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HPS USER MANUAL

Hybrid Power Conversion System (Battery Inverter)

This manual specifically covers the Freedom Won Encore HPS. For a comprehensive overview of Freedom Won's products, visit the website.

Amendment Record

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2. Introduction

The Encore Hybrid Power System (HPS) inverter range is ideal for commercial operations requiring stable and lower cost energy. The inverters operate both on and off grid and offer a seamless (<20ms) transition from on grid to off grid operation in the event of a grid outage.

The inverters combine multiple energy sources to provide a managed energy flow that is adaptable to varying conditions.

Each model incorporates the option to include photo voltaic (PV) connections using optional integrated Direct Current (DC) coupled solar charge controllers.

This inverter combines various functions, including DC coupled Maximum Power Point Trackers (MPPT's) for solar panel integration, bidirectional energy conversion from DC to Alternating Current (AC), system isolation, and on/off-grid switching, to enhance local power reliability.

The HPS has a built-in busbar connection for batteries, the AC energy source connection, the load connection, and built in racks or cabinets for addition of integrated MPPTs for solar panel integration. The AC energy source input supports an external ATS integration for switching between the grid and a generator.

All models include a built-in transformer and static transfer switch as well as AC and DC circuit breakers (including a maintenance bypass breaker).

The inverters can be connected in parallel with up to four of one model in parallel. They can be integrated with AC Coupled PV inverters through the inclusion of the Freedom Won EMS (Energy Management System).

This manual applies to the Freedom Won Encore HPS inverter product range, including models with power ratings from 50kW to 500kW where the model number in the name represents the rated AC inverting power of the inverter:

- HPS50kW
- HPS100kW
- HPS150kW
- HPS250kW
- HPS500kW

The Freedom Won Encore HPS models are specifically prepared for superior compatibility with the range of Freedom Won HV and HV+ batteries as applicable as well as the powerful and versatile Freedom Won EMS. All Encore HPS plants should include a Freedom Won EMS for optimal control and monitoring.

This manual provides Freedom Won Encore HPS features, installation, operation, maintenance, and troubleshooting information for the trained installer and operator.

For safe and proper installation of the Freedom Won Encore HPS, installers and users must possess a comprehensive understanding of electrical theory and be familiar with electrical equipment and wiring.

3. Section 1: Product Description

3.1. Freedom Won Encore HPS Range Details

The Encore 50 to 150 models are self-contained units with integrated MPPT module racks, while the Encore 250 and Encore 500 models are split into two parts. The Encore 250 model consists of one AC power conversion cabinet and one PV controller cabinet .The Encore HPS500 model consists of one AC power conversion cabinet and up to two PV controller cabinets.

Each PV controller cabinet includes racks for up to six MPPT modules.

Refer to the HPS range details below, featuring a variety of sizes. For detailed information and how to configure refer to Section 2: HPS Operations and Configuration.

Table 1: HPS Range Details

Range	Range Details
About the HPS50 	The Encore HPS50 is a robust power conversion system with the following dimensions: • Width: 800mm • Depth: 800mm • Height: 1900mm • Weight: 750kg This system boasts an impressive efficiency of 96.5% and delivers a maximum output of 55kVA. It can accommodate up to two 60kW MPPT modules.
About HPS100 	The Encore HPS100 is a robust power conversion system with the following dimensions: • Width: 1200mm • Depth: 800mm • Height: 2050mm • Weight: 1150kg This system boasts an impressive efficiency of 97.1% and delivers a maximum output of 165kVA. It can accommodate up to three 60kW MPPT modules.

About the HPS150 	The Encore HPS150 is a robust power conversion system with the following dimensions: • **Width: 1200mm** • **Depth: 800mm** • **Height: 2050mm** • **Weight: 1310kg** This system boasts an impressive efficiency of 97.1% and delivers a maximum output of 165kVA. It can accommodate up to four 60kW MPPT modules.
About HPS250 	The Encore HPS250 is a robust power conversion system with the following dimensions: • Width: 1800mm • Depth: 800mm • Height: 2050mm • Weight: 1680kg This system boasts an impressive efficiency of 97.3% and delivers a maximum output of 275kVA. It can accommodate up to five (extendable to six) 60kW MPPT modules. The MPPT cabinet has the following dimensions: • Width: 600mm • Depth: 720mm • Height: 2050mm • Weight: 330kg The maximum weight of the Encore HPS250 system is 1980kg.
About the HPS500 	The Encore HPS500 is a robust power conversion system with the following dimensions: • Width: 1600mm x2 • Depth: 1050mm x2 • Height: 2050mm x2 • Weight: 2665kg This system boasts an impressive efficiency of 97.5% and delivers a maximum output of 550kVA. It can accommodate up to ten (extendable to twelve) 60kW MPPT modules. The MPPT cabinet has the following dimensions: • Width: 600mm • Depth: 720mm • Height: 2050mm • Weight: 660kg The maximum weight of the Encore HPS500 system is 3265kg.

3.2. HPS Features and Advantages

The HPS hybrid inverter has innovative features that provide efficient and flexible power solutions. Learn more about the HPS benefits:

- Supports both off-grid and grid-connected PV modes.
- Modular design for easy expansion.
- Compatible with FW energy management system (EMS) for monitoring and control.
- Scalable, supporting up to four (4) parallel connections.
- Integrated maintenance bypass switch.
- Handles unbalanced three-phase loads in off-grid mode.
- Built-in isolation transformer for adaptability to different loads.
- Seamless switching (<20ms) between on-grid and off-grid modes for uninterrupted power supply to the load.

3.2.1. Anti-export Function

- The HPS has an anti-export feature that:
- Prevents excess photovoltaic electricity from flowing back to the grid.
- Can be enabled or disabled according to user needs.
- Allows users to sell electricity to the grid for profit in permitted areas.
- Allows users to export power back to the Grid when disabled.

3.2.2. Overload Ability Feature

The HPS is designed to handle temporary overloads, allowing 110% of rated power for several minutes and up to 120% for one minute.

3.2.3. Advance Interface Options and Easy Maintenance

The Encore HPS hybrid inverter offers multiple interface options and a user-friendly design, making it easy to commission and maintain complex application scenarios.

The Encore HPS design unlocks several benefits such as:

- Multiple working modes: self-consumption, battery priority, peak shaving, etc.
- BMS system communication through RS485 and CAN.
- External EMS integration support via RS485 or Modbus TCP.
- Expandable photovoltaic controller power for flexible configuration.
- Strong three-phase unbalanced load capacity in off-grid mode.
- Power frequency design with high impact resistance.
- Dual-channel auxiliary power supply with redundant design for improved reliability.

3.3. Encore HPS Basic Functions

3.3.1. On-Grid Mode

In this mode, the Encore HPS synchronizes its voltage and frequency with the grid, adjusting its AC output accordingly.

The inverter is directly connected to the grid. It can access energy from PV and absorb additional energy from the grid to charge the battery, if necessary, as illustrated in the example below.

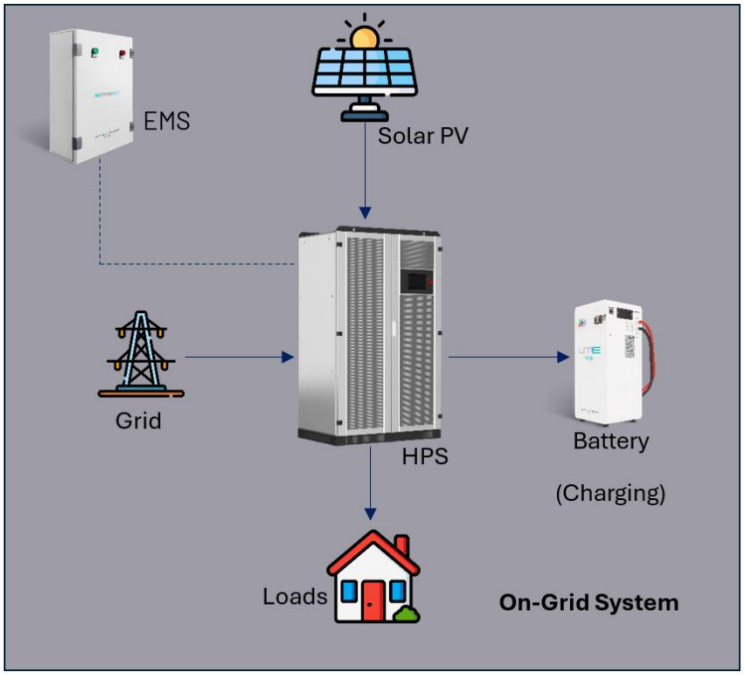


Figure 1: On-Grid Mode Scenario

3.3.2. Off-Grid Mode

In off-grid mode, the Encore HPS takes control of the microgrid by regulating both voltage and frequency to ensure a stable and reliable power supply.

The energy storage converter operates independently to provide power in the absence of the grid, as illustrated in the example below.

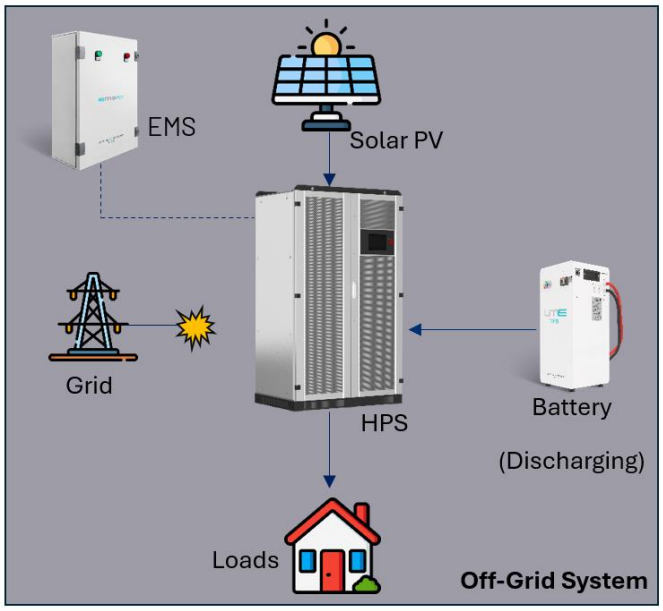


Figure 2: Off-Grid Mode Example

3.3.3. On-Grid/Off-Grid Switch

The Encore HPS supports seamless switching between on-grid and off-grid modes, with a switching time of less than 20ms. It is equipped with automatic switching capability, which enables the HPS to automatically switch from on-grid to off-grid mode when it detects abnormal grid voltage or frequency. During the switching period, the HPS continues to supply power to the loads without interruption, refer to the illustrated example below.

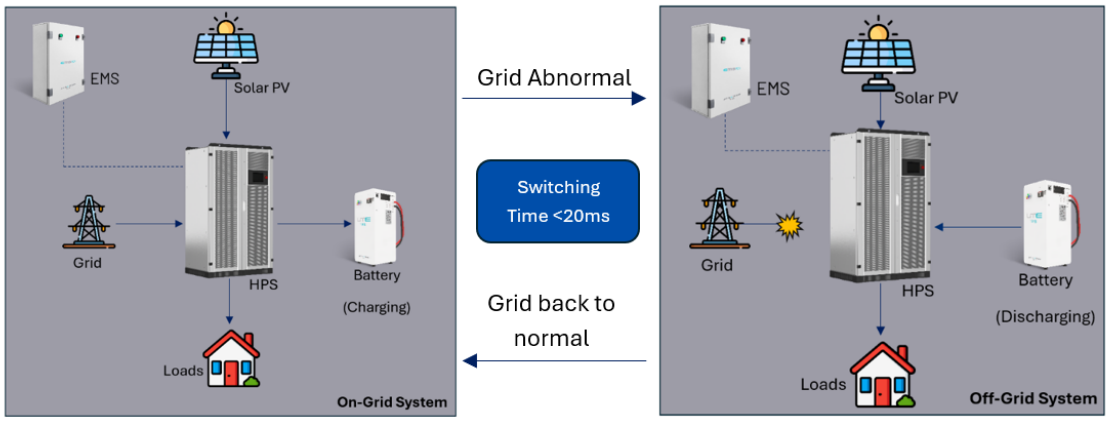


Figure 3: On-Grid/Off-Grid Switch Example

3.3.4. Parallel Connection

In large-scale applications, the Encore HPS inverter can be connected in parallel to improve system redundancy, capacity, and reliability.

A maximum of four (4) units can be connected in parallel.

It is feasible to only pair units of the same model (size).

Refer to the image below for parallel connection example. Note that each inverter requires its own DC bus with the same model and capacity batteries on each. Also note that each Encore HPS should be fitted with PV panel arrays that are similar in power potential and layout such that throughout the day the PV power delivered to each inverter is similar.

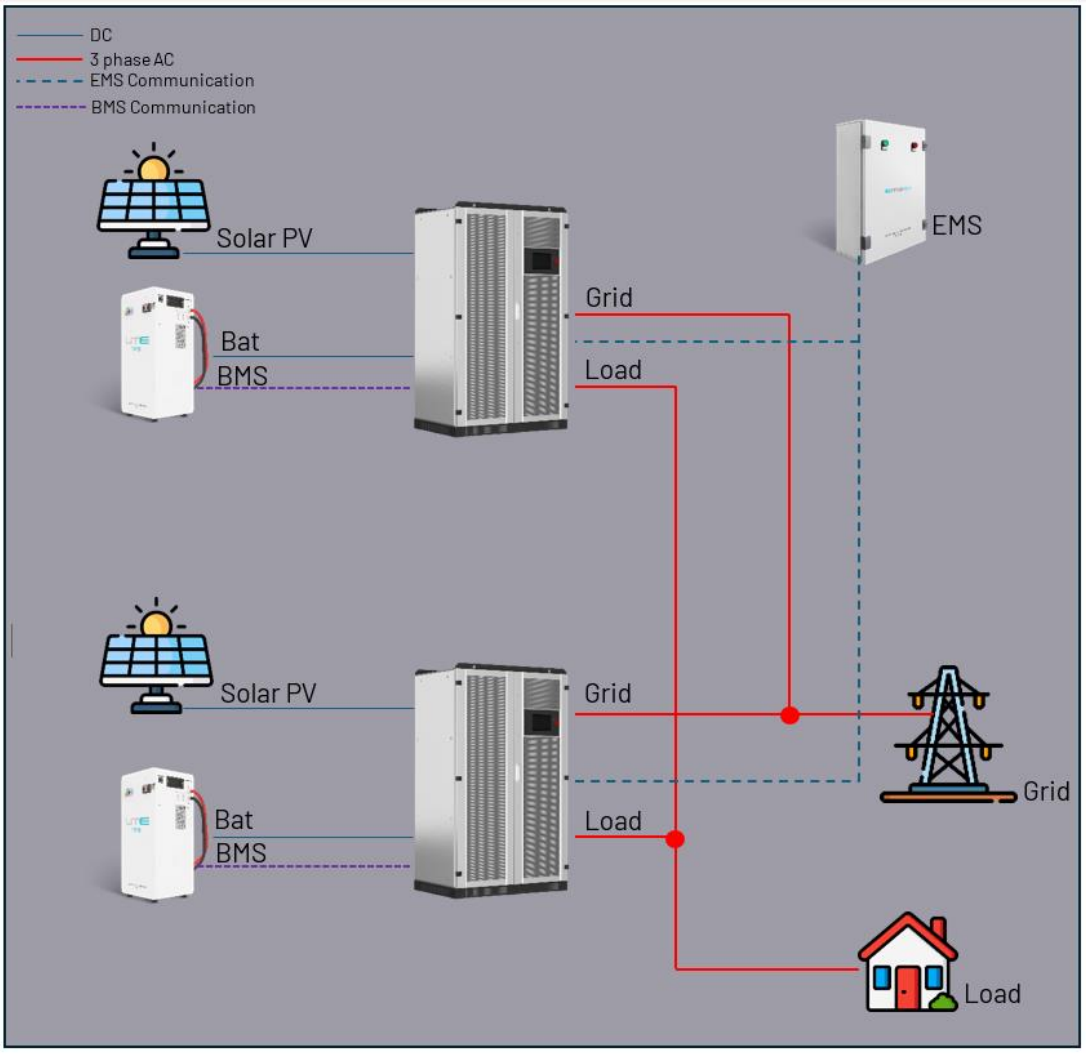


Figure 4: Parallel Connection Example

WARNING When operating in parallel mode, it is essential to complete the parallel connection setup process before applying the load to the HPS. Failure to do so may result in system failure.

3.3.5. Equipped with MPPT

Maximum Power Point Tracking (MPPT) is a technique used in PV inverters or controllers to optimise power generation from solar panels. This function ensures that the solar panels operate at their maximum power point, generating power under varying conditions. Refer to the image below for the MPPT example.

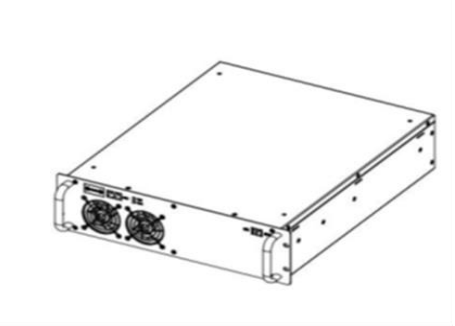


Figure 5: MPPT Module Example

The MPPT dynamically adjusts the operating voltage of PV module strings to deliver maximum power to the inverter or batteries, increasing the overall efficiency of the PV power system.

MPPT Operating Range:

- The MPPT module operates within a voltage range of 250V-850V, applicable to all models.
- The MPPT module can operate at full power when the PV input voltage is between 450V-850V.
- The maximum input current of a single MPPT module is 120A.
- Note that the string operating voltage range also depends on the battery voltage and the model and not only the range capability of the MPPT – **refer to specification sheet for important string voltage range requirements**.

Cabinet Design Examples

- The Encore HPS50 cabinet has two slots (racks), allowing up to two MPPT modules to be easily installed as shown in the figure below.

Figure 6: MPPT Module Example for HPS50

- The Encore HPS250 standalone cabinet has six slots, allowing up to six MPPT modules to be easily installed as shown in the figure below (five MPPTS installed in this example).

Figure 7: HPS250 Split Unit MPPT Slots Example

- The design makes expanding and maintaining the system easy, without wiring.
- The MPPT module uses a three-level topology, which improves conversion efficiency.

3.3.6. Over-Temperature Derating Operation

The Encore HPS operates within an ambient temperature range of -30°C to 55°C. If the temperature exceeds the limit, the Encore HPS will derate its performance.

- If the Insulated-gate Bipolar Transistor (IGBT) temperature reaches 112°C, the HPS will stop inverting:
- When the IGBT temperature drops below 73°C, the HPS can resume full-power operation.
- The converter operates at the set power when the IGBT junction temperature is less
    - than 105°C.
- When the IGBT junction temperature is higher than 105°C, the converter will be derated according to the set power percentage.

3.3.7. Equipped with Forced Air-Cooling System

The Encore HPS has multiple cooling fans, ensuring that if one fan fails, the others can continue to operate, providing system redundancy.

The air-cooling system will automatically start when the HPS reaches a certain temperature or rated power threshold. The following image displays the fan design.

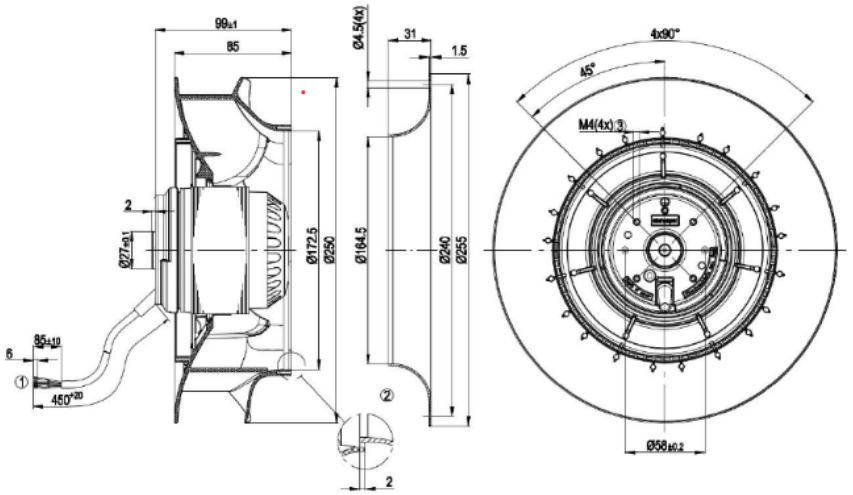


Figure 8: Forced Air-Cooling System

3.3.8. Equipped with an EPO Button

The EPO (Emergency Power Off) button is used to turn the inverter off only in a fault or emergency scenario.

- If the EPO button is not correctly used, it can cause damage to the inverter.
- Pressing the emergency shutdown button while the load is on can cause extra stress to the inverter parts, which may cause them to fail. The button should therefore only be used in an emergency.

The image below displays an example of the EPO button.

Figure 9:EPO Button

3.3.9. Centralised Control Unit Communication

The communication scheme of the HPS system involves the interaction between the Battery Management System (BMS), Energy Management System (EMS), and various data exchange protocols.

Overview of the communication scheme:

BMS and Encore HPS Communication

The BMS communicates with the HPS using standardised communication protocols such as Modbus or CAN (Controller Area Network). The BMS transmits data to the Encore HPS regarding the battery's state of charge (SoC), temperature, and other critical parameters. This information enables the HPS to optimise its operation and ensure safe and efficient energy storage and release.

EMS and BMS Communication

The EMS sends control information to the inverter based on optimisation and scheduling, enabling control of the entire HPS. The EMS also reads data from the HPS, which is used to determine energy efficiency, power management, and overall system performance.

Data Exchange Protocols

The communication between the HPS, BMS, and EMS involves various data exchange protocols, including:

- CAN/ RS485 (BMS coms)
- Ethernet /RS485 (EMS communication)

These protocols ensure timely and effective communication between the components, enabling the system to operate efficiently and safely.

Closed-Loop Communication

The closed-loop communication between the BMS and the HPS is crucial for modern energy storage systems. This communication enables the system to respond to changes in the battery's state and adjust its operation, accordingly, ensuring optimal performance and safety.

The following communication scheme illustrates the HPS system with BMS, EMS, and Data Exchange Protocols.

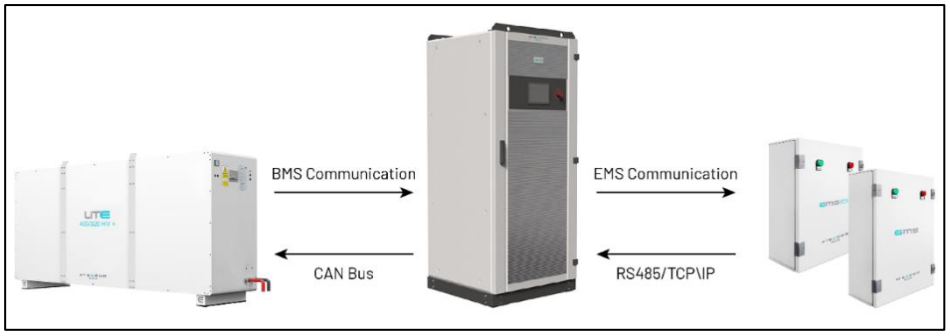


Figure 10: Centralised Control Unit Communication Scheme

3.3.10. About Loads

When connecting loads to the HPS, ensure that the total power of resistive loads does not exceed the HPS 's rated power. For inductive or capacitive loads, ensure the steady-state current does not exceed the HPS's rated current to prevent overload. Also ensure that the following limitations are applied in relation to electric motors connected to the HPS load output:

- No direct online (DoL) connected motor may be connected that exceeds 7% of the total rated inverter power. All such motors must be fitted with Variable Speed Drives (VSD's) (not electronic soft starters).
- The total (combined) power of all DoL connected motors may not exceed 20% of the inverters total rated power. Should the combined power of all DoL motors exceed this level, the largest ones must be selected from the motor list and fitted with VSD's such that the total installed DoL motor power is below the limit.
- The total installed power of all motors on VSD's may not exceed 50% of the inverters total rated power.

4. Section 2: HPS Operations and Configuration

The tables below provide an overview of the Encore HPS Range of inverters, demonstrating their key specifications and features. The range consists of five models to suit various power requirements:

- HPS50kW
- HPS100kW
- HPS150kW
- HPS250kW

The table highlights the maximum output power, rated power, voltage, current, and frequency for both on-grid and off-grid AC connections. The tables also provide details on

the photovoltaic input, battery voltage range, maximum charging power, and general data such as dimensions, weight, operating temperature, and noise emission.

4.1. AC On-Grid Technical Parameters

The following table outlines the key technical specifications for AC On-Grid systems.

Table 2: AC On-Grid Technical Parameters

Model (kW)	Maximum Output Power (kVA)	Rated Voltage (V)	Voltage Rage (V)	Rated Current (A)	Rated Frequency (Hz)	Frequency Range (Hz)	THDi	Power Factor	AC Connection	Transformer Ratio
HPS50	55	400	320 - 460	72	50/60	45 – 55/55 - 65	< 3%	1 Lagging-1 Leading (Configurable)	3W+N+PE	200/400
HPS100	110	400	320 - 460	144	50/60	45 – 55/55 - 65	< 3%	1 Lagging-1 Leading (Configurable)	3W+N+PE	270/400
HPS150	165	400	320 - 460	216	50/60	45 – 55/55 - 65	< 3%	1 Lagging-1 Leading (Configurable)	3W+N+PE	270/400
HPS250	275	400	320 - 460	361	50/60	45 – 55/55 - 65	< 3%	1 Lagging-1 Leading (Configurable)	3W+N+PE	270/400
HPS500	550	400	320 - 460	722	50/60	45 – 55/55 - 65	< 3%	1 Lagging-1 Leading (Configurable)	3W+N+PE	315/400

4.2. AC Off-Grid Technical Parameters

The following table details the AC Off-grid parameters.

Table 3: Ac Off-Grid Technical Parameters

Model (kW)	Maximum Output Power (kVA)	Rated Voltage (V)	Rated Current (A)	THDu	Rated Frequency (Hz)	Overload Capacity
50	55	400	72	≤1% Linear or ≤5% Nonlinear	50/60	110% of its rated capacity for an extended period continuously (long term). 120% of its rated capacity for 1 minute.
100	110	400	144	≤1% Linear or ≤5% Nonlinear	50/60	110% of its rated capacity for an extended period continuously (long term). 120% of its rated capacity for 1 minute.
150	165	400	216	≤1% Linear or ≤5% Nonlinear	50/60	110% of its rated capacity for an extended period continuously (long term). 120% of its rated capacity for 1 minute.
250	275	400	361	≤1% Linear or ≤5% Nonlinear	50/60	110% of its rated capacity for an extended period

						continuously (long term). 120% of its rated capacity for 1 minute.
500	550	400	722	≤1% Linear or ≤5% Nonlinear	50/60	110% of its rated capacity for an extended period continuously (long term). 120% of its rated capacity for 1 minute.

4.3. PV Input Technical Parameters

The following table guides you on the requirements for the PV string voltages per HPS model. There are two categories for string voltage selection:

4.3.1. HPS50, HPS100, and HPS150 Models: Buck Conversion Configuration

- The HPS50, HPS100 and HPS150 models are configured with a buck conversion between the PV string voltage and the battery voltage. This means that the PV string open circuit voltage (Voc) must always be configured for 200V to 250V above the maximum battery voltage.

4.3.2. HPS250 and HPS500 Models: Boost Conversion Configuration

- The HPS250 and HPS500 inverters are always configured for a boost conversion, meaning that the PV string Voc must be configured to a similar voltage to the minimum battery operating voltage – as high as possible without exceeding the minimum battery operating voltage.

Table 4: PV Input Technical Parameters

Model (kW)	Maximum Allowed PV Input Voltage (Voc)	Maximum PV Power (kW)	MPPT Module Quantity *	Recommended Input Voltage Range (Voc) *	MPPT Voltage Range at Full Load (V)
50	1000	60-120	1-2	600 - 880	450 - 850
100	1000	60-180	1-3	600 - 880	450 - 850
150	1000	60-240	1-4	600 - 880	450 - 850
250	750	60-360	1-6	450 - 650	450 - 850
500	750	60-720	1-12	450 - 650	450 - 850


Some cabinets in stock may have 5 slots instead of 6, double check what you have ordered.

Actual voltage selected depends on battery voltage – refer to 4.3.1 and 4.3.2 above.

4.4. Battery Parameters

The following table guides you on how to select the correct battery voltage for the HPS models.

Table 5: Battery Parameters

Model (kW)	Battery Voltage Range with DC Coupled MPPT's (V)	Battery Voltage Range without DC Coupled MPPT's (V)
50	320 - 680	320-850
100	420 - 680	420-850
150	420 - 680	420-850
250	600 - 850	420-850
500	600 - 850	500-850

4.4.1. Freedom Won HV Battery Compatibility

The Encore HPS50, 100 and 150 models must be matched with Freedom Won HV batteries. The HV+ batteries are not suitable for these Encore models because the higher battery voltage will disrupt the buck conversion from string voltage to battery voltage by leaving insufficient voltage gap between the battery and the strings.

4.4.2. Freedom Won HV+ Battery Compatibility

The Encore HPS250 and 500 models must be matched with the Freedom Won HV+ batteries. The higher voltage of these batteries allows greater battery discharge power at lower currents, which is more important for the larger models. The higher the battery voltage the higher the string voltage can be, which allows more power per string.

4.5. Encore HPS Modes and Functions

The Encore HPS offers four distinct operating modes: Self-consumption, Battery Priority, Mixed Mode, and Manual Mode. Users can select the most suitable mode based on their needs. These modes are only applicable when the Freedom Won EMS is not used because the EMS will control the required mode and logic where it is installed. The EMS modes operate similarly to the built-in modes but offers much more control and versatility.

Encore HPS inverters are sold without an EMS or data logger (monitoring platform), the EMS must be ordered separately, which includes logging of data to the monitoring platform.

4.5.1. Self-Use Mode

Self-Consumption Mode On-Grid

This mode prioritises powering the load. If the PV is insufficient, the system supplements it with energy from batteries or the grid.

In this mode, the grid is active, and the grid side of the Automatic Transfer Switch (ATS) is closed. The system's primary objective is to power the load. There are three possible scenarios:

1. When the PV generates sufficient electricity, it supplies power to the load and then charges the batteries. If the batteries are fully charged and the PV output exceeds the load's demand, the excess PV energy is restricted as illustrated in the image below.

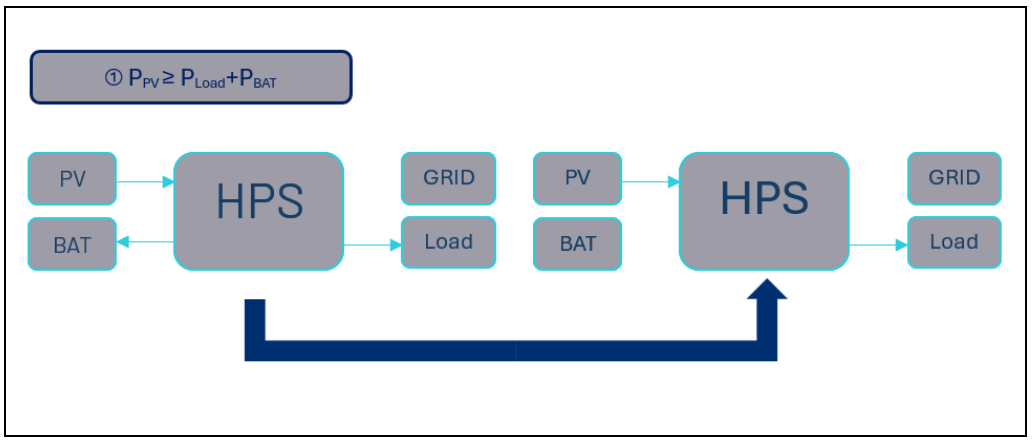


Figure 11: PV Fully Charged Scenario

2. In this scenario, the PV and batteries work together to supply power to the load, as long as their combined output meets the load's demand. To prevent deep discharge, the batteries will stop supplying power when their State of Charge (SoC) falls below 20% (adjustable set point/threshold). At this point, the load will be powered solely by the PV and the grid.

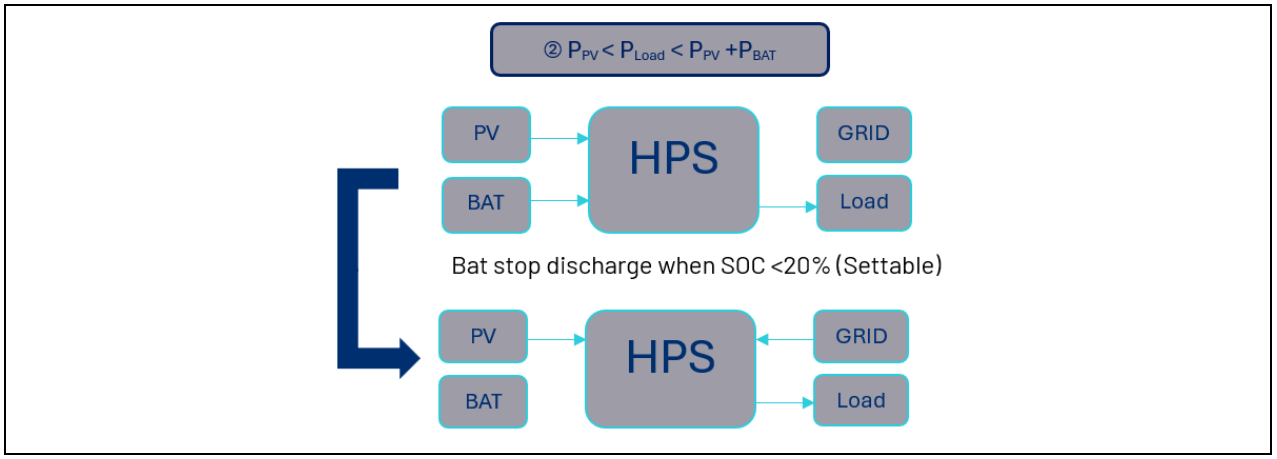


Figure 12: Control DG Power Through EMS Scenario

3. If the PV and batteries are unavailable, the grid will take over as the primary power source, supplying power to the load to ensure continuous operation.

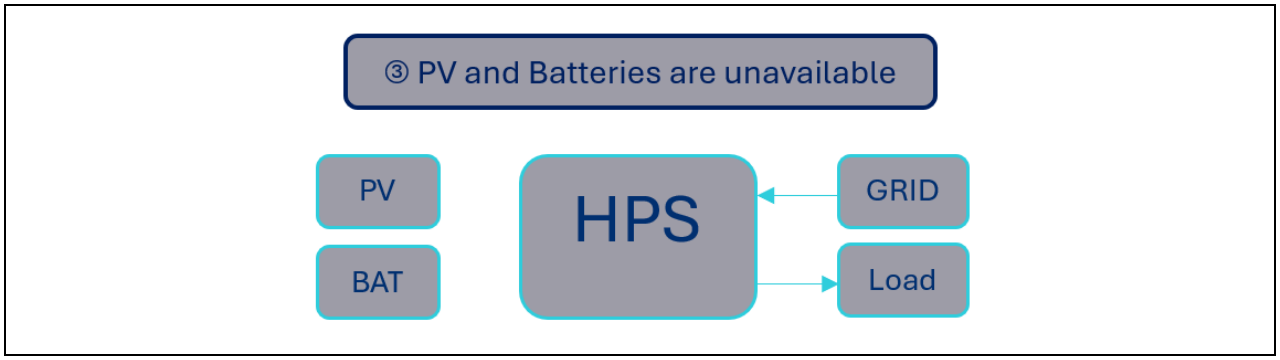


Figure 13: PV and Batteries Unavailable Scenario

Self-Consumption Mode Off-Grid

In the event of a power grid fault or outage, the ATS will automatically switch from the grid side to the diesel generator based on gen start setpoint side to ensure a seamless transition. This mode has two possible scenarios:

1. When the PV generates sufficient electricity, the primary priority is to supply power to the load. Only when the load's energy demands are fully met the excess energy will be used to charge the batteries. Once the batteries are fully charged, if the PV system continues to produce more electricity than the load requires, the solar output will be limited.

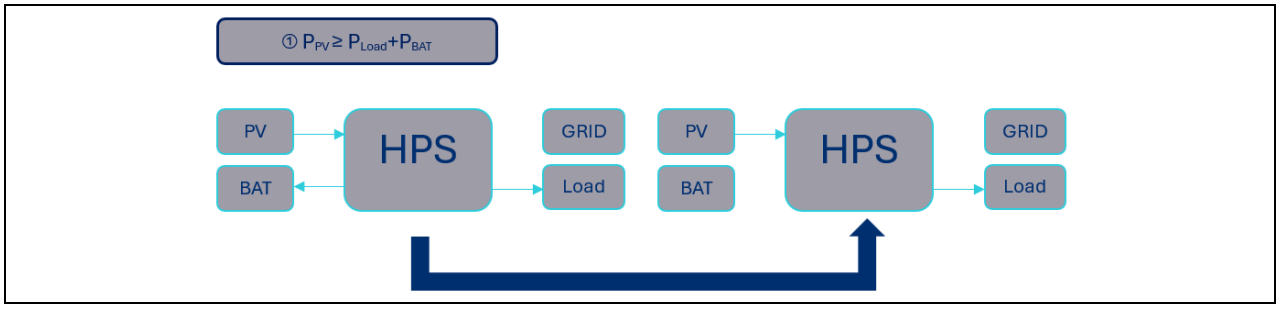


Figure 14: PV Limited

2. When the battery reaches minimum gen start SOC, the generator will start and supply power to the load and charge the battery. If gen is not available, the inverter will stop discharging on the battery's low cutoff SOC, which is 10% for Freedom Won batteries.

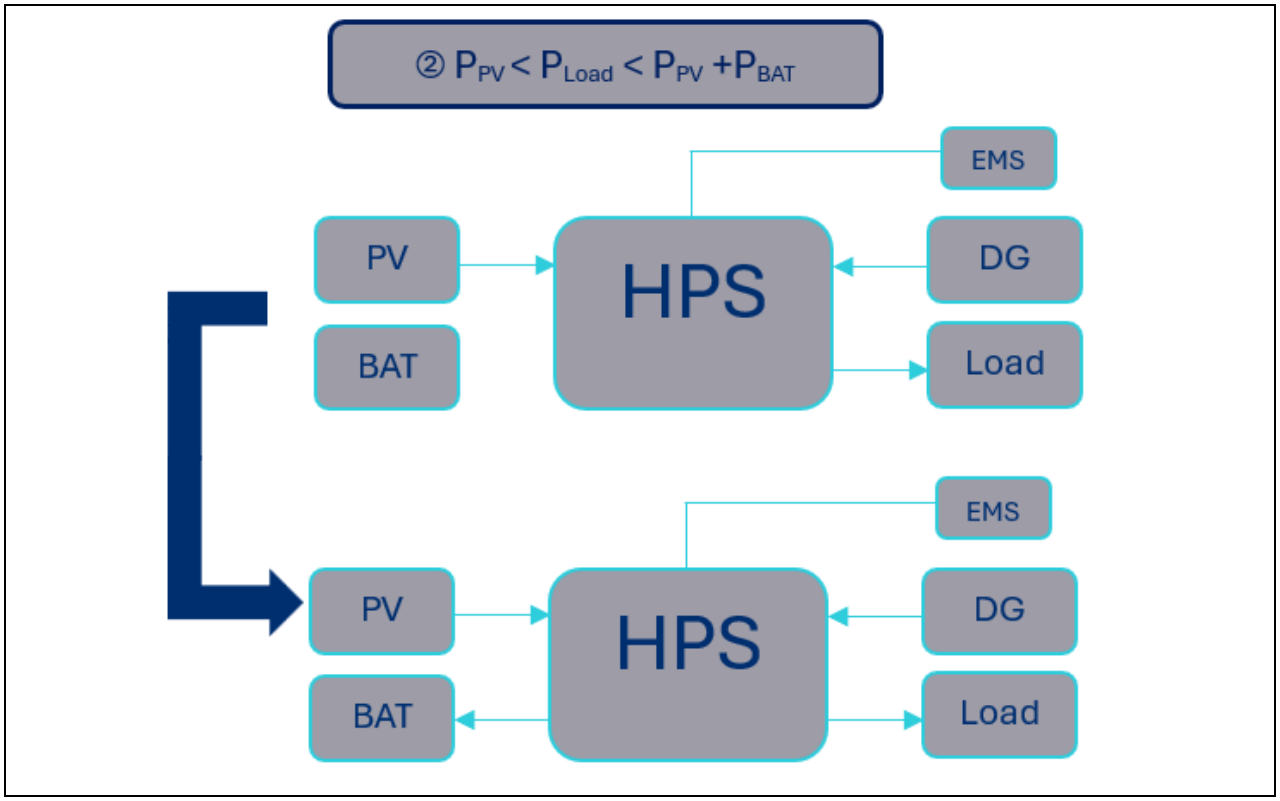


Figure 15: DG Supply to Load

a. For instance, let's consider a scenario with a 100kW diesel generator (DG) and a 20kW load. Through the EMS, we can set the DG's output power to 80% of its rated capacity, which is 80kW. In this case, the DG will supply 20kW to the load and 60kW to the battery, resulting in a total output of 80kW, which meets the setpoint of 80% of its rated power.

4.5.2. Battery Priority Mode

On-Grid Operating Mode

The grid is operational, and the grid side of the ATS is closed. The system prioritises charging the batteries in this mode, which can occur under the following five scenarios:

1. When there is sufficient PV power, the system simultaneously charges the batteries and supplies power to the load.

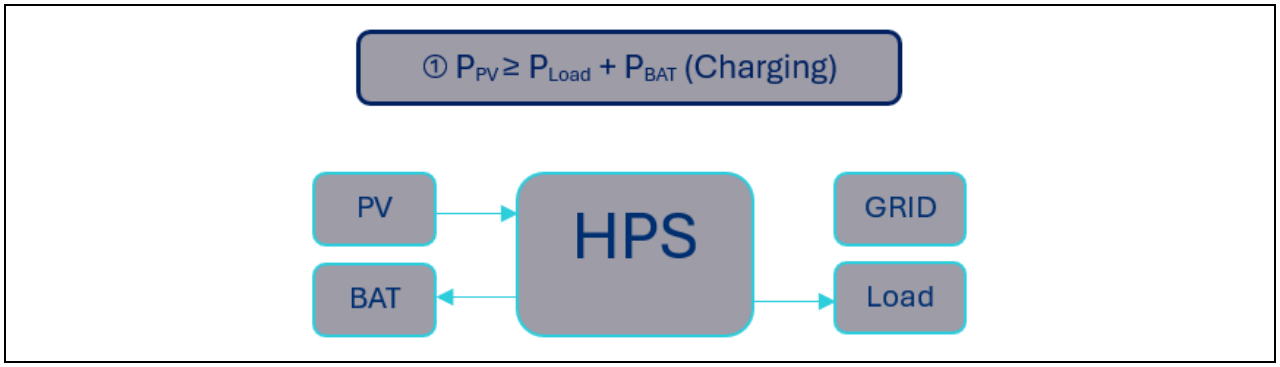


Figure 16: System Charges Simultaneously

2. When PV power is limited, the system prioritizes charging the batteries and uses grid power to supplement the remaining energy needed to power the load.

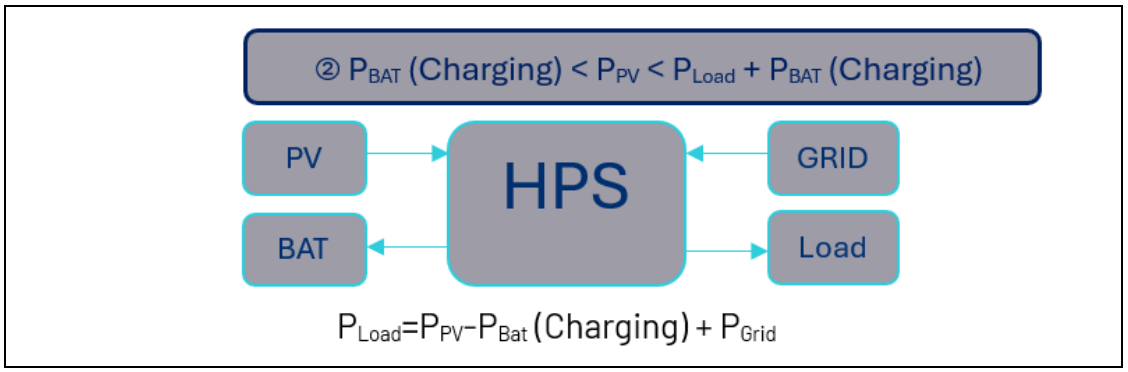


Figure 17: PV Power Insufficient

3. When PV power is insufficient to fully charge the batteries, the system uses the available PV power for charging, supplements the remaining energy needed from the grid, and simultaneously powers the load from the grid.

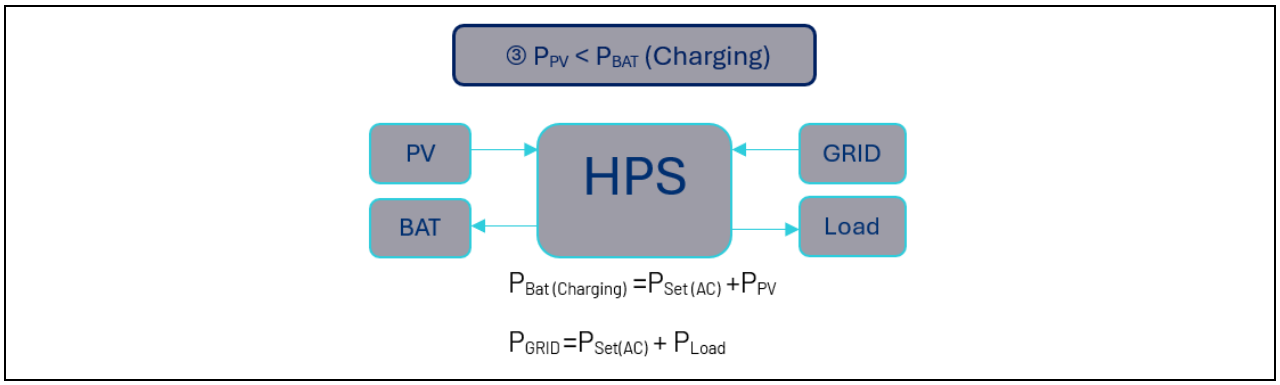


Figure 18: PV Power Limited

4. When the batteries are fully charged and PV power is limited, the system uses grid power to supply energy to the load.

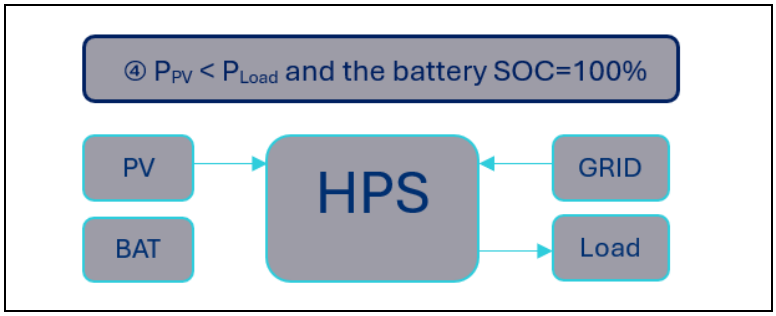


Figure 19: PV Power Limited

5. When PV power is not available, the system uses the grid to power the load and charge the batteries.

The grid provides power to the load and charges the batteries simultaneously when the PV system is unavailable.

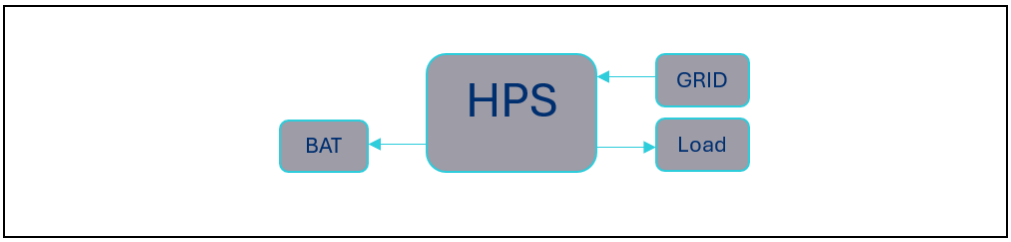


Figure 20: PV Unavailable

Battery Priority OFF Grid

The ATS automatically switches to the diesel generator (based on generator start setpoints) when there is a fault or grid outage. The system relies on PV power and batteries to meet power consumption needs. There are six possible scenarios:

1. When PV power is sufficient, the system prioritizes powering the load and uses any excess energy to charge the batteries.

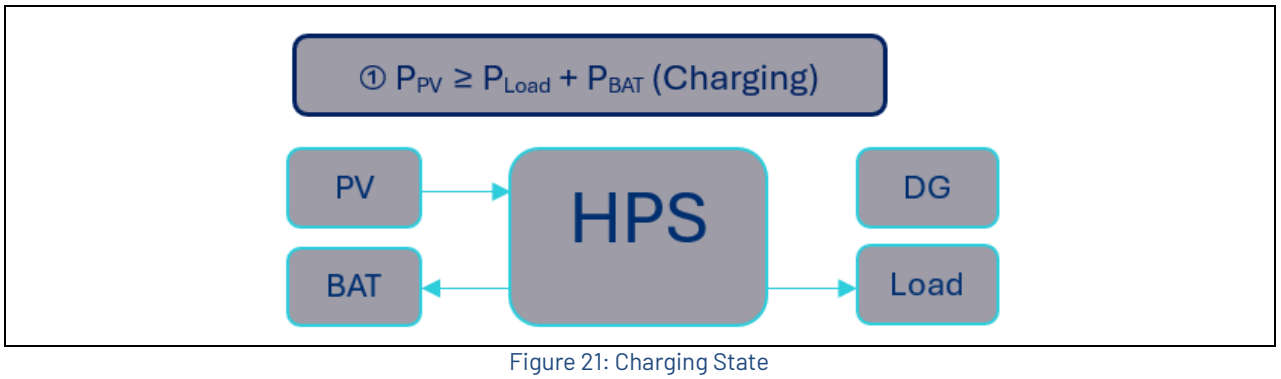


Figure 21: Charging State

2. When PV power is insufficient to meet the load's demands, the system supplements the power with energy from the batteries. If the battery SoC drops to 20%, the diesel generator is activated to support the load and recharge the battery.

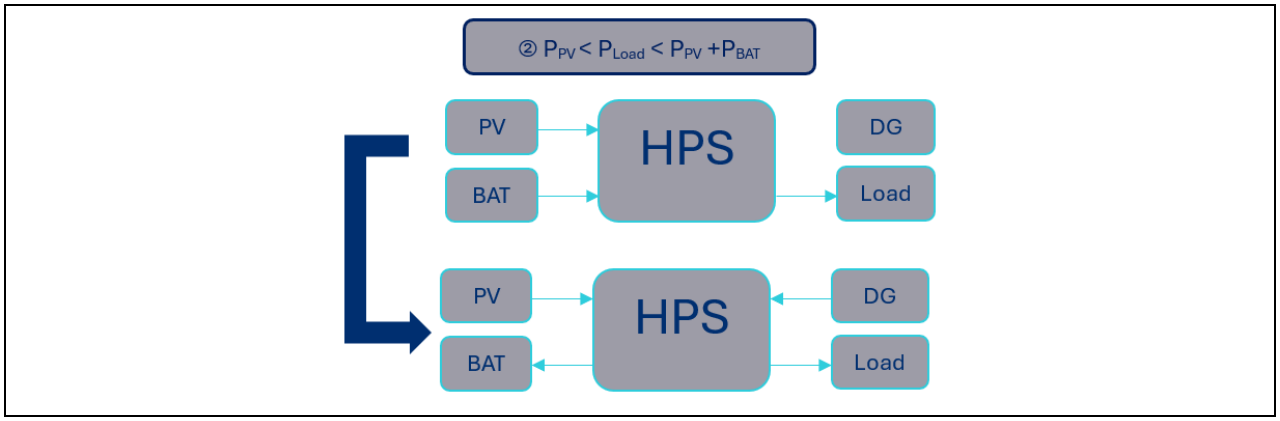


Figure 22: PV Power Shortfall

3. When PV power is not enough to power the load and charge the battery, the system prioritizes charging the battery using PV power. The remaining power needed for the load is supplied by the PV and DG working together.

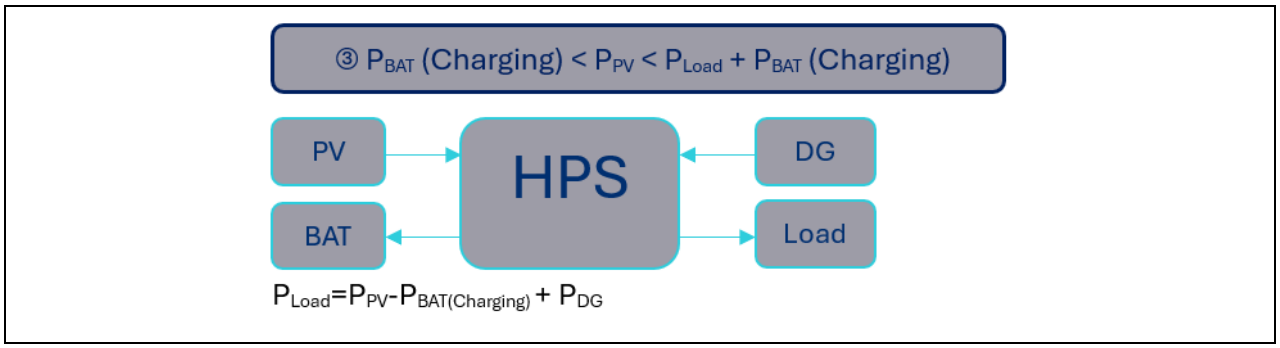


Figure 23: Battery Charging State

4. When PV power is not enough to charge the battery, the PV and diesel generators work together to charge the battery, and the load is powered entirely by the diesel generator.

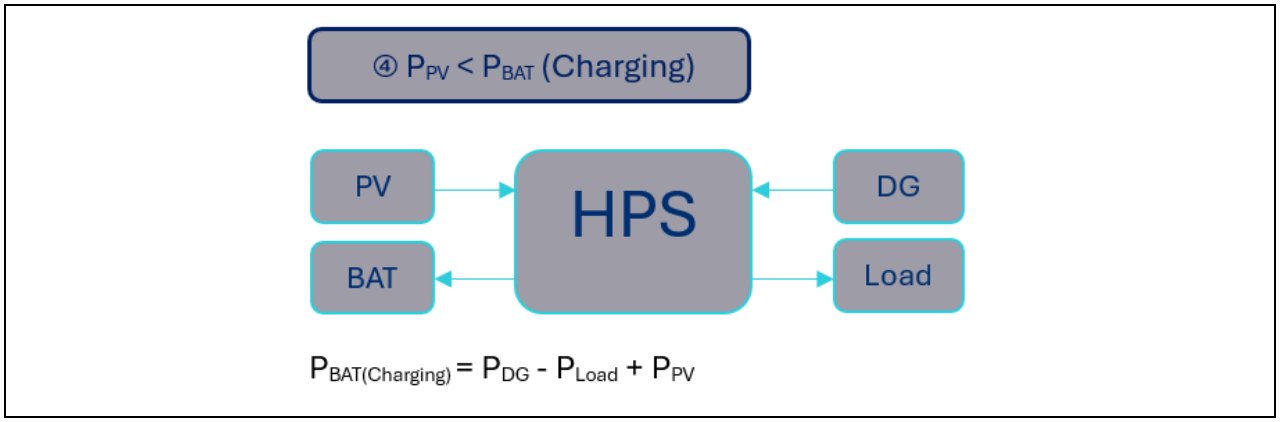


Figure 24: PV and Diesel Charging Battery

5. When PV power is unavailable, the diesel generator supplies power to the load and charges the battery.

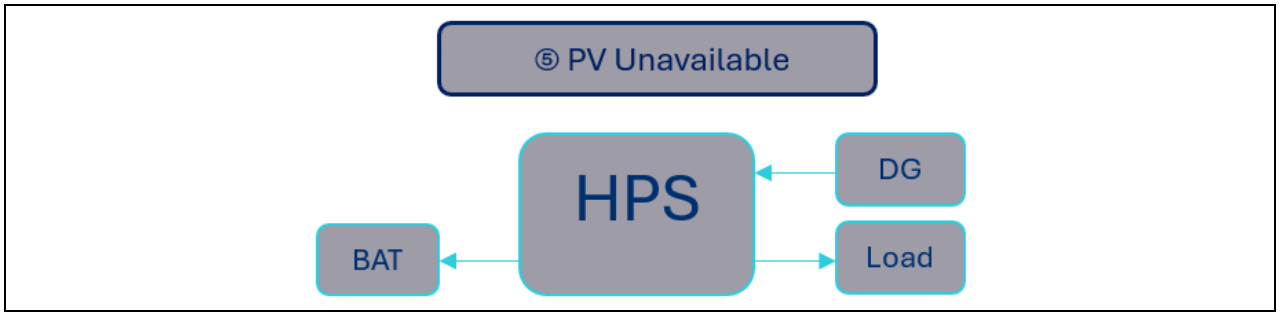


Figure 25: PV Unavailable

6. When PV power is less than the load's needs, the PV and diesel generators work together to supply power to the load.

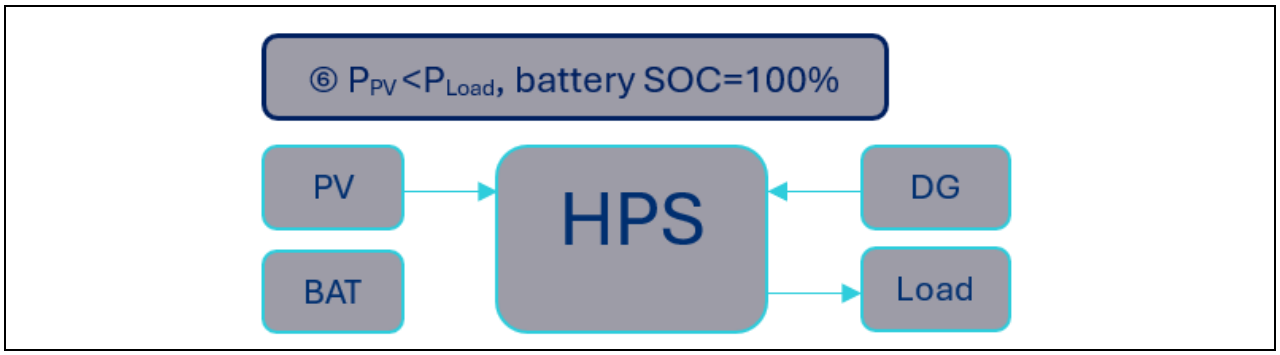


Figure 26: PV and Diesel Supply Power

4.5.3. Mixed Mode

This mode enables the system to automatically switch between various operating modes at predetermined times. For instance, users can choose a specific period by setting a start and end time, and then configure the system to either charge or discharge during that period. They can set the desired power level for that period, ensuring that the system automatically switches to the predefined charging or discharging mode with the specified power output when that scheduled time arrives.

The following two modes can be set in Mixed Mode:

1. Economic Mode:
   a) Peak: This mode enables "Self-consumption", where the load is powered by the battery.
   b) Fair: This mode also enables "Self-consumption", but the load is powered by the grid.
   c) Valley: This mode operates on "Battery priority", where the grid charges the battery and provides energy to the load.
2. Peak Shaving: This mode allows you to set the maximum grid power level.

When the anti-counter current function is turned on the system will not send power back to the grid in the following modes:

- Self-generate and self-consumption
- Peak-load shifting
- Optimal mode
- Mixed mode

4.5.4. Manual Mode

The "Manual Mode" manually controls battery charging and discharging. This mode is applicable in the following scenarios:

- Battery charge and discharge.
- EMS scheduling of the HPS.

When the user needs to manually control the system using the Freedom Won EMS, they can select 'manual mode' as illustrated in the scenario below.

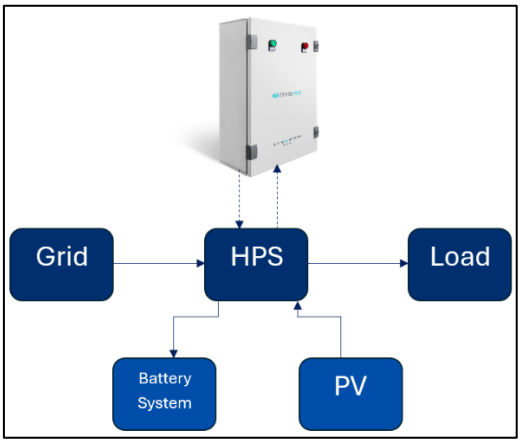


Figure 27: Manual Mode Scenario

4.5.5. Optimal Mode

This mode ensures optimal use of photovoltaic energy, grid power, and battery backup to provide power supply to the load.

- The system uses photovoltaic energy to charge the battery and power the load.
- If the photovoltaic energy is insufficient, the grid provides additional power to support the load.
- The battery provides the remaining energy if the load requires more power than the grid can supply.
- In the absence of photovoltaic energy, the grid powers the load and charges the battery if there is excess energy available.

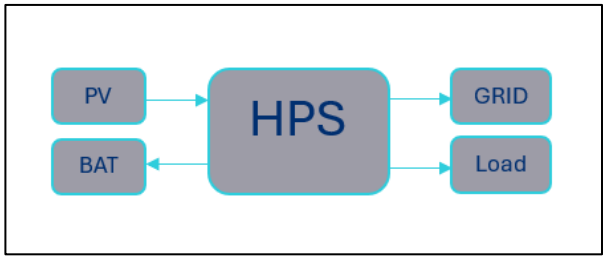


Figure 28: Optimal Mode Scenario

4.6. How to Use the HPS User Interface

The HPS has a user-friendly LCD touchscreen interface on the front of the inverter cabinet door. This interface enables users to:

- Monitor the inverter status and operations in real-time.
- View and access data parameters of the inverter, including voltage, current, and temperature.
- Adjust inverter parameters to meet specific application requirements. The image below illustrates the user interface's main menu.

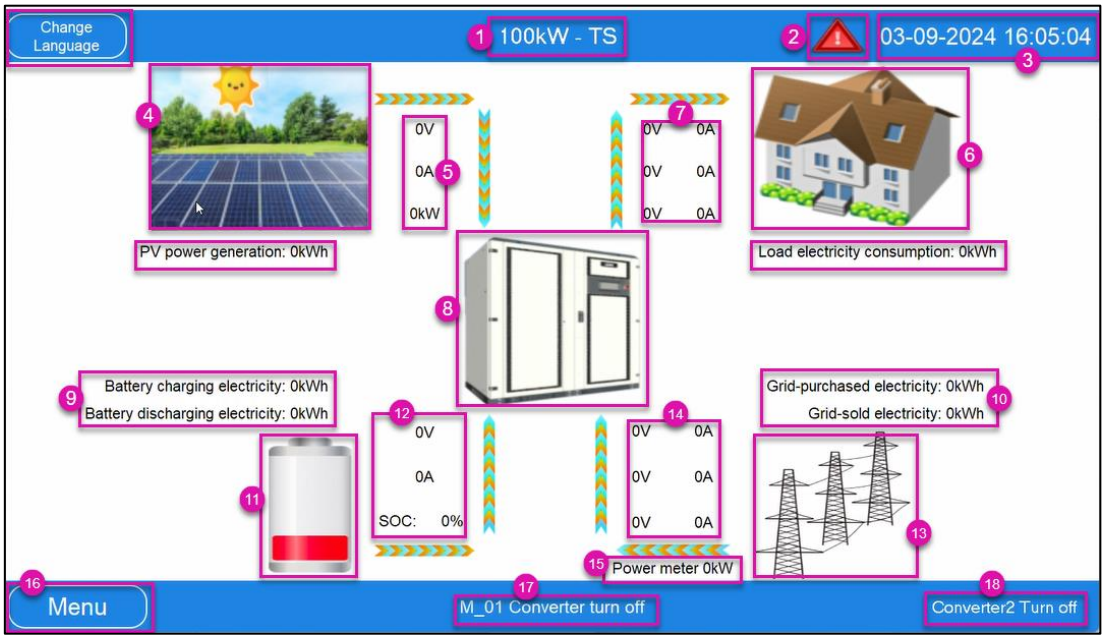


Figure 29: Software User interface

The table below lists the main menu screen options and settings.

Table 6: Software User Interface Settings

Option	Settings
1. Machine Model	View the machine model.
2. Alarm Status	Click to view current alarms.
3. Time	Click to set the time.
4. Photovoltaics (PV)	Click to jump to the real-time data interface, where you can view the real-time analogue data for each module.
5. Displayed Values	View the PV voltage, current, and power value.
6. Load	Click to access the real-time data interface and view real-time analogue data of the load.
7. Displayed Values	View the PV voltage, current, and power value.
8. Converter	Click to access the real-time data interface and view real-time analogue data of the load.
9. PV	View the PV daily power generation, battery daily charge amount, and battery daily discharge amount.
10. Daily Energy Consumption and Grid Interaction Metrics	View the load's daily power consumption, the grid's daily power purchase, and the grid's daily power sale.

11. Battery	Click to access the real-time data interface and view the summary of battery data uploaded by the BMS.
12. Battery	Battery voltage value, battery current value, state of charge (SOC) value uploaded by BMS.
13. Grid	Click to access the real-time data interface and view real-time analogue data of the load.
14. Grid	Displays Grid phase voltage and current values.
15. Power Meter	Displays power meter wattage.
16. Menu	Click to access the menu options.
17. Master Converter Button	Displays the DCAC inverter status.
18. Converter Button	Displays the DCDC converter status.

4.6.1. View the Menu Page

The interface has eight distinct buttons, each providing direct access to a specific option. Clicking on each button will redirect you to the corresponding option.

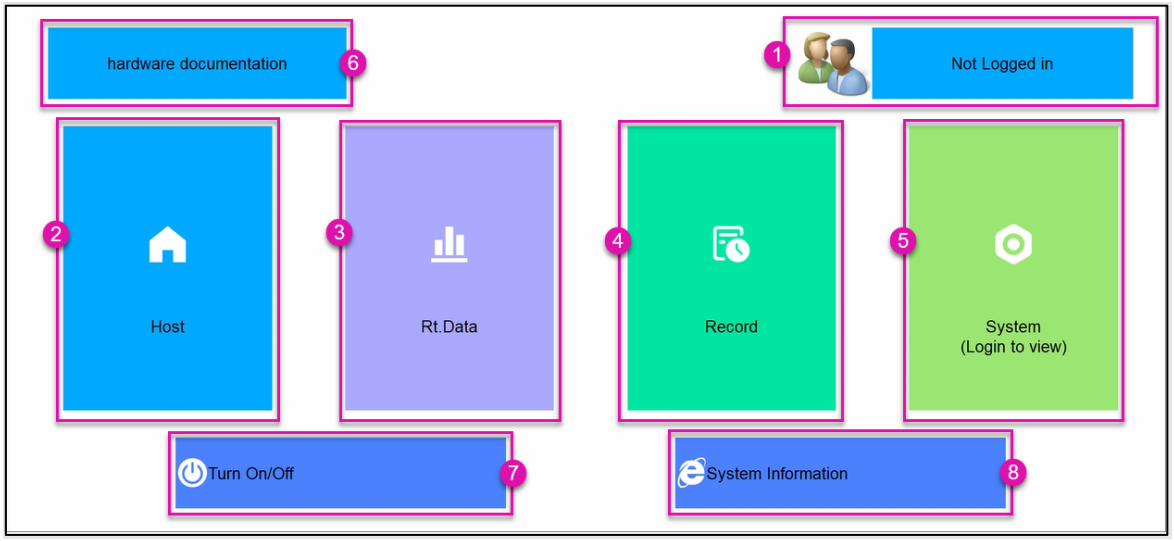


Figure 30: Menu Page

The table below lists the menu page and settings.

Table 7: Menu Page Settings

Option	Settings
1. Login	Click to access the login page, where you will be directed to a customized interface based on your user role and permissions.
2. Host	Click to return to the homepage.
3. Rt.Data	Navigate to the real-time data page to view analogue data for inverters, photovoltaics, the grid, and loads. This includes the operational status of various devices like circuit breakers, contactors, inverters, battery data uploaded by the BMS, and device alarms.
4. Record	This option lets you record data, logs, and statistics for PVs, batteries, loads, and the grid.
5. System	The system option lets you choose the working mode and set the necessary parameters
6. Hardware Information	This option is not available on the latest version.
7. On/Off	Access the on/off button to control the operation of the DCAC and DCDC converters independently.
8. System Information	Use this option to view the monitoring, DCAC converter, DCDC converter versions, serial number (SN code) and network port information.

4.6.2. Login to the User Interface

To log into the interface, do the following steps.

You cannot access system settings or change work modes when you are not logged in. The system will automatically log out after one (1) hour of inactivity.

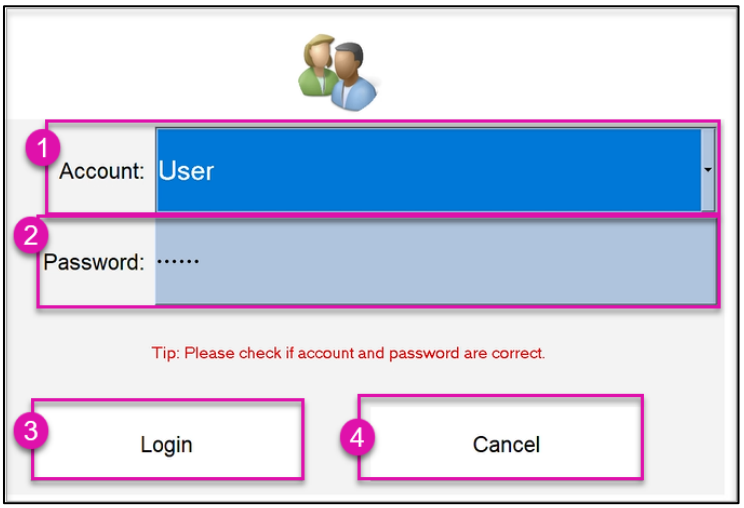


Figure 31: Login Screen

1. Click on the Account drop-down arrow to select your account. The following options will be available:
   - User
   - Maintenance
   - Super Permission

The default password for the "User" account is 123456. This mode allows you to modify only the basic settings, advanced settings are view-only.

2. Enter your password in the required field and click the "Login" button. You will be redirected to the homepage after a successful login.

4.6.3. Set the System Modes

Once logged in, you can view work modes, switch between modes, and adjust basic and advanced settings.

1. Basic Settings include:
   - DC/AC parameters
   - DC/DC parameters

- Battery settings
- Time segment settings

2. Advanced Settings include:
    - Function settings
    - System settings
    - Peripherals
    - DC/AC tuning
    - DC/DC tuning
    - Port messaging

In the Mode Introduction, active buttons are displayed in blue, and inactive mode buttons are displayed in light blue, as illustrated in Figure 32.

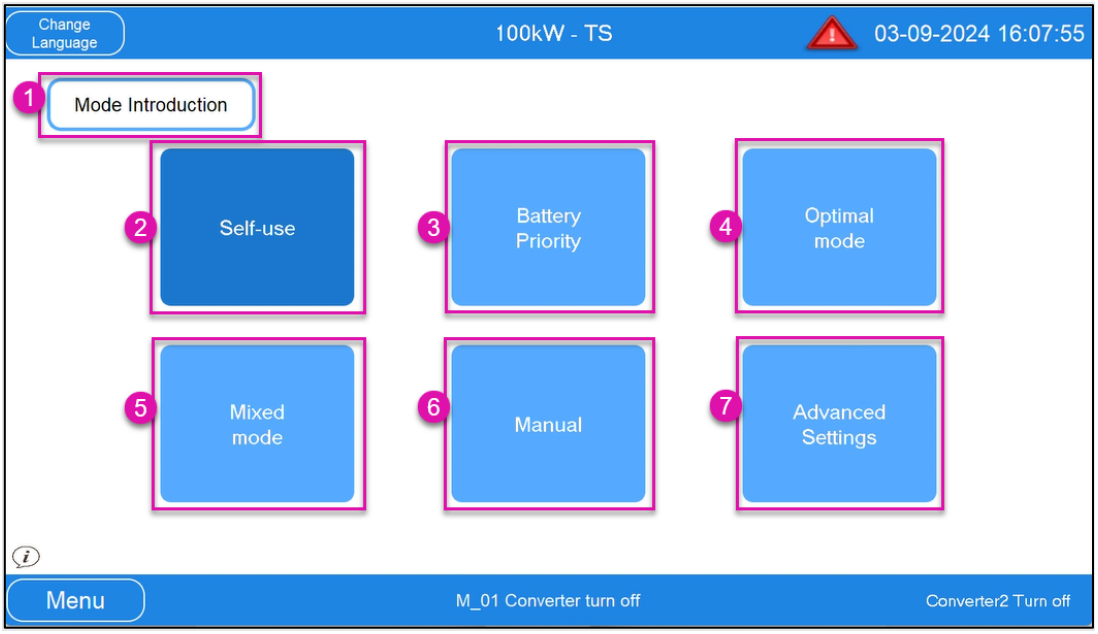


Figure 32: System Options

The table below displays the Mode Introduction options and settings.

Table 8: Mode Introduction Settings

Options	Settings
1. Mode Introduction	Click on the Mode Introduction button to view the operational logic of each work mode.
2. Self-Consumption	To configure the Self-Consumption mode, click to access the basic settings interface, activate the Self-Consumption mode, and adjust relevant parameters.
3. Battery Priority	To configure the Battery Priority mode, click to access the basic settings interface, where you

	can activate the Battery Priority mode and adjust relevant parameters.
4. Optimal Mode	To configure the Optimal Mode, click to access the basic settings interface, activate the Optimal Mode, and adjust relevant parameters.
5. Hybrid Mode	To configure the Hybrid Mode, click to access the basic settings interface, activate the Hybrid Mode, and adjust relevant parameters.
6. Manual	To configure Manual Mode, click to access the basic settings interface, where you can activate the Manual Mode and adjust relevant parameters.
7. Advanced Settings	Click to access advanced settings.

4.6.4. Learn How to Navigate Between Modes

Follow these steps to navigate between modes and view details.

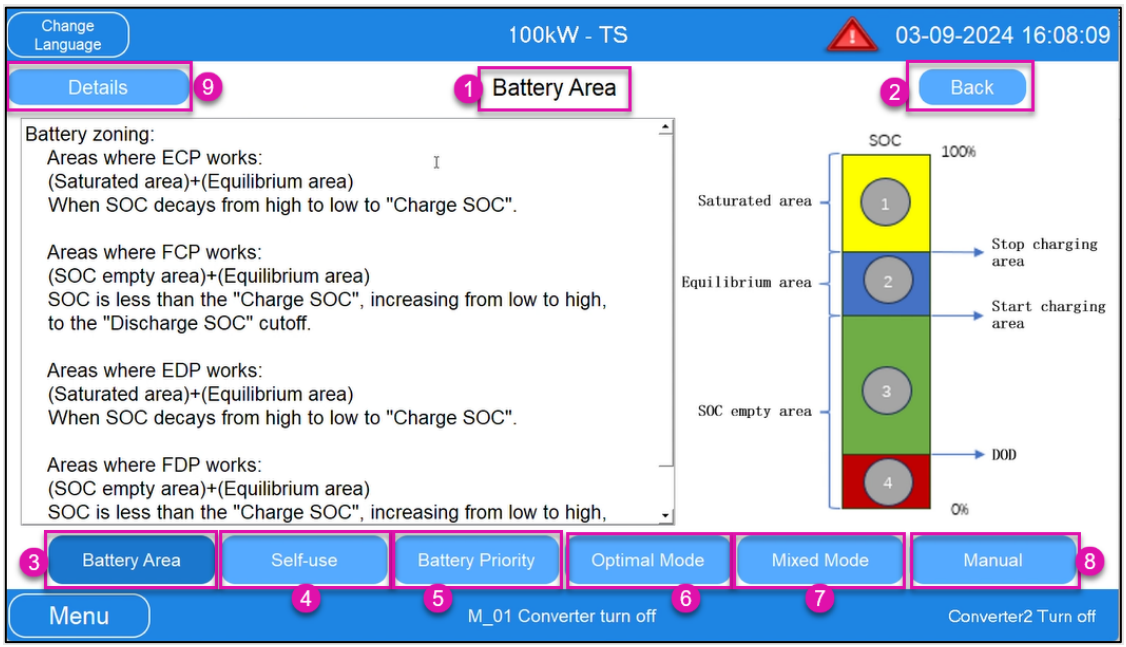


Figure 33: Mode Settings

The table below illustrates mode details and settings.

Table 9: Mode Settings

Option	Settings
1. Battery Area	View the information of the currently selected option.
2. Back Button	Click to return to the system page.
3. Battery Area Button	Click to view the introduction of the battery area division.
4. Self-use Button	Click to view the operation logic of the self-use mode.
5. Battery Priority Button	Click to view the operation logic of battery priority mode.
6. Optimal Mode Button	Click to view the operation logic of the optimal mode.
7. Mixed Mode Button	Click to view the operation logic of the mixed mode.
8. Manual Button	See the manual mode logic.

Basic Setting

Users can navigate through pages using the navigation arrow button, view the current selected mode, exit and return to the interface, and access these pages: DC/AC Parameters, DC/DC Parameters, Battery Settings, and Period Settings.


Greyed-out parameters cannot be adjusted.

Figure 34: System Overview

The table below illustrates system options and settings.

Table 10: System Settings

Option	Settings
1. Page Title	View the current page title.
2. Navigation Arrow	Click to navigate to the previous page.
3. Battery Priority	View the current working mode type.
4. Navigation Arrow	Click to navigate to the next page.
5. Page Number Button	View the current page number and the total page number.
6. Mode Enable Button	Click to activate and apply the currently selected mode.
7. Exit Button	Click to close the current page and return to the system screen.
8. Current Page settings	The table displays the current parameter settings.

4.6.5. Real-time data

The Real-time Data interface is divided into five options: Device Data, Device Status, Device Alarms, Battery Data, and BMS Alarms.

These options display the current real-time status and data for the machine's various components.

The Device Data option allows you to view detailed real-time data for the inverter, PV, grid, and load. Users can click on the corresponding buttons on the right side. After clicking the “Converter” button, the interface will display the detailed inverter data as shown in the diagram Figure 34.

View Device Data

This interface displays real-time operational data for the machine, covering:

- Inverter
- PV
- Grid
- Load

Click on one of the buttons displayed on the right side of the interface to view detailed data for each unit. For instance, selecting the Inverter button displays the following detailed information.

Figure 35: Device Data

The table below illustrates Device Data options and settings.

Table 11: Device Data

Option	Settings
1. Device Data Button	Click this button to view detailed real-time analogue data for the inverter, PV (photovoltaics), grid, and load.
2. Device State Button	Click this button to view the operational status of various devices such as circuit breakers, contactors, and inverters.
3. Device Alarms Button	Click this button to view current DCAC and DCDC alarms.
4. Battery Data Button	View a summary of battery data uploaded by the BMS.
5. BMS Alarms Button	Click to view BMS alarms uploaded from the Battery Management System (BMS).
6. Converter Button	Click to view analogue data related to the inverter.
7. PV Button	Click to view analogue data related to PV.
8. Grid Button	Click to view analogue data related to the grid.
9. Load Button	Click to view analogue data related to the load.
10. Real-Time Analogue Data Display	This data is displayed in the table on this interface.

View the PV Data

After clicking the PV button, the interface will switch to the PV data interface. The data list on this interface includes twelve (12) buttons representing the number of modules. Offline modules will be displayed in a dimmed state. View the figure below for more details on PV Data.

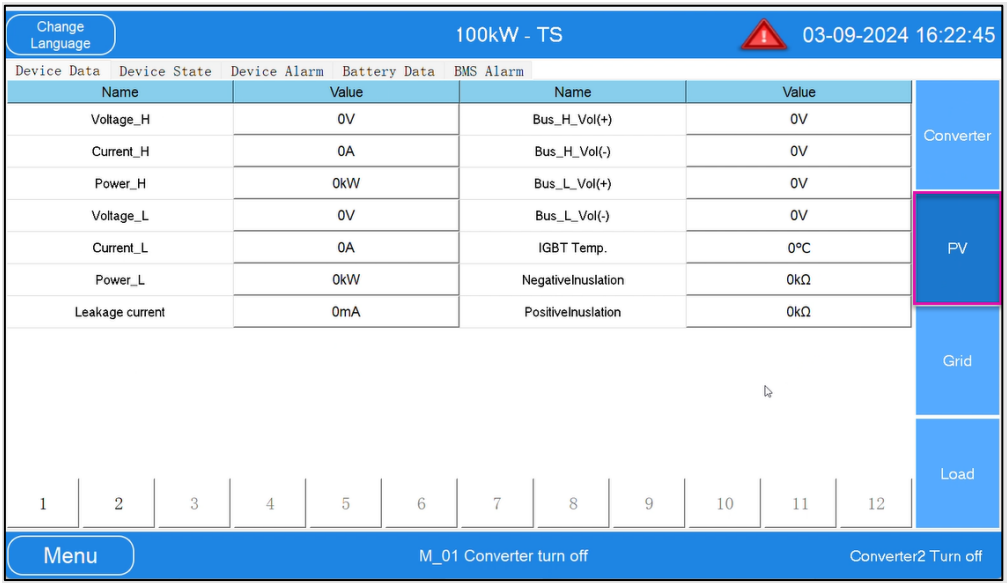


Figure 36: PV Data

View the Grid Data

Click on the Grid button to view the grid data.

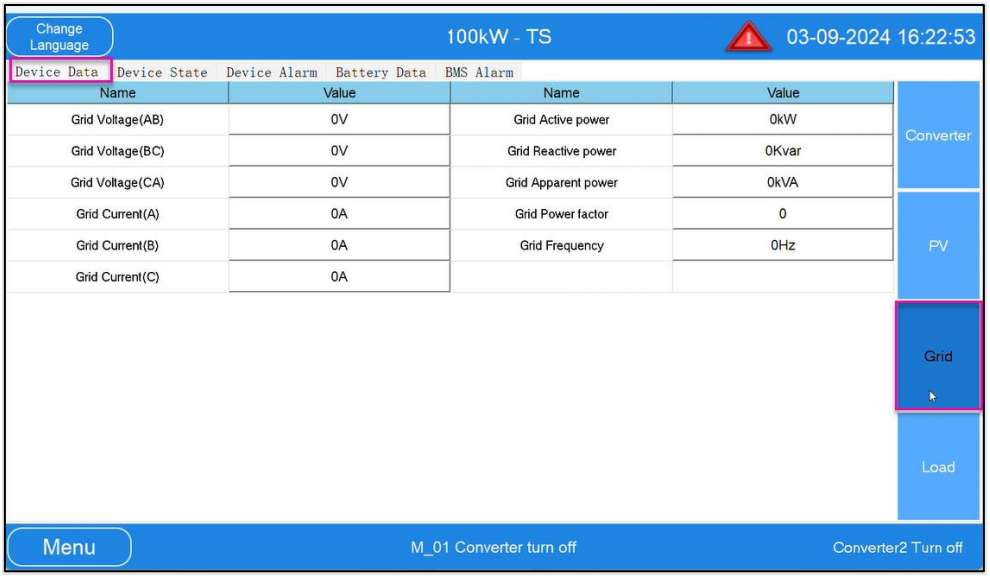


Figure 37: Grid Data

View the Loaded Data

Click on the Load button to view loaded data.

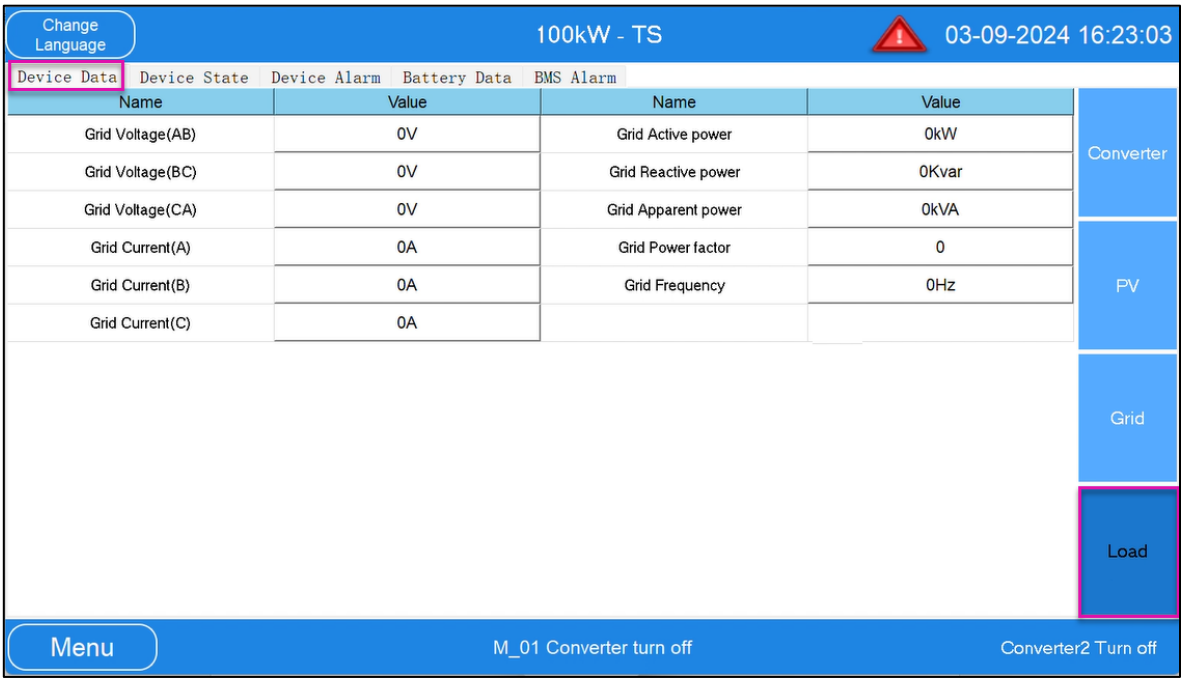


Figure 38: Load Data

4.6.6. View the Device State

This interface shows the status of HPS components such as circuit breakers, contactors, and inverters. This helps the user to understand the system's operational status.

The data is organized into three columns:

- The first two columns show the real-time status of the DC-AC module.
- The third column shows the status of the DC-DC module.

Offline modules are displayed in a dimmed state. When you click on the module number the system will automatically update to real-time status.

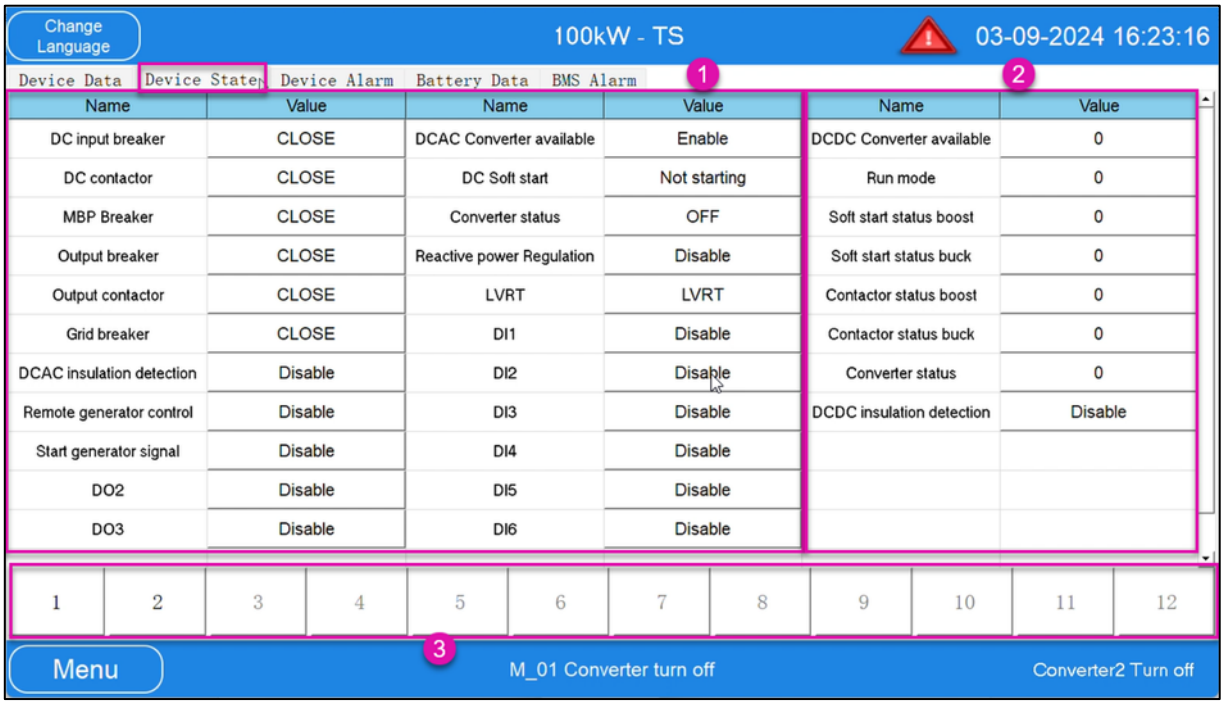


Figure 39: Device State

The following table displays the Device Statuses.

Table 12: Device State Details

Option	Settings
1. Display DCAC Status	Displays the status of the DCAC module.
2. Display DCDC Status	Displays the status of the DCDC module.
3. Select Module Number	Select the module number to update the corresponding module's PV status.

4.6.7. Device Alarm

This Device Alarm tab allows the user to view faults and alarms that occur during the operation of the machine, including descriptions of alarms related to DCAC and DCDC components.

Users can view the total number of alarm pages and the current page number. Users can select a specific page by clicking on the page number box or navigate through the pages using the back and forward ("<" and ">") buttons. When faults occur during machine operation, the alarm tab allows users to understand the causes of these faults, facilitating effective troubleshooting. The screen below is for illustration only.

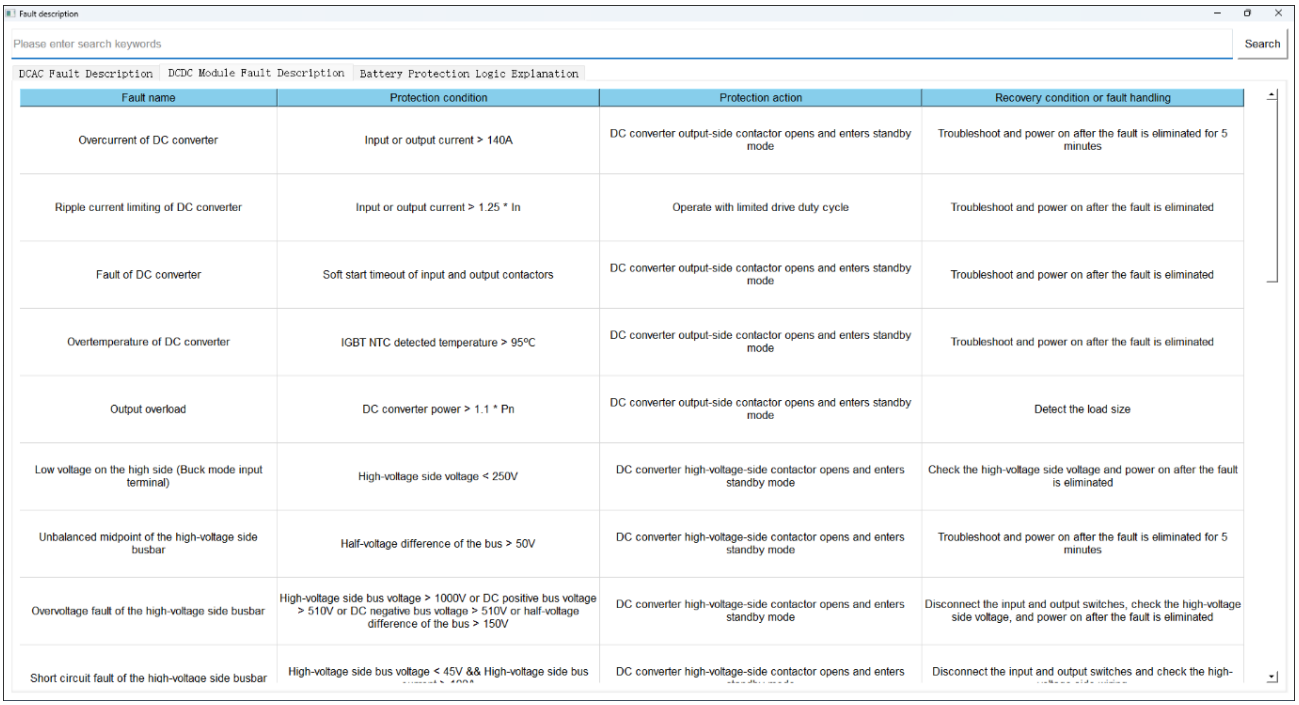


Figure 40: Device Alarm

The table below displays Device Alarm settings.

Table 13: Device Alarm Settings

Option	Settings
1. |<	Click this button to navigate to the first page.
2. <	Click this button to navigate to the previous page.
3. >	Click this button to navigate to the next page.
4. >|	Clicking this button on the alarm description page will jump to the last page.
5. DCAC Alarm description	Displays the current DCAC alarm that has been triggered.
6. DCDC Alarm description	Displays the current DCDC alarm that has been triggered.

4.6.8. Battery Data (Lithium Battery)

This tab displays lithium battery data uploaded from the BMS.

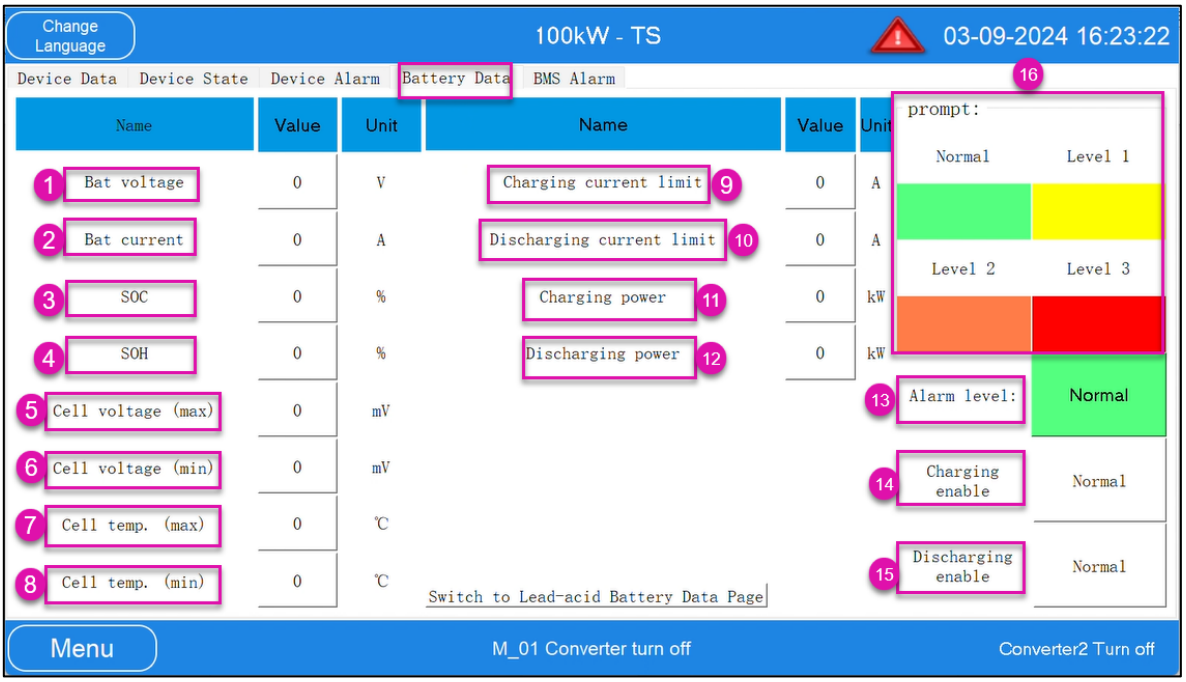


Figure 41: Lithium Battery Data

The table below displays uploaded lithium battery data.

4.6.9. Battery Data (Lead-acid)

This tab displays uploaded lead-acid battery uploaded data.

Table 14: Battery Data (Lead-acid)

Option	Settings
1. Battery Voltage	Displays the total battery voltage uploaded by the BMS.
2. Battery Current	Display the total battery current uploaded by the BMS.
3. SOC (State of Charge)	Percentage of the remaining charge in the battery pack uploaded by the BMS.
4. SOH (State of Health)	Displays the percentage of the battery pack's remaining usable capacity after a full charge, compared to its original capacity, as reported by the BMS.
5. Highest Single Cell Voltage	Displays the highest voltage of a single cell, as reported by the BMS.
6. Lowest Single Cell Voltage	Displays the lowest voltage of a single cell as reported by the BMS.
7. Highest Single Cell Temperature	Displays the highest temperature of a single cell reported by the BMS.
8. Lowest Single Cell Temperature	Displays the lowest temperature of a single cell uploaded by the BMS.
9. Charge Current Limit	Displays the maximum charging current limit reported by the BMS.
10. Discharge Current Limit	Displays the minimum discharge current limit reported by the BMS.
11. Charging Power	Displays allowed charging power reported by the BMS.

12. Discharging Power	Displays allowed discharging power reported by the BMS
13. Alarm Level	Displays the alarm level reported by the BMS, with three levels: • Level 1: Yellow • Level 2: Orange • Level 3: Red By default, the inverter ignores Level 1 and 2 alarms but shuts down in response to Level 3 alarms.
14. Charge Enable	Displays the battery charging status reported by the BMS, indicating whether the battery is: • Enabled (can be charged) • Disabled (cannot be charged)
15. Discharge Enable	Displays the battery's discharging status, as reported by the BMS, with two possible states: • Enabled: Battery can be charged • Disabled: Battery cannot be charged
16. Alarm Level Colour 17. Indication	Colour indication for the current alarm level.

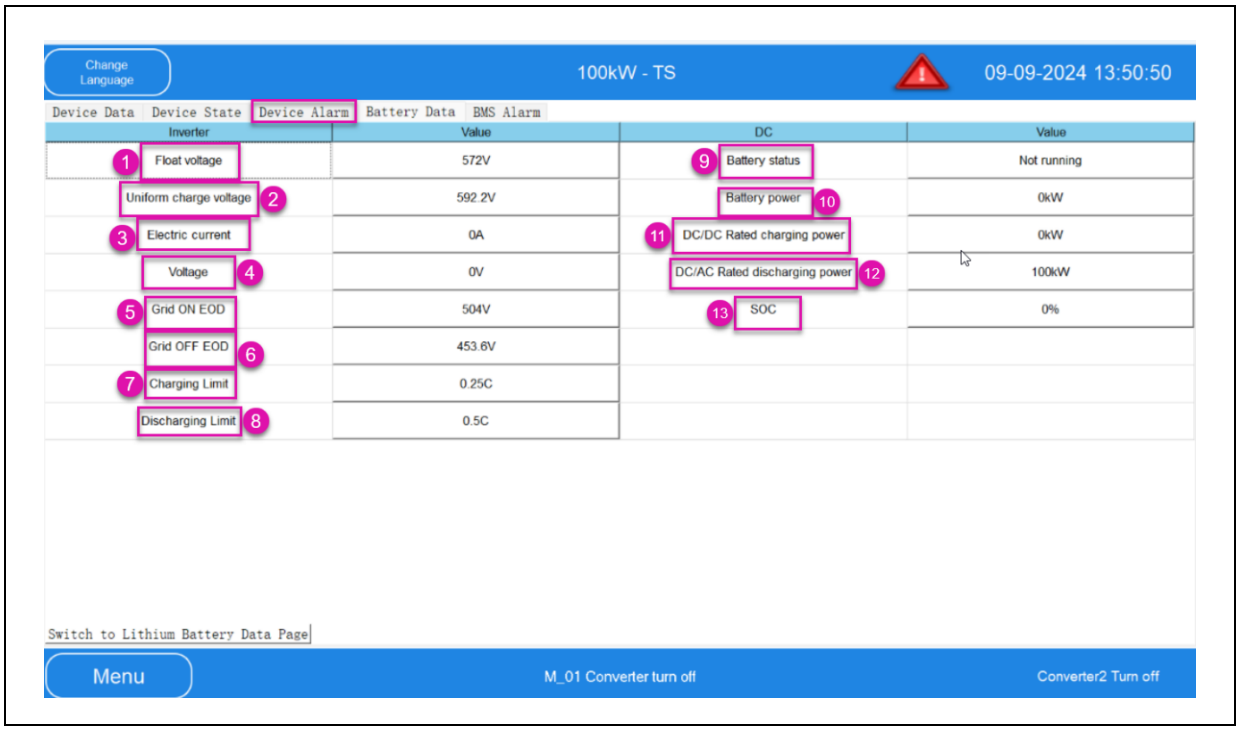


Figure 42: Lead-acid Battery Data

The table below displays uploaded lead-acid battery data.

Table 15: Battery Data

Option	Settings
1. Float Charge Voltage	Calculated by multiplying the set float charge voltage of a single cell by the total number of cells.
2. Equalization charge voltage	Calculated by multiplying the set equalization charge voltage of a single cell by the total number of cells.
3. Current	Displays the electric current on the DC side of the inverter.
4. Voltage	Displays the voltage on the DC side of the inverter.
5. Grid-connected EOD (end of discharge)	Displays the cut-off voltage for discharging when connected to the grid.
6. Off-grid EOD (end of discharge)	Displays the cut-off voltage for discharging when not connected to the grid.
7. Charge current limit	Displays the maximum allowable current on the battery side to prevent overcurrent during charging. (Upper limit of 0.25C)
8. Discharge current limit	Displays the maximum allowable current on the battery side to prevent overcurrent during discharging. (Upper limit of 0.5C)
9. Battery status	Monitors the operational state of the battery.
10. Battery power	Displays the current power of the battery during charging and discharging.
11. DC/DC rated charging power	Displays the total rated power of the DC/DC module on the DC side.
12. DC/AC rated charging power	Displays the rated power on the AC side for DC/AC, similar to the machine model.
13. SOC (state of charge)	Calculated based on the total voltage of the battery, representing the percentage of remaining battery power.

4.6.10. BMS Alarm

This tab allows the user to view BMS alarm details and how to navigate between the pages.

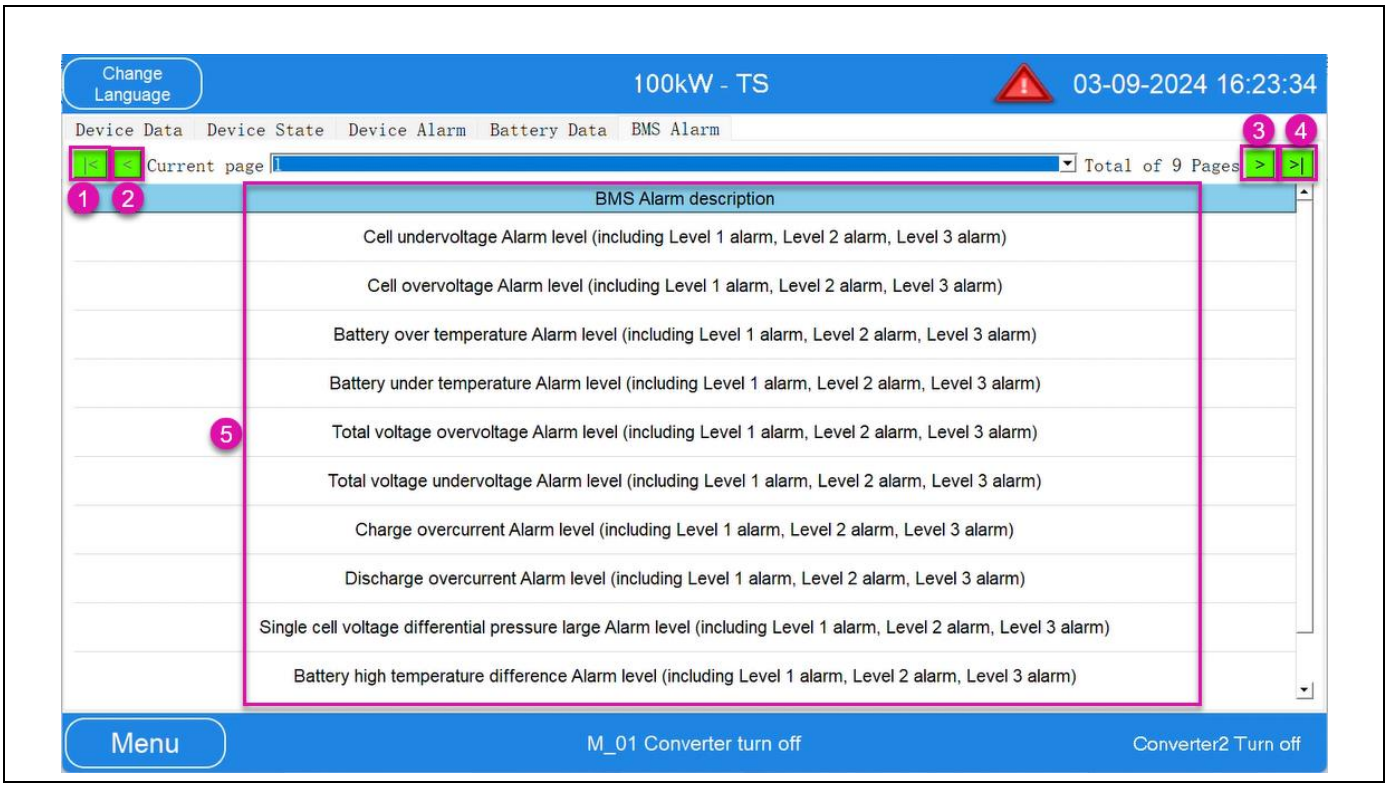


Figure 43: BMS Alarm

The table below displays the BMS alarm details and navigation options.

Table 16: BMS Alarm Settings

Option	Settings
1. |<:	Click this button on the alarm description page to navigate to the first page.
2. <	Click this button to navigate to the previous page.
3. >	Click this button to navigate to the next page.
4. >|	Click this button on the alarm description page to navigate to the last page.
5. BMS Alarm Description	Displays the current BMS alarm that has been triggered.

4.6.11. Record

The record tab allows the user to view the following options:

- Data Reports
- Export Data
- Historical Records
- Operation Logs

Users can track charging and discharging amounts, record system operational history and logs, and easily query and trace data for convenient analysis.

4.6.12. Data Reports

This tab logs and displays charging and discharging data for:

- PV
- Load
- Battery
- Grid

The data is categorized by:

- Daily
- Monthly
- Yearly
- Total electricity amounts

Use the time query button on the right side to search for specific data. You can:

- Set the year by clicking "Year+" or "Year-" to increment or decrement by one year
- Adjust the month and day using similar buttons to view reports for specific dates.

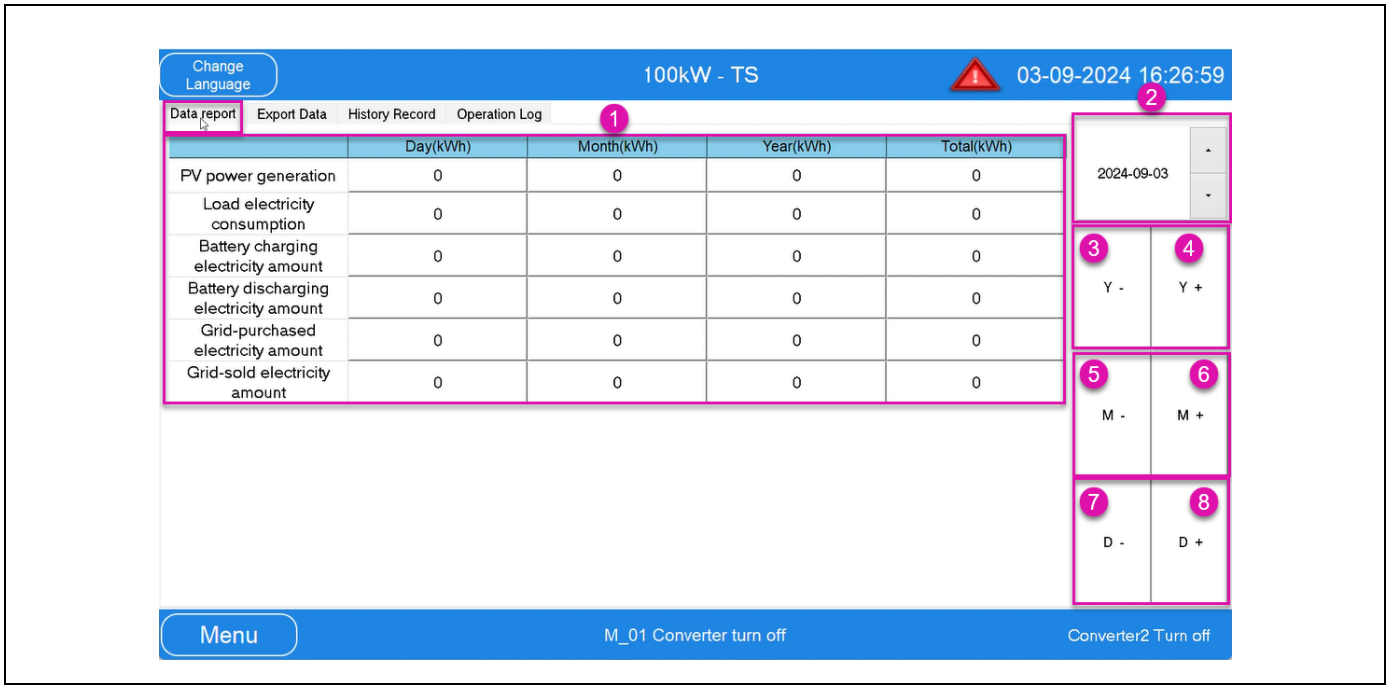


Figure 44: Data Reports

The table below to view Data report options and settings.

Table 17: Data Reports Settings

Option	Settings
1. Data Reports	Displays the recorded charging and discharging amounts for PV, load, battery, and the grid for the currently selected date in a table format.
2. Data reports	Shows the date of the data report currently being viewed.
3. Year (-)	View the data from the previous year.
4. Year (+)	View the data from the next year.
5. Month (-)	Displays the current BMS alarm that has been triggered.
6. Month (+)	View the data from the previous month.
7. Day (-)	View the data from the previous day.
8. Day (+)	View the data from the following day.

4.6.13. Export data

This tab allows you to export data to other applications. To use it follow these steps.

1. Ensure the USB drive is formatted in FAT32.
2. Check the status bar to confirm the USB drive is inserted.
3. If the USB drive is detected, select the type of data to export.

Figure 45: Export Data

4. Click the "Export Data" button to start the export process.
5. Once the export is complete, click the "Eject USB Drive" button to finalise the process.

The table below displays the Export Data options and details.

Table 18: Export Data Settings

Legend	Settings
1. Export history to USB	The filename for history records exported to a USB drive is "Record.csv".
2. Export operation log to USB	The filename for operation logs exported to a USB drive is "Log.csv".
3. Export electricity statistics to USB	The filename for electricity statistics exported to the USB drive is "Report.csv".
4. USB status display	Check the connection status of the USB drive.
5. History records export button	This button exports the history records to a USB drive. The file, "Record.csv", needs to be opened with Excel.
6. Operation log export button	Click here to export the operation log to a USB drive.
7. Electricity statistics export button	Click here to export the electricity statistics report to a USB drive.
8. Eject USB drive	This option safely removes the USB drive after the export operations are complete.

4.6.14. Historical Records

This tab displays the start and end times of status and fault records that occur during equipment operation.

Figure 46: Historical Records

The table below displays Historical data records and details.

Table 19: Historic Record Details

Option	Settings
1. Level	The log entries are color-coded: • 0: Alarm event (highlighted in red) • 1: Status event
2. Start Time	View the event start time.
3. End Time	View the event's end time.
4. Describe	View the event description.

4.6.15. Operation Logs

This tab records the changes made to the key system parameters.

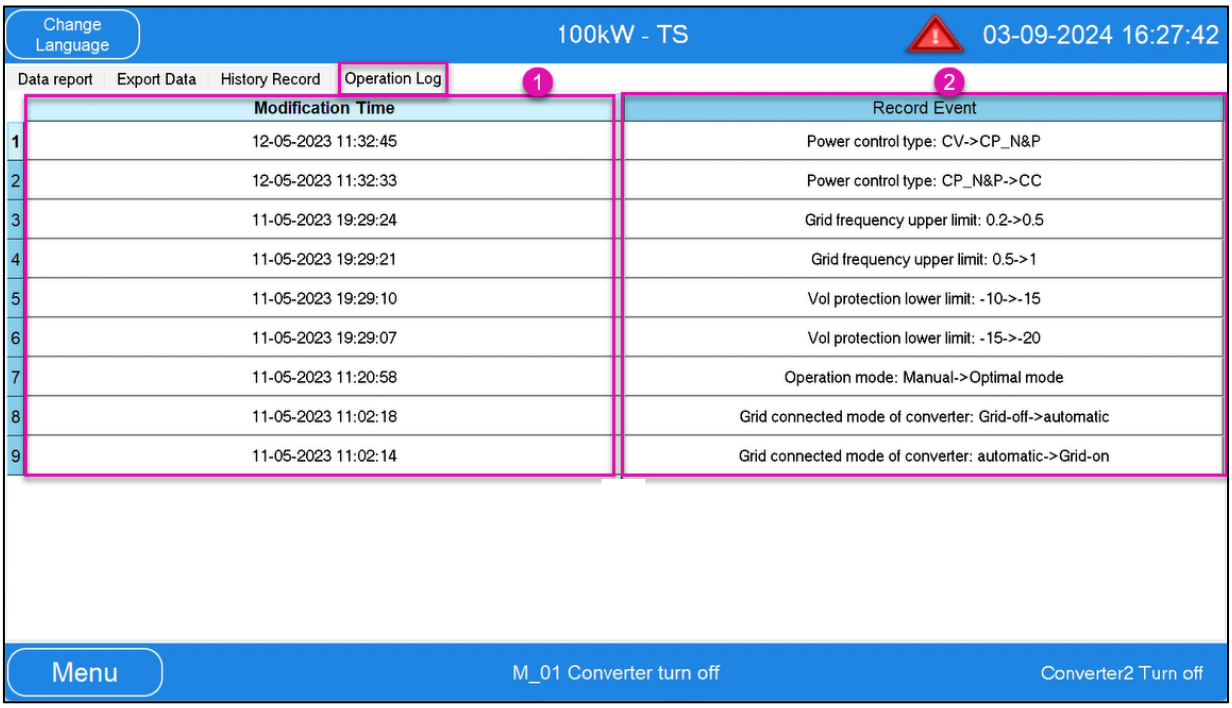


Figure 47: Operation Logs

The table below displays operation log details.

Table 20: Operation Logs Details

Option	Details
Modification time	View the time when the system settings were modified.
Record Events	View an operations log performed on the system settings.

4.6.16. Turn On/Off

This button allows the user to turn the DCAC and DCDC converter on and off.

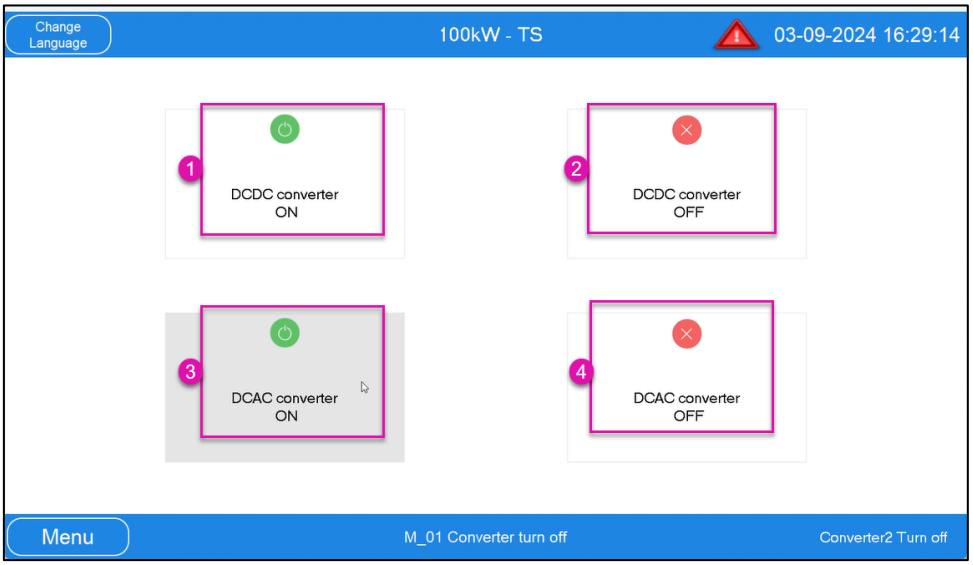


Figure 48: On and Off Options

1. Click the "DCDC Converter ON" button to turn on the DCDC converter.
2. Click the "DCDC Converter OFF" button to turn off the DCDC converter.
3. Click the "DCAC Converter ON" button to turn on the DCAC converter.
4. Click the "DCAC Converter OFF" button to turn off the DCAC converter.

4.6.17. System Information

This interface displays system information for the following:

- Monitoring version
- DC-AC converter version
- DC-DC converter version
- Network port information

Figure 49: System Information

To manage system settings, follow these steps:

1. View the current system version information in the Version Information Field.
2. Check the current monitored network port information in the Network Monitoring Field.
3. Click the Apply and Restart System Button to apply changes and restart the system.

4.6.18. Time Settings

Follow these steps to set the time.

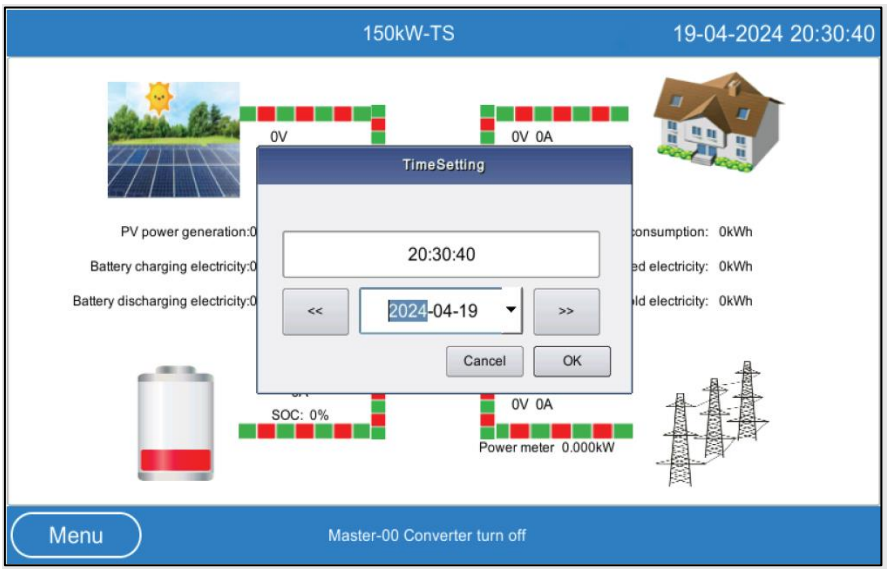


Figure 50: Time Setting

1. Click on the Time field to set the time.
2. The Time Setting pop-up will appear, displaying the current time on the window.
3. Use the drop-down arrow and adjustable buttons to set the time.

5. Section 3: Safety Precautions

This section highlights users' safety procedures to prevent damage to the HPS inverter during installation.

5.1. Operator Safety Requirements

To operate the HPS inverter safely and effectively, personnel must:

Important Safety Precautions

- Be familiar with the energy storage system's structure and working principle.
- Read and understand this user manual.
- Be aware of relevant local standards and regulations.
- The operators must thoroughly understand wiring, electrical theory, and mechanical principles. Failure to meet these requirements may result in serious injury, equipment damage, or system malfunction.

Safe and Handling Precautions

To safely handle the HPS equipment, follow these precautions.

- When using a forklift to move the inverter box, it's important to ensure that the centre of gravity is evenly balanced between the two forks. This ensures optimal stability and control.
- When moving a larger size inverter ensure that your view is not obstructed. It is recommended to arrange for assistant personnel.

Maintenance Safety Precautions

- The maintenance cycle of the product depends on its installation environment. Factors like the location and on-site conditions can affect the maintenance schedule. If the product is exposed to harsh conditions like strong winds, sand, or heavy dust, maintenance should be done more frequently.
- Before performing maintenance, safely disconnect the equipment and wait 5 minutes to allow the inverter to fully discharge.
- Never perform maintenance or repairs on live equipment.

Warning Signs and Nameplates

To ensure safe operation, follow labelling guidelines.

- Do not remove or damage warning signs as they contain critical safety information.
- The nameplate inside the front door contains essential product parameters.
- Do not remove or damage it.
- Ensure the equipment label always remains clear and readable. If the label is damaged or blurred, replace it immediately.

Electrical Safety Precautions

To ensure safe operation, avoid touching live components, inspect equipment before use, and observe electrostatic protection rules.

- Do not touch terminals or conductors connected to power network circuits.
- Pay attention to all safety instructions and warning signs when connecting to the power grid.
- Inspect equipment for damage or hazards before operating.
- Avoid contact with circuit boards and follow electrostatic protection rules.
- Disconnect the inverter and battery pack before maintenance to avoid voltage risk between battery pack electrodes.

Environmental and Space Requirements

To ensure an efficient installation of the inverter, it is crucial to select an installation location that meets the following requirements.

- Select an installation location that is free from electromagnetic radiation, oil mist, corrosive or flammable gases, metal powder, dust, oil, water, or other foreign objects that could interfere with the inverter's operation.
- Ensure that the selected location does not have wood or other flammable materials near the inverter, as they can pose a fire hazard.
- Verify that the installation area is clear of radioactive or harmful gases and liquids that could compromise the inverter's performance or pose a risk to human safety.
- Avoid opening in rainy or wet weather.

- For best performance, install the inverter indoors in a well-ventilated area.
- Avoid keeping the inverter away from areas with high humidity, high temperatures, or exposure to corrosive gases. These elements can negatively impact performance and lifespan.
- direct sunlight, this can cause overheating.
- Ensure that the grounding cable in the power distribution room is properly grounded. The resistance in a dry environment should be less than 4 Ω.
- The inverter mounting surface must have sufficient bearing capacity.

Personal Protective Equipment (PPE)

- Failure to wear required PPE may result in serious injury or death, wear protective gear (insulating gloves, shoes, etc.).

Touch Screen Parameter Setting

- Parameters on the touch screen critically impact energy storage inverter operation.
- Incorrect settings can compromise inverter function and capabilities. Only authorized professionals may modify parameters after thorough system analysis.

Product Scraping

When disposing of the energy storage inverter, do not treat it as regular waste. Return to Freedom Won (fees may apply) or contact a local authorized recycling agency.

Other Considerations

Take necessary precautions when maintaining or repairing equipment:

- Wear protective gear (earplugs, insulating shoes, scald-proof gloves).
- Ensure emergency rescue facilities are available at remote installation sites.
- Implement all necessary measures to ensure personnel and equipment safety.
- Ensure energy storage inverter operations meet national/regional standards.
- This manual is for standard configurations. For special needs, provide instructions when ordering. Refer to actual products received.

- This manual does not cover all possible situations. For unclear situations, contact us.

6. Section 4: Mechanical Installation

This section highlights the importance of thorough preparation to ensure a smooth and successful HPS installation process.

Mechanical installation of the HPS requires at least two qualified individuals working together and must comply with local electrical installation standards.


Before you start the installation, carefully inspect all equipment for any signs of damage. Should any damage be identified, please promptly contact Freedom Won and provide photographs for assistance.

6.1. Pre-installation Preparations

6.1.1. Site Preparations

- For best performance, install the inverter indoors in a well-ventilated area.
- Keep the inverter away from areas with high humidity, high temperatures, or exposure to corrosive gases. These elements can negatively impact performance and lifespan.
- Avoid direct sunlight, this can cause overheating.

6.1.2. Temperature and Environment Consideration

To achieve optimal performance of the inverter and ensure warranty validity, keep the internal temperature within specified limits. Refer to Table 21, for detailed temperature requirements to ensure an optimal installation environment for your HPS inverter.

Table 21: Environmental Requirements

Required Temperature	Measurements
Temperature	- 30℃ - 55℃
Humidity	＜95%（No condensation）
Altitude	< 3000m

To ensure an efficient HPS installation, ensure that the location meets the following requirements

to minimise the risk of malfunctions, damage, or safety hazards.

1. Select an installation location that is free from electromagnetic radiation, oil mist, corrosive or flammable gases, metal powder, dust, oil, water, or other foreign objects that could interfere with the inverter's operation.
2. Ensure that the selected location does not have wood or other flammable materials near the inverter, as they can pose a fire hazard.
3. Verify that the installation area is clear of radioactive or harmful gases and liquids that could compromise the inverter's performance or pose a risk to human safety.

6.1.3. Proper Environment Ventilation

For proper cooling, the HPS relies on good airflow. To ensure a ventilated environment, the installation site must meet the following requirements:

- Avoid installing the inverter in areas with poor ventilation and low air circulation.
- Consider adding air conditioning measures like air supply grids or fans to ensure sufficient airflow.
- The air inlet must have enough space and volume for unrestricted air intake.
- Maintaining clean air is crucial. If the environment has a high concentration of sand and dust, installing air filters on the building's air supply grilles is recommended.

6.1.4. Product and Package Inspection

Before you start the installation, carefully inspect all equipment for any signs of damage. Should any damage be identified, please promptly contact Freedom Won and provide photographs for assistance.

Verify Package Contents

Refer to the HPS package checklist in Table 22, to ensure all items are present before installation.

Table 22: HPS Package Checklist

Items	Number
Inverter	1 Piece
Key	2 Pieces

Certificate	1 Piece
Warranty Card	1 Piece
Product User Manual	1 Piece
Factory Inspection Report	1 Piece

6.1.5. Installation Tools and Parts

Refer to the HPS parts checklist in Table 23, to ensure all items are present before installation.

Table 23: Tools and Parts List

Tools	Number
Forklift or Crane	1 Vehicle
Wire Stripper	1 Piece
Crimping Pliers	1 Piece
Insulating Gloves	1 Pair
Socket Set	1 Piece
Multimeter	1 Piece

Screwdriver	1 Piece
Screws, Nuts, Gaskets	Various items

6.1.6. Equipment Handling Practices

This section highlights the importance of handling procedures to prevent damage to the HPS inverter during installation.

1. When using a forklift to move the inverter box, it's important to ensure that the centre of gravity is evenly balanced between the two forks.

Figure 51: Packaged Handling

2. The enclosed bottom frame must be removed as illustrated in Figure 51 for safe and efficient movement without packaging.

Figure 52: Unpackaged Handling

3. When moving a larger size inverter your view may be obstructed. It is recommended that assistant personnel be arranged.
4. Forklift trucks cannot transport inverter equipment over long distances or on sloping roads.

7. Dimensions of Various Models

This section provides a clear overview of the physical size requirements for each HPS model. Refer to the table below to identify the specific dimensions of your model.

Table 24: Dimensions of Various Models

Name	Dimensions of Various Models
HPS50	800×800×1900 mm
HPS100	1200×800×2050 mm

HPS150	1200×800×2050 mm Box
HPS250	（600×720×2050）×1+1200×800×2050 mm
HPS500	（600×720×2050）×2+1600×1050×2050 mm

The HPS250 is split-type which consists of one photo-voltaic controller (600×720×2050) and one energy storage inverter (1200×800×2050). HPS500 is split-type which consists of two photo-voltaic controllers (600×720×2050) and one energy storage inverter (1600×1050×2050).
Figure 3 below illustrates the recommended clearance dimensions for the installation of the HPS inverter.

7.1.1. Base Mounting and Fixing

Securing the inverter to the base surface is essential for ensuring safe and stable operation. This section details the process:

The bottom of the HPS series inverter is equipped with designated fixing holes for secure attachment. These holes allow for fastening the inverter either to a bottom support channel or directly to the ground.

Refer to the Figure for dimension illustrations of the bottom section for each inverter model.

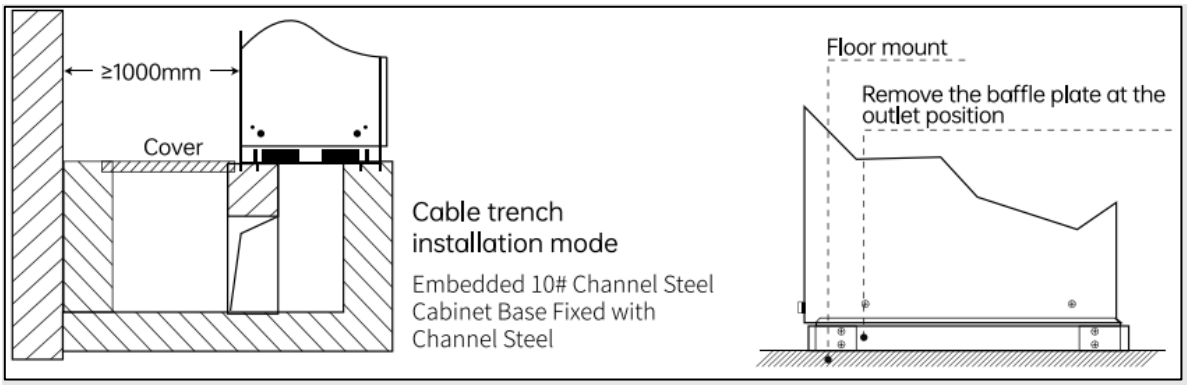


Figure 53: Base Mounting and Fixing

- The inverter mounting surface must have sufficient bearing capacity.
- The channel steel should be designed according to the positioning holes at the bottom of the inverter, which are equipped with a base. The dimensions of the bottom section of each

model are shown in millimetres (mm).

- Cooling air enters the unit from the front and bottom. Cables are connected through the bottom of the inverter. Each HPS inverter features inlet and outlet holes at the front for DC and AC power connections. Refer to the example below.

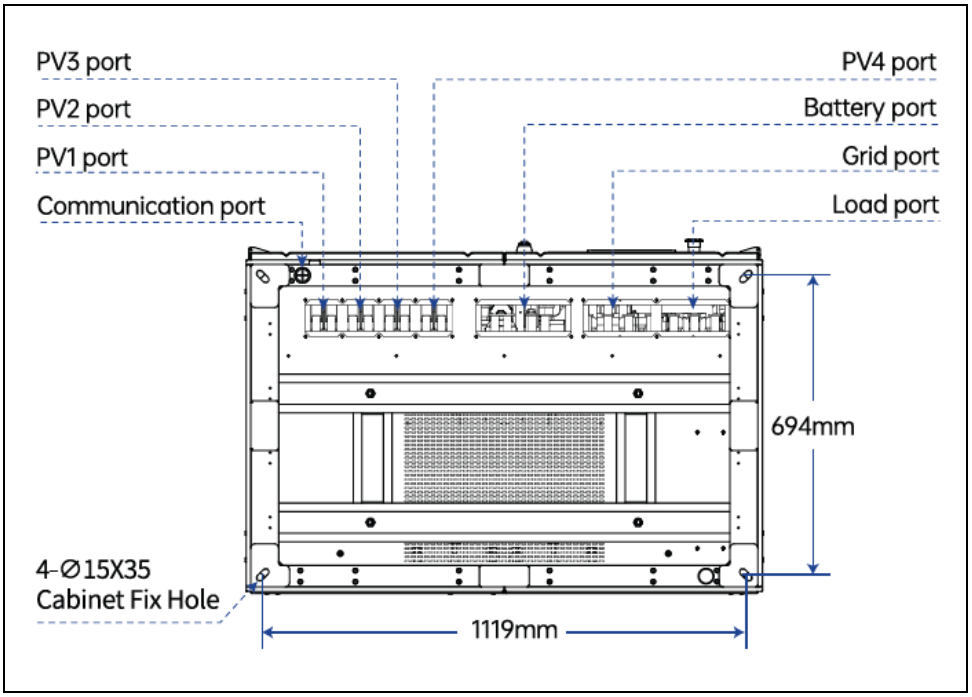


Figure 54: Inlet and Outlet Holes Examples

7.1.2. Installation of Air Ducts

This section emphasises the importance of maintaining sufficient air intake for achieving optimal performance and ensuring the longevity of the inverter.

Air ducts are necessary for the inverter to expel heat and draw in cool air. The HPS series energy storage inverters utilise a forced air-cooling system to dissipate heat efficiently.

Refer to Table 9, for a specific inverter model and its minimum air intake requirements.

Table 25: Forced Air-Cooling System

Inverter Model	Minimum Area Air （m^2）
HPS50	0.543858
HPS100/150	0.8068668
HPS250	0.9715392
HPS500	1.6123272

7.1.3. Air Duct Setup

The HPS does not come equipped with air ducts. As a result, it is the user's responsibility to install the correct air ducting system.

The HPS inverter utilises a well-designed air duct for different models and site environments for efficient heat dissipation.

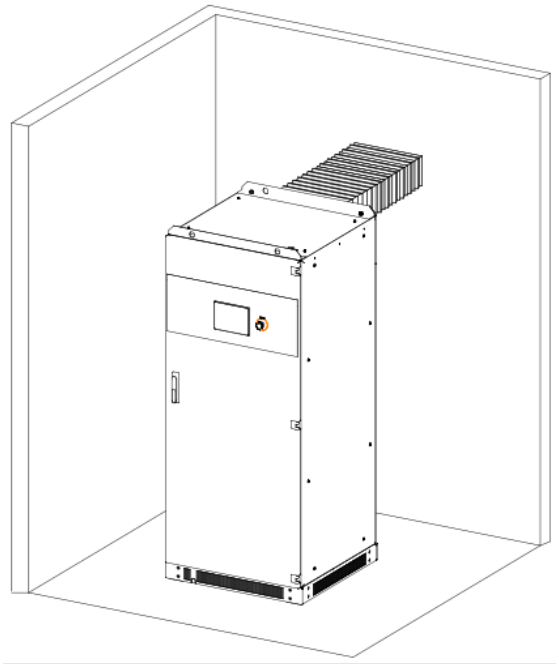


Figure 55: Internal Vent Hose

1. Fresh air enters the inverter through vents at the bottom and dustproof mesh on the front door to ensure a clean and cool air supply for internal cooling.

2. Hot air generated by the inverter's operation is expelled through exhaust vents at the top of the unit to maintain optimal internal temperatures for reliable performance.

7.1.4. Maintaining Airflow

Due to the inverter's wall-mounted design, it is essential to install external air ducts to ensure adequate airflow. Proper air ducting is critical for maintaining optimal performance, as it facilitates the removal of hot air from the inverter. Effective cooling helps prevent overheating, thereby enhancing the longevity and efficiency of the inverter system. Ensuring a well-ventilated environment is crucial for the reliable operation of the inverter and the overall safety of the installation.

Specific requirements for adding external air ducts to inverters are as follows.

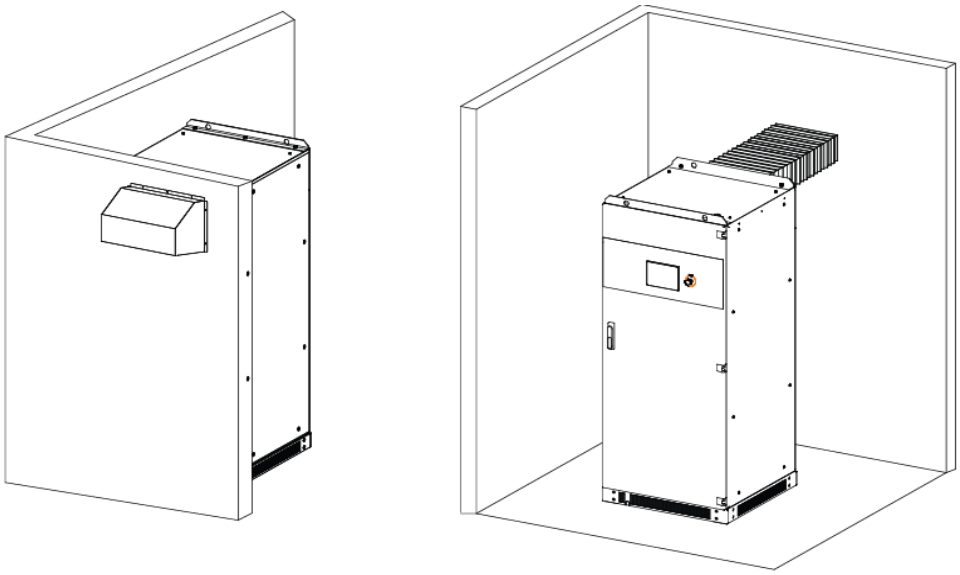


Figure 56: Internal and External Duct of Converter

1. The air duct must not restrict the overall ventilation volume of the HPS inverter cabinet.
2. The connection point between the air duct and inverter cabinet must be well sealed to prevent air leaks and to ensure efficient airflow through the intended part.
3. The outlet of the air duct must be angled downwards to prevent rainwater from entering the inverter.
4. Consider adding elements like barbed wire on the air duct outlet to deter rodents, birds, or other animals from entering the inverter.

7.1.5. Equipment Transportation

1. Incorrect equipment transportation can result in damage to your HPS inverter and increased costs.
2. Use packaged transportation whenever possible to keep your inverter in a better protective state.

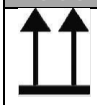
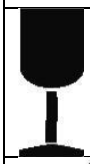
3. Ensure forklifts or cranes have sufficient carrying capacity and reasonable support or lifting points when transporting the inverter.
4. Follow the detailed product parameters and transport requirements marked on the packaging labels.
5. Refer to Table 26 for a description of inverter packaging labels for regulatory compliance, and effective product handling.

Table 26: Description of Packing Labels

Label	Description
Model	Inverter Model
Size	Outer packing dimensions
NW	Net weight of inverter
GW	Gross Weight

Refer to Table 27 for a description of inverter graphical packing signs to ensure proper product handling.

Table 27: Graphical Packing Signs

Label	Description
	**Handle with care:** Do not transport the inverter upside down, on a side, or at an angle to prevent damage.
	**Fragile:** Protect the inverter from impact and friction during transportation to prevent damage.
	**Keep the inverter dry:** Avoid exposure to rain and moisture to prevent water damage.

8. Section 5: Electrical Installation

8.1. Pre-Wiring Safety and Cable Considerations

 Always ensure that the grid and battery input switches are disconnected before starting the wiring installation. Use warning signs to communicate that the switches should not be operated while wiring is in progress.

 Route all power cables through trenches or metal wiring channels. This protects them from mechanical damage and minimises Radio Frequency (RF) interference with nearby devices.

 The provided cable dimension in Table 30 is for reference only.

The final cable selection should consider:

- Working environment temperature
- Cable laying method (e.g., underground, overhead)
- Heat dissipation conditions

 The HPS inverter model does not include pre-installed external cables. Users are responsible for providing their own cables according to their specific needs.

 All external cables must be routed through the designated bottom entry and exit holes to connect with their corresponding terminals.

The necessary terminals and fixing screws for power cable wiring are pre-installed on

the respective wiring terminals upon delivery of the inverter.

8.1.1. Cable Selection Considerations

Below are considerations for the selecting correct cables for your HPS.

- When selecting cables, consider the environmental conditions where they will be installed such as temperature, etc.
- Ensure all cables connected on the same side of the system are of the same size and type.
- Different cable suppliers have different ratings.
- The installer must ensure that cables meet specifications, refer to cable selection in Table 30 This table is for reference only.
- It is recommended that the current through a 1 mm^2 conductor does not exceed 3A. When connecting on the same side, use conductors of the same size and type.

Table 28: Power Cable Specifications (Reference only)

Capacity	AC Output (Each Phase)	Zero Line	Ground Wire	Positive and Negative DC Input (Per Pole)	Photovoltaic
50 kW	≥ 35mm^2×3	≥ 35mm^2	≥ 16mm^2	Input 70mm^2	50mm^2/group
100 kW	≥ 50mm^2×3	≥ 50mm^2	≥ 25mm^2	Input 95mm^2	50mm^2/group
150 kW	≥ 95mm^2×3	≥ 50mm^2	≥ 50mm^2	Input 95mm^2	50mm^2/group
250 kW	≥ 120mm^2×3	≥ 120mm^2	≥ 50mm^2	2 Input channel 120mm^2/channel	50mm^2/group
500 kW	≥ 185mm^2×3	≥ 185mm^2	≥ 95mm^2	4 Input channel 120mm^2/channel	50mm^2/group

8.1.2. Power Cable Terminals

This section provides detailed instructions on installing terminals and fixing screws for power cable connections on the HPS inverter.

For cable recommendations, refer to Figure 56 and Table 29 below as a reference guide.

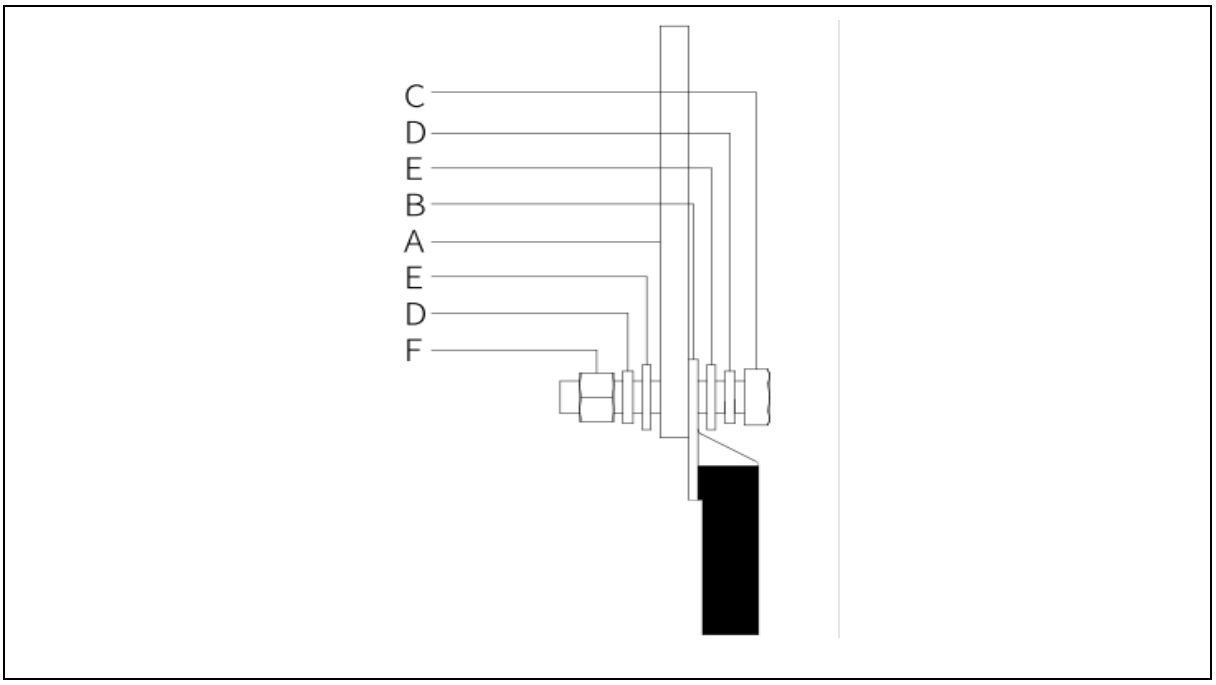


Figure 57: Connected Terminal

Table 29: Wiring Terminals

Label	Parameter
A	Copper Bar
B	Connection Terminal
C	Screw
D	Spring Washer
E	Large Pad
F	Nut

8.1.3. Wiring Specification

This section emphasises the importance of proper cable separation during installation. Maintaining the recommended spacing between cables minimizes electrical interference and ensures safe operation.

1. Communication lines, power lines, and control cables should be laid separately to avoid interference.
2. DC and AC circuits must be separated with a minimum distance of 300 mm between them. When a control cable needs to cross a power cable, the angle between the two should be close to 90 degrees.
3. The recommended minimum distance between parallel shielded data lines and power cables varies depending on the specific field or application.

Refer to Table 30 below, for a specification of communication and power lines.

Table 30: Distance Between Signal Lines and Power Cables

Parallel Line Length (m)	Minimum Spatial Distance (m)
200m	0.3m
300m	0.5m
500m	1.2m

8.1.4. Installation and Cable Protection

Cable Installation

The screw dimension and torque values listed in Table 33 are specifically designed to secure the circuit breaker and earth points' terminal input and output connections. The specified torque values are essential to achieve uniform compression and clamping force across the joint, ensuring a reliable connection between the cables and terminals. The installer must avoid over-tightening the screws to prevent damage.

Refer to the table below for screw dimensions and required torque values.

Table 31: Screw Dimensions and Required Torque Values

Screw Dimensions	M4	M5	M6	M8	M10	M12	M14	M16

Torques (N·M)	2	3.2	7	16	34	46	56	68

Cable Protection

The protection of cables includes communication cables and power cables. The protective methods are as follows:

- Communication cables are thin and susceptible to damage during installation. To minimise the risk of breakage, it is recommended that you start with connecting the power circuit first, followed by other connections.
- When connecting cables, the cable must be laid in a conduit or steel cable tray. In the absence of a conduit or steel cable tray, secure the cable using cable ties to prevent strains.
- During installation and connection avoid actions that could scratch or damage the insulation layer of the power cable. This helps prevent potential short circuits.
- Ensure all power cables are securely fixed to prevent strain or movement.

8.1.5. Remove the Switch Panel and Lower Brackets

Remove Baffle

The baffle must be removed to access the connections of the HPS series inverters. Upon removing the baffle, the power terminal becomes visible.

Internal wiring terminals and input/output terminals vary across different models.

Follow these steps to remove the baffle to access the breakers and install wiring.

1. Open the front door as shown in Figure 57.

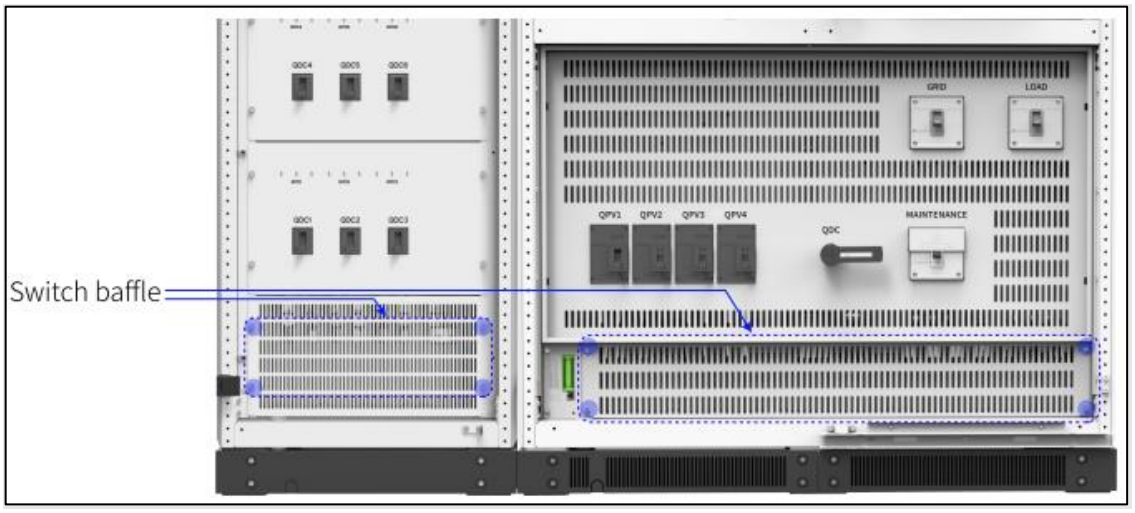


Figure 58: Switch Baffle

2. Use a screwdriver to loosen the four screws of the lower baffle of the switch.
3. Remove the screw and the lower baffle of the switch and continue with the operation.

8.1.6. Lower Brackets Installation

The HPS inverters have separate lower brackets for the bottom front, back, left, and right. These brackets are typically placed at the bottom of the inverter to prevent dust and any foreign objects.

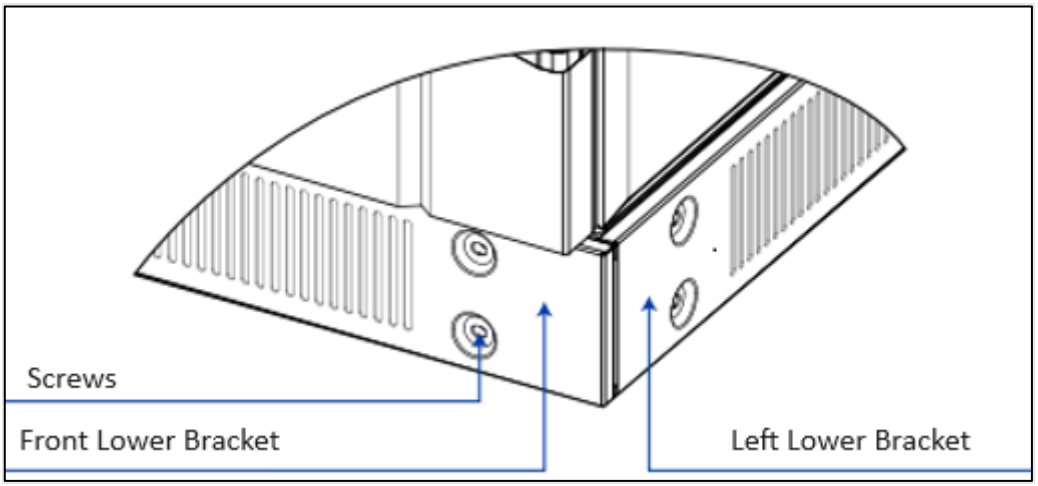


Figure 59: Lower Bracket

1. Before installation, remove all lower fencing boards from the packaging box and set them aside.
2. Once you have chosen the installation location, carefully position the inverter and secure it using the recommended mounting method.
3. After the inverter is secured and the screws are locked, take each lower coaming and install it on the corresponding side.
4. Ensure that dust-proof cotton is installed in the lower fencing board, which cannot be lost during installation.

8.1.7. Dimensions of Various Models

This section provides a clear overview of the physical size requirements for each HPS inverter model. Refer to the table below to identify the specific dimensions of your model.

Table 32: Dimensions of Various Models

Inverter Model	Dimensions of Various Models
HPS50	800×800×1900 mm

HPS100	1200×800×2050 mm
HPS150	1200×800×2050 mm Box
HPS250	（600×720×2050）×1+1200×800×2050 mm
HPS500	（600×720×2050）×2+1600×1050×2050 mm

The HPS250 is split-type which consists of one photo-voltaic controller (600×720×2050) and one energy storage inverter (1200×800×2050). HPS500 is split-type which consists of two photo-voltaic controllers (600×720×2050) and one energy storage inverter (1600×1050×2050).

Refer to the following examples for the dimensions of the HPS50/250 example, including front, left, and top views.

HPS50 Dimensions Example

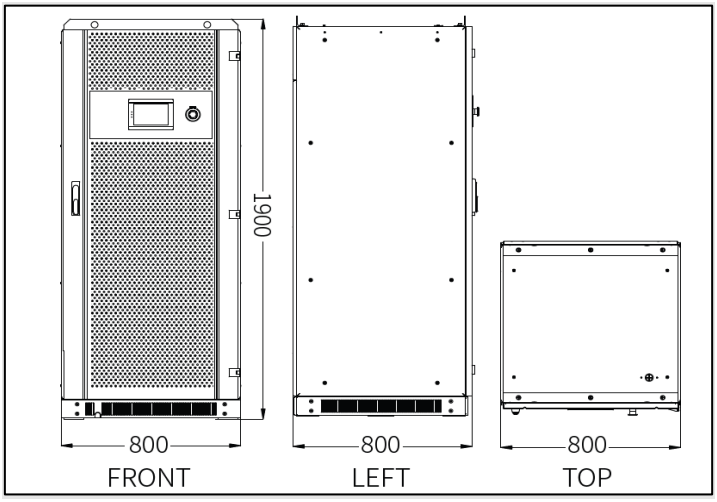


Figure 60: HPS50 Dimension Example

HPS250 Dimension Example

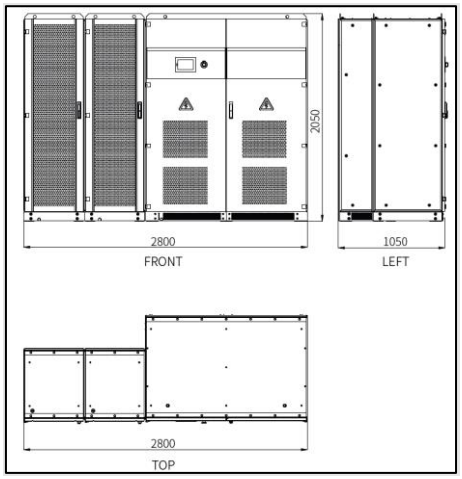


Figure 61: HPS250 Dimension Example

8.1.8. Install DC Side Wiring for Single Unit

To install the DC side wiring for a single unit, follow the steps below.

Always prioritise safety when working on the wiring of your HPS inverter system, to minimise the risk of personal injury or equipment damage.

---

1. Ensure all power is OFF before starting any wiring tasks. Verify this using a multimeter to confirm there is no voltage present on the DC wiring terminals.
2. Double-check that the DC disconnect switch is in the OFF position.

The HPS inverter has a maximum DC input voltage limit of 850V. Exceeding this limit can damage the unit and void your warranty.

---

3. Use the pre-installed terminals and fixing screws provided for DC cable connections.
4. If copper and aluminium wires are connected, use special copper-aluminium connectors to prevent corrosion. Never directly connect copper and aluminium wires.
5. Accurately identify the negative and positive poles of each DC cable. Mark these poles to avoid confusion during the connection.

For parallel systems, each inverter must have its own battery.

6. Connect the positive pole of the battery pack cable to the "BAT+" terminal on the inverter. Similarly, connect the negative pole of the battery pack cable to the "BAT-" terminal.
7. Repeat this process for the PV system, connecting the positive and negative poles of the PV to the "PV+" and "PV-" terminals on the inverter.
8. Ensure all connections are secure and tightened to the recommended torque specification.
9. Visually confirm that the positive and negative polarities are correctly matched between the cables and inverter terminals.

PMDE 1 to inverter:

10. Connect the positive and negative terminals of your photovoltaic (PV) input cables to the corresponding "PV+" and "PV-" terminals on the PMDE cabinet.

PMDE 2 to HPS:

11. Locate the "DC+OUT" and "DC-OUT" terminals on the PMDE cabinet.
12. Connect the "DC+OUT" terminal from the PMDE cabinet to the "PV+" terminal on the HPS inverter. Then, connect the "DC-OUT" terminal from the PMDE cabinet to the "BAT-" terminal on the HPS inverter. Refer to the image below for the connections.

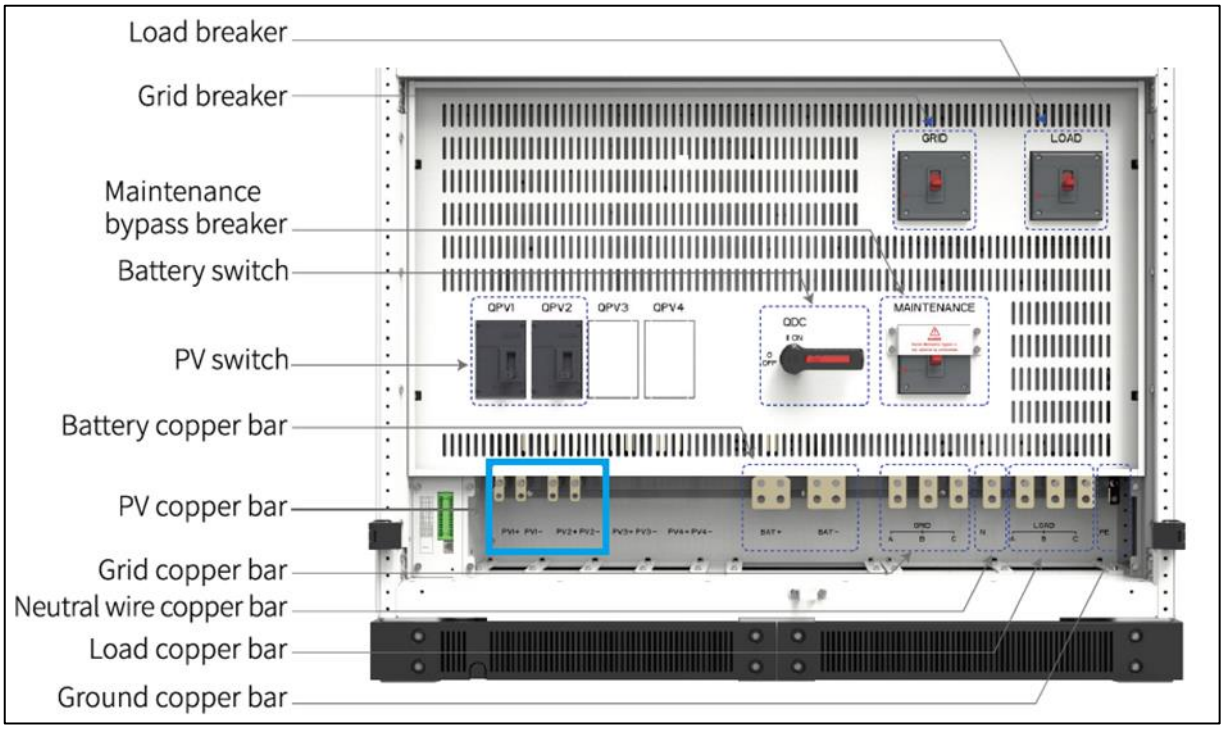


Figure 62: Terminal Connection

8.1.9. Install AC Side Wiring

Before commencing any AC wiring tasks, use a multimeter to verify that all terminals on the inverter are fully deactivated and free of any voltage. Refer to the wiring schematic diagram below for more details on AC side wiring.

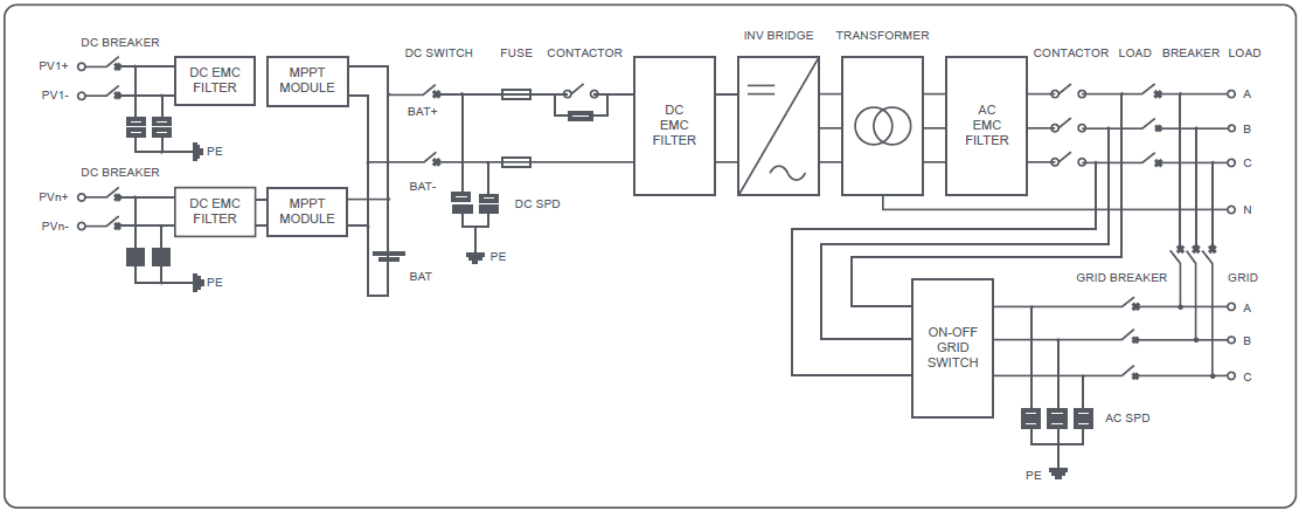


Figure 63: AC Side Wiring Schematic Diagram

Refer to Table 33 for wiring, and detailed instructions on connecting the three phases (A, B, C) of your AC cables to the grid. These sections include tables specifying the correct connection points for each phase based on your specific HPS inverter model.

Table 33: Grid

Load	Different Phase/Lines
A	Phase A connected to the grid.
B	Phase B connected to the grid
C	Phase C connected to the grid

8.1.10. Install AC Side Line

Before commencing any AC wiring tasks, use a multimeter to verify that all terminals on the inverter are fully deactivated and free of any voltage.

Accurately determine the phase sequence (order of the live wires) of your AC cables. Clearly label each cable with its corresponding phase (A, B, C, N) using color-coded insulating bushings for easy identification during connection.

1. Confirm the phase sequence of the cables and mark them well. Three-phase AC output cables A, B, C, and N should be added with insulating bushing to distinguish the phase sequence.
2. Connect three phases A, B, and C to the grid according to the three phases A, B, and C connected to the load correctly according to the table.

Table 34: Load

Grid	Different Phase/Lines
A	Phase A or U connected to the AC out
B	Phase B or V connected to the AC out
C	Phase C or W connected to the AC out
N	Phase N connecting to the AC out.

8.2. Connect Communication Cable

8.2.1. External Wiring of Communication

This section guides you on how to connect an external communication cable to your HPS inverter. The cable enables the inverter to communicate with external systems for monitoring and control purposes.

The communication cable connection port is situated at the bottom of the HPS inverter. Refer to Figure 62 and Table 35 for the exact location and silkscreen labels of the port.

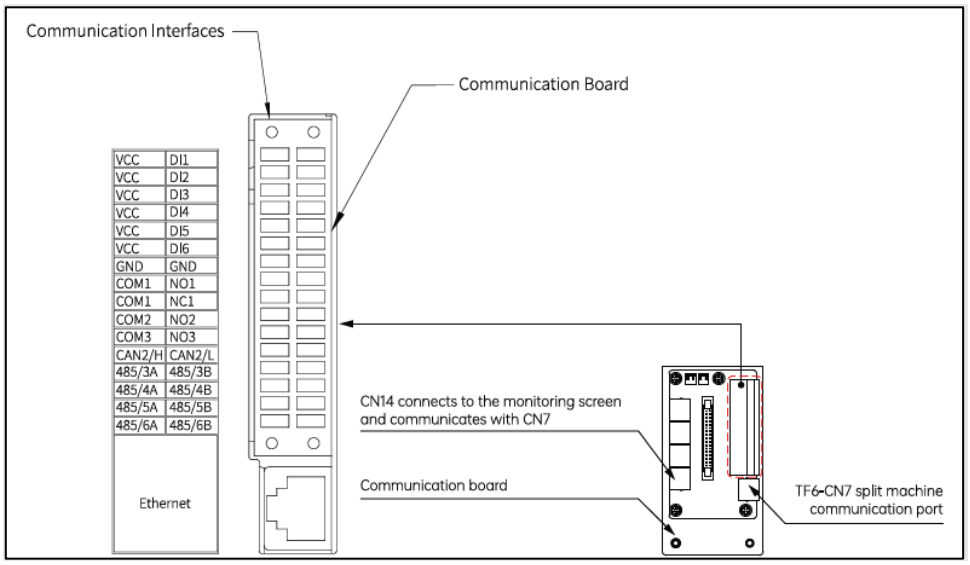


Figure 64: External Communication Wiring

Table 35: External Point for Communication Cables

Terminal Item	Function
DI1	EPO（default） Shutdown Switch ATS Signal Water Logging Fire protection

DI2	EPO Shutdown（default） Switch ATS Signal Water Logging Fire Protection
DI3	EPO Shutdown Switch（default） ATS Signal Water Logging Fire Protection 0%active power
DI4	EPO Shutdown Switch ATS Signal（default） Water Logging Fire Protection 30% Active Power
DI5	EPO Shutdown Switch ATS Signal

	Water Logging（default） Fire Protection 60% Active Power
DI6	EPO Shutdown Switch ATS Signal Water Logging Fire Protection（default） 100% Active Power
GND	/
NC1 COM1 NO1	Generator
NO2 COM2	Warning Signal
NO3 COM3	Operation Signal
485/3A 485/3B	Battery BMS Communication（default）
485/4A 485/4B	/

485/5A 485/5B	Electricity Meter
485/6A 485/6B	HPS to EMS Communication

8.3. Parallel Communication Connection

The communication cable for the HPS is used to facilitate data exchange and control signals between the inverter and external systems, such as monitoring devices or control panels.

You may need to adjust the communication settings for the cable, depending on your system's technical protocols and the type of cable used.

This section details the process for establishing parallel communication between the HPS250 and HPS500 split-machine models.

To facilitate communication between these two units, connect the power cord and network cable in parallel between the HPS inverter and the DCDC multi-module cabinet.

- The HPS inverter is equipped with a TF6 communication interface board located on the top of the unit. The DCDC multi-module cabinet also has a TF1 communication board installed on the top.

For a detailed illustration of the connection points and configuration, refer to Figure 64.

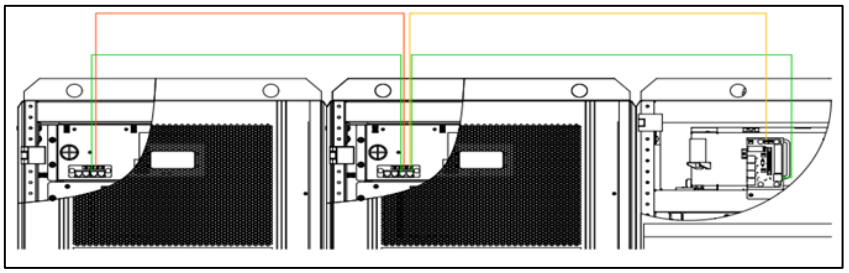


Figure 65: External Communication Wiring

The HPS series energy storage inverters provide a flexible solution for large-scale energy storage. The following section details how to connect multiple HPS inverter units in parallel to increase capacity.

The diagram below illustrates the parallel connection configuration for the HPS, demonstrating the multiple simultaneous connections.

The images below are for illustrations only.

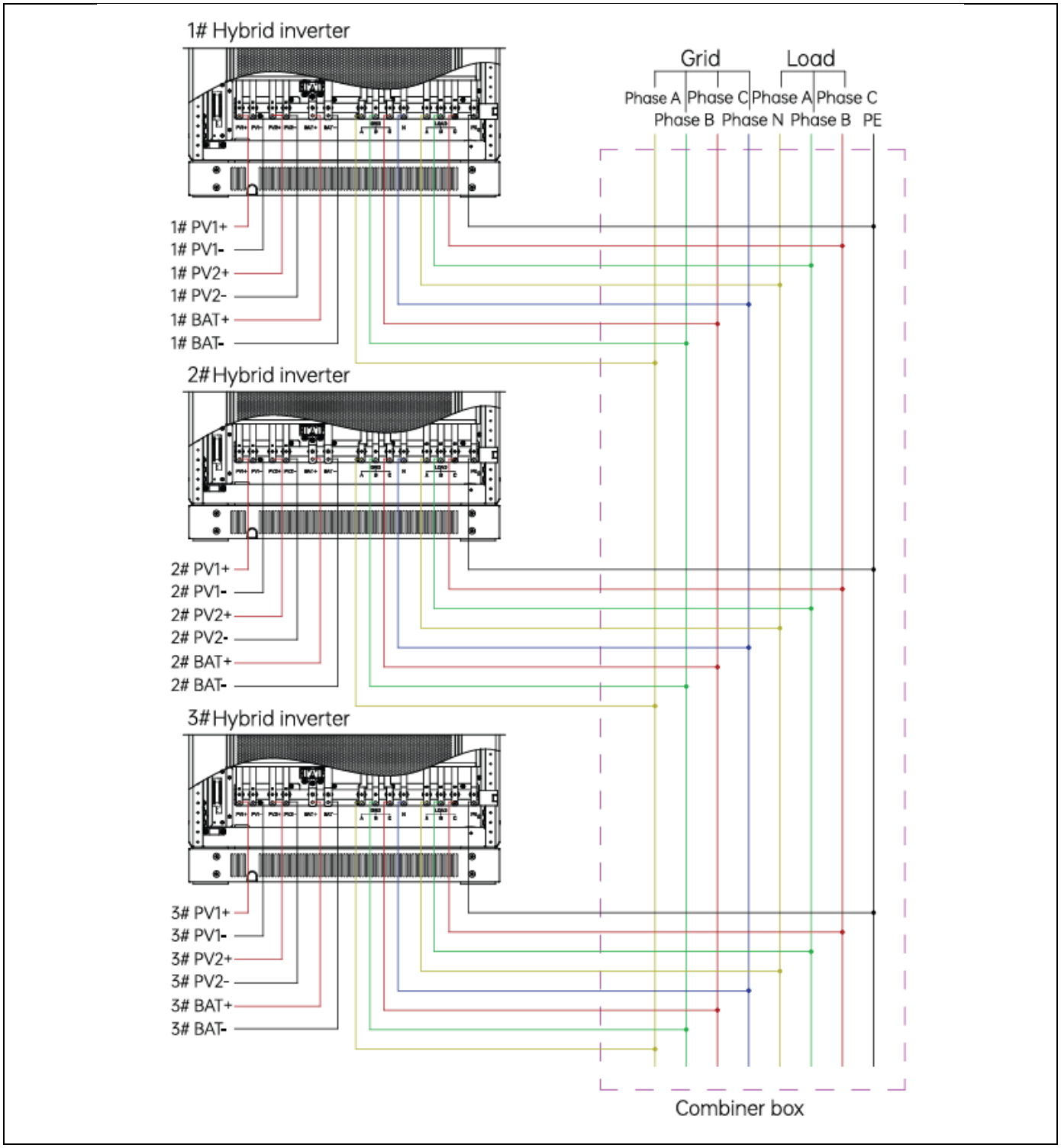


Figure 66: Parallel Connection Example

- You can connect up to four HPS inverters in parallel, and significantly expand the overall energy storage capacity of your system.
- All HPS inverter models are equipped for parallel use. A TF6 communication board is located on the top of each unit to facilitate communication between parallel-connected inverters.
- When using multiple HPS inverters in parallel, connect them using network cables. These cables should be plugged into the designated parallel ports on each inverter.
- When connecting an HPS converter to a DCDC multi-module cabinet (split-machine system), use network port CN7 on the HPS converter for communication.
- Parallel Connection of Multiple Devices: If you're using multiple HPS in parallel, utilise network ports CN1 to CN3 for communication between the units.

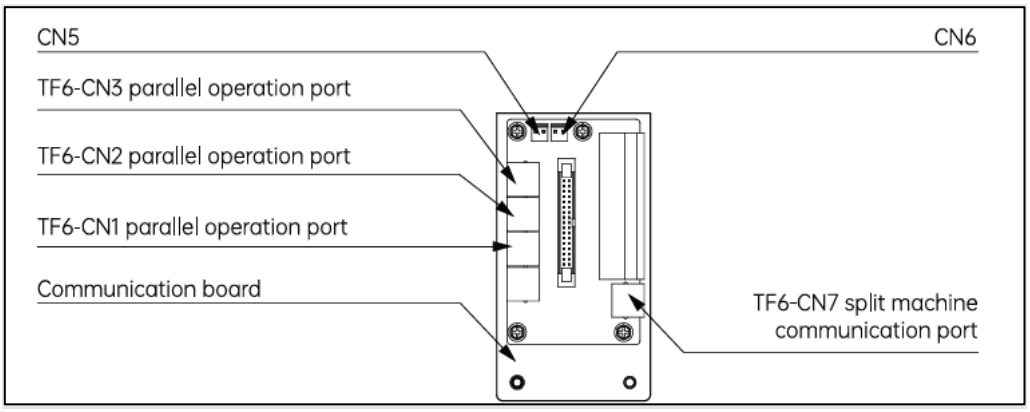


Figure 67: Split Machine Communication Wiring

8.4. Grounding Requirements

Safe and reliable grounding is crucial for the HPS series inverter. Adhering to these guidelines ensures correct grounding for your HPS series converter's secure and reliable operation.

- The inverter is equipped with grounding copper bars pre-connected to the outer shell within the cabinet.
- The grounding cable resistance must be 4Ω or lower.
- The grounding cable diameter must be at least 16 mm^2.

8.4.1. External Grounding Connection

- These grounding bars must be securely connected to the equipotential connection point of your installation site or electrical control room using grounding cables.

8.4.2. Individual grounding

The ground terminal of the PMDE should be connected to the ground copper bar of the power distribution cabinet, not to the ground copper bar of the HPS.

8.5. Installation complete

After completing all mechanical and electrical installations, reinstall the removed switch baffles (panel) and lower fences on the converter. Power-on operation is permitted only after confirming the correct installation.

9. Commissioning Steps for HPS Inverter

Pre-checks:

- Before commencing commissioning, ensure that all cable connections are correct.
- Check grid, battery, and PV voltage to be within acceptable range of the inverter.

9.1. Power ON Procedure

Personal Protective Equipment (PPE)

Failure to wear required PPE may result in serious injury or death, wear protective gear (insulating gloves, shoes, etc.).

Battery Bank Section:

1. Press the battery ON button to switch on the BMS. If you have more than one battery, ensure that all of them are switched ON.
2. Close the battery breaker. There are three options on the battery breaker: ON, Trip and OFF position. Ensure that the battery circuit breaker is in the ON position.

To close the battery breaker, utilise your palm to handle the breaker, applying gentle yet firm pressure while ensuring you are in a comfortable and stable position.

MPPT Cabinet Section (For Encore HPS250 and HPS500):

1. Confirm that the screen on the MPPT Cabinet starts up.
2. Turn the EPO push button clockwise to release it.

Inverter Section:

1. Turn the EPO push button clockwise to release it.
2. Close the battery breaker.
3. Close the MCBs KB1, KB2 and KB3 on the inverter.
4. Confirm that the LCD screen is ON, and that the sampling data is normal and consistent with actual values. Ensure that the SOC on the screen matches the battery.

If incorrect battery data is displayed on the HMI screen check the following:

- Check that the correct battery manufacturer is selected on the inverter settings.
- Check that the CANbus cable configuration is correct (CANH Pin 7 and CANL Pin 8 on battery side).
- Ensure that the battery profile loaded on the BMS is for encore HPS inverter. If issues persist after verifying 1, 2 and 3 contact Freedom Won Tech Support for assistance.

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5. Navigate to the HMI screen.
6. Click on the "Menu" button to access the "System Login menu", as shown in the screen below.

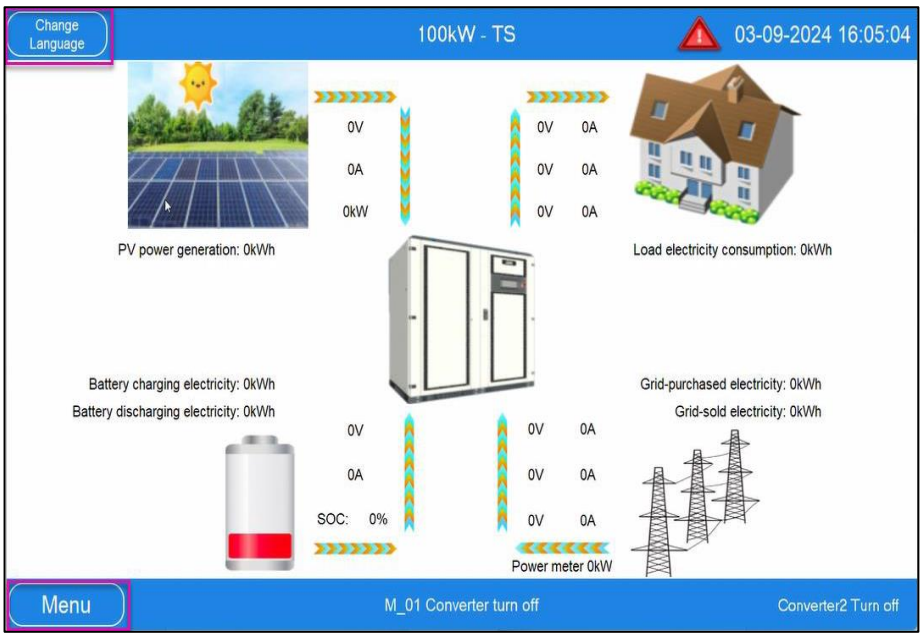

Figure 68: Menu Screen

The "Not logged in" screen menu will appear, select the "Not logged in" button, as shown in the in the screen below.

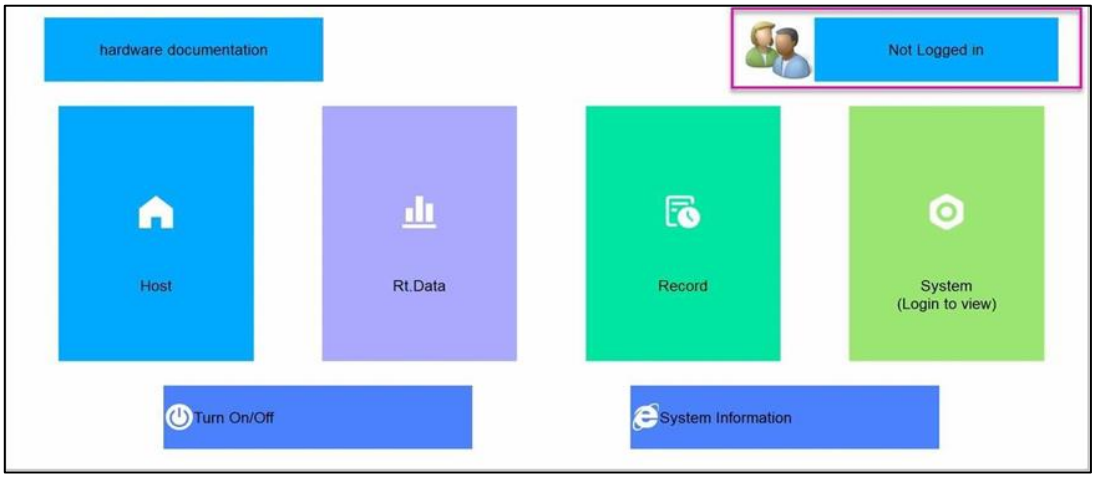

Figure 69: Login Screen

7. The login screen will appear, select the "Account" drop-down menu (1) and select the "maintain" option.
   Enter the password "888888" (2) in the required field to gain access to inverter setting menu.

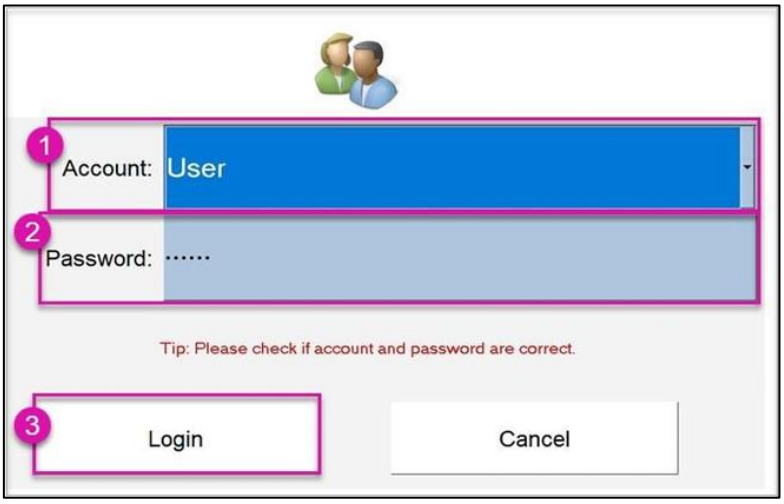

Figure 70: Password Screen

8. Click on the Login button (3) and navigate to the "System Information" button.
9. Use the parameter tables provided to configure your Encore HPS inverter settings.

Configure DC/AC Parameters

Use Table 36 to configure the DC/AC parameters in Figure 71.

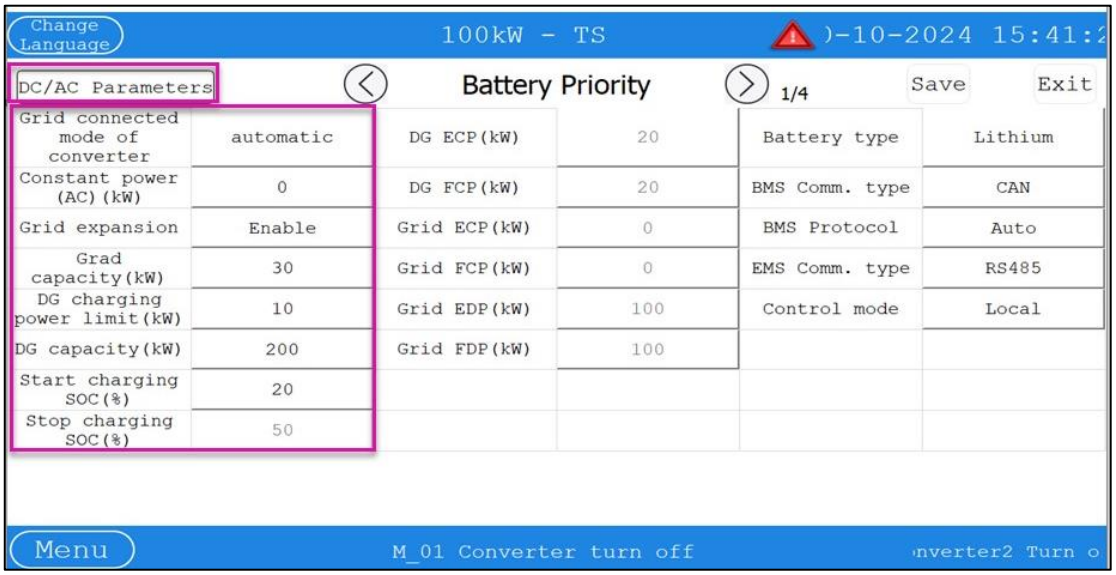

Figure 71: DC/AC Screen

Table 36: DC/AC Parameters

Parameter	Recommended Settings	Notes
Grid Connected Mode of Converter	Automatic	• There are three modes available: • Automatic-The grid connection mode, when is selected, the Grid will automatically switch from On-grid to off-grid. • On-grid- when On-grid is selected, the inverter will only function On-grid, when Grid is abnormal, the converter will shut down. • Off-Grid- when off grid is selected, the converter will Run in off-grid mode only
1. Constant Power(AC) (kW)	-9.7	• Constant Power-used for setting charge and discharge power with grid connected. Positive value means discharge and negative value means charge. • You can control the charging and discharging power of the battery from the AC side by modifying the constant power. NB: The DC side power will be

		higher than the AC side power in this case.
Grid Expansion	Enable	• This allows the inverter to adjust grid capacity.
Grid Capacity	30	• The maximum power limit is imposed on the grid side.
DG Charging Power Limit (kW)	70	• The maximum power taken from the generator to charge the battery.
DG Capacity (kW)	70	• This is the rated power of the generator.
Start Charging SOC (%)	20	• This is the level of SOC at which the converter starts charging the battery. • This can be viewed on the battery priority mode option, the ECP or FCP state is determined based on the current SOC.
Stop Charging SOC (%)	50 (Default)	• This is the level of SOC at which the converter stops charging the battery.
Battery Type	Lithium	• There are two options namely, Lithium and Lead-acid.
BMS Comm. Type	CAN	• This refers to the battery communication modes.
BMS Protocol/Manufacturer	Freedom	• Select the applicable battery manufacturer. When auto is selected, the inverter will automatically detect BMS protocols. For FW lite, select "Freedom".
Control Mode	Remote	• The Local mode means that the EMS can only read and cannot write. • The Remote mode means the EMS can read and write.

Configure DC/DC Parameters

Use Table 37 to configure the DC/DC parameters in Figure 72.

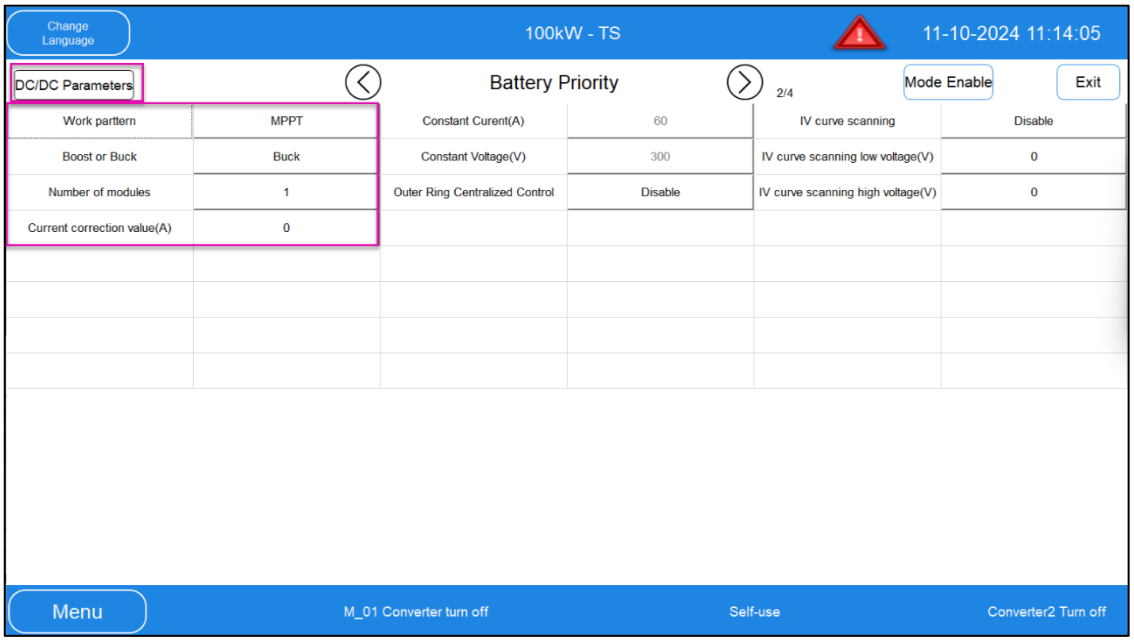

Figure 72: Parameters

Table 37: DC/DC Parameters Configuration

Parameter	Recommended Settings	Notes
Work Pattern	MPPT	• The working modes of the DC-DC module are constant voltage, constant current and MPPT.
Boost or Buck	Buck MPPT for HPS50 - HPS150. Boost for HPS250 to HPS500	• For HPS50 -HPS150 uses buck MPP. PV string Voc is (>) greater than the battery maximum voltage • For HPS250 and HPS500 boost MPPT. PV string Voc is (<) less than battery nominal voltage.
Number of Modules	3	This is set according to the number of modules in the converter.
Constant Current	120 (Default)	This is the constant current for each MPPT.
Constant Voltage	600 (Default)	• This is the DC constant voltage. • Set according to the converter name plate.
Outer ring centralized control	Disable	• Used when there is multiple DCDC modules with significant power fluctuations.

Configure Lithium Battery Settings Parameters

Use Table 38 to configure the Lithium Battery Settings parameters in Figure 73.

Figure 73: Lithium Battery Settings Parameters

Table 38: Lithium Battery Settings Parameters

Parameter	Recommended Settings	Notes
On-Grid DOD (%)	88	• Allowable depth of discharge in grid-on. • Allowable depth of discharge in grid-off.
Off-Grid DOD (%)	88	• Allowable depth of discharge in grid-on. • Allowable depth of discharge in grid-off.
Off-Grid DOD Protection (%)	85	• The off-grid DOD protection can only be lifted when the battery SOC reaches this set value.
Charge Voltage Upper Limit (V)	756	• Set according to battery maximum charge float voltage.

Charge Voltage Upper Limit Delta (V)	10	• When battery charge float voltage drops below the charging voltage upper limit, then the inverter will trickle charge.
Discharge Voltage Lower Limit (V)	650	• When the battery total voltage reaches this value during discharge, the inverter will shut down. • Must be set according to battery name plate.
Discharge Voltage Lower Limit Delta (V)	10	• If the battery total voltage drops below the discharge voltage lower limit, the inverter will shut down.
Charge Current Limit (A)	Set according to battery name plate.	• The maximum allowed current on the battery side to prevent overcurrent during charging. • Must be set according to battery name plate.
Discharge Current Limit (A)	Set according to battery name plate.	• The maximum allowed current on the battery side to prevent overcurrent during discharging. • Must be set according to battery name plate.
Generator Turn ON SOC (A1)	20	• Gen Turn on SOC A1- Generator start signal will be triggered when battery reaches the set SOC when

		system is running off-grid
Generator Turn Off SOC (B1)	60	• Gen Turn-Off SOC B1- Generator stop signal will be triggered when battery reaches the set SOC.
Force Charge Start (mV)	2850	• When the cell voltage drops below this value, the inverter switches to battery priority and AC side charge the battery.
Force Charge Stop (mV)	3200	• When the cell voltage exceeds this value, the inverter exits battery priority mode.
DCAC Cell Protection Voltage (mV)	3650	• This is the maximum cell voltage that the inverter will allow while charging the battery, when one of the battery cell voltages reaches this set point, the inverter will momentarily stop charging the battery until the cell voltage drops below the set point.
DCAC Cell Protection Voltage Delta (mV)	200	• This is the maximum allowable delta voltage between the highest cell and lowest cell.

Configure Lead-acid Battery Settings Parameters

The parameters in Figure 74 are for Lead acid battery and are not used for lithium-Ion phosphate battery bank.

Figure 74: Lead-acid Battery Settings Parameters

Configure Time Period Settings Parameters

Time period settings are not adjustable in Battery Priority mode. To configure these settings, switch to Mixed mode.

In Economy Mode, the HPS operates based on configured periods. Users can set the remaining SOC capacity, combined grid power supply, and charging power from the grid or diesel generator based on the on-site situation. This ensures backup power consumption during peak demand periods.

The table below displays period settings example.

Table 39: Period Settings Example

Cycle Mode: Weekly Cycle Timetable: Thursday Cycle						DG Capacity: 150kW				
Check	Start Time	End Time	Features	Grid Charge Power	DG Charge Power	Backup SOC	Co-power SOC	Grid Capacity	Gen Charge	Gen Charge
✓	08:00	12:00	Economic	10	20	60	90	150	✓	✓

Use Table 40 to configure the Time Period Settings parameters in Figure 75.

Figure 75: Time Period Settings Parameters

Table 40: Time Period Settings Parameters

Parameter	Recommended Settings	Notes
Cycle Mode	Choose a suitable cycle between weekly and daily.	
Timetable	Choose the operating schedule from Monday to Sunday.	
Grid Capacity	Set the grid capacity.	Accurately set the grid capacity to avoid overload.
DG Capacity	Set the diesel generator capacity.	This option allows you to ensure sufficient backup power during outages.
Check	Enable the time period.	
Start Time	Set the start time for operation.	
End Time	Set the stop time.	
Features	Select the economy mode.	
Backup SOC	Set the backup battery capacity.	
Co-power	Set the combined power supply SOC.	

Grid Capacity	Set the available grid capacity.	
Grid Charge	Allow grid charging.	
DG Charge	Allow diesel generator charging.	

Configure Advanced Parameters

Use Table 39 to configure the Advanced Settings in Figure 77.

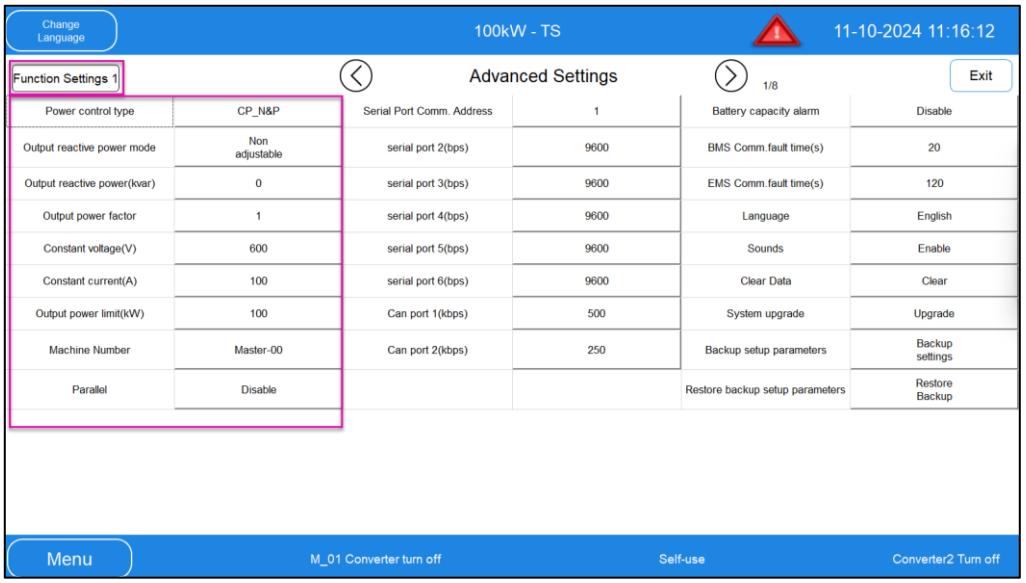

Figure 76: Advanced Settings

Table 41: Advanced Settings

Parameter	Recommended Settings	Notes
Power Control Type	CP AC	• In Constant Voltage (CV) mode the converter will operate in constant voltage mode on the DC side. • In Constant Current (CC) mode the converter will operate in constant current mode. • In AC (CP_AC) mode the power level can be set to Constant power. The value represents the power level, positive for discharge and negative for charge.
Output Reactive Power Mode	Not adjustable.	This option is set by default.

Output Reactive Power (Kvar)	0	This parameter can change the reactive power Q, positive value indicates leading reactive power, while negative value indicates lagging reactive power.
Output Power Factor	1	• The power factor is equal to the ratio of active power to apparent power. • A positive value indicates leading reactive power, while the negative value indicates lagging reactive power.
Constant Voltage (V)	600	The DCAC converter will operate at the constant voltage value and function as a constant voltage source.
Constant Current (A)	0	The DCAC converter will charge and discharge the battery with the constant current.
Power Limit (kW)	150	Set the power value according to the inverter's capacity (in kW).
Machine Number	Master-00	Device number can be set from M_01 to M_12. This is applicable for parallel units.
Parallel	Set the Parallel option to "Disable" for single unit and "enabled" for parallel.	Enable this option for parallel units.
Serial Communication Address	1	This communication address is for the 485A-B.
Can Port 1 (kbps)	500	The default baud rate for internal communication between HPS units or PMDE is 500.
Can Port 2 (kbps)	250	Set the baud rate according to the CANbus2 protocol of the battery.
Energy Priority	Bat>Grid	This option is set according to site requirements.
Battery Capacity Alarm	Prohibit	• The "Prohibit "option prevents battery from over discharge. • When the battery's SOC falls below the On-Grid DOD threshold, the

		system will automatically enter a protection mode for low SOC.
BMS Comm. Fault Time	20	Time delay before a fault notification is reported on the inverter When BMS communication is disconnected, and the communication is not recovered.
EMS Comm. Fault Time	120	Time delay before a fault notification is reported on the inverter When BMS communication is disconnected, and the communication is not recovered.

Use Table 40 to configure the Advanced Settings in Figure 78.

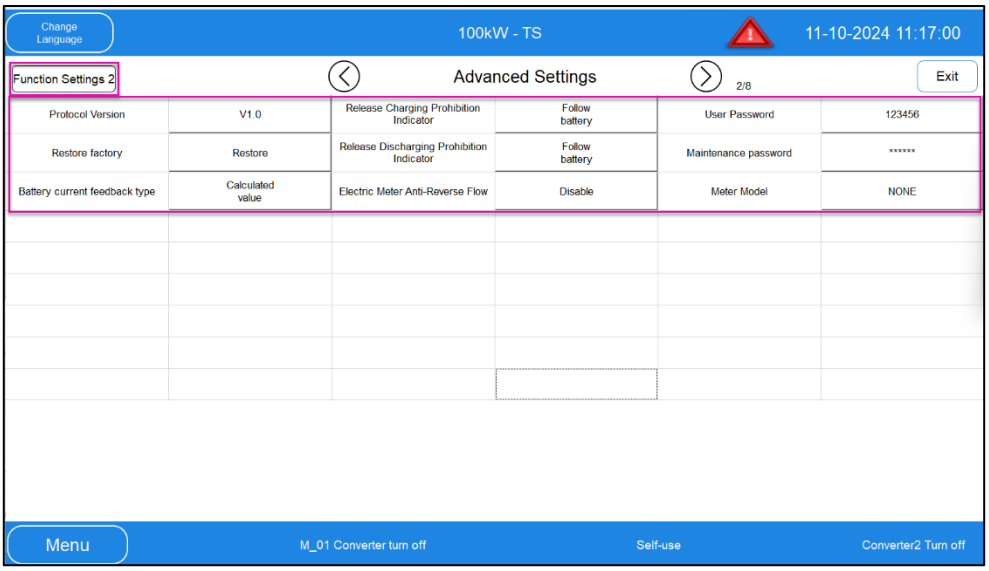

Figure 77: Advanced Settings

Table 42: Advanced Settings

Parameter	Recommended Settings	Notes
Protocol and Version	V1.0	
Release Charging Prohibition Indicator	Set by default.	When the battery SOC is below the selected value there are four options available, Follow Battery, 90%, 95% and 98%.
Release Discharging Prohibition Indicator	Set by default.	When the battery SOC is below the selected value there are four options available, Follow Battery, 5%, 10% and 15%.
User password	Configurable, default 12345	Can be changed to own preference to limit user control
Maintenance Password	Configurable, default 888888	Can be changed to own preference to limit access to parameter setpoint control

Configure System Settings Parameters

Use Table 41 to configure the Advanced Settings in Figure 79.

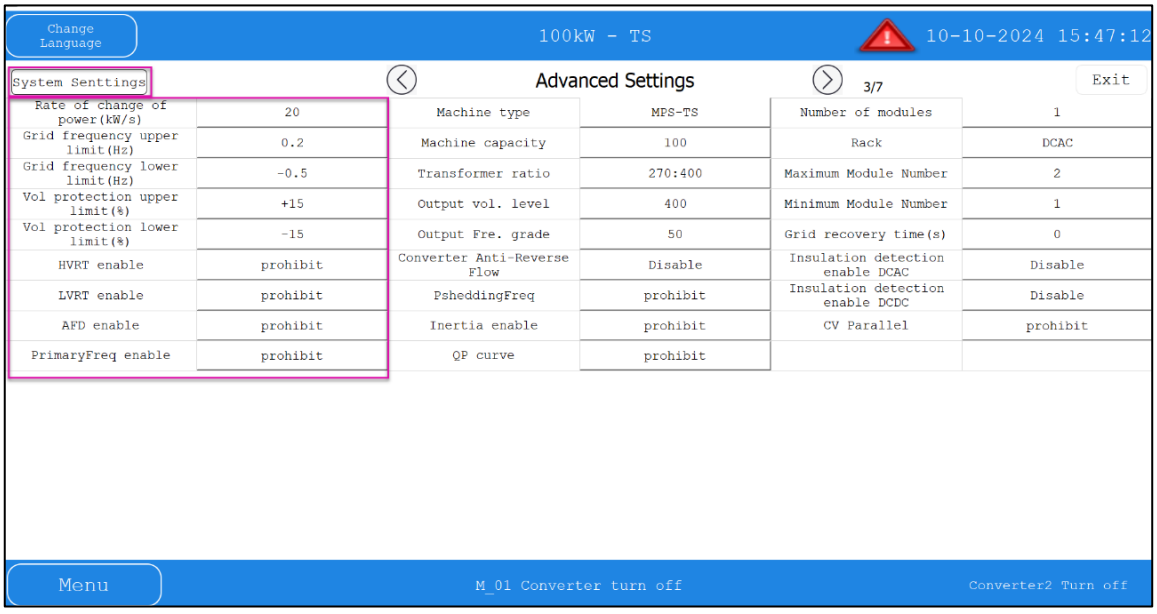

Figure 78: System Settings Parameters

Table 43: System Settings Parameters

Parameter	Recommended Settings	Notes
Rate of Change (kW/s)	20	The power changes within a second at this rate.
Grid Frequency Upper Limit (Hz)	5	This is the maximum range of frequency variation allowed on the AC side.
Grid Frequency Lower Limit (Hz)	-5	This is the minimum range of frequency variation allowed on the AC side.
Voltage Protection Upper Limit (%)	+20	This is the maximum range of voltage variation allowed on the AC side.
Voltage Protection Lower Limit (%)	-20	This is the minimum range of voltage variation allowed on the AC side.
Machine Type HPS	Set by default.	As per factory setting, this option is generally not adjustable.
Machine Capacity	150	The rated capacity of the inverter based on the factory value cannot be changed.
Transformer Ratio	Set by default to 270:400 according to Inverter nameplate.	This is defined as the ratio of output voltage to the input voltage of the transformer.
Converter Anti-Reverse Flow	Enable	Converter Anti-Reverse Flow can be set to Enable or Disable. The enable option prevents the converter current from flowing in the grid, while disable allows the converter current to flow in the grid.
Rack Settings	DCAC option is set by default and must not be adjusted.	When you select DCDC, the screen will freeze on the PDME interface, making all settings inaccessible. To resolve this issue, a firmware update of the inverter is required.

Configure Device Parameters

The DI parameter in Figure 80 is reserved in Table 37: DC/DC Parameters Configuration for internal debugging.

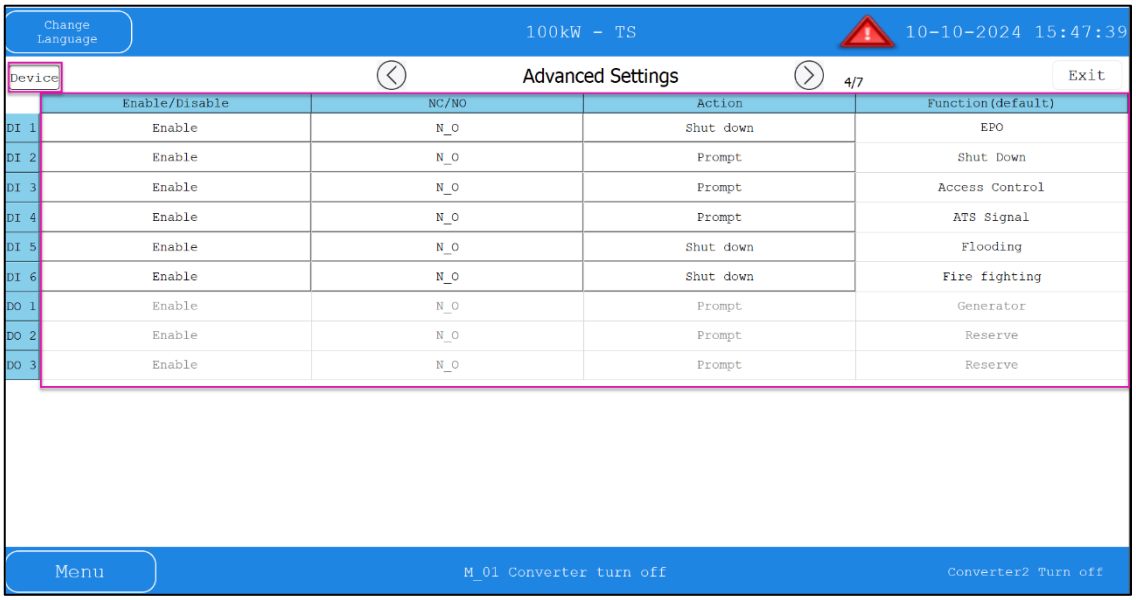

Figure 79: Device Parameters

DI 1 to DI 6 are configurable inputs that can be activated using an external dry contactor. For instance, when a fire signal is installed in the inverter room, the output signal from the fire system can be connected to DI 6 (utilising a dry contactor) in either a normally open (NO) or normally closed (NC) configuration to trigger inverter shutdown in the event of a fire.

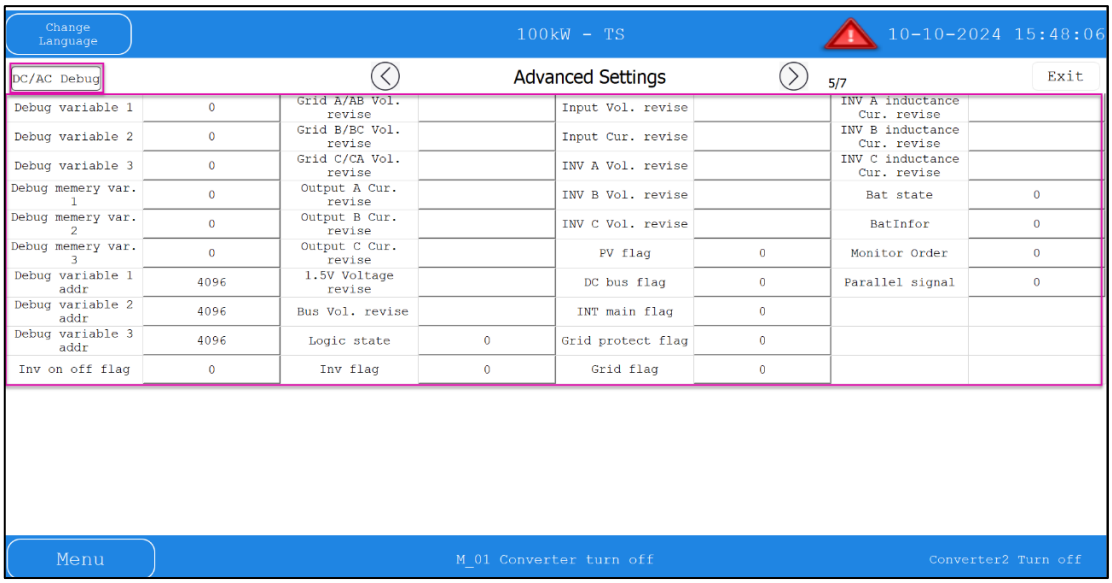

Figure 80: AC/DC Debug

10. Confirm that the inverter screen displays the correct battery data.

After configuring the inverter parameters continue to the Safe Start-up procedure in heading 9.2.

9.2. Safe Startup Precautions

Pre-startup Procedure System Inspection:

1. Inspect the entire installation thoroughly, especially focusing on the AC and DC voltages.
2. Verify that these voltages meet the converter's requirements and confirm AC's correct polarity and phase sequence.
3. Ensure that all connections comply with relevant standards and specifications.
4. Check that the system is properly grounded.

Converter Checks:

1. Refer to Essential Precautions for DC Wiring for proper installation and wiring of the converter.
2. Ensure all AC and DC circuit breakers are disconnected.

AC Side Voltage Verification:

1. Check for proper connection of the converter's three phases to the power grid.
2. Verify phase and line voltages fall within the specified range. Record these values.
3. If possible, measure and evaluate the Total Harmonic Distortion (THD). High THD may indicate converter malfunction.

DC Side Voltage Verification:

1. Connect the battery pack to the converter, to ensure correct polarity for each battery.
2. Connect the PV system to the converter, to ensure correct polarity for each PV group.

Voltage Limits:

1. Battery voltage should not exceed 850V.
2. PV voltage should not exceed 1000V.
3. Investigate voltage deviations exceeding 3% (potential causes: load fluctuations, cable damage, loose connections).

Communication

1. Ensure that the CAN bus communication is connected correctly.
2. Proper CAN bus-shielded cable should be used for communication with the battery.
3. Ensure that the connected battery has the correct profile compatible with Encore HPS for CAN bus communication (contact Freedom Won Technical support for assistance if you are unsure of how to check the battery profile).

9.2.1. Actual Startup Steps

Follow the instructions to start your HPS.

1. Make sure that the battery DC and AC sides are connected correctly, and that the battery voltage is lower than 850V.
2. Close the AC and DC circuit breaker.
3. Close the lighting protection switch KS applicable to split models and KB1 KB2, and KB3 applicable to Encore HPS50 –150.

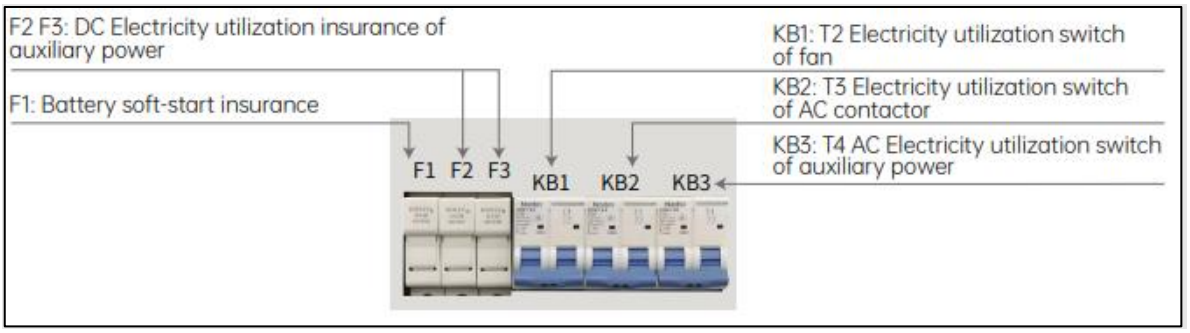

Figure 81: KB Switches

4. After completing the above steps, access the menu button on the touch screen (HMI), and click the "DC/DC converter ON" button until the bottom right of the screen displays from standby to MPPT. Refer to the instructions on How to Use the HPS User .

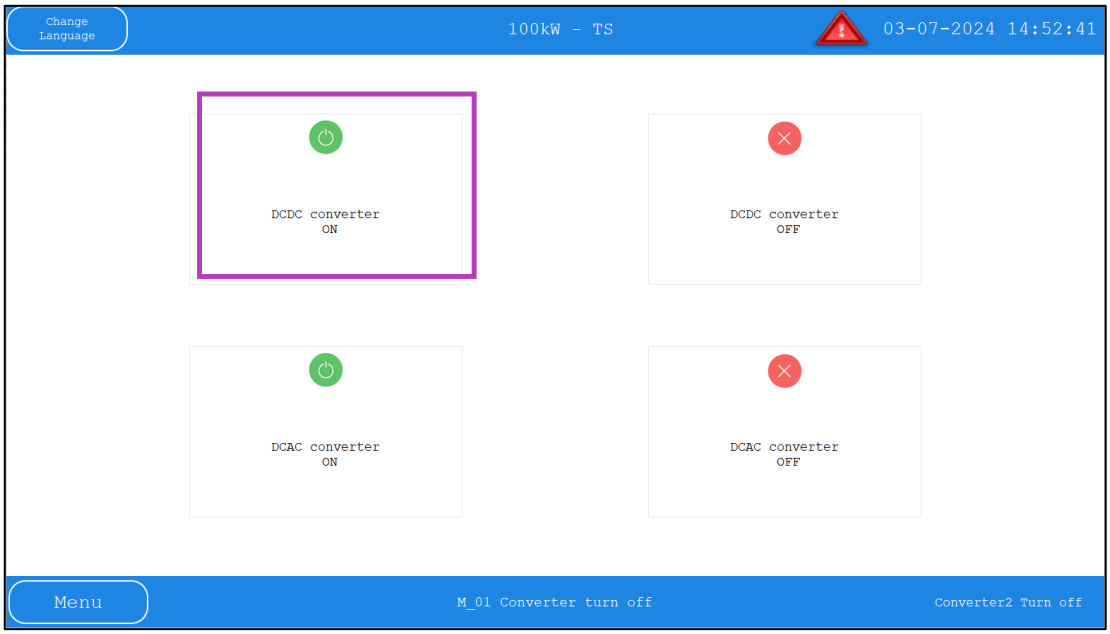

Figure 82: DC/DC Converter On

5. Click on the "DC/AC converter ON " until the screen displays right below the switch from the converter Turn off the converter to charge or discharge the converter. After the machine is turned on normally, you can check if it is running.

Figure 83: DC/AC converter on

6. Close the cabinet door and hand over the key for safekeeping. View the status of the machine on the touch screen.
7. Ensure that the PV polarity is correct. Close the QPV1 and QPV2 circuit breaker monitor the screen and observe PV input voltage. (Refer to figure 68).

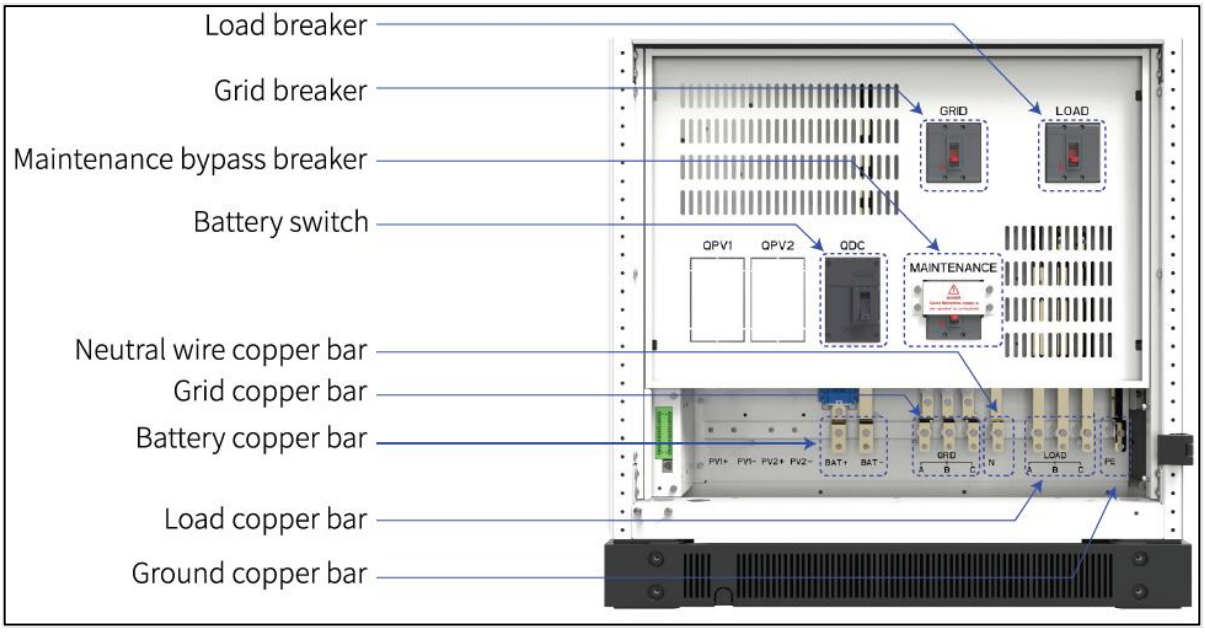

Figure 84: HPS50 Example

10. Measure each photovoltaic channel to prevent short circuits before transmitting power.

11. Confirm the photovoltaic input and close the photovoltaic input switches “QPV1” and “QPV2” in Figure 69. After closing the PV input switch, if the monitor screen was black before, the monitor screen will start running at this time. (When photovoltaic power is transmitted, each photovoltaic channel must be measured to prevent short circuits.
12. Close both AC and DC circuit breaker switches.

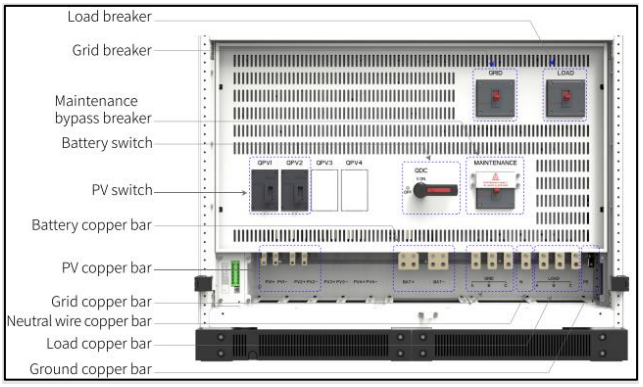

Figure 85 : HPS250 Example

13. The battery system is turned ON.
14. After the photovoltaic input and the battery are turned on, you will hear the sound of the DC contactor closing inside the photovoltaic controller (the closing sound of the DC contactor after the bus is softly lifted). The photovoltaic controller will be displayed in the lower right corner of the monitoring main interface. The status will change from "off" to "converter x standby".
15. Open the cabinet door, close KB1, KB2, and KB3, wait about 30 seconds, and the battery voltage data will be displayed on the monitoring interface.
16. Power up through Touchscreen (HMI). The photovoltaic controller is turned on.

Figure 86: Menu Screen

17. Click on the "Menu" button on the touchscreen.

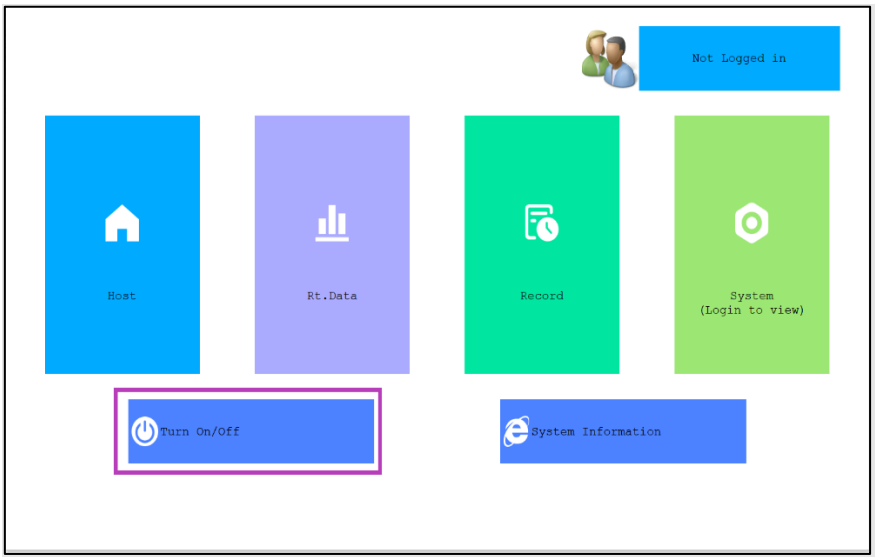

Figure 87: Menu Screen

18. Click on the "Turn On/Off" button.

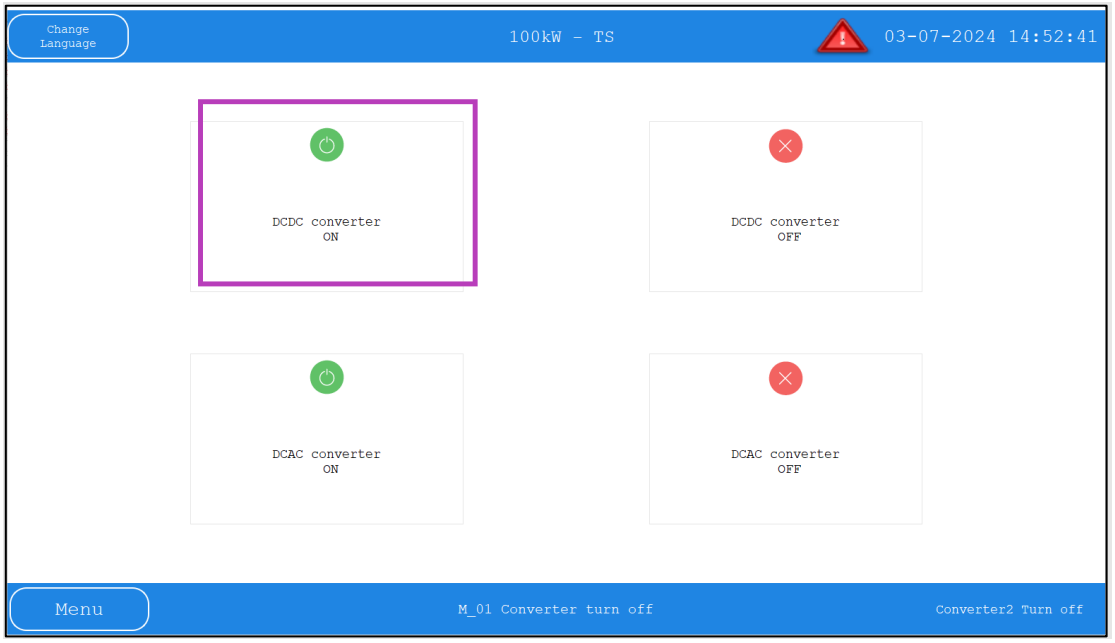

Figure 88: DCDC Converter ON

19. After activating the "DCDC converter ON" function, the PV controller status in the lower right corner of the main monitoring interface will change from its initial "Standby" state to "Converter MPPT", indicating that the PV controller is now operating within normal parameters.
20. To start the converter, navigate to the "Menu" button at the bottom left corner of the monitoring interface, then select the “Turn On/Off” button, and the "DCAC converter ON" option.

Figure 89: DCAC converter ON" option

19. Click on the "DC/AC converter ON" option until the screen displays right below the switch from the converter.
20. After selecting the “DCAC converter ON” option, you will hear the DC contactor sound, followed by the soft start of the converter. Once the soft start is completed, you will hear the AC contactor sound. At this point, the converter status displayed in the lower right corner of the monitoring main interface will update to "converter off-grid discharge", " converter grid-connected charging", or " converter grid-connected discharge", indicating normal operation.
21. The HPS converter will power on.

9.3. Shutdown Procedures

Always prioritise a normal shutdown using the touch panel button whenever possible. The emergency power-off (EPO) button should only be used in emergencies.

For planned shutdowns use the designated button on the touch panel following the on-screen instructions.

9.3.1. Normal Shutdown

This procedure ensures a safe shut down for maintenance or overhaul.

1. Click on the Menu button on the screen.

Figure 90: Menu Button

2. Click on the “Turn On/Off” button.

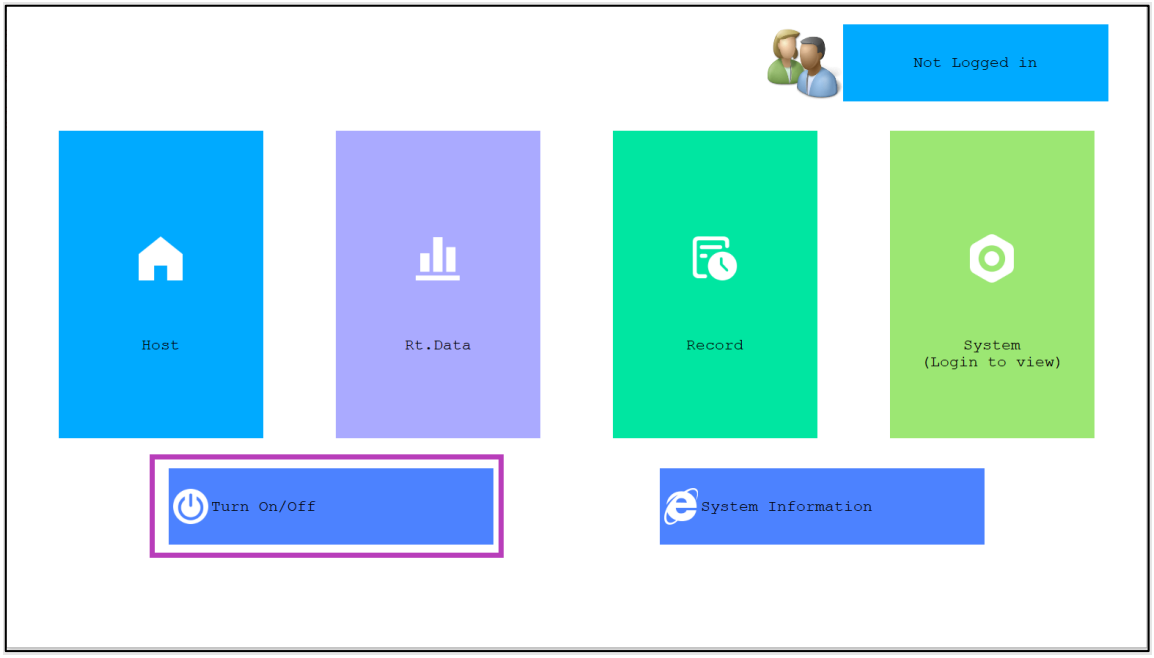

Figure 91: Menu Screen

3. Click on the "DCDC Converter OFF" followed by "DCAC Converter OFF" after the DCDC converter is off.

Figure 92: DCDC or DCAC off Example

4. Verify Shutdown and Disconnect DC Power:
   a) Listen for the AC contactor disconnection sound.

b) Ensure the touchscreen displays "Master-00 Converter OFF" and "Converter 1 Turn OFF."
c) Manually turn off the DC circuit breaker or load switch.

5. Switch OFF the converter fan switch and the KB1, KB2, KB3, and KS switches.
6. Disconnect the AC side circuit breaker of the converter to ensure that the switch is in the "OFF" position.
7. Wait until the bus capacitor discharge is complete, the touch screen is off, and the converter is off. (Wait for about 10 minutes for the bus capacitor to discharge completely).
   a. Verify the touchscreen is OFF, indicating the energy storage converter is fully shut down.

To prevent damage to the breaker and converter from electrical arcing, never disconnect the circuit breaker while the converter is operating. This may lead to damage of the HPS.

9.3.2. Photovoltaic Controller Shutdown

Follow the steps below to shut down the Photovoltaic Controller.

1. On the monitor, navigate to the “Menu” button in the lower-left corner of the screen.

Figure 93: Menu Button

2. Click on the “Turn On/Off” button
3. Click on the “DCDC Converter OFF” option.
4. After clicking, the PV controller status in the lower-right corner will change from "Converter MPPT" to "standby," indicating the PV controller has stopped working.

9.3.3. Converter Shutdown

1. On the monitor, navigate to the “Menu” button in the lower left corner.
2. Click on the “Turn On/Off” button
3. Click on the “DCAC Converter OFF” option.
4. You will hear a sound signifying the AC contactor disconnecting.
5. The converter status at the bottom of the main monitoring interface will change to "Host-00 converter OFF," indicating the converter has stopped working.

9.3.4. In Case of an Emergency or Malfunction

1. For immediate stop: Press the stop button (EPO) to cut power quickly.
2. For isolating power: Once safe, disconnect the machine's power supply from both the DC and AC sides using the circuit breakers or load switches.
3. To reset: Only after confirming the emergency or fixing the malfunction, reset the stop button (EPO) to resume operation.

9.3.5. Maintenance Bypass Procedure

The maintenance bypass circuit breaker (MAINTENANCE), as depicted in figure 94, is normally in the off-state. This bypass ensures continuous power to the load during maintenance or in case of energy storage converter failure, assuming the grid is operational. After closing the maintenance bypass, connect the load to the diesel generator or the grid.

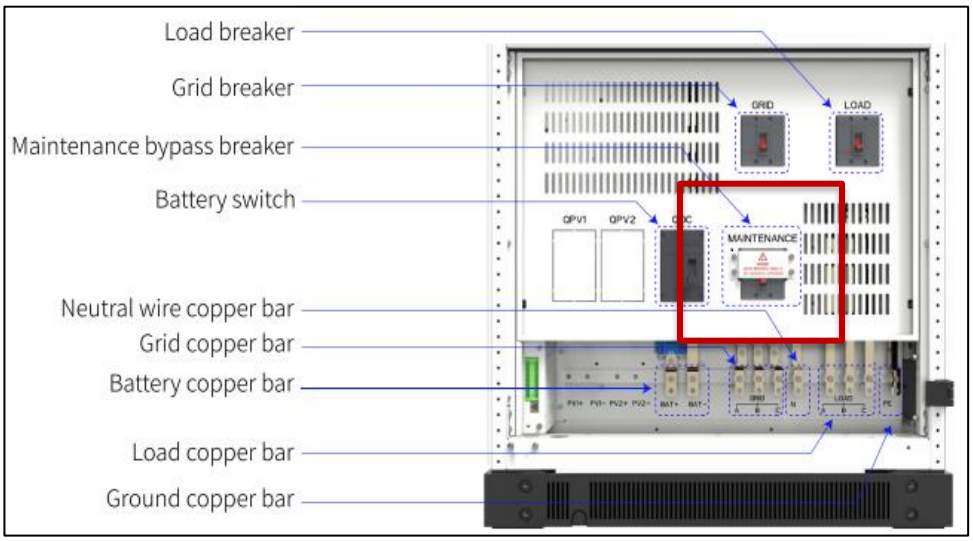

Figure 94: Maintenance Bypass

1. Ensure the diesel generator is operational, or there's grid power available.
2. Shutdown the HPS.
3. Disconnect all relevant switches.
4. Remove the cover on the maintenance bypass circuit breaker (MAINTENANCE) located in Figure 75.
5. Close the maintenance bypass circuit breaker.
6. This bypass allows the load to receive power from the diesel generator or grid while the energy storage converter undergoes maintenance or repair.

Once you have completed the maintenance or repairs, remember to disconnect the maintenance bypass and replace the cover.

10. Section 7: Maintenance and Troubleshooting

Due to ambient temperature, humidity, dust, and vibration, the internal devices of the HPS can age, which can affect the performance and lead to failure.
Therefore, it is necessary to carry out routine and regular maintenance of the HPS to maintain its normal operation and service life.
If you experience any malfunction, contact us and provide the information below:

- Photographs of fault site.
- Model and serial number of the HPS.
- Information on components connected to the HPS configuration.
- HPS batteries and network parameters.
- Communication connection scheme of the HPS.
- Fault information and brief description.

10.1. General Safety Rules

To ensure the safety of the operators, the following safety rules must be observed when maintaining or overhauling the HPS:

- Disconnect all external connections and the internal power supply of the equipment.
- Ensure that the energy HPS is not accidentally re-energized.
- Use the multimeter to ensure that the internal HPS is completely uncharged.
- Ensure that the HPS is well grounded.
- The operating part is close to the parts that may be electrified and is covered with insulation material.

10.2. Fault finding

10.2.1. Considerations and Precautions

To ensure user safety, follow the safety protocols when performing maintenance or overhaul procedures on the HPS.

- Disconnect all external connections of the HPS and the internal power supply of the equipment.
- Ensure that the HPS is well grounded.
- The operating component located close to the parts must be covered in insulation tape to prevent electrical conduction.

- Use a multimeter to verify that all components on the HPS are fully deactivated and free of any voltage.

During this, ensure that all screws, washers, and other metal parts are removed to prevent them from being left inside the HPS, which could cause damage to the equipment.

Disconnecting only the circuit breaker is not sufficient. The cable connection terminals in the AC/DC cabinet of the HPS remain live. To ensure safe maintenance, it is essential to disconnect not only the circuit breaker but also the front and backstage circuit breakers before opening the cabinet door and commencing maintenance work. After the energy storage inverter is out of operation, please wait at least 15 minutes before operating it.

10.2.2. Maintenance Work and Cycle

Refer to the table below for maintenance and recommendation time frames.

Table 44: Maintenance Work Item Sheet

Inspection	Check List	Recommendation Cycle
Save record	Export data with USB and save backup	One (1) month
Inverter Inspection	• Observe whether the appearance of HPS is damaged, deformed, or rusted. • Listen to the abnormal sound of the HPS. • LCD was used to observe the running parameters. • Use a thermal imager and other detection systems to detect the heating status. • Check whether the ventilation, ambient temperature, humidity and dust around the inverter meet the requirements.	Half a year (6 months)
Duct Cleaning	• Check duct for dust. • Listen to if there is any abnormal vibration when the fan is running. • Use compressed air and turn on the fan for cleaning. • Clean or replace the air filter	Half a year (bad environment needs to be shortened as appropriate)
Security function	• Check whether the EPO button is invalid. • Check whether the LCD closed inverter function is invalid.	Half a year (6 months)
Circuit connection	• Check all electrical	1 year (12 months)

	connections for looseness or poor contact. • Check the surface of all cables and metal surfaces for damage or scratches. • Check that the insulation bandage of all terminals is off Check the screw position for signs of overheating. • Check the color change of the copper bars and bolts	
Circuit Breaker Maintenance	• Check all circuit breakers for failure. • Check whether the circuit breaker or load switch is damaged.	1 year (12 months)
Identification check	Check device warning signs and other equipment labels. If blurred or damaged, please replace it in time	1 year (12 months)
	Due to the capacitance of the DC bus, it will take at least 15 minutes to wait until the energy storage inverter is completely cut off. Before removing the dust, please use the multimeter measurement to confirm that there is no electricity in the machine, to avoid electric shock.	

The overwhelming majority of maintenance work can only be carried out by removing the protective net cover inside the machine. At the end of all maintenance work, it is necessary to restore all dismantled maintenance covers to their original state. Make sure all screws are tightened in place.

Only the recommended product routine maintenance cycle is included in the table. The actual maintenance cycle should be determined according to the specific installation environment of the product. The maintenance cycle of the product will be affected by factors such as the scale of the power plant, the location of the plant, and the on-site environment. It is necessary to shorten the maintenance cycle and increase the maintenance frequency if the wind and sand in the operation environment are larger or the dust is thicker.

Check and Replace the Air Filter

Read the safety instructions carefully.

1. Open the cabinet door.
2. Check the air filter and remove it with a screwdriver if necessary.
3. Check the cleanliness of the cabinet. If necessary, use a soft cloth or vacuum cleaner for cleaning.
4. Close the cabinet door.

Replacement of Electronic Components

When replacing the electronic and electrical components in the energy storage inverter, be sure to replace the same type of components from the same manufacturer. The type of components can be obtained by identifying the product. If not, contact Freedom Won.

Be aware that if you need to replace products from other manufacturers or different models from the same manufacturer, it is crucial to obtain confirmation from our engineers in advance. Failure to do so may result in losses, for which we will not be held liable.

10.2.3. Troubleshooting

WARNING Even if the HPS is in a failed state, it may still contain lethal high voltage within the inverter. Therefore, only authorised technicians who meet the requirements are permitted to perform the operations outlined in this section.

To be considered compliant with the requirements, operators must have completed professional training on equipment troubleshooting operations in the early stages. It is essential to strictly adhere to the troubleshooting procedures described in this manual and to observe all safety operation specifications during operation.

When the HPS can't output as expected or the charge and discharge quantity changes abnormally, check the following items:

- Open-circuit voltage of energy storage battery.
- Whether the machine is in a state of failure.
- Whether the power grid is correctly connected and powered on.
- Check whether the communication of measuring equipment is normal.

Non-Alarm Inducing Failure Machine working noise is high:

- Check whether the power is in the normal range.
- Measure whether the grid-connected current and voltage waveforms are normal.
- Check the replacement of cooling fans.

Network communication mode:

- Check whether the IP address, subnet mask, and gateway are set correctly.
- Check whether the communication line is through and whether it is well connected.
- If all the above tests are normal and correct, try to replace the LCD monitoring board.

Serial communication mode:

- Check the wiring, check all wiring is good, and A/B has no connection.
- The communication adapter does not match. Replace communication adapter and try again.
- Check whether the local address and baud rate are consistent with the host computer.

The LCD screen cannot be switched on and off:

- Check the communication connection between the LCD screen and the DSP board.

10.2.4. Alarm Failure List

LCD alarm displays and the corresponding solutions are shown in Table 37.

Table 45: Alarm Fault Handling Method

Fault Type	Solution
Low battery voltage	Disconnect the DC load switch and check the DC side voltage and battery configuration.
Battery Voltage Low Auxiliary	Disconnect the DC load switch and check the DC side voltage and battery configuration.

Power Supply	
Low battery power	Disconnect the DC circuit breaker load switch and check the energy storage battery status.
Battery Back Connection Failure	Switch-off the DC-side input bus.
Busbar Overvoltage Fault	Turn off to check the DC side voltage.
Bus Short Circuit Fault	Turn off and check the DC bus connection.
Overvoltage of grid	Check the voltage of the grid connection point by shutdown.
Low grid voltage	Check the voltage of the grid connection point by shutdown.
Inverse Voltage Sequence of Power Grid	Disconnect the power supply switch and turn it off to check the three-phase wiring.
Abnormal Frequency of Power Grid	Turn off and check the grid voltage.
DC Contactor Fault	Turn off and check whether the DC contactor is damaged.
Output contactor open circuit	Turn off and check if the AC contactor is damaged.
Output Contactor Short Circuit	Turn off and check if the AC contactor is damaged.
AC Fan Fault	Turn off and check the AC fans.

AC auxiliary power failure	Turn off and check the AC auxiliary power supply board.
DC auxiliary power supply failure	Turn off and check the DC auxiliary power supply board
15V power failure	Turn off, and check AC and DC auxiliary power supply board
Inverter overcurrent	Turn off, and check whether the input and output of the inverter are short-circuited or whether the inverter is overloaded.
Wave by Wave Current Limitation of Inverter	Turn off, and check whether the input and output of the inverter are short circuit or whether the inverter is overloaded.
Inverter Fault	Check operation before switching off the repetitive inverter
Inverter overheating	Turn off, and check whether the inverter fan is out of order and whether the air duct is unobstructed.
Inverter Phase Shortage Fault	Turn off and check the AC sideline.
Inverter synchronisation	Turn off and check the inverter settings.
Lightning protection failure	Turn off and check the lightning protection of the inverter.
BMS Communication Fault	Turn off and check if the communication cable between the inverter and battery system is loose.
Overload	Turn off and check the load size.
Isolated island protection	Turn off.
Drive Line Fault	Turn it off and check whether the internal drive line is loose.
Insulation impedance anomaly	Turn off and check inverter grounding and cable aging.
EPO	Turn off.

CT or Hall Opening	Turn off check CT wiring.
DC converter overcurrent	Shut down, troubleshoot, and turn on after the trouble is eliminated.
Wave-by-wave current limiting of DC converters	Shut down, troubleshoot, and turn on after the trouble is eliminated.
DC converter over temperature	Shut down, troubleshoot, and turn on after the trouble is eliminated.
Output overload	Shut down and check the load size.
Voltage on the high voltage side (Buck Mode Input)	Shut down, check the voltage on the high-voltage side, and turn it on after the fault is eliminated.
High voltage side busbar overvoltage fault	Shut down, disconnect the input and output switches, check the voltage on the high-voltage side, and start the machine after the fault is eliminated.
High voltage side busbar short circuit fault	Shut down, disconnect the input and output switches, check the voltage on the high-voltage side, and start the machine after the fault is eliminated.
High-voltage side input reverse connection fault	Shut down, disconnect the input and output switches, check the voltage on the high-voltage side, and start the machine after the fault is eliminated.
Low voltage side low (Boost input)	Shut down, check the low-voltage side voltage, and turn it on after the fault is eliminated.
Low-voltage side busbar overvoltage fault	Shut down, disconnect the input and output switches, check the voltage on the low-voltage side, and turn it on after the fault is eliminated.
Low-voltage side busbar short-circuit fault	Shut down, disconnect the input and output switches, check the voltage on the low-voltage side, and turn it on after the fault is eliminated.

Low-voltage side reverse connection fault	Shut down, disconnect the input and output switches, check the voltage on the low-voltage side, and turn it on after the fault is eliminated.
Drive cable fault	Shut down and check the IGBT drive cable.
Lightning protection fault	Shut down, disconnect the input, and output switches, and replace the lightning protection module in the cabinet.
Abnormal insulation resistance	Shut down, and disconnect the input, and output switches.
DC auxiliary power failure	Shut down and replace the auxiliary power board.
DC fan failure	Shut down, and check the fan air duct, and power supply.
Emergency shutdown	Shut down, disconnect the input, and output switches, and check the fault.
DC converter out of sync	Shut down, disconnect the input, and output switches, check the parallel network cable, and restart the DC module.
High-voltage side contactor open circuit	Shut down, disconnect the input, and output switches, and replace the DC contactor.
High voltage side contactor short circuit	Shut down, disconnect the input, and output switches, and replace the DC contactor.
Low-voltage side contactor open circuit	Shut down, disconnect the input, and output switches, and replace the DC contactor.
Low voltage side contactor short circuit	Shut down, disconnect the input, and output switches, and replace the DC contactor.

10.2.5. Safety Protection Functions

T HPS has a perfect protection function and warning function. When the input voltage or abnormal situation of the power grid occurs, it can operate effectively to protect the safe operation of the energy storage inverter and continue to operate the set mode until the abnormal situation disappears.

Table 46: Inverter Warning and Protection Functions

Function	Function Description
DC over/under voltage protection	When the DC voltage of the energy storage battery exceeds the allowable voltage range, the HPS will stop working, send out warning signals, and display the fault type on the LCD screen. The HPS can detect abnormal voltage quickly and react.
Overvoltage/undervoltage protection of power grid	When the HPS detects that the grid voltage exceeds the allowable voltage range, the energy storage inverter will stop working send out warning signals and display the fault type on the LCD screen. The HPS can detect abnormal voltage quickly and react.
Over/Under Frequency Protection of Power Grid	When the HPS detects that the frequency fluctuation of the power grid exceeds the allowable range, the energy storage inverter will stop working and send out warning signals. The fault type is displayed on the LCD screen. The HPS can detect abnormal frequency quickly and respond to it.
Isolated island protection	When the HPS detects that the grid voltage is 0, the energy storage inverter will stop working, send out warning signals, and display the fault type on the LCD screen. The HPS can detect abnormal voltage quickly and react.
AC Overcurrent Protection	When the output power of the HPS battery exceeds the maximum DC input power allowed by the energy storage inverter, the energy storage inverter will work at the allowable maximum AC output power. When the AC is detected to be greater than 1.2 times the rated current, the energy storage inverter will stop working. After restoring to normal, the energy storage inverter should be able to work normally.
AC leakage current protection	The HPS has the function of grounding protection. A leakage current sensor is installed in the grounding cable. When the leakage current exceeds 2A, the machine will stop immediately. When the current is less than 1.5A, the protection can be eliminated. The fault will be displayed on the LCD screen.

IGBT Overtemperature Protection	The IGBT module of HPS uses a high-precision temperature sensor, which can monitor module temperature in real time. When the temperature is too high, the DSP will issue instructions to stop the operation of the HPS to protect the stable operation of equipment.
IGBT Fault Protection	The IGBT module of the HPS has a self-protection function. When the module detects that the module has over-current, it can send fault information to the DSP quickly. The DSP will issue instructions to stop the energy storage inverter running, send warning signals, and display the fault type on the LCD.
Polarity Reverse Connection Fault Protection	When the HPS detects that the DC voltage is negative, the energy storage inverter will send a warning signal and display the fault type on the liquid crystal.
Environmental Overtemperature Protection	The high-precision temperature sensor is used in the HPS, which can monitor the temperature inside the machine in real-time. When the temperature is too high, the DSP will issue instructions to stop the operation of the energy storage inverter to protect the stable operation of the equipment.
DC Overcurrent Protection	When the energy storage inverter detects that the DC current is greater than 1.2 times the rated current, the energy storage inverter will stop working, send out warning signals and display the fault type on the LCD. After restoring to normal, the energy storage inverter should be able to work normally.
Independent Inverter Overvoltage Protection	When the energy storage inverter operates in the independent inverting mode and detects that the three-phase output voltage exceeds the allowable voltage range, the energy storage inverter will stop working and send out warning signals and display the fault type on the liquid crystal.
Phase Sequence Reverse Connection Protection	When the energy storage inverter self-checks and finds that the three-phase voltage phase of the connected power grid is wrong, the inverter will send out warning signals and display the fault type on the LCD. After returning to normal, the energy storage inverter should be re-energized and self-checked to work normally.
AC voltage unbalance protection	When the energy storage inverter detects that the difference of three-phase AC voltage exceeds the allowable range, the energy storage inverter will stop working and send out warning signals and display the fault type on the LCD. Energy storage inverter can detect abnormal voltage quickly and react.
AC current unbalance protection	When the energy storage inverter detects that the difference of three-phase AC voltage exceeds the allowable range, the energy storage inverter will stop working and send out

	warning signals and display the fault type on the LCD. Energy storage inverter can detect abnormal voltage quickly and react.
Transformer Overtemperature Protection	The transformer of energy storage inverter uses high precision temperature sensor, which can monitor module temperature in real time. When the temperature is too high, the DSP will issue instructions to stop the operation of energy storage inverter to protect the stable operation of equipment.
Fan Fault Protection	The fan of the energy storage inverter has the function of automatic detection. When the fan is not turned, it can send fault information to the DSP quickly. The DSP will issue instructions to stop the energy storage inverter, and send warning signals, and display the fault type on the LCD.

10.3. Appendix: Quality Assurance

Assurance:

- Products that fail during quality assurance.
- We will repair or replace new products free of charge.

Evidence:

During the warranty period, the company requires customers to produce invoices and dates for purchasing products. At the same time, the trademark on the product should be visible, otherwise it has the right not to give quality assurance.

Conditions:

- Unqualified products after replacement shall be handled by our company.
- Customers should reserve a reasonable time for the company to repair faulty equipment.

Immunity from liability:

In the following circumstances, the company has the right not to undertake quality assurance:

- The whole machine and parts have exceeded the free warranty period.
- Transportation damage.
- Improper installation, modification, or use.
- Operating in very harsh environments beyond those described in this manual.
- Machine failure or damage caused by installation, repair, alteration, or disassembly by non-company service personnel.
- Any installation and use beyond the scope specified in the relevant international standards.
- Machine failure or damage caused by the use of non-standard or non-approved components or software.
- Damage caused by abnormal natural environment causes product failure due to the above situation. Customers require maintenance services. After judging by the company's service agencies, it can provide paid maintenance services.

The company's products and manuals are continuously improving and upgraded to improve your satisfaction. If there is a difference between the manuals and the products in your hand, it may be the reason for the edition, please refer to the specific products. If you still have questions, please contact us.

11. List of Abbreviations

HPS – Hybrid Power System

DC – Direct Current

AC –Alternating Current

A - Ampere

kWh – Kilowatt-hour

ESS – Energy Storage System

IGBT - Insulated-gate Bipolar Transistor

BMS - Battery Management System

EMS - Energy Management System

MW – Megawatts

V/F - Voltage/Frequency

P/Q - Power Quality

EPO - Emergency Power Off

AO – Digital Input

DI - Digital Output

MPPT - Maximum Power Point Tracking

SoH - State of Health

SoC - State of Charge

THDi - Total Harmonic Distortion in Current

THDu - Total Harmonic Distortion in Voltage

CAN - Controller Area Network

UART - Universal Asynchronous Receiver / Transmitter

Hz - Hertz

KvA - Kilo-Volt-Amperes

DG - Diesel Generator

HMI – Human Machine Interfaces

DSP - Digital Signal Processing

FAT32 - File Allocation

DSP - Digital Signal Processors

ATS - Automatic Transfer Switch

DOD - Depth of Discharge

CB - Circuit Breaker

VSD - Variable Speed Drives

Gen - Generator

VOC – Volatile Organic Compounds