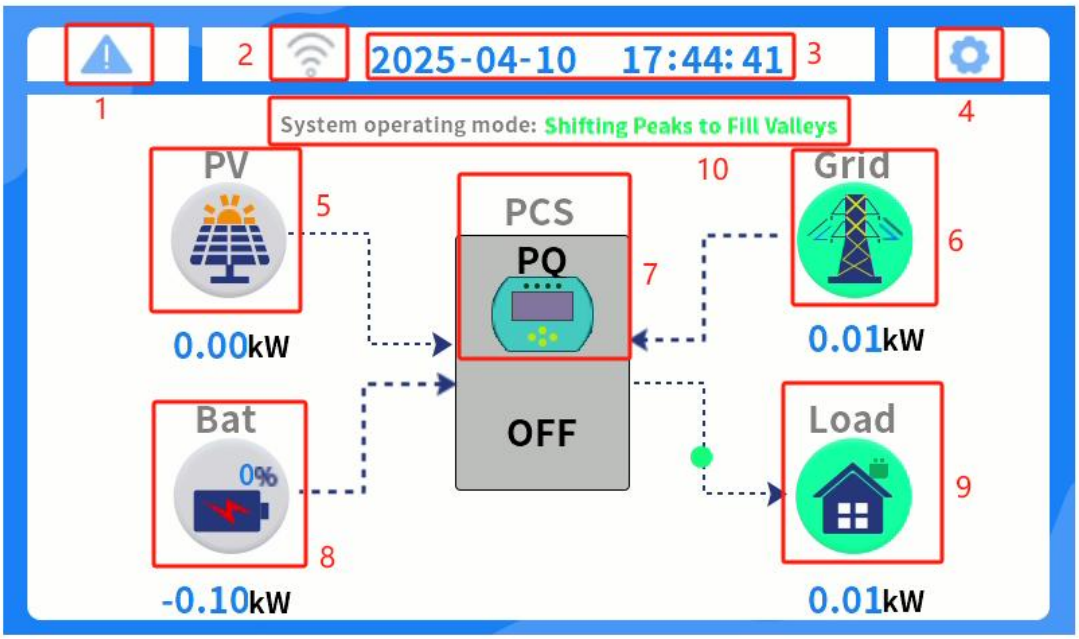


Figure 26 Homepage interface.

(1) When the fault/warning icon is gray, there is no warning or fault. When the fault/warning icon is yellow, there is a warning. When the fault/warning icon is red, there is a fault.

(2) The Wi-Fi icon shows whether the communication stick is online. When the communication stick is online, the Wi-Fi icon is blue; when the communication stick is offline, the Wi-Fi icon is gray.

(3) Time display.

(4) Settings button, click this button to enter the settings interface.

(5) Photovoltaic section: includes photovoltaic power, photovoltaic icon, and energy flow. Click the photovoltaic icon to enter the detailed information interface of the photovoltaic system.

(6) Grid section: includes grid power (positive value indicates inverter power consumption, negative value indicates inverter discharge), energy flow, and grid icon. Click the grid icon to enter the detailed information interface of the grid.

(7) Inverter section: When powered on (inverter icon is green), when powered off (inverter icon is

gray). Click the inverter icon to enter the detailed information interface of the inverter.

(8) Battery section: includes battery power (positive value for discharge, negative value for charging), energy flow, battery SOC, and battery icon. Click the battery icon to enter the detailed information interface of the battery.

(9) Load section: includes load power, energy flow, and load icon. Click the load icon to enter the detailed information interface of the load.

(10) Operating mode section: displays the current operating mode of the EMS in real time.

7.2 System Settings Interface.

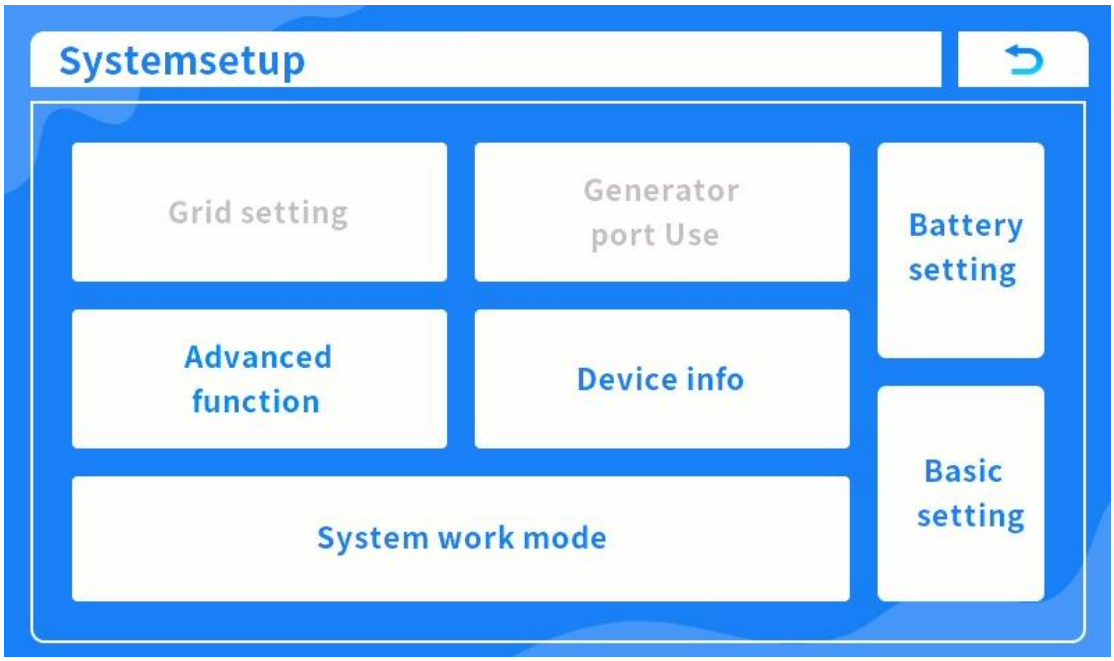


Figure 27 System Settings Interface.

Grid setting（Not available yet）

Generator port Use（Not available yet）

7.3 System Settings Interface.

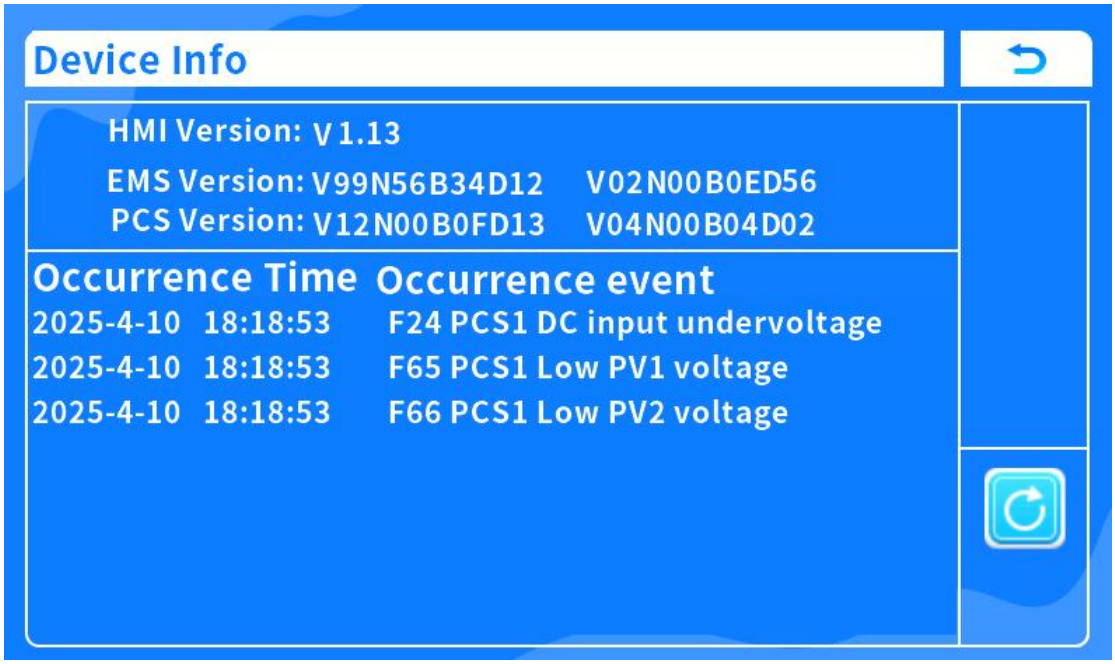


Figure 28 System Settings Interface.

The device information interface includes information such as the display version number, EMS software version number, inverter software version number, event occurrence time (based on system time), and the events that occurred.

7.4 Query Process

There are two methods to query the software and hardware version numbers (operation steps are as follows):

(1) Enter the Device Information Interface from the homepage (via the alarm icon):

Step 1: On the homepage, locate and click the alarm icon (usually located at position "1" on the homepage).

Step 2: After clicking, the system will automatically redirect to the Device Information Interface, displaying the status and information of the relevant devices.

(2) Enter the Device Information Interface from the System Settings Interface:

Step 1: On the homepage, locate and click the settings icon (usually located at position "4" on the homepage).

Step 2: After clicking the settings icon, enter the System Settings Interface.

Step 3: In the System Settings Interface, find and click the Device Information option, and the system will redirect to the Device Information Interface, displaying the detailed information of the relevant devices.

8 DRM Control Function Implementation Instructions

8.1 DRM Function Activation Protocol

Send a standard Modbus RTU command frame to the energy storage inverter (PCS) via the RS-485 communication interface:

01 06 01 48 00 01 C9 E0

After successful execution, the system will activate the Dynamic Response Management (DRM) function module, enabling grid dynamic characteristic adjustment capability

8.2 Parameter Persistence Storage Operation

Execute the device parameter persistence storage command by sending a standard Modbus RTU command frame to the energy storage inverter (PCS) via the RS-485 communication interface:

01 06 02 93 00 01 B9 9F

This operation will permanently write the current operating parameters into the FLASH memory, ensuring that the configuration parameters remain valid after the device is powered off and restarted.

9 Active Anti-Islanding Method

9.1 Enabling Island Protection Function

Send the standard Modbus RTU instruction frame through the RS-485 communication interface to the energy storage inverter (PCS):

01 06 03 16 00 01 A9 8A

After enabling this function, the island protection function can be activated.

9.2 Parameter Persistence Storage Operatio

Execute the device parameter persistence storage command by sending the standard Modbus RTU instruction frame through the RS-485 communication interface to the energy storage inverter (PCS):

01 06 02 93 00 01 B9 9F

This operation writes the current operating parameters permanently into the FLASH memory, ensuring that the configuration parameters remain valid after the device is powered off and restarted.