SP30-SP60HCG2、SP30-SP60HCPS

Energy Storage Converter
User Manual

Version: V1.0

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Table of Contents

1 Manual

This document provides comprehensive guidance on hybrid converters, covering product specifications, installation wiring, configuration and debugging, fault diagnosis, and maintenance procedures. Before installation or operation, please thoroughly review this manual to understand safety protocols and product features. The document may be updated periodically. For the latest version and additional product information, please visit the official website.

1.1 Applicable products

This document applies to the following hybrid converters:

SP60HCG2、SP50HCG2、SP40HCG2、SP30HCG2、SP60HCPS、SP50HCPS、SP40HCPS、SP30HCPS

1.2 Applicable personnel

Only for professionals who are familiar with local regulations and standards, electrical systems, and have received professional training and know the relevant knowledge of the product.

1.3 symbol definition

To make the most of this manual, the following symbols are used to highlight important information. Read the symbols and descriptions carefully.

⚠ danger
● Indicates a high potential hazard that could result in death or serious injury if not avoided.
⚠ warn
● Indicates a moderate potential hazard, a situation that may result in death or serious injury if not avoided.
⚠ take care
● Indicates a low potential hazard that may result in moderate or minor injury if not avoided.
pay attention to
● Emphasis and supplementation of content may also provide tips or tricks for optimizing the use of the product, which can help you solve a problem or save your time.

2 Security

The safety precautions in this document must always be followed when operating the converter.

pay attention to
● The converters involved in this document have been designed in strict accordance with safety regulations and have passed tests, but as electrical equipment, the relevant safety instructions must be followed before any operation on the converters. Improper operation may cause serious injury or property damage.

2.1 General Description

pay attention to
● Due to converter version upgrades or other reasons, the document content may be updated periodically. Unless otherwise specified, the document content cannot replace the safety precautions in the product label. All descriptions in the document are for guidance only. ● Read this document carefully before installing the converter to understand the converter and precautions. ● All converter operations must be performed by professional and qualified electrical technicians who are familiar with the relevant standards and safety specifications of the project site. ● The manufacturer is not responsible for converter damage or personnel injury caused by failure to install, use, or configure the converter in accordance with this document or the corresponding user manual.

2.2 String safety for PV

⚠ warn
● Ensure the component frame and bracket system are properly grounded. ● After completing the photovoltaic input cable connection, ensure the cable is securely fastened and not loose. ● Use a multimeter to measure the positive and negative terminals of the PV input cable to ensure that the PV input cable is connected correctly and the voltage is within the allowable range. ● Do not connect the same PV string to multiple hybrid converters, as this may cause damage to the hybrid converters.

2.3 Hybrid converter safety

warn
● Ensure that the voltage and frequency of the grid access point meet the converter grid connection specifications. ● It is recommended to add protective devices such as circuit breakers or fuses to the AC side of the hybrid converter. The specification of the protective devices should be greater than 1.5 times the rated current of the AC output of the hybrid converter. ● The protective ground wire of the hybrid converter must be firmly connected to ensure that the impedance between the neutral wire and the ground wire is less than 10Ω. ● For AC output lines, copper-core cables are recommended. If aluminum wire is required, use a copper-aluminum transition terminal to connect to the converter. ● The converter can automatically restart when the hybrid converter is triggered by overload protection.

danger
● When installing the converter, avoid placing weight on the converter connector, as this may cause connector damage. ● After the converter is installed, the labels and warning signs on the converter must be clearly visible. It is forbidden to cover, alter or damage them. ● The converter is labeled as follows:

	High voltage hazard. The converter operates at high voltage. Ensure the converter is powered off before operating it.		Delayed discharge. After the converter is powered off, wait 15 minutes for the converter to fully discharge.
	Read the converter manual carefully before operating it.		The converter is potentially dangerous when running. Take precautions when operating.
	The surface of the converter is hot. Do not touch the converter during operation, otherwise it may cause burns.		Protect the grounding wire connection point.

CE	CE sign		Do not treat the converter as household garbage. Dispose of the converter according to local laws and regulations, or send it back to the converter manufacturer.

2.4 Battery Safety

warn
● Before installing the battery pack, carefully read the user manual to understand the product and precautions. Follow the instructions in the user manual strictly. ● If the battery pack is completely discharged, charge it strictly according to the user manual. ● The output capacity of the battery pack will be affected by some environmental factors, such as temperature, humidity, weather conditions, etc., which may limit the output capacity of the battery pack, thus limiting the load capacity of the converter. ● If the battery pack fails to start, contact customer service immediately. Otherwise, the battery pack may be permanently damaged. ● Use a multimeter to measure the positive and negative terminals of the battery pack output cable to ensure that the positive and negative terminals of the battery pack output cable are correctly connected to the positive and negative terminals of the converter's battery input interface. The battery pack output voltage is within the allowable range of the converter's battery input voltage.

2.5 Personnel Requirements

pay attention to
● The staff responsible for the installation or maintenance of the hybrid converter must be strictly trained to understand the various safety precautions and master the correct operation of the hybrid converter. ● Only qualified professionals or trained personnel are allowed to install, operate, maintain and repair the hybrid converter.

2.6 handling safety

When operating the converter, the operator should use insulating tools and wear safety protective equipment to ensure the personal safety of the operator.

3 product presentation

3.1 product features

3.1.1 product orientation

This high-efficiency, high-reliability energy storage inverter is specifically designed for small and medium-sized energy storage microgrids. It features photovoltaic integration capabilities, off-grid switching functionality, and support for multi-unit parallel operation. The system also enables hybrid operation with diesel generators and supports rapid on-grid/off-grid switching. Ideal for backup power supply, load leveling, peak shaving, small island microgrids, and battery cascade utilization, it meets diverse user requirements across multiple applications.

3.1.2 product superiority

(1) Efficient and highly reliable:

- Low power consumption: standby power consumption is low ≤ 15W, no-load running loss is less than 160W;
- High efficiency: the highest conversion efficiency is 97.8%;
- High protection: The core control part has IP5X protection grade, which can work stably in harsh environments, such as sand, dust, high salt fog, etc.;
- Airway isolation design: the isolation airway design improves the safety and reliability of the product;
- High overload capacity: with 150% instantaneous overload capacity, the system is more adaptable and durable;
- Seamless switching function: supports seamless switching on and off the grid to ensure continuous and stable power supply.

(2) function ：

- Oil engine hybrid mode: supports oil engine hybrid operation, provides flexible energy combination mode, improves energy utilization efficiency;
- Three-phase independent grid-connected control technology: realizes three-phase

independent control, optimizes power distribution, improves the flexibility and efficiency of the system;

- Seamless switching: seamless switching between grid and off-grid (less than 10ms);
- Grid adaptability: perfect high and low voltage traversal function, island protection, black start function;
- Parallel operation: The AC side supports 15 units in parallel grid-connected or off-grid operation;
- Flexible application scenarios: suitable for small industrial and commercial enterprises, small island microgrids, farms, villas and other scenarios to meet the specific needs of different users.

(3) Convenience:

- Communication and monitoring: Supports multiple communication protocols, including mainstream BMS protocols, enabling remote monitoring and management.
- High maintainability: front wiring and maintenance;
- Fault protection: complete fault protection and fault recording function;
- Wide voltage range: Compatible with various battery configurations, adaptable to diverse energy demands. Enhanced battery compatibility and superior cost-effectiveness, operating down to 200V, such as 30kW/20-70kWh (100AH) and 30kW/60-215kWh (280AH).

3.1.3 Specifications

(1) Product Parameters

parameter	SP60HCG2	SP50HCG2	SP40HCG2	SP30HCG2
Battery Settings				
Maximum battery voltage	850V			
Minimum battery voltage	200V			
Supported battery types	Lithium iron phosphate battery, ternary battery, lead acid battery, etc			
Rated battery voltage range	420V-850V	350V-850V	270V-850V	210V-850V
Maximum battery current	150A			
PV parameter				
maximum power	38.4kW+38.4kW			
Maximum PV voltage	850V			
PV starting voltage	250V			
MPPT voltage range	200V-800V			
Maximum PV current	64A+64A			
Exchange side (grid-connected)				
power rating	60kVA	50kVA	40kVA	30kVA
rated current	87A	72.5A	58A	43.5A
Maximum bypass current	174A	145A	116A	87A
Rated grid voltage	400V/230V			
Grid voltage range	-20%~15%			
Grid frequency range	50Hz/47Hz~52Hz(60Hz/57Hz~62Hz)			
current harmonics	<3% (over 50% load)			
power factor	-1~1			
Exchange side (off-grid)				
output rating	60kVA	50kVA	40kVA	30kVA
maximumoutput	66kVA	55kVA	44kVA	33kVA
rated output current	87A	72.5A	58A	43.5A
maximum output current	95.7A	79.8A	63.8A	47.9A
rated voltage	400V/230V			

Output voltage harmonics	<3% (resistive load)
degree of unbalancedness	100%
frequency range	50/60Hz
Output overload (current) Ie: Rated output current	Ie*1.1<Iload≤Ie*1.25 100s Ie*1.25<Iload 300ms Ie*1.25<Iload 300ms
system parameter	
Communications port	EMS：RS485 Battery: CAN or RS485
DIDO	DI: 2 channels; DO: 2 channels
maximal efficiency	97.8%
way to install	Insert Frame
loss	Standby <15W, no-load power <160W
weight	≤50kg
size	W*L*H：440*670*200mm
protect	IP20
temperature range	-30 to 60℃（45℃ derated)
Humidity range	5-95%
cooling-down method	Smart forced air cooling
height	4000m (2000m above rated capacity)
attestation	CE，IEC62019，IEC62477，IEC6100，EN50549

parameter	SP60HCPS	SP50HCPS	SP40HCPS	SP30HCPS
Battery Settings				
Maximum battery voltage	850V			
Minimum battery voltage	200V			
Supported battery types	Lithium iron phosphate battery, ternary battery, lead acid battery, etc			
Rated battery voltage range	420V-850V	350V-850V	270V-850V	210V-850V
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system parameter				
Communications port	EMS：RS485			

	Battery: CAN or RS485
DIDO	DI: 2 channels; DO: 2 channels
maximal efficiency	97.8%
way to install	Insert Frame
loss	Standby <15W, no-load power <160W
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size	W*L*H：440*670*200mm
protect	IP20
temperature range	-30 to 60℃ (45℃ derated)
Humidity range	5-95%
cooling-down method	Smart forced air cooling
height	4000m (2000m above rated capacity)
attestation	CE，IEC62019，IEC62477，IEC6100，EN50549

3.1.4 Product Work Characteristics Curve

(1) Battery voltage drop curve

The curve of side charge-discharge power versus battery voltage for SP60HCG2/PS batteries:

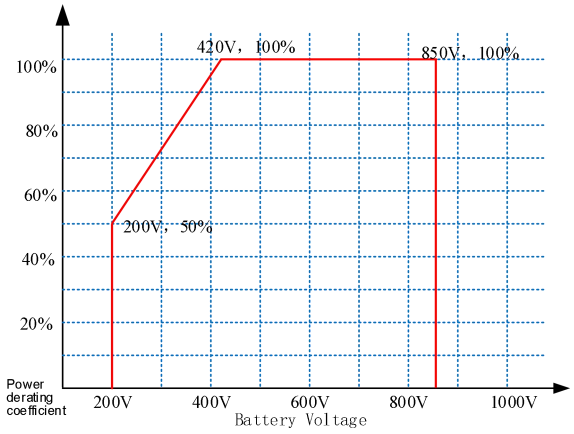


Figure 1

The curve of side charge-discharge power versus battery voltage for SP50HCG2/PS batteries:

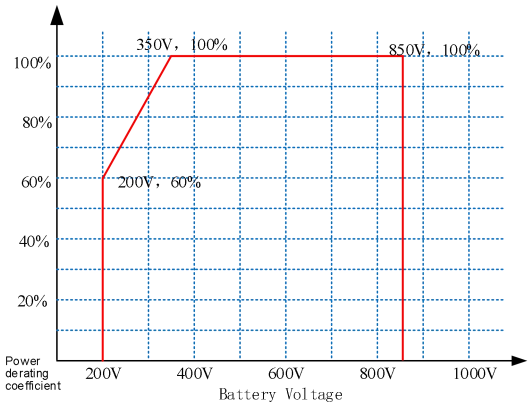


Figure 2

The curve of side charge-discharge power versus battery voltage for SP40HCG2/PS batteries:

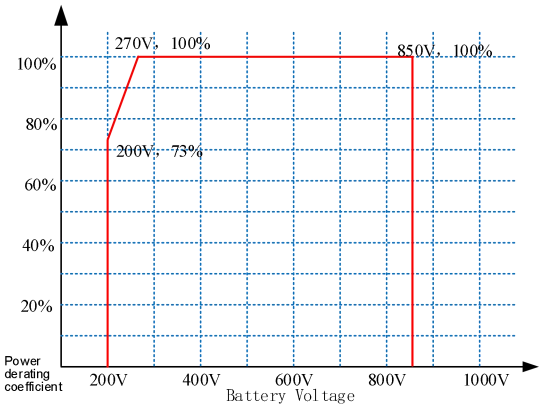


Figure 3

The curve of side charge-discharge power versus battery voltage for SP30HCG2/PS batteries:

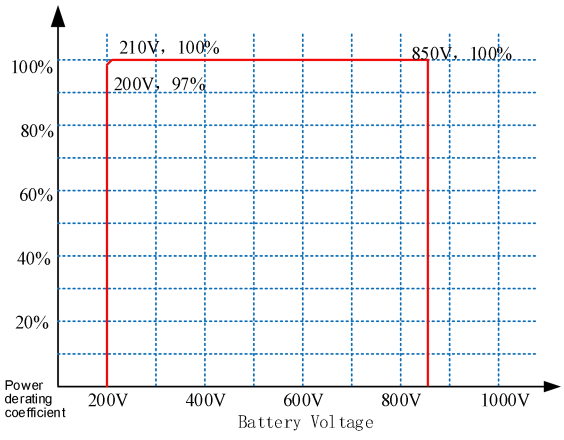


Figure 4

(2) Grid voltage derating curve

The relationship between AC charge-discharge power and grid voltage for the SP30~60HCG2/PS series:

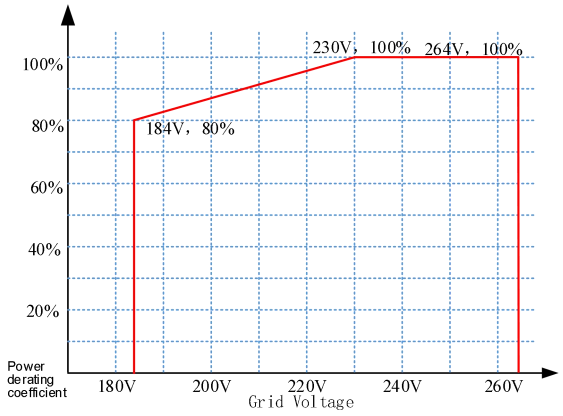


Figure 5

(3) Work environment temperature derating curve

The relationship between AC charge-discharge power and ambient temperature for the SP30~60HCG2/PS series:

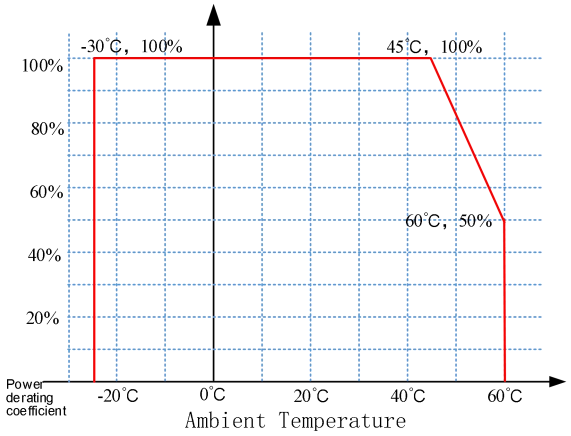


Figure 6

3.2 Classic Apps

The classic applications are as follows:

(1) Small industry and commerce: suitable for small factories, commercial buildings, office buildings, etc., to optimize energy consumption, achieve peak and valley electricity price management, reduce electricity costs, and provide emergency backup power

function 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 power grid coverage, the SP30~60HCG2 series can be combined with renewable energy such as solar photovoltaic panels and wind turbines to build an independent microgrid and provide stable power supply;

(3) Farm and agricultural facilities: In the agricultural sector, the inverter can be combined with solar and energy storage systems to provide power for irrigation, greenhouse control, automation equipment, etc., while supporting oil engine hybrid mode to ensure operation in the event of energy shortage;

(4) Villas and homes: Provide energy solutions for high-end homes, combining solar power generation and energy storage to improve energy self-sufficiency, while providing emergency power for the home to ensure that the home is not affected by grid failures;

(5) Temporary power supply and construction sites: The SP30~60HCG2/PS series can be used as a portable power supply for construction sites, outdoor activities, and temporary facilities, providing necessary power support. It also supports diesel generator hybrid operation to ensure continuous power supply.

(6) Remote Areas and Emergency Rescue: The SP30~60HCG2/PS series features lightweight design and high integration, enabling rapid deployment in remote areas or emergency scenarios. It delivers stable power supply to support critical infrastructure including communication and medical equipment.

(7) Battery cascade utilization: Participate in national or regional energy optimization projects, such as wind-solar-diesel-storage island demonstration projects, to demonstrate the performance and benefits of SP30~60HCG2/PS series in practical applications.

3.2.1 Small industrial and commercial energy storage

Main application scenarios: supermarket, farm, field construction and other scenarios.

Main functions: photovoltaic self-generation and self-use, emergency backup power, etc.

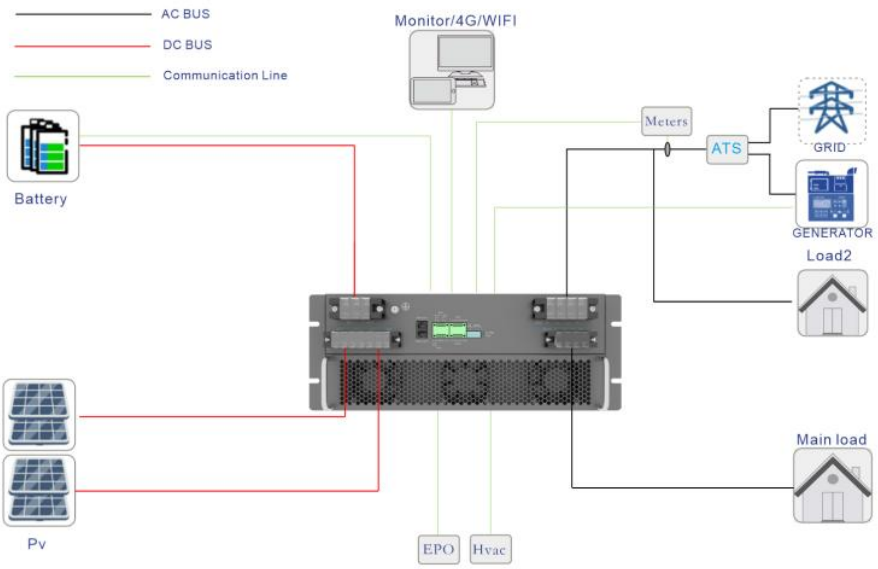


Figure 7

3.2.2 Off-grid microgrid solutions

Main application scenarios: power unstable areas, farms, islands, oil extraction, and other areas without power.

Main functions: self-use, emergency backup power, generator management, fan management, etc.

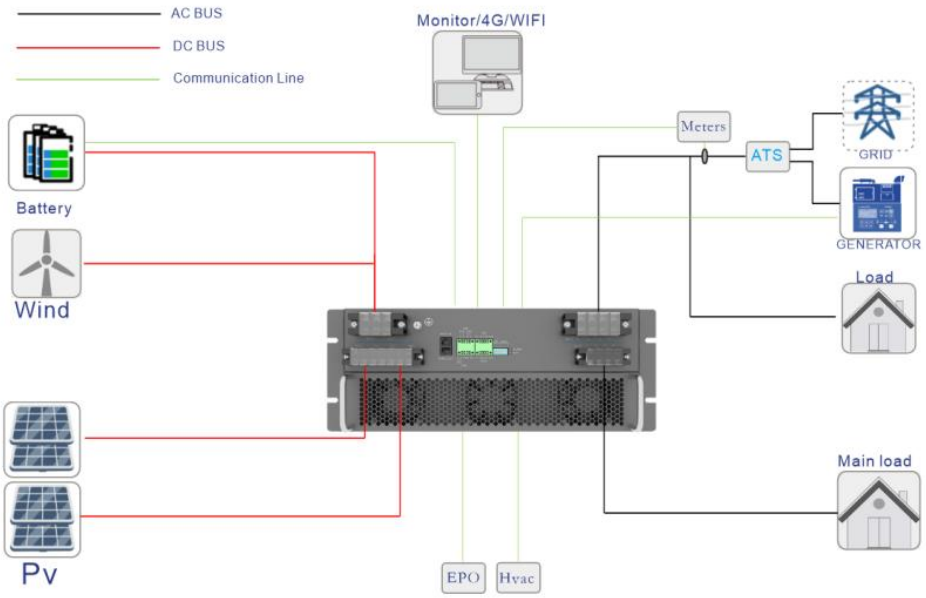


Figure 8

3.2.3 Three-phase imbalance and low voltage management

Main application scenarios: high voltage, low voltage, and imbalance of the terminal power grid caused by new energy access or load fluctuation, line impedance, etc.

Main functions: three-phase independent grid connection and independent control, realize energy balance, maximum compensation 150%.

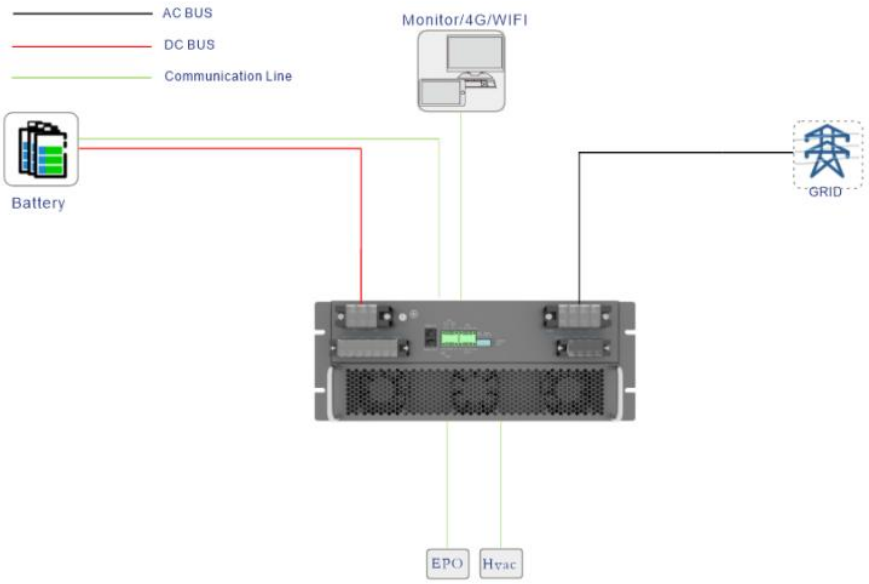


Figure 9

3.2.4 Energy storage + emergency backup power

Main application scenarios: EPS replacement, mobile power supply, battery cascade utilization, sodium-ion batteries, fuel cells, etc.

Key features: The SP30~60HCG2/PS series converters support single-phase charging, deliver wide battery power and voltage ranges, and handle up to 150A current.

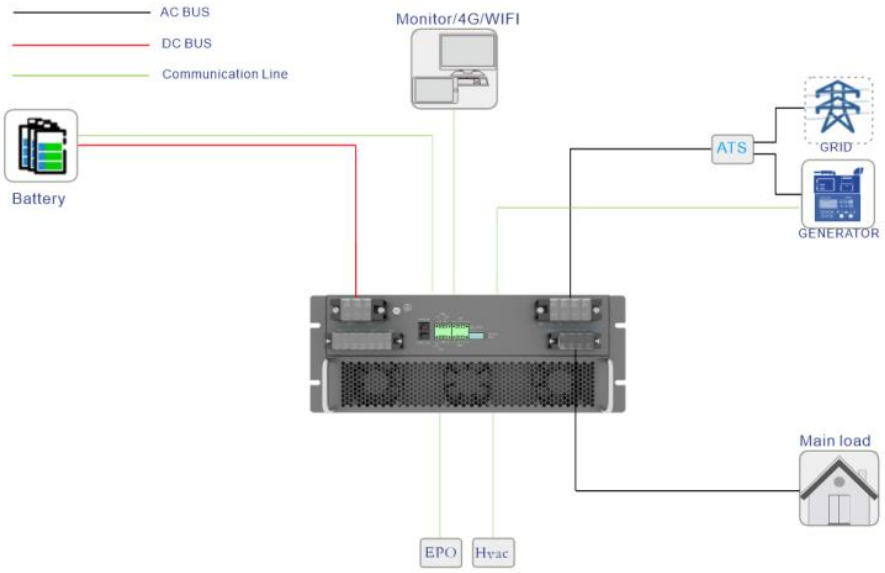


Figure 10

3.2.5 Multi-machine solution

Main functions: supports multiple parallel machines, supports transformerless output, and supports transformer startup.

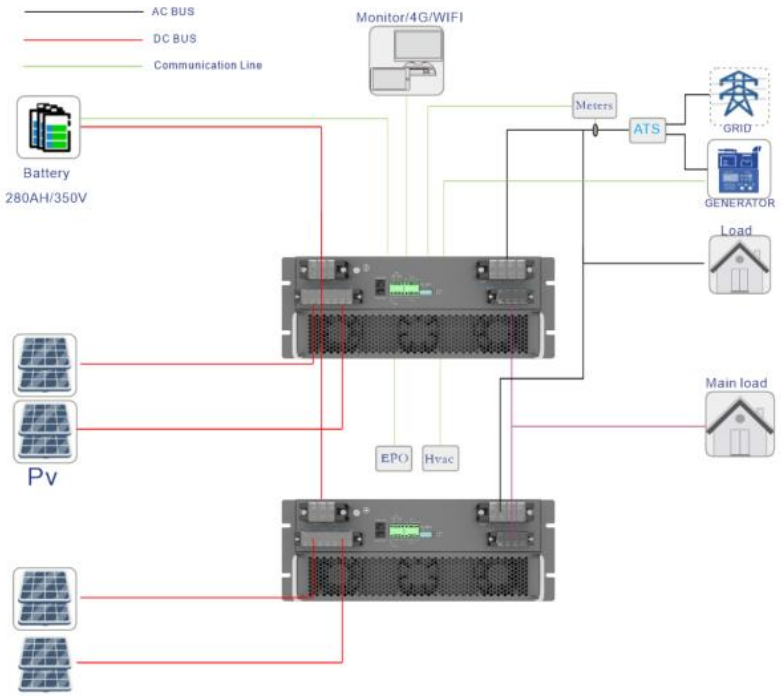


Figure 11

3.3 Model Number Guidelines

This document provides model specifications for SP**HC** series converters.

order number	code	meaning
1	corporate name	SP: Zhongteng Microgrid
2	Rated AC power	60: Rated output power of AC 60kW 50: Rated output power 50kW 40: Rated output power 40kW 30: Rated output power 30kW
3	DC voltage level	H: The DC input voltage ranges from 200 to 1000V
4	way to install	C: Insert frame
5	Module Classification	G2： Hybrid energy storage converter

		PS：Energy storage converter DC：DC transformer PV：DC MPPT IV：dc-to-ac converter

3.4 Product Circuit Introduction

3.4.1 Power Circuit Introduction

The power circuit diagram of the SP30~60HCG2 series converter is shown in Figure 12. As the converter already contains a bus capacitor soft-start circuit, the BMS does not require a corresponding bus capacitor soft-start circuit.

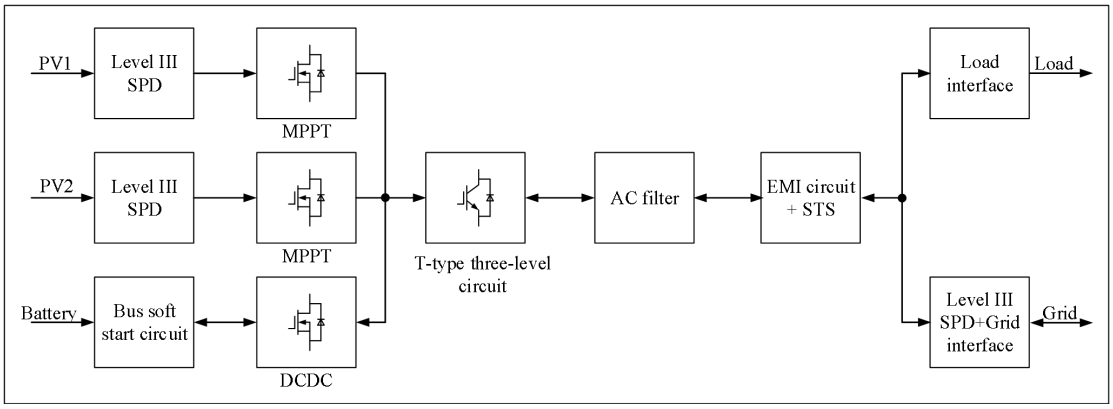


Figure 12 Power circuit diagram

The power circuit diagram of the SP30~60HCPS series converter is shown in Figure 13. The converter already contains a bus capacitor soft-start circuit, so the BMS does not need the corresponding bus capacitor soft-start circuit.

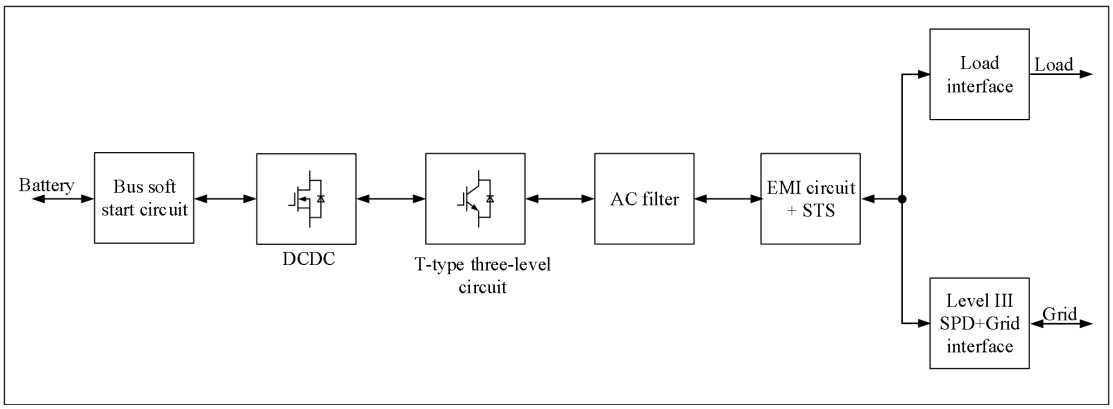


Figure 13 Power circuit diagram

3.4.2 Work Mode Introduction

The converter operates in three primary modes: self-consumption, energy-saving mode, and priority grid connection. These modes require an optional SAEMS300 controller. For further details, please contact our sales team.

(1) Self-Use

This model is designed for regions with relatively high electricity prices and low or no subsidies for grid feed-in. The system's core mechanism involves storing excess solar power in batteries. When solar generation is insufficient or nighttime power is unavailable, the stored energy is released to power household appliances. This approach optimizes the utilization rate of photovoltaic systems and enhances home energy self-sufficiency, while reducing reliance on grid electricity to lower household energy costs.

For example: a) When PV systems operate at full capacity (e.g., 35kW output) with a 10kW load, the surplus 25kW PV power charges the battery instead of feeding back to the grid; b) When PV output drops to 10kW with a 20kW load, the battery supplements the shortfall to meet energy demands without drawing from the grid.

(2) economic pattern

This operational mode is designed for scenarios with significant electricity price differences between peak and off-peak hours, enabling efficient arbitrage. During periods of relatively lower electricity prices, the converter is set to charging mode, while switching to grid-connected discharge mode during peak demand periods when electricity prices are higher. By manually configuring the charging and discharging schedules, the system automatically adjusts the converter's operational state according to real-time electricity price variations.

(3) Prefer Internet access

This model is designed for full grid-connected scenarios to maximize photovoltaic power generation. When the PV output exceeds the converter's rated AC-side capacity, the excess energy is fed back to the battery for charging. Conversely, when the PV output falls below the rated capacity, the battery supplements the shortfall. This dual mechanism ensures the converter delivers maximum energy to the grid while maintaining operational efficiency.

For example: a) When PV systems receive sufficient sunlight (e.g., 35kW output), 30kW is fed back to the grid, while the remaining 5kW is used to charge the battery. b) When sunlight diminishes (e.g., 10kW output), 30kW is still fed back, and the 20kW shortfall is covered by the battery to maximize grid energy feedback.

3.5 Product Structure

(1) product appearance

Figure 14

(2) product size

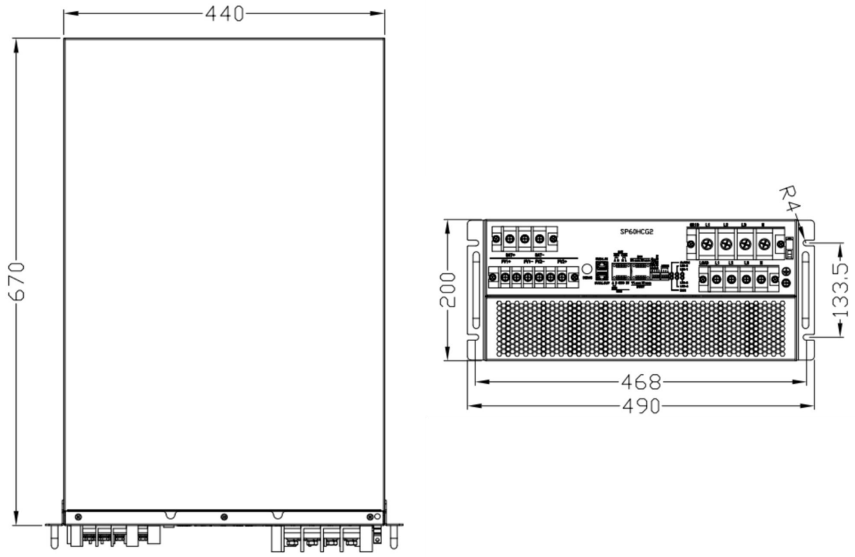


Figure 15

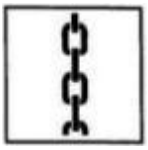
4 Transportation, storage and installation

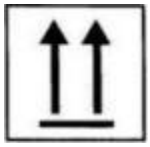
4.1 Transportation and storage

When transporting and storing the converter module, pay attention to the label on the packing box. The transportation and storage process shall meet the following requirements:

⚠Caution
● Ensure that the converter's outer packaging is not removed during storage and transportation; ● Ensure that the storage environment is free of corrosive and toxic gases; ● Ensure the storage temperature is maintained between-45℃ and 70℃, and the relative humidity is kept between 5%RH and 95%RH; ● Ensure that the maximum number of pallets is 4 layers when storing, and ensure that there is no risk of tipping the pallets; ● During storage, regular inspection is required. If there is insect infestation or rat bite, the packaging material should be replaced in time; ● Ensure that transport vehicles and storage warehouses meet fire safety requirements; ● If the storage time is more than half a year, the converter needs to be checked and tested by professionals before being put into use; ● Avoid transporting the converter in rain or bad weather. If unavoidable, take necessary protective measures. ● For long-term storage, ensure that the appliance is powered on once a year from the date of purchase, and the power on time is not less than 6 hours.

The packaging label diagram is shown in the table below

icon	explain
	The center of gravity indicates the center of gravity of the energy storage converter.
	Lift signs indicate the position of chains or ropes when lifting energy storage converters.

	The upper sign indicates the way to place the energy storage converter when handling and placing. It is strictly prohibited to invert, lay horizontally or tilt.
	Lightly mark and avoid violent friction or collision during transportation and placement.
	Wetness warning: the energy storage converter should be protected from rain or moisture during transportation and storage.

4.2 Unbox and inspect

When unpacking the converter, the following checks should be performed:

⚠warn
● Before unpacking, check whether the converter's outer packaging is damaged. If damaged, contact the relevant personnel for confirmation and replacement. ● Place the converter on the horizontal ground and face upward, remove the sealing tape of the outer package; ● Take out the shipping attachments and check whether there is any missing or wrong delivery. If there is any missing or wrong delivery, please contact the relevant personnel for confirmation and reissue the relevant attachments. ● Take out the filling buffer cotton, and then two or more people should assist each other to take out the converter module, so as to prevent the converter module from falling down when taking out the converter module, so as to threaten the life and property safety; ● Check whether the plastic film packaging bag of the converter module is damaged. If damaged, contact the relevant personnel for confirmation and replacement. ● Remove the plastic film of the module and check whether there are obvious scratches or defects on the appearance of the module. If there are obvious scratches or defects, please contact the relevant personnel for confirmation and replacement. ● Check whether the converter module nameplate parameters are consistent with the order contract, such as model, rated power, voltage range and other key parameters. If the

converter module nameplate parameters are inconsistent with the order contract, please contact the relevant personnel for confirmation and replacement.

- Packaging materials related to converters shall be disposed of in a reasonable manner in accordance with local laws and regulations.

4.3 Handling and installation

4.3.1 Installation and Handling Notes

When transporting, storing, or installing the converter, comply with the laws, regulations, and relevant standards of the country or region. Before installation, move the hybrid converter to the installation site. During transportation, avoid personal injury or equipment damage. Note the following:

⚠warn
● Please equip the corresponding personnel according to the weight of the hybrid converter to avoid injury caused by the weight exceeding the range of human carrying. ● Wear safety gloves when installing or moving a hybrid converter to avoid injury. ● Ensure the converter is balanced during handling to avoid falling.

4.3.2 replacement tool

tool		
forklift	torque spanner	bolt driver
 When moving equipment over short distances, forklifts should be used to avoid falling during handling, which may cause injury to	 When connecting the power cable, use a torque wrench to fix it according to the relevant torque size to prevent the power cable from being unfastened from the terminal	 An M6 screwdriver is used to secure the module in the cabinet.

personnel or damage to equipment.	or the terminal from being damaged by excessive torque.	

4.3.3 Installation environment

The converter installation environment must meet the following conditions:

⚠ take care
● The converter must be installed in a place with a shield to avoid sunlight; ● The converter should be installed in a well-ventilated place to prevent the poor heat dissipation from affecting its working performance; ● During the operation of the converter, the temperature of the machine surface is high, so be sure to install it in a place that is not easy to touch; ● The converter must be kept away from children and special groups; ● The installation area of the converter should be far away from inflammable and explosive items, and far away from strong interference equipment; ● The mounting frame or wall of the converter should have certain fire performance; ● Converters should be avoided near office areas or residential areas that are relatively sensitive to noise.

To ensure the safety of the installation personnel, relevant safety measures must be taken when installing or maintaining the product. The following procedures must be followed during electrical installation:

⚠ danger
● Disconnect all power sources connected to the converter and ensure that the converter is off. ● A warning sign must be left at the disconnect point to prevent re-powering during installation. ● Necessary grounding and short circuit connections are required.

- The charged parts should be treated and isolated with insulating materials to avoid injury to personnel.
- Only professionals can install the converter, and the installation process should be carried out strictly according to the user manual.
- Installers must comply with the relevant electrical operating procedures in their country or region.
- The installation personnel should understand the voltage level of the power supply area and determine the voltage compatibility.

The converter has the following environmental requirements:

⚠take care
● This product is installed in the cabinet and needs to be installed in the final system for use. ● The installation altitude should not exceed 4000m. If the altitude exceeds 2000m, the rated capacity should be reduced. If the altitude exceeds 4000m, the use is prohibited. ● The operating temperature of the converter is-30℃~+60℃. When the ambient temperature is>45℃, the converter should be derated. ● The converter operates in an environment with humidity ranging from 5%RH to 95%RH and no condensation; ● When the converter works in a high dust environment, it is necessary to add dust filter according to the site conditions, but it does not affect the air intake and air output of the converter;

4.3.4 Air duct requirements

The module employs intelligent fan speed-regulated air cooling. Its front panel serves as the air intake while the rear panel functions as the exhaust port. With a rated airflow capacity of 500CFM(14.1m3/min), when installed in an integrated system, the cabinet's intake port must align directly with the module's front intake port, maintaining a minimum distance of 110mm between the module's intake and cabinet structure. The cabinet must incorporate dedicated air ducts and exhaust ports that correspond to the module's exhaust port and cabinet's exhaust port, ensuring a minimum distance of 110mm between the module's exhaust port and cabinet structure to effectively discharge hot air externally and prevent internal recirculation. Where existing exhaust ducts are unavailable, a fan with twice the module's airflow capacity should be installed

at the cabinet's exhaust port. To accommodate the dust-proof cotton layer required for intake ports, the cabinet's intake area must be three times larger than the module's intake area. The dust-proof cotton should be 40PPI polyurethane mesh foam with a flame retardancy rating of 94V0. The cabinet's exhaust port area should double the module's exhaust port area, and a 10-mesh insect-proof steel mesh is recommended for the exhaust port. Refer to Figure 16 for intake configuration details.

Figure 16 Product size

5 Cable Connection Instructions

5.1 Port definition

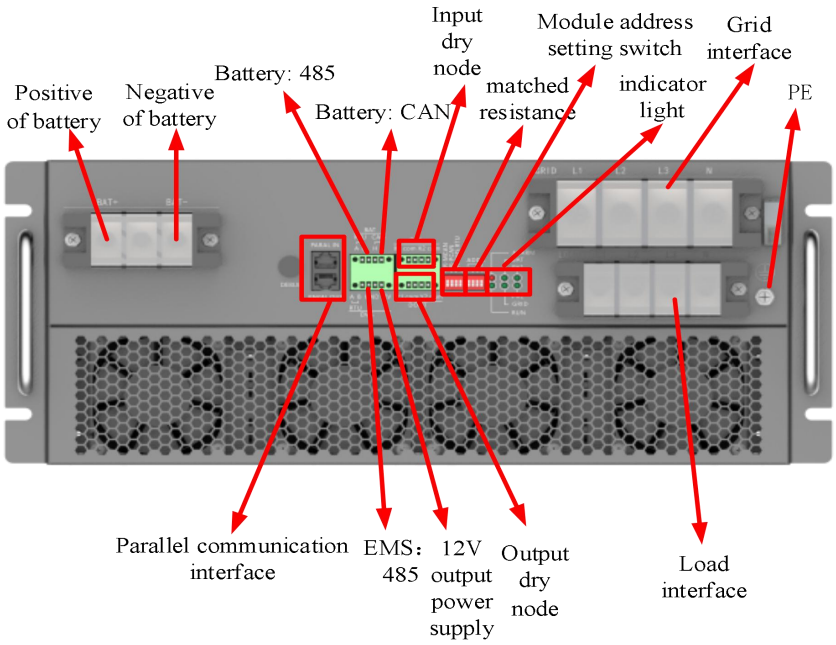


Figure 17 Port definition diagram

Power port definition:

name	function	remarks
BAT+/BAT-	Battery input terminal	OT terminal (RNB38-6), recommended with 35mm² cable
LOAD（L1/L2/L3/N）	AC load terminal	OT terminal (RNB22-6S), 25mm² cable
GRID（L1/L2/L3/N）	Exchange AC power terminal	OT terminal (RNB60-8), recommended with 50mm² cable
PE	earth terminal	OT terminal (RNB22-6S), recommended with 10mm² cable

⚠ take care
● The power terminals of the battery interface and load interface are secured with M6 screws. Use the included screws to fasten the power cables, with a torque of 3N.m (30kgf · m).

Excessive torque may damage the terminals, while insufficient torque may cause poor contact.

- The power terminals of the power grid are fixed with M8 screws. Use the screws provided with the power cable to fix them. The torque of the fixing screw is 4.9N.m (49kgf· m). Too large will cause terminal damage, and too small will cause poor contact.
- The module must be reliably grounded during operation. Poor grounding may cause electric shock hazard and module damage. The fixing screw torque is 5N.m.

The signal terminal interface definition is shown in Figure 18:

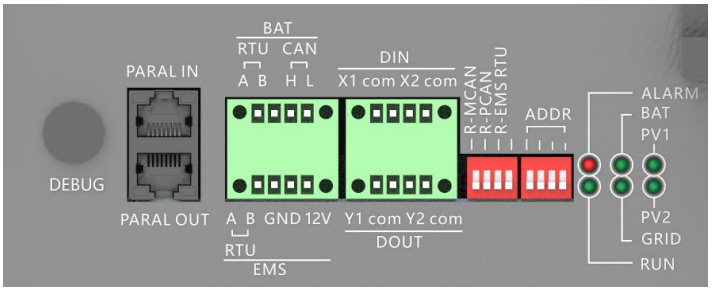


Figure 18

name	function	remarks
PARAL IN	Parallel input	Sync Line
PARAL OUT	Parallel output	Sync Line
BAT_RTU	Battery RS485 interface	BAT communication interface
BAT_CAN	Battery CAN interface	
RTU(A-B)	Communicate with EMS	Upper computer, EMS, or SAEMS300 (optional) coordinated control system
12V-GND	SAEMS power supply port	Output capability 12V/0.5A
X1	Enter the node	scram button
X1_com	Enter the node	
X2	Enter the node	obligate
X2_com	Enter the node	obligate
Y1	Output dry contact	Output capability: The maximum voltage of the port is not higher than 24V, and the maximum current is not higher than 200mA
com		
Y2	Output dry contact	
com		
R-MCAN	Match resistance for parallel communication	ON: indicates the communication matching resistor is connected Module 1 and the final module must be equipped with parallel communication
R-PCAN	Parallel communication matching resistor	

R-EMS RTU	EMS RTU communication matching resistor	matching resistors (set the DIP switch to ON position). Only the first and last modules require these components; the rest are exempt.
ADDR	Module address dialing	ON: indicates 1, OFF indicates 0 The binary method is used to represent the module address, with the left side being the high bit and the right side being the low bit. For example, module 1 is represented as 0001, and module 3 is represented as 0011.
DEBUG	debugging interface	For internal debugging only
ALARM	fault indicating lamp	The converter fails to turn on when it is faulty and turns off when it is not.
RUN	Status indicator	The converter is normally on. When there is no fault, it flashes once per second. When there is a fault, it is often off.
BAT	Battery status indicator	The battery circuit function is on during normal operation. When the battery is normal, it flashes once per second. When the battery is abnormal, it is off.
GRID	Grid status indicator	It stays on during grid operation. It flashes once per second when the grid is normal and turns off when the grid is abnormal.
PV1	Photovoltaic 1 status indicator	The PV input remains on during normal operation. When attempting fault detection, it flashes slowly with a 1-second interval. When PV input is absent, it turns off permanently.
PV2	Solar PV status indicator	The PV input remains on during normal operation. When attempting fault detection, it flashes slowly with a 1-second interval. When PV input is absent, it turns off permanently.

The schematic diagram of the output node is shown in Figure 19:

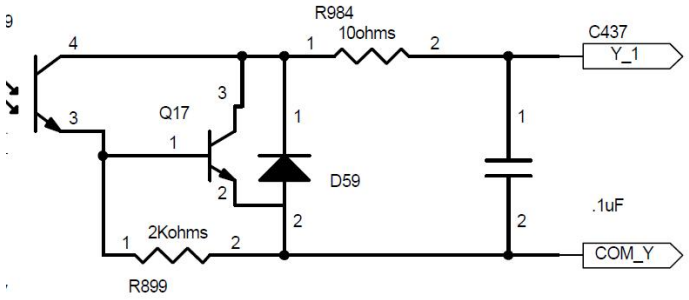


Figure 19

Note: The maximum voltage of the port should not exceed 24V, and the maximum

current should not exceed 200mA.

The internal schematic of the input node is shown in Figure 20:

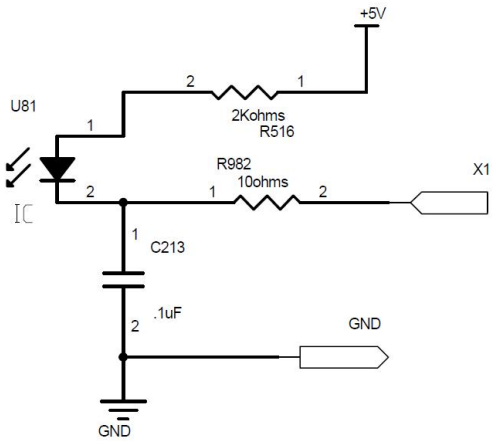


Figure 20

Note: The dry node has built-in power supply. Only a switch is required to short the external node. The sum of the switch shorting impedance and line impedance should be less than 0.1Ω.

5.2 Cable Winding Tool

Tools and Instruments		
multimeter	torque spanner	Wire stripper
 Check if the measuring device is powered	 Connect power wire, torque 3N.m (30kgf/m)	 For power cable crimping
bolt driver	connection cover cutting pliers	Hot air gun (or hot air blower), heat shrink tube
 A screwdriver used to tighten and remove M6 screws	 For power cable processing	 Wrap the conductive part of the power cable to prevent leakage

Add appropriate tools to the site as needed to avoid delays in installation due to lack of tools.

5.3 DC side wiring

⚠warn
● The battery voltage must not exceed the maximum allowable DC voltage of 850V of the converter, otherwise the equipment may be damaged; ● When there is a grounding fault in the system, the grounding fault must be eliminated before the wiring is carried out after the fault; ● The DC power cable screw of the converter should be tightened according to the installation torque of 3N.m. If the installation torque is less than this, it will cause fire due to poor contact, and if the installation torque is more than this, it will cause damage to the power terminal; ● If the wiring error of the converter, it will cause the converter to work normally, or even lead to equipment damage; ● During installation, install cables in strict order to prevent accidents.

The installation sequence of the battery side cable is as follows:

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

Step 2 Turn off the battery switch, measure with a multimeter, and confirm that the power cable to be installed to the converter is not charged;

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

Step 4: Use a wire stripper to strip the insulation of the power cable to the appropriate length, then put on the corresponding cold press terminal, and finally use a wire press to tighten the terminal;

Step 5 After the terminal crimping is completed, check whether the terminal crimping is reliable. If the crimping is not strong enough, cut off the terminal and repeat step 4;

Step 6 After the terminal is securely crimped, use a heat gun to heat shrink the sleeve and make the corresponding insulation;

Step 7 Connect the battery pack's positive and negative power cables to the converter's terminals "BAT+" and "BAT-". Use a torque wrench to calibrate and tighten the connection, ensuring a secure fit between the power cables and terminals.

5.4 Communication side wiring

⚠warn
● The power grid voltage shall not exceed the maximum allowable AC voltage of the converter 264V, otherwise the equipment may be damaged; ● When there is a grounding fault in the system, the grounding fault must be eliminated before wiring; ● The AC power cable screw of the converter should be tightened according to the installation torque of 4.9N.m. If the installation torque is less than this, it will cause fire due to poor contact, and if the installation torque is more than this, it will cause damage to the power terminal; ● During the installation process, if the phase sequence is wrong, the converter will not work normally or even be damaged; ● During installation, install cables in strict order to prevent accidents.

The installation sequence of AC power cables is as follows:

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

Step 2 Turn off the power grid switch, measure the AC power cable and the converter AC terminal with a multimeter, and confirm that the AC power cable and the converter AC terminal to be installed are in the non-electric state;

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

Step 4: Use a wire stripper to strip the insulation of the power cable to the appropriate length, then put on the corresponding cold press terminal, and finally use a wire press to tighten the terminal;

Step 5 After the terminal crimping is completed, check whether the terminal crimping is reliable. If the crimping is not strong enough, cut off the terminal and repeat step 4;

Step 6 After the terminal is securely crimped, use a heat gun to heat shrink the sleeve and make the corresponding insulation;

Step 7 Connect the power cable of the grid to the "L1", "L2", "L3" and "N" terminals of the converter grid side power terminal. Use a torque wrench to calibrate and install the torque so that the power cable and power terminal have good contact.

Step 8 Connect the AC load power cable to the "L1", "L2", "L3" and "N" terminals on the converter load side. Calibrate and install the torque with a torque wrench to ensure good contact between the power cable and the power terminals.

5.5 Wiring Diagram

This section mainly illustrates the wiring diagram of one cluster one management single machine, one cluster one management multi-machine parallel, and single battery pack multi-machine parallel.

pay attention to
● Ensure the battery pack addresses are uniquely mapped to converter addresses to prevent EMS control inaccuracies caused by PCS and battery pack mismatches. ● The SAEMS300 must communicate with all battery packs using either RTU or CAN communication. Either method is acceptable, with RTU operating at 115200 baud and CAN at 125kbps. ● The SAEMS300 communicates with converters through RTU and CAN protocols. Both methods require simultaneous connection, with RTU and CAN cables for all parallel converters being individually linked. ● Ensure the matching resistor for RTU and CAN communication in the last converter module remains enabled. ● Ensure all parallel converters have unique addresses (by changing the converter address via DIP configuration), with RTU communication at 115200 baud and CAN communication at 125kbps. ● The SAEMS300 communicates with the electricity meter via RTU (Remote Terminal Unit) at a baud rate of 9600, primarily to enable the external reverse flow protection function. ● For SAEMS300 product selection, please contact the relevant staff. ● STS is a product for purchase. For purchasing, please contact the relevant staff.

5.5.1 Cluster and manage single-machine connection diagram

The wiring diagram for this operational mode is shown in Figure 21. All power cables connected to the converter must be externally equipped with isolating switches. The converter operates in both grid-connected and off-grid modes, with automatic switching between these states. The SAEM300 coordinates system-wide control based on user-defined parameters, enabling the system to adapt to diverse operational requirements.

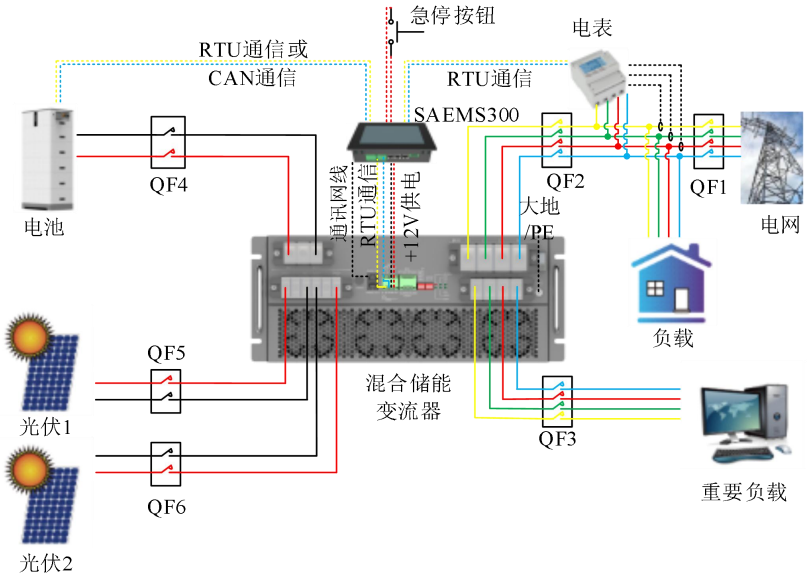


Figure 21. Diagram of cluster management wiring

warn
● When using a photovoltaic simulator or DC power supply to replace solar panels for testing, first close the isolating switches QF5 and QF6 before turning on the simulator or power supply. ● For electricity metering, we recommend the Acrel ADL400 model. ● The CT must be installed between the load and QF1; otherwise, the intended effect cannot be achieved. ● If the electricity meter is not installed, the internal anti-current function of the converter can be enabled. In this case, the load is powered by the grid, and the converter only supplies power to the important load; ● The converter must be reliably grounded, otherwise it will cause personal safety and converter damage.

5.5.2 Cluster-based management of multiple parallel (off-grid) machines

The wiring diagram of this operational mode is shown in Figure 22. All power cables connected to the converter must be externally linked to isolation switches, with the converter operating exclusively in off-grid mode. A maximum of 15 units can be connected in parallel, each converter being equipped with an independent battery pack on its battery side for one-to-one management. The SAEMS300 coordinates system-wide control based on user-defined parameters, enabling the system to operate according to diverse user requirements.

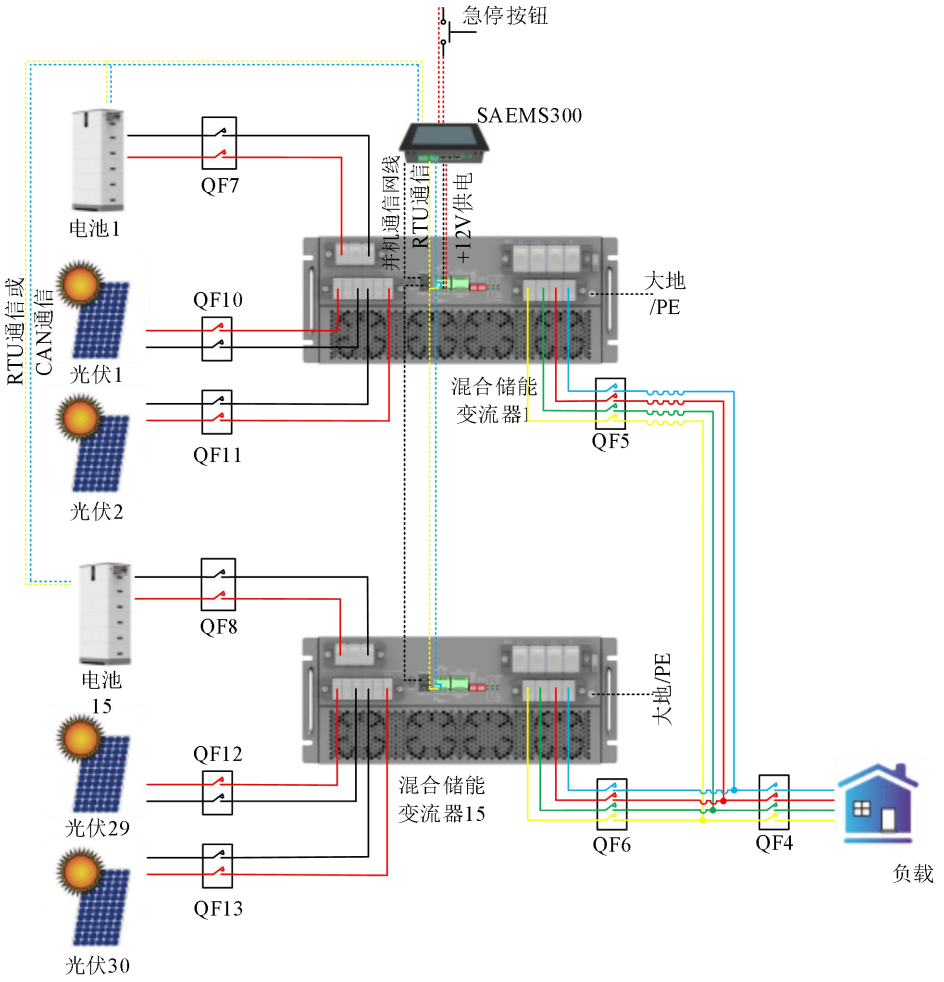


Figure 22: Diagram of Cluster-1-Management for Multi-Parallel Machine Connection

warn
● When using a photovoltaic simulator or DC power supply to replace solar panels for testing, first close the isolating switches QF10, QF11, QF12, and QF13, then turn on the simulator or power supply. ● In this wiring mode, the converter only works in off-grid mode and cannot be connected to the grid; ● All converters must be reliably grounded, otherwise personal safety and converter damage will occur.

5.5.3 Cluster-based management of multiple parallel machines (with off-grid switching)

(1) Scenarios for using up to 3 units in parallel

The wiring diagram for this operational mode is shown in Figure 23. The converter can independently perform grid-connected and off-grid switching functions. The number of parallel-connected converters must not exceed three, and all power cables must be externally

connected to isolation switches. The SAEMS300 coordinates system-wide control based on user-defined parameters, enabling the system to operate according to diverse user requirements.

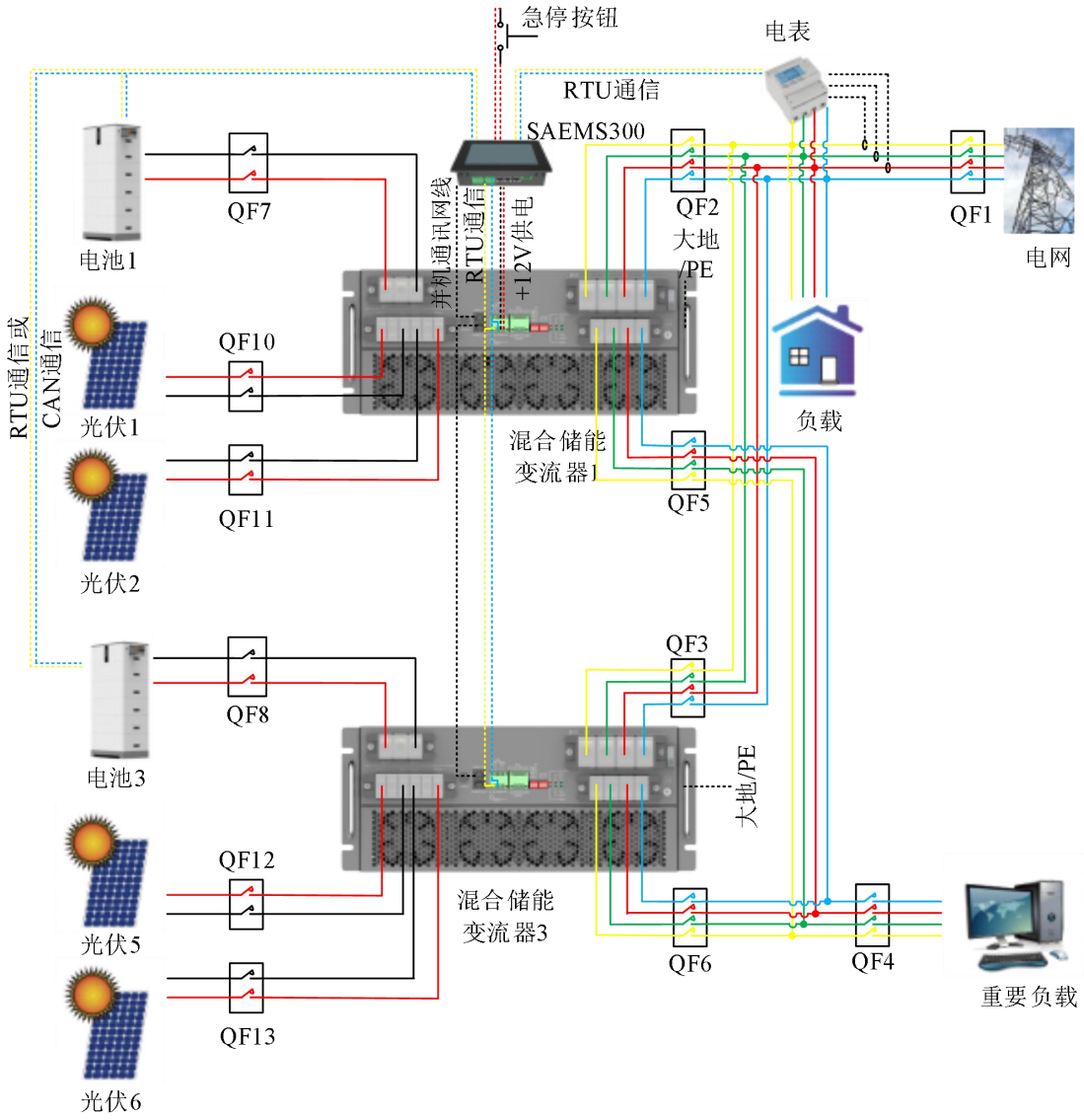


Figure 23: Schematic diagram of cluster-based management for multi-machine parallel wiring

warn

- When using a photovoltaic simulator or DC power supply to replace solar panels for testing, first close the isolating switches QF10, QF11, QF12, and QF13, then turn on the simulator or power supply.
- For electricity metering, we recommend the Acrel ADL400 model.
- The CT must be installed between the load and QF1; otherwise, the intended effect cannot be achieved.
- If the electricity meter is not installed, the internal anti-current function of the converter can be enabled. In this case, the load is powered by the grid, and the converter only supplies power to the important load;

- All converters must be reliably grounded, otherwise personal safety and converter damage will occur.

(2) Scenarios with more than three parallel units

The wiring diagram for this operational mode is shown in Figure 24. The converter must work with an external STS device to enable grid-connected and off-grid switching, supporting up to 15 parallel-connected units. All power cables connected to the converter must be equipped with external isolating switches. The SAEMS300 coordinates system-wide control based on user-defined parameters, allowing the system to operate according to diverse user requirements.

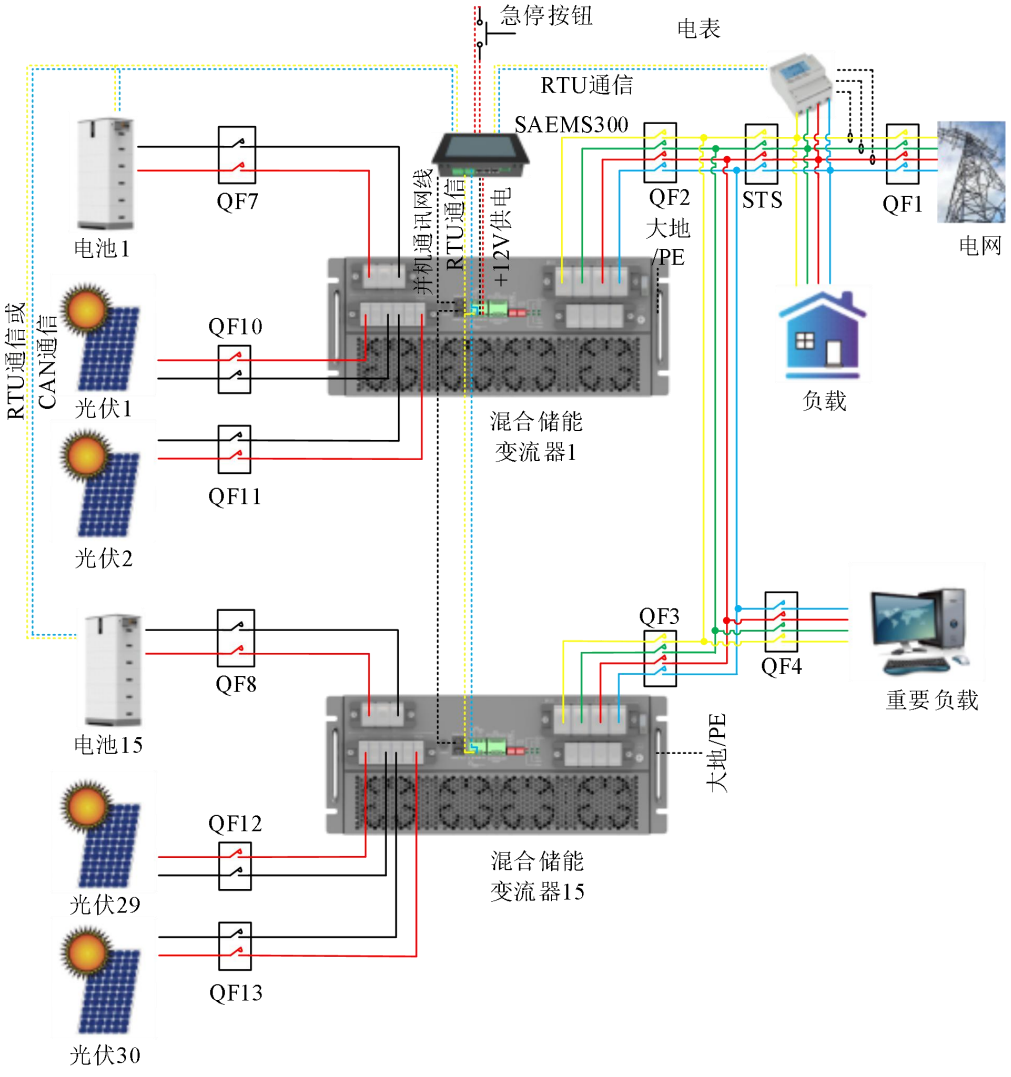


Figure 24: Schematic diagram of cluster-based management for multi-machine parallel wiring

warn

- When using a photovoltaic simulator or DC power supply to replace solar panels for testing, first close the isolating switches QF10, QF11, QF12, and QF13, then turn on the simulator or power supply.

- For electricity metering, we recommend the Acrel ADL400 model.
- The CT must be installed between the load and QF1; otherwise, the intended effect cannot be achieved.
- If the electricity meter is not installed, the internal anti-reverse flow function of STS can be enabled. In this case, the load is powered by the power grid, and the converter only supplies power to the important load.
- All converters and STS must be reliably grounded to prevent personal injury and converter damage.

5.5.4 Diagram of multi-unit parallel connection of single battery pack (off-grid)

The wiring diagram for this operational mode is shown in Figure 25. The system supports up to 15 converters in parallel, with each converter operating exclusively in off-grid mode. All power cables connected to the converters must be equipped with external isolating switches. The SAEMS300 coordinates the entire system based on user-defined parameters, enabling customized operation to meet diverse user requirements.

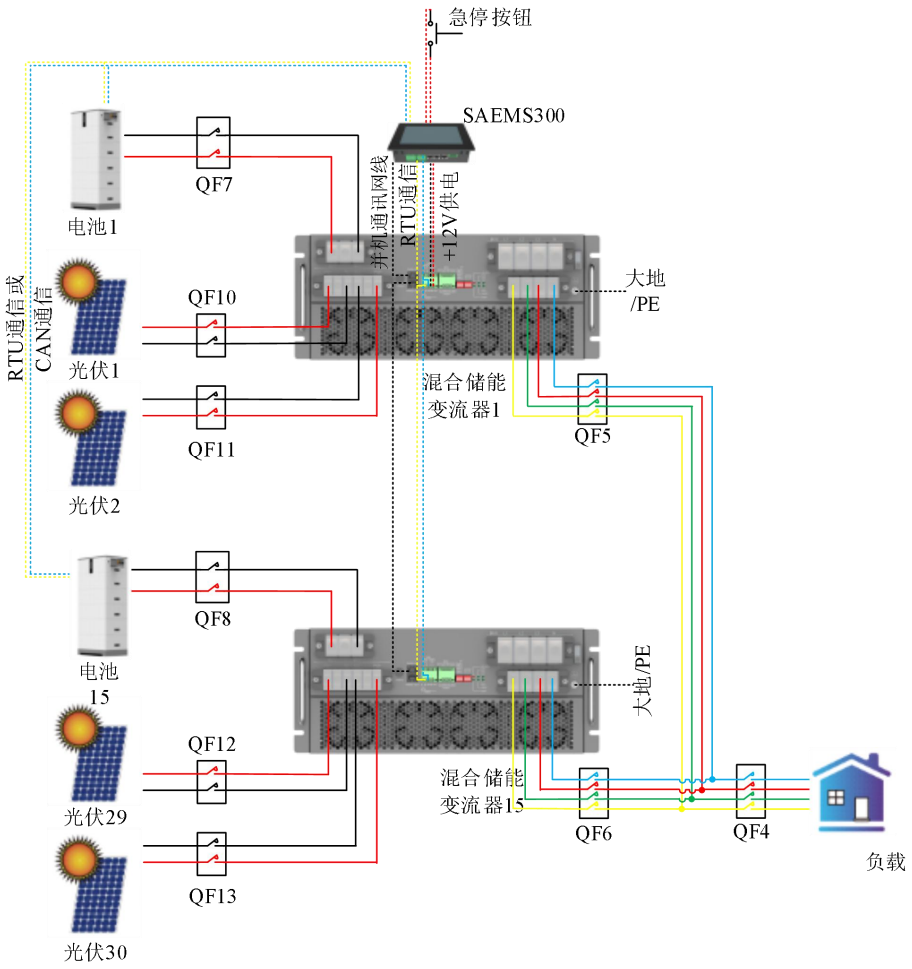


Figure 25 Schematic diagram of multi-machine parallel wiring of a single battery pack

warn
● When using a photovoltaic simulator or DC power supply to replace solar panels for testing, first close the isolating switches QF10, QF11, QF12, and QF13, then turn on the simulator or power supply. ● This wiring mode only works in off-grid mode and cannot be connected to the grid; ● All converters must be reliably grounded, otherwise personal safety and converter damage will occur.

5.5.5 Diagram of multi-unit parallel connection with single battery pack (with off-grid switching capability)

(1) Scenarios for using up to 3 units in parallel

The wiring diagram of this operational mode is shown in Figure 26. The parallel configuration features built-in grid-connected/disconnected switching capability, supporting up to three parallel-connected units. All power cables connected to the converter must be externally equipped with isolating switches. The SAEMS300 coordinates system-wide operations based on user-defined parameters, enabling customized operation to meet diverse user requirements.

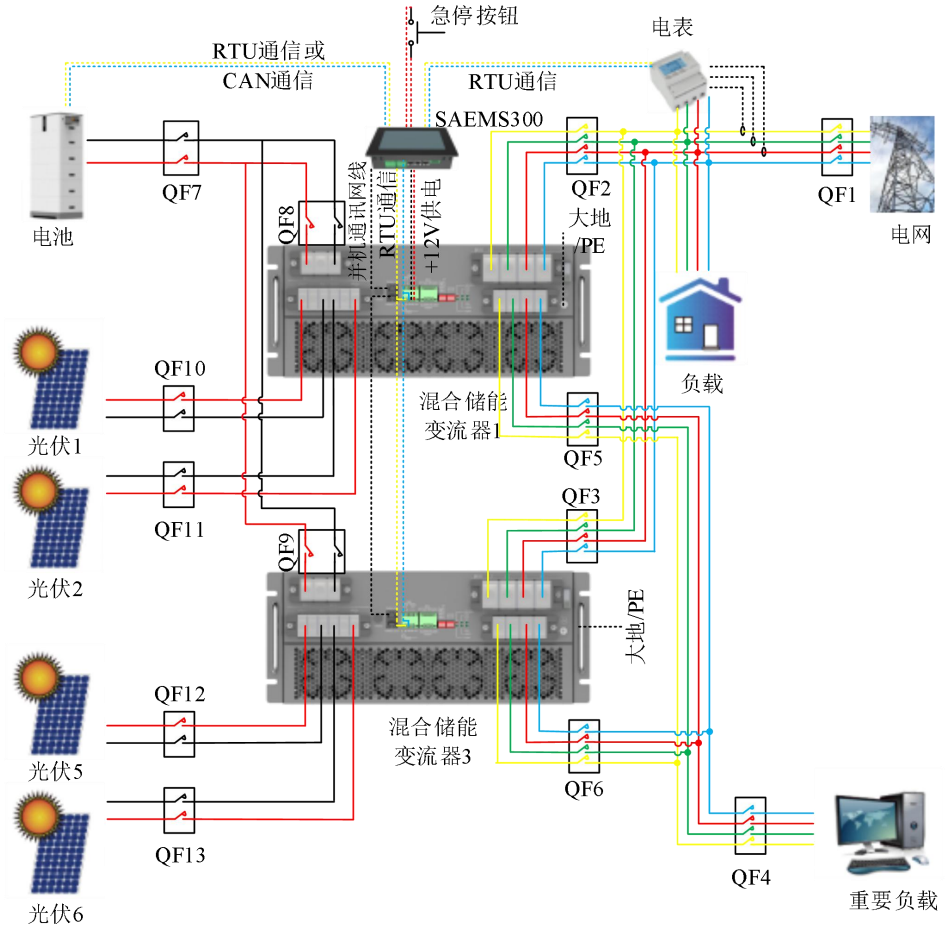


Figure 26 Schematic diagram of multi-machine parallel wiring of single battery pack

warn
● When using a photovoltaic simulator or DC power supply to replace solar panels for testing, first close the isolating switches QF10, QF11, QF12, and QF13, then turn on the simulator or power supply. ● For electricity metering, we recommend the Acrel ADL400 model. ● The CT of the electricity meter must be installed between the load and QF1; otherwise, the expected effect cannot be achieved. ● If the electricity meter is not installed, the internal anti-current function of the converter can be enabled. In this case, the load is powered by the grid, and the converter only supplies power to the important load; ● All converters must be reliably grounded, otherwise personal safety and converter damage will occur.

(2) Scenarios with more than three parallel units

The wiring diagram for this operational mode is shown in Figure 27. This parallel configuration requires an external STS device to enable grid-off switching, supporting up to 15

units in parallel. All power cables connected to the converter must be equipped with external isolating switches. The SAEMS300 coordinates system control based on user-defined parameters, allowing the system to operate according to different user requirements.

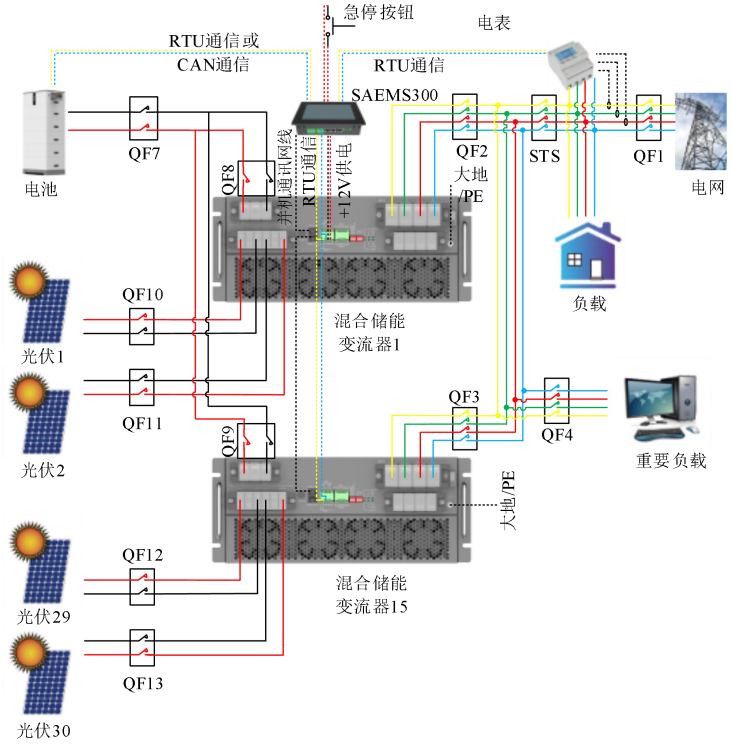


Figure 27 Schematic diagram of multi-machine parallel wiring of single battery pack

warn
● When using a photovoltaic simulator or DC power supply to replace solar panels for testing, first close the isolating switches QF10, QF11, QF12, and QF13, then turn on the simulator or power supply. ● For electricity metering, we recommend the Acrel ADL400 model. ● The CT must be installed between the load and QF1; otherwise, the intended effect cannot be achieved. ● If the electricity meter is not installed, the internal anti-reverse flow function of STS can be enabled. In this case, the load is powered by the power grid, and the converter only supplies power to the important load. ● All converters and STS must be reliably grounded to prevent personal injury and converter damage.

6 Power on/off operations and fault diagnosis

6.1 Power on/off

6.1.1 Power-on steps after initial power-on and maintenance

(1) Turn on the off-grid PV system

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, and other items. Refer to the wiring diagram in section 5.5 for the check.

Step 2: Use the multimeter's beeper function to test for short circuits between the positive/negative terminals of the battery port, PV1 port, PV2 port, and the L1, L2, L3, and N terminals of the load port. If the multimeter's beeper sounds and the impedance reading is below 2Ω, it indicates a short circuit between the tested terminals. In this case, check whether the power cable has insulation damage or incorrect wiring. If the beeper does not sound and the impedance reading exceeds 2Ω, no short circuit is present.

Step 3: Test for short circuits between the positive/negative terminals of the battery port, the L1, L2, L3, and N terminals of the load port, the positive/negative terminals of PV1, and the positive/negative terminals of PV2 versus the PE (grounding) terminal using the multimeter's beeper function. If the multimeter's beeper sounds and displays an impedance below 2Ω, it indicates a ground short circuit. In this case, check for insulation damage or incorrect cable connections in the power cables. If the multimeter shows normal readings, no short circuit exists.

Step 4: Use the DC voltage range of the multimeter to test the battery voltage and check whether the battery voltage is within the range required by the converter. If the battery voltage is not within the range required by the converter, replace the battery pack so that the battery voltage is within the range required by the converter.

Step 5: Close the circuit breaker at the converter's battery terminal. Wait for 10 seconds and check if the fault indicator light and battery status indicator light on the front panel remain illuminated. If the lights fail to illuminate, use a multimeter to verify whether the voltage at

the converter's battery port falls within the specified range. If the voltage is outside the required range, inspect whether the power cables are properly connected and check for any reverse connections at the battery port. If no reverse connections are detected and the voltage meets the specified range, contact the converter's technical support for troubleshooting. (For parallel-connected converters, close the circuit breaker at the load port while disconnecting the main circuit breaker connected to critical loads.)

Step 6: Wait for the converter's fault indicator light to transition from continuously on to continuously off with a 1-second blinking cycle. Then issue the inverter startup command. After 20 seconds, verify that the status indicator light transitions from blinking to solid on. If the light remains off, check whether the startup command was successfully issued and whether the communication protocol is compatible.

Step 7: Use the AC voltage test function of the multimeter to verify if the RMS voltage between L1, L2, L3, and N at the converter's load port is 230±2V. If the measured value differs from this standard, check whether the multimeter's test range matches the AC voltage measurement requirements. If the multimeter is set to the AC voltage test mode and within its range, but the measured value still deviates from the standard, contact the converter's technical team for troubleshooting.

Step 8: Close the main circuit breaker on the critical load side and verify if the critical load operates normally. If the critical load functions properly, the converter is successfully started. If the critical load fails to operate normally, use the AC voltage test function on a multimeter to check the AC voltage at the critical load. If the AC voltage at the critical load is abnormal, inspect the voltage at the converter's output port. If the converter's AC output voltage is normal, there is likely a cable connection issue between the converter and the critical load. If the converter's AC output voltage is abnormal, contact the converter's technical support team immediately for troubleshooting.

Step 9: Test the PV voltage using the DC voltage range of a multimeter to verify if it falls within the converter's specified range. If the PV voltage exceeds the converter's required range, reduce the number of PV modules connected in series to bring it within the required range. If the PV voltage is below the converter's specified range (under favorable lighting conditions),

increase the number of PV modules connected in series to meet the converter's requirements.

Step 10: Close the circuit breaker at the inverter's PV input. Wait for 10 seconds and check if the PV status indicator on the front panel flashes. If the indicator does not flash, use a multimeter's DC voltage setting to measure the PV port voltage. Verify if it falls within the inverter's specified PV voltage range. If not, inspect whether the power cables are properly connected and check for reverse connections at the PV port. If no reverse connections are found and the PV port voltage meets the required range, contact the inverter maintenance team for troubleshooting.

Step 11: Send the PV inverter startup command. After 20 seconds, the PV status indicator light will transition from 1-second blinking to permanent illumination. If the light remains unlit, verify the command delivery and protocol compatibility (configure for automatic activation upon PV conditions met).

(1) Connect to the grid and turn on the PV system

Step 1: Check whether the power cable and communication cable are connected correctly and securely, whether the module address is correct, and whether the communication matching resistor is enabled. Refer to the wiring diagram in section 5.5 for the check.

Step 2: Test for short circuits between the positive/negative terminals of the battery port, PV1 port, PV2 port, load port (L1, L2, L3, N), and grid port (L1, L2, L3, N) using the multimeter's beeper function. If the multimeter's beeper sounds and displays an impedance below 2Ω, it indicates a short circuit between the tested terminals. Verify if the power cable has insulation damage or incorrect wiring. If no abnormalities are found, contact the converter maintenance team for troubleshooting. Otherwise, confirm no short circuit exists.

Step 3: Test for short circuits between the battery port's positive/negative terminals, load port's L1, L2, L3, and N terminals, PV1's positive/negative terminals, PV2's positive/negative terminals, and grid port's L1, L2, L3, N, and PE (grounding terminal) using the multimeter's beeper function. If the multimeter's beeper sounds and displays an impedance below 2Ω, it indicates a ground short circuit. In this case, check for insulation damage or wiring errors in the power cables. If the multimeter shows normal readings, no short circuit exists.

Step 4: Use the DC voltage range of the multimeter to test the battery voltage and check whether

the battery voltage is within the range required by the converter. If the battery voltage is not within the range required by the converter, replace the battery pack so that the battery voltage is within the range required by the converter.

Step 5: Test the grid voltage using the AC voltage range of a multimeter to verify if the phase voltage falls within the converter's specified range. If the phase voltage exceeds the required range, check the grid phase sequence and cable connections. If both the phase sequence and cable connections are correct, the converter will operate in off-grid mode. Once the grid voltage stabilizes, the converter will automatically resume grid-connected operation.

Step 6: Close the circuit breaker at the converter's battery terminal. Wait for 10 seconds, then check if the fault indicator light and battery status indicator light on the front panel remain illuminated. If the lights are off, use the DC measurement mode of a multimeter to verify the battery voltage at the converter's battery port falls within the specified range. If not, inspect whether the power cables are properly connected and check for reverse connections at the battery port. If no reverse connections are found and the battery voltage meets the required range, contact the converter's technical support for troubleshooting. (For parallel-connected converters, close the circuit breaker at the load port while disconnecting the main circuit breaker connected to critical loads.)

Step 7: Close the circuit breaker at the converter's grid terminal. Wait for 10 seconds and check if the grid status indicator on the front panel flashes. If the indicator does not flash, use the AC detection mode of a multimeter to verify whether the voltage at the grid port falls within the converter's specified range. If not, confirm the correct connection of the power cables and check for phase sequence errors in the grid port cables. If no reversed connections are detected, this indicates a grid fault. Wait for the grid to stabilize before rechecking the converter's status. If the measured voltage at the grid port is within the specified range, contact the converter maintenance team for troubleshooting.

Step 8: Wait for the converter's fault indicator light to transition from continuously on to continuously off, with status indicators blinking at 1-second intervals. Then issue the converter's inverter startup command. After 20 seconds, observe the operational status indicator light, battery status indicator light, and grid status indicator light transitioning from

blinking to continuously on at 1-second intervals. If the operational status indicator light or battery status indicator light fails to turn on continuously, verify the successful issuance of the startup command and the compatibility of the communication protocol. If the grid status indicator light does not transition from blinking to continuously on, contact the converter maintenance personnel for troubleshooting.

Step 9: Use the AC voltage test function of the multimeter to measure the difference between the RMS values of L1, L2, L3, and N at the converter's load port and the grid phase voltage. Verify if the difference exceeds 2V. If the measured RMS difference is greater than this threshold, check whether the multimeter's test function matches the AC voltage measurement requirements. If the multimeter's test function is set to AC voltage and within the appropriate range, and the measured RMS difference still exceeds 2V, contact the converter's technical team for troubleshooting.

Step 10: Close the main circuit breaker on the critical load side and verify its operational status. If the critical load functions normally, the converter is successfully started. If not, use the AC voltage test function on a multimeter to check the AC voltage at the critical load. Abnormal AC voltage indicates a faulty cable connection between the converter and the critical load. Normal AC voltage suggests the critical load is damaged.

Step 11: Test the PV voltage using the DC voltage range of a multimeter to verify if it falls within the converter's specified PV voltage range. If the PV voltage exceeds the converter's required range, reduce the number of PV modules connected in series to bring the voltage back within the specified range. If the PV voltage is below the converter's required range (under favorable lighting conditions), increase the number of PV modules connected in series to meet the converter's voltage requirements.

Step 12: Close the circuit breaker at the inverter's PV input. Wait for 10 seconds and check if the PV status indicator on the front panel flashes. If the indicator does not flash, use a multimeter's DC voltage setting to measure the PV port voltage. Verify if it falls within the inverter's specified PV voltage range. If not, inspect whether the power cables are properly connected and check for reverse connections at the PV port. If no reverse connections are found and the PV port voltage meets the required range, contact the inverter maintenance

team for troubleshooting.

Step 13: Send the PV inverter startup command. After 20 seconds, the PV status indicator light will transition from blinking at 1-second intervals to remaining on. If the light fails to turn on, verify the command delivery and protocol compatibility (configure for automatic activation upon PV conditions met).

(2) Start without grid-connected PV

Step 1: Check whether the power cable and communication cable are connected correctly and securely, whether the module address is correct, and whether the communication matching resistor is enabled. Refer to the wiring diagram in section 5.5 for the check.

Step 2: Test for short circuits between the positive/negative terminals of the battery port, PV1 port, PV2 port, load port (L1, L2, L3, N), and grid port (L1, L2, L3, N) using the multimeter's beeper function. If the multimeter's beeper sounds and displays an impedance below 2Ω, it indicates a short circuit between the tested terminals. Verify if the power cable has insulation damage or incorrect wiring. If no abnormalities are found, contact the converter maintenance team for troubleshooting. Otherwise, confirm no short circuit exists.

Step 3: Use the multimeter's beeper function to test for short circuits between the battery port's positive/negative terminals, load port's L1, L2, L3, and N terminals, PV1's positive/negative terminals, PV2's positive/negative terminals, and grid port's L1, L2, L3, N, and PE (grounding) terminals. If the multimeter's beeper sounds and displays an impedance below 2 Ω, it indicates a ground short circuit. In this case, check for insulation damage or incorrect cable connections in the power lines. If the beeper remains silent, no short circuit is present.

Step 4: Use the DC voltage range of the multimeter to test the battery voltage and check whether the battery voltage is within the range required by the converter. If the battery voltage is not within the range required by the converter, replace the battery pack so that the battery voltage is within the range required by the converter.

Step 5: Test the grid voltage using the AC voltage range of a multimeter to verify if the phase voltage falls within the converter's specified range. If the phase voltage exceeds the required range, check the grid phase sequence and cable connections. If both the phase sequence and cable connections are correct, the converter will operate in off-grid mode. Once the grid

voltage stabilizes, the converter will automatically resume grid-connected operation.

Step 6: Close the circuit breaker at the converter's battery terminal. Wait for 10 seconds, then check if the fault indicator light and battery status indicator light on the front panel remain illuminated. If the lights are off, use the DC measurement mode of a multimeter to verify the battery voltage at the converter's battery port falls within the specified range. If not, inspect whether the power cables are properly connected and check for reverse connections at the battery port. If no reverse connections are found and the battery voltage meets the required range, contact the converter's technical support for troubleshooting. (For parallel-connected converters, close the circuit breaker at the load port while disconnecting the main circuit breaker connected to critical loads.)

Step 7: Close the circuit breaker at the converter's grid terminal. Wait for 10 seconds and check if the grid status indicator on the front panel flashes. If the indicator does not flash, use the AC detection mode of a multimeter to verify whether the voltage at the grid port falls within the converter's specified range. If not, confirm the correct connection of the power cables and check for phase sequence errors in the grid port cables. If no reversed connections are detected, this indicates a grid fault. Wait for the grid to stabilize before rechecking the converter's status. If the measured voltage at the grid port is within the specified range, contact the converter maintenance team for troubleshooting.

Step 8: Wait for the converter's fault indicator light to transition from continuously on to continuously off, with status indicators blinking at 1-second intervals. Then issue the converter's inverter startup command. After 20 seconds, observe the operational status indicator light, battery status indicator light, and grid status indicator light transitioning from blinking to continuously on at 1-second intervals. If the operational status indicator light or battery status indicator light fails to turn on continuously, verify the successful issuance of the startup command and the compatibility of the communication protocol. If the grid status indicator light does not transition from blinking to continuously on, contact the converter maintenance personnel for troubleshooting.

Step 9: Use the AC voltage test function of the multimeter to measure the difference between the RMS values of L1, L2, L3, and N at the converter's load port and the grid phase voltage.

Verify if the difference exceeds 2V. If the measured RMS difference is greater than this threshold, check whether the multimeter's test function matches the AC voltage measurement requirements. If the multimeter's test function is set to AC voltage and within the appropriate range, and the measured RMS difference still exceeds 2V, contact the converter's technical team for troubleshooting.

Step 10: Close the main circuit breaker on the critical load side and verify its operational status. If the critical load functions normally, the converter is successfully started. If not, use the AC voltage test function on a multimeter to check the AC voltage at the critical load. Abnormal AC voltage indicates a faulty cable connection between the converter and the critical load. Normal AC voltage suggests the critical load is damaged.

6.1.2 Pre-charge steps

(1) Grid-connected photovoltaic system

Step 1: Send the shutdown command and check if the inverter's front panel status indicators (including grid status, battery status, PV1, and PV2) are blinking every second or remaining constantly off. If any indicator stays permanently lit, verify the communication protocol with the inverter and confirm successful command delivery. If no issues are detected, contact the inverter maintenance team for troubleshooting.

Step 2: Ensure that the important load is in the state of power off or the external maintenance bypass switch is closed. Otherwise, the maintenance converter will cause the power off of the important load, resulting in unnecessary loss;

Step 3: Disconnect the grid, load, battery, PV1, and PV2 circuit breakers of the converter. Post a "Under Maintenance, Do Not Power On" sign at each breaker. The converter's fault indicator will remain lit, while the grid, PV, and battery status indicators will stay off.

Step 4: Test the voltage between PV1, PV2, battery, grid, and load ports with the multimeter's DC and AC voltage ranges, respectively, to confirm it drops below 60V. If the voltage remains above 60V, wait until it falls below 60V before proceeding.

Step 5: Use the multimeter's DC voltage and AC voltage test ranges to measure the voltage between the positive and negative terminals of PV1, PV2, and the battery. Also measure the voltages 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. Verify if the voltage drops below 60V. If the voltage remains above 60V, continue waiting until the voltage drops below 60V before proceeding.

Step 6: Wait for 15 minutes until the converter is fully discharged;

Step 7: Take a photo with your phone to record the cable connections, so you won't connect the wrong cables after maintenance.

Step 8: Remove the power cable and communication cable connected to the converter, and use the insulation tape to protect the cable insulation;

Step 9: Two or more people are required to remove the converter for maintenance and repair. It is strictly prohibited for a single person to maintain and repair the converter.

(2) Shut down without grid connection and photovoltaic power

Step 1: Send the shutdown command and check if the inverter's front panel status indicators (operational, grid, and battery) are blinking every second or remaining constantly off. If any indicator stays on, verify the communication protocol with the inverter and confirm successful command delivery. If no issues are detected, contact the inverter maintenance team for troubleshooting.

Step 2: Ensure that the important load is in the state of power off or the external maintenance bypass switch is closed. Otherwise, the maintenance converter will cause the power off of the important load, resulting in unnecessary loss;

Step 3: Disconnect the converter's grid port circuit breaker, load port circuit breaker, and battery port circuit breaker, and hang a "Under maintenance, do not power on" sign at the circuit breaker. At this time, the converter fault indicator light is always on, and the grid status indicator light and battery status indicator light are always off;

Step 4: Use the multimeter's DC and AC voltage test ranges to measure the voltage between the battery port, grid port, load port, and PE. Verify if the voltage drops below 60V. If it remains above 60V, wait until all port voltages drop below 60V before proceeding.

Step 5: Use the multimeter's DC voltage and AC voltage test ranges to measure the voltage between the battery terminals (positive/negative), the grid terminals L1, L2, and L3, the grid terminals L1, L2, L3 and N, the load terminals L1, L2, and L3, and the load terminals L1, L2,

L3 and N. Verify if the voltage drops below 60V. If the voltage remains above 60V, continue waiting until the voltage decreases below 60V before proceeding.

Step 6: Wait for 15 minutes until the converter is fully discharged;

Step 7: Take a photo with your phone to record the cable connections, so you can avoid misconnecting cables after maintenance.

Step 8: Remove the power cable and communication cable connected to the converter, and use the insulation tape to protect the cable insulation;

Step 9: Two or more people are required to remove the converter for maintenance and repair. It is strictly prohibited for a single person to maintain and repair the converter.

(3) Turn off the off-grid PV system

Step 1: Ensure that the important load is in the state of power off, otherwise, the maintenance of the converter will cause the power off of the important load, resulting in unnecessary loss;

Step 2: Send the shutdown command and verify if the inverter's front panel status indicator and battery status indicator are flashing every second or remaining constantly off. If both indicators stay on, check the communication protocol with the inverter and confirm successful command delivery. If no issues are detected, contact the inverter maintenance team for troubleshooting.

Step 3: Disconnect the load port circuit breaker and battery port circuit breaker of the converter, and hang a sign "Under maintenance, do not power on" at the circuit breaker. At this time, the fault indicator light of the converter is always on, and the battery status indicator light is always off;

Step 4: Use the multimeter's DC voltage and AC voltage test ranges to measure the voltage between the battery port, load port, and PE. Verify if the voltage drops below 60V. If it remains above 60V, wait until all ports' voltage to PE falls below 60V before proceeding.

Step 5: Use the multimeter's DC voltage and AC voltage test ranges to measure the voltage between the battery terminals (positive and negative), between the load ports L1, L2, and L3, and between the load ports L1, L2, L3 and the neutral (N) terminal. Verify if the voltage drops below 60V. If the voltage remains above 60V, continue monitoring until all terminal

voltages drop below 60V before proceeding.

Step 6: Wait for 15 minutes until the converter is fully discharged;

Step 7: Take a photo with your phone to record the cable connections, so you won't connect the wrong cables after maintenance.

Step 8: Remove the power cable and communication cable connected to the converter, and use the insulation tape to protect the cable insulation;

Step 9: Two or more people are required to remove the converter for maintenance and repair. It is strictly prohibited for a single person to maintain and repair the converter.

6.1.3 The host computer controls the startup

As shown in Figure 26, when the inverter fault indicator remains off while the operational status indicator and battery status indicator flash at 1-second intervals, the upper-level computer control software selects the module ID from the upper-left corner of the selection module. This ID must match the address dialing code on the module; otherwise, parameter settings and operations cannot be performed on the inverter. After selecting the corresponding module ID, click the "All Start" button in the lower-left corner of the control software to initiate operation. For parallel-connected inverters, enable the multi-unit mode to perform simultaneous operations on all connected units. By selecting different module IDs, individual inverters can be controlled separately.

Figure 28 Schematic diagram of power-on and power-off settings

As shown in Figure 27, the converter's operational status can be determined through the' Working Mode 'option in the basic information panel at the top-left corner of the host computer software. When the converter is in grid-connected operation, users can adjust charging/discharging power by clicking' Grid-connected Power Scheduling Method' with the left mouse button, where positive values indicate discharge power and negative values indicate charging power.

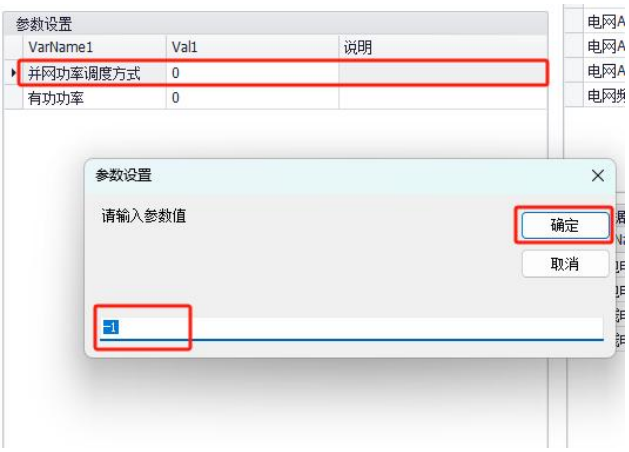


Figure 29 Power scheduling window

6.1.4 Customer EMS control system operation and power-on/off

The converter is controlled by sending on/off commands, charging power, discharging power, maximum allowable charging current, and maximum allowable discharging current through EMS. For details, refer to the relevant communication protocol.

6.1.5 Equipped with SAEMS300 for operation control and power management

The converter can be started and stopped via physical buttons, while parameters can be adjusted through the screen. Users can customize settings to meet their specific charging/discharging needs at different times. For detailed configuration instructions, please refer to the user manual of SAEMS series products.

6.2 Fault diagnosis and resolution

6.2.1 Module alarm or failure and solutions

Alarm or fault name	fault code	Shut down?	Fault recovery method	Troubleshooting measures
Soft launch failed	1	shut down	From recovery	1. Power off the module, wait 1~2 minutes, then restart the module; 2. If the issue persists after these steps, contact Zhongteng Micro Network's customer service for assistance.

Duplicate or invalid address	3	shut down	Check before startup and restore after power loss	1. Power off the module and select a different module address from the system (address range: #1 to #10). 2. Addresses range from #1 to #10. The DIP switch is arranged from left to right, with the left side representing the high bit and the right side the low bit. The 'NO' position is valid and is counted in binary. 3. After resetting the address, power off and restart to take effect.
ECAP hitch	4	shut down	From recovery	1. Check whether the network cable between the parallel machines is not properly connected. Reconnect the network cable. 2. Replace the network cable.
AC relay short circuit	5	shut down	Power off and restart	1. When the module is powered off, check whether the inverter's intermediate relay is damaged.
CPLD wave-by-wave current limiting fault	6	shut down	From recovery	1. The machine has overcurrent. Check the load or wiring.
Short circuit between input/output lines	8	Shut down	From recovery	1. Power off the module and check whether there is a short circuit between each phase and line.
Shut down with overload protection	9	shut down	From recovery	1. The device has been overloaded for a long time. Check the load.

6.2.2 Battery issues and solutions

Alarm or fault name	fault code	Shut down?	Fault recovery method	Troubleshooting measures
Busbar BUS imbalance	17	shut down	From recovery	1. Power off the module, wait 1 to 2 minutes, then restart the module; 2. Contact customer service.
Busbar BUS overvoltage	18	shut down	From recovery	1. Check for overvoltage on the busbar's P and N terminals. Deactivate the system, wait for 1 minute, then reactivate it.
Busbar BUS undervoltage	19	shut down	From recovery	1. Check whether the busbar's P and N terminals are under-voltage

				and whether the input voltage is too low; 2. Contact customer service.
Busbar BUS sampling error	20	shut down	From recovery	1. The bus voltage differs from P+N, indicating sampling error.
DC soft start failed	21	shut down	From recovery	1. Wait for the bus voltage to rise and restart the machine
Battery reversed	22	shut down	From recovery	1. Check whether the positive and negative terminals of the battery are reversed.
Battery Overvoltage	23	shut down	From recovery	1. Check whether the battery input is overvoltage. Power off and wait for 1 minute before re-powering.
Battery under-voltage	24	shut down	From recovery	1. Check whether the battery input is under voltage.
Overcurrent discharge	25	shut down	From recovery	1. Check whether the discharge is overcurrent.
Overcharge	26	shut down	From recovery	1. Check whether the current is excessive during charging.
DC contactor fault	32	shut down	From recovery	1.PTC or DC contactor malfunction.

6.2.3 Power grid faults and solutions

Alarm or fault name	fault code	Shut down?	Fault recovery method	Troubleshooting measures
Low grid frequency	33	shut down	From recovery	1. Check whether the low-frequency protection point setting of the power grid is too high; 2. Check whether the time of the low-frequency protection point of the power grid is too short; 3. Check whether the actual frequency of the power grid is too low.
High power grid frequency	34	shut down	From recovery	1. Check whether the setting of high-frequency protection point of power grid is too low; 2. Check whether the time of high-frequency protection point is too short; 3. Check whether the actual frequency of the power grid is too high.

Low grid voltage	35	shut down	From recovery	1. Check whether the setting of the power grid undervoltage protection point is too high; 2. Check whether the time of the power grid undervoltage protection point is too short; 3. Check whether the actual voltage of the power grid is too low.
The power grid voltage is high	36	shut down	From recovery	1. Check whether the setting of the power grid overvoltage protection point is too low; 2. Check whether the time of the power grid overvoltage protection point is too short; 3. Check whether the actual voltage of the power grid is too high.
Phase reversed	37	shut down	From recovery	1. Check whether the phase sequence is reversed.
Island failure	40	shut down	From recovery	
Abnormal output current	41	shut down	From recovery	1. Check whether the current output is overcurrent; 2. Check for short circuit in AC output.
The inverter overcurrent is abnormal	43	Do not turn off	Alerts, self-recovery	The machine inductor current is inconsistent with the output current.
Abnormal leakage current	47	Do not turn off	Alerts, self-recovery	1. Check whether the leakage current protection point is set too low; 2. Check whether the time of leakage current protection point is too short; 3. Check whether there is insulation problem in the power circuit (check when power is off).

6.2.4 Module system failure and solution

Alarm or fault name	fault code	Shut down?	Fault recovery method	Troubleshooting measures
Fan failure	50	Do not turn off	Alerts, self-recovery	1. Check for fan damage.

Model error	52	shut down	From recovery	1. Failed to lock phase in VF mode.
Auxiliary source error	53	shut down	From recovery	1. Check whether the auxiliary voltage is too low.
SysFault	54	shut down	From recovery	1. Report other faults that cause the shutdown. To eliminate this fault, first eliminate the other faults.
Arm hitch	55	shut down	From recovery	1. Check for dialing code errors, communication interruptions, or emergency stop failures.
Overheating fault	57	shut down	From recovery	1. Check whether the machine environment is too high and strengthen ventilation.
IGBT temperature anomaly	58	shut down	From recovery	1. Check whether the temperature difference between the three IGBTs is excessive.
Flash initialization error	59	shut down	From recovery	1.EEPROM chip initialization failed
Internal communication failure	61	shut down	From recovery	1. Check whether the wiring between DSP and ARM is unstable or disconnected. 2. Does the DSP or ARM lack a program?
CPLD unusual	64	shut down	From recovery	1. The CPLD hardware version number is incorrect.

7 Installation and use of the host computer

7.1 Install and uninstall the host computer

(1) Software installation

Step 1: Extract the installation package "setup.zip" to generate the executable file "setup.exe".

Step 2: Double-click the executable file "setup.exe" to install the software.

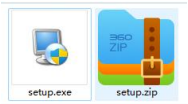


Figure 30

Step 3: Follow the prompts to install the software as shown in Figure 31 and Figure 32. The installation path is fixed by default and cannot be modified. (The installation path cannot contain Chinese characters or special symbols.)

Figure 31

Figure 32

Step 4: After successful software installation, the desktop shortcut "VGrid" will be generated, as shown in Figure 33.

Figure 33

(2) Uninstall software

As shown in Figure 34, the software can be uninstalled by entering the computer Settings function.

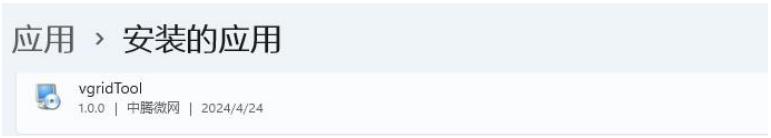


Figure 34: Host computer uninstallation window

7.2 Host computer usage

(1) communication junction

Connect the PC to the EMS RTU communication port.

(2) Upper computer software debugging function

a) Communication connection page

Step 1: Select basic information. The user type is customer, and the model and language are optional.

Step 2: As shown in Figure 35, during RTU communication, users must select the corresponding serial port and baud rate (default: 115200). After completing parameter selection, click Connect.

Figure 35

b) Display interface

The main information display interface is shown in Figure 36:

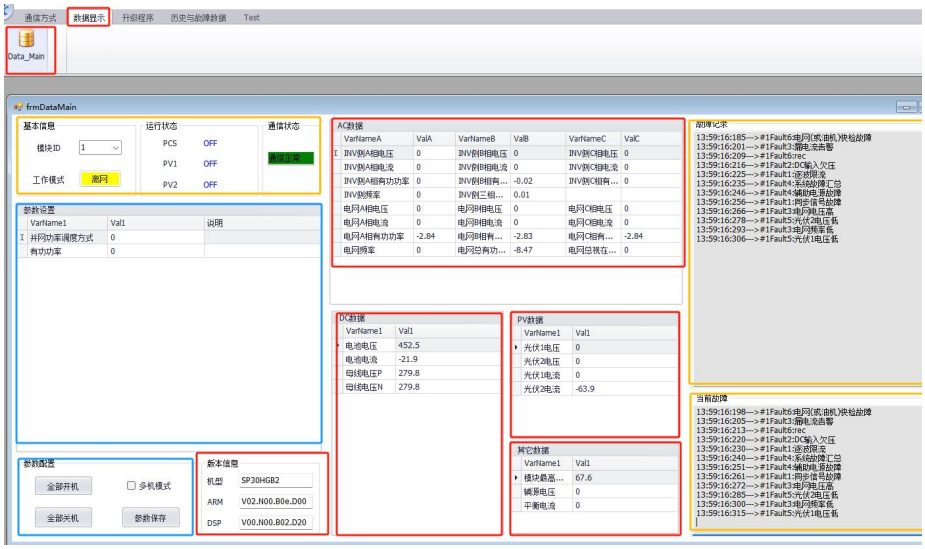


Figure 36 Information display interface

The red boxes contain read-only data, including AC data, DC data, PV data, version information, and other information. The yellow boxes indicate status information, while the blue boxes represent configurable data or information.

Information bar features (yellow box):

pay attention to
● You can select the target module ID from the dropdown options to control it. ● In the status bar, the running part of the device is marked as "Run", and the closed part is marked as "OFF".

- In the communication status box, the color is green when communication is normal and red otherwise.
- The fault record box displays all faults (including historical and current ones). When a new fault occurs, the fault record accumulates. Double-click to clear the fault information.
- The fault box displays real-time updates. When a fault changes, the information in the box updates. Double-click to clear the fault information.

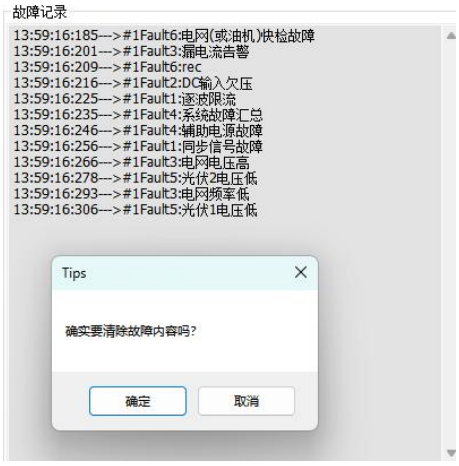


Figure 37

Description of the data or information settings bar (in the blue box):

pay attention to

- Multi-device mode: If you select multi-device mode from the lower-left corner, all devices will be turned on or off. If not selected, the operation will only affect the devices in the current module.
- Parameter settings: Left-click anywhere in the parameter row to display a pop-up window for configuration.

Figure 38: Upgrade function of the host computer

7.2.1 ARM native upgrade

The specific steps for ARM native upgrade are shown in the figure.

Step 1: Close all information display and parameter settings interfaces.

Step 2: Select "Local ARM Upgrade";

Step 3: Select "ARM" from the dropdown menu.

Step 4: Select the modules to upgrade. You can upgrade a single module or multiple modules simultaneously.

Step 5: Select the files to upgrade. The upgrade file path must not contain Chinese characters or special characters such as parentheses. The file name must include the device model as a prefix and an underscore as a separator, for example, "SP30HGB2_MASTER_CPU.hex".

Step 6: Click Start Upgrade. You can check the upgrade status in the upgrade process interface. If the upgrade fails, follow the upgrade steps to find the reason. If the upgrade is successful, the ARM upgrade is complete.

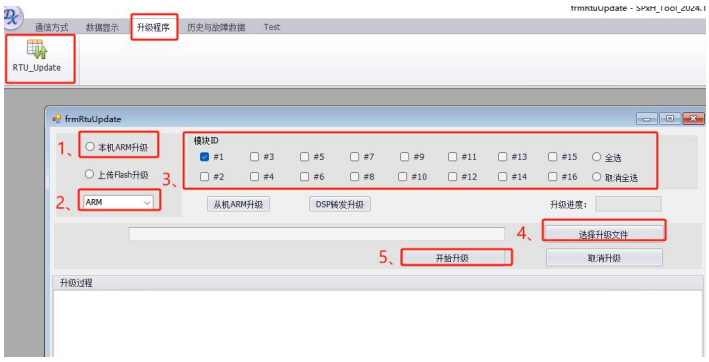


Figure 39

7.2.2 DSP local upgrade

pay attention to
● The DSP firmware upgrade consists of two phases: First, the upgrade program is uploaded to the ARM's Flash memory; second, the stored program is transferred to the DSP. During the upgrade, all other interfaces must be disabled to prevent failure. The upgrade file path must not contain Chinese characters or special symbols like parentheses, and the file name should include the device model as a prefix with an underscore as the separator, e.g., "SP30HGB2_0424.out". ● The first phase of the DSP firmware upgrade involves the following steps: Step 1: Select 'Upload Flash Upgrade'; Step 2: Choose 'DSP' from the dropdown menu. After completing these four steps, click 'Start Upgrade'. ● After completing the first upgrade phase, proceed to the second phase. After selecting the first two steps, click "DSP Forward Upgrade" to start the second phase. You can check the upgrade progress using the progress bar (if the selection box is gray, this step will be skipped by default).

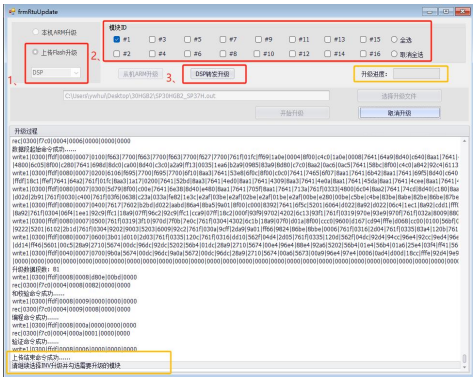


Figure 40

7.3 History and Error Page

7.3.1 history

Select the module ID, click Query History, and click Export to Excel if needed to export the data.

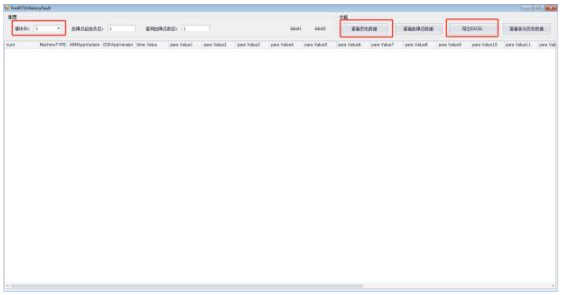


Figure 41

7.3.2 fault data

Select the module ID and the starting entry for the fault point, which indicates the address offset for querying fault point data (default is 1, representing the latest fault record). The default fault point count is 1 (multiple queries are not supported). Click Query Fault Point Data, and if needed, click Export to Excel to export the data.

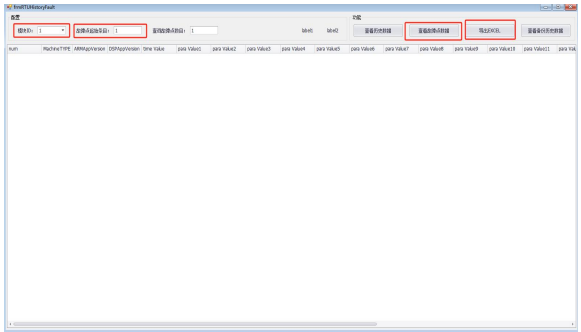


Figure 42