Residential Smart PV Solution (EMMA Networking & SmartGuard Networking)

User Manual

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About This Document

Purpose

This document describes the Residential Smart PV Solution (EMMA & SmartGuard) in terms of the networking, cable connections, and device commissioning. The safety precautions, product introduction, site selection requirements, and maintenance information of the devices involved in the solution are described in the user manuals of the corresponding devices.

Intended Audience

This document is intended for:

- Sales engineers
- System engineers
- Technical support engineers
- End users

Symbol Conventions

The symbols that may be found in this document are defined as follows.

Symbol	Description
DANGER	Indicates a hazard with a high level of risk which, if not avoided, will result in death or serious injury.
WARNING	Indicates a hazard with a medium level of risk which, if not avoided, could result in death or serious injury.
CAUTION	Indicates a hazard with a low level of risk which, if not avoided, could result in minor or moderate injury.
NOTICE	Indicates a potentially hazardous situation which, if not avoided, could result in equipment damage, data loss, performance deterioration, or unanticipated results. NOTICE is used to address practices not related to personal injury.

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Symbol	Description
NOTE	Supplements the important information in the main text. NOTE is used to address information not related to personal injury, equipment damage, or environment deterioration.

Change History

Changes between document issues are cumulative. The latest document issue contains all the changes made in earlier issues.

Issue 03 (2024-06-30)

- Added **4 Three-Phase SmartGuard Networking**.
- Updated **1 Solution Overview**.

Issue 02 (2024-01-30)

Updated **2.1.1 PV+ESS System**.

Issue 01 (2023-09-08)

This issue is the first official release.

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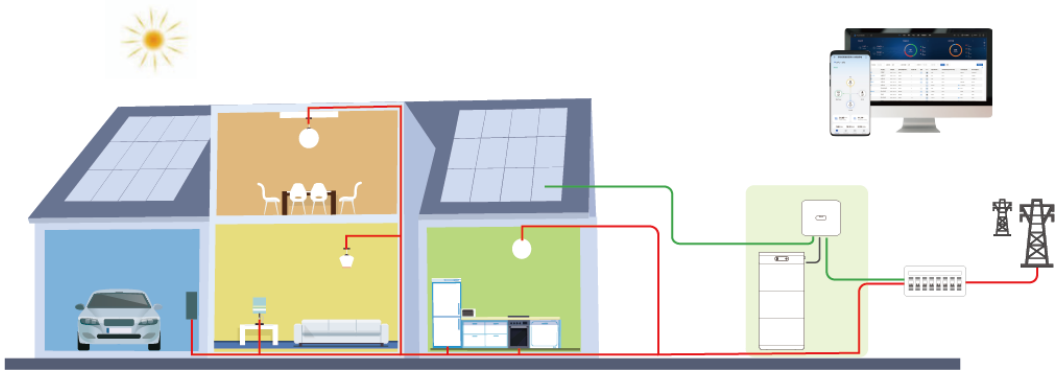
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1 Solution Overview

The residential Smart PV solution integrates a PV system and energy storage system (ESS) to convert solar energy into green electricity to meet residential power consumption requirements. When the sunlight is sufficient in the daytime, the PV system generates electricity and supplies it to home appliances, and the surplus electricity is used to charge the ESS. When the sunlight is insufficient, the ESS discharges to loads. In this scenario, green power generation and efficient power consumption are achieved through load scheduling and control.

Figure 1-1 Overview of the residential Smart PV solution



Solution Networking

The residential Smart PV solution involves two typical networking scenarios, including the EMMA-A01/A02 and SmartGuard scenarios.

- In the EMMA networking scenario, home energy can be scheduled and managed in a unified manner. The EMMA has two models as follows:
  - EMMA-A01: Only PV and ESS features are supported. Plant-level power control functions, such as maximum self-consumption and grid-tied point control, are supported for unified scheduling and management of home energy and plant-level energy optimization, further improving the PV power utilization.
  - EMMA-A02: PV and ESS features and smart loads are supported. In addition to unified scheduling and management of home energy, the EMMA can connect to smart appliances such as SG Ready heat pumps

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and smart switches as well as a maximum of two chargers. Users can set the reservation time to charge vehicles and heat water in advance at the specified time. In addition, users can set the priority to use PV power for devices as required to make the best use of PV power.

- In the SmartGuard networking scenario, the SmartGuard integrates the EMMA-A02 and supports the on/off-grid switchover in addition to functions of home energy management and access to smart appliances. When the grid fails, the inverter switches to the off-grid state and supplies power to appliances connected to the backup power ports.

Table 1-1 List of networking features

Feature	EMMA-A01	EMMA-A02	Connect All Loads to the SmartGuard	Connect Some of Loads to the SmartGuard
PV+ESS self-consumption	√	√	√	√
Response time controlled at the grid connection point	2s	2s	2s	2s
AI-based PV+ESS scheduling[1]	×	√	√	√
Heat pump and smart switch	×	√	√	√
Max. number of chargers	0	2	2	2
Power meter	Not required	Not required	Not required	Required[2]

NOTE

Note [1]: The AI-based PV+ESS scheduling can be used for free for two years.

Note [2]: The three-phase SmartGuard supports a maximum load current of 63 A. If the load current exceeds 63 A, only some of loads can be connected to it. In addition, a power meter needs to be connected between the three-phase SmartGuard and the main circuit breaker.

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Products in the Solution

Table 1-2 Product list

Product	Model	Description
Inverter	Single-phase: SUN2000-(2KTL-6KTL)-L1 SUN2000-(8K, 10K)-LC0 Series Three-phase: SUN2000-(3KTL-10KTL)-M1 SUN2000-10KTL-BEM1 SUN2000-(8KTL-20KTL)-M2 SUN2000-(12KTL-25KTL)-M5 Series SUN2000-(12K-25K)-MB0 Series SUN2000-(5K-12K)-MAP0 Series SUN5000-(8K, 12K)-MAP0 Series SUN5000-(17K, 25K)-MB0 Series	The inverter converts the PV power generated by the PV system.
ESS	LUNA2000-(5-30)-S0 LUNA2000-(7, 14, 21)-S1	Energy storage system, used for electricity charge and discharge.
EMMA	EMMA-A01 EMMA-A02	• EMMA-A01, PV+ESS features • EMMA-A02, PV+ESS features and smart appliances
SmartGuard	SmartGuard-63A-S0 and SmartGuard-63A-AUS0 (single-phase) SmartGuard-63A-T0 and SmartGuard-63A-AUT0 (three-phase)	• Used for on/off-grid switchover of backup power for the whole house.
AC charger	SCharger-7KS-S0 (single-phase) SCharger-22KT-S0 (three-phase)	Multiple charge modes are available.
Optimizer	SUN2000-450W-P2 SUN2000-600W-P MERC-600W-PA0 MERC-(1300W, 1100W)-P	For details about the optimizer supported by the inverter, see • **SUN2000 Smart PV Optimizer User Manual** • **MERC-600W-PA0 Smart PV Optimizer User Manual** • **MERC-(1300W, 1100W)-P Smart PV Optimizer User Manual**
Smart switch and heat pump	View **5.2 Smart Switch Networking** to obtain the list of appliances that can be connected to the EMMA.	

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NOTE

- SUN5000 inverters cannot be cascaded with SUN2000 inverters.
- Optimizers must be configured for all PV modules connected to the SUN5000 inverter. Otherwise, the inverter cannot be started.
- The LUNA2000-(5-30)-S0 and LUNA2000-(7, 14, 21)-S1 cannot connect to the same inverter in a parallel system.
- If inverters are cascaded, the LUNA2000-(5-30)-S0 and LUNA2000-(7, 14, 21)-S1 cannot connect to different inverters.

References

For details about the installation, cable connection, and configuration of the products in the network, see the following documents.

Table 1-3 Quick guides for the solution

Networking Scenario	Link
EMMA networking	**Residential Smart PV Solution Quick Guide (Single-Phase PV+ESS Scenario + EMMA Networking)**
	Residential Smart PV Solution Quick Guide (Three-Phase PV+ESS Scenario + EMMA Networking)
SmartGuard networking	**Residential Smart PV Solution Quick Guide (Single-Phase PV+ESS Scenario + SmartGuard Networking)**
	Residential Smart PV Solution Quick Guide (Three-Phase PV+ESS Scenario + SmartGuard Networking)

Table 1-4 Product documents

Item	Link
Single-phase inverter	**SUN2000-(2KTL-6KTL)-L1 Quick Guide**
	SUN2000-(8K, 10K)-LC0 Series Quick Guide
Three-phase inverter	**SUN2000-(3KTL-10KTL)-M1 Quick Guide**
	SUN2000-(8KTL-20KTL)-M2 Quick Guide
	SUN2000-(12KTL-25KTL)-M5 Series Quick Guide
	SUN2000-(12K-25K)-MB0 Series Quick Guide
	SUN2000-(5K-12K)-MAP0 series Quick Guide
	SUN5000-(8K, 12K)-MAP0 Series Quick Guide
	SUN5000-(17K, 25K)-MB0 Series Quick Guide

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Item	Link
ESS	**LUNA2000-(5-30)-S0 Quick Guide**
	LUNA2000-(7, 14, 21)-S1 Quick Guide
Charger	**Smart Charger User Manual (SCharger-7KS-S0, SCharger-22KT-S0)**
EMMA	**EMMA-(A01, A02) Quick Start Guide**
SmartGuard	**SmartGuard-63A-(S0, AUS0) Quick Guide**
	SmartGuard-63A-T0/AUT0 Quick Guide
Optimizer	**SUN2000-(600W-P, 450W-P2) Smart PV Optimizer Quick Guide**
	MERC-(1300W, 1100W)-P Smart PV Optimizer Quick Guide
	MERC-600W-PA0 Smart PV Optimizer Quick Guide
FusionSolar app	**FusionSolar App Quick Guide (EMMA)**
Smart switch and heat pump	For details, see the quick guides delivered with the product.

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2 EMMA Networking

2.1 Networking Application

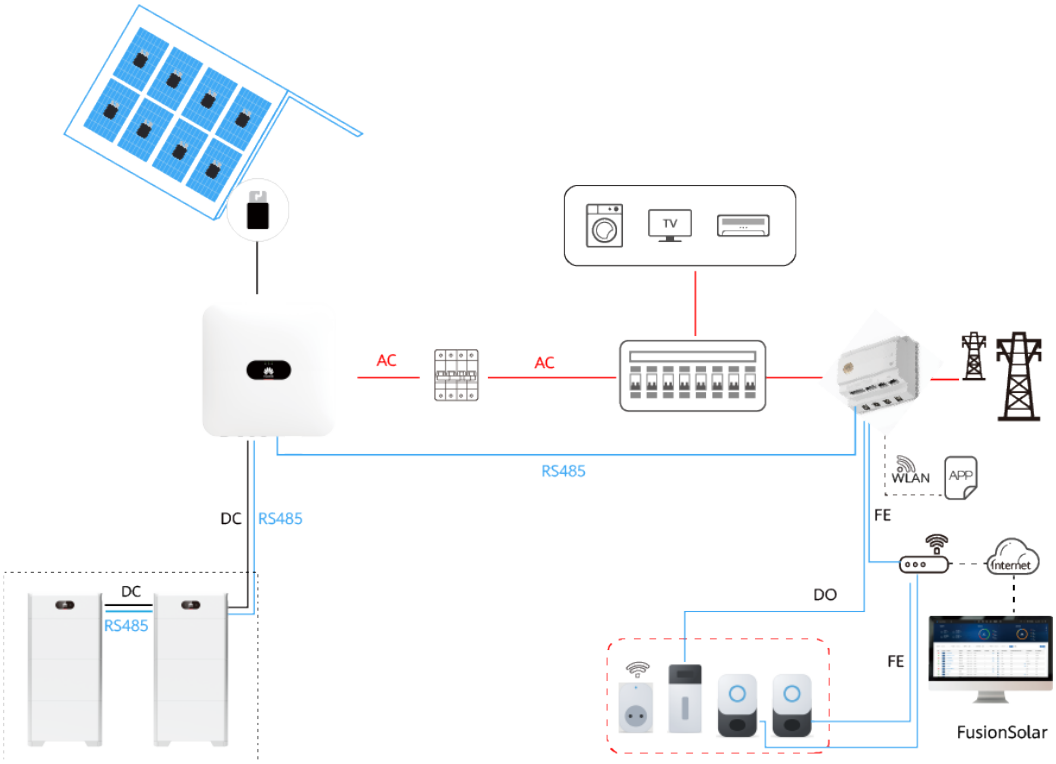
NOTE

- Only one EMMA can be connected to a router.
- It is recommended that the charger and EMMA be connected to the router in wired network (FE) mode. If the charger and EMMA are connected to the router in WLAN mode, the charging power may decrease due to unstable signals.
- Both the EMMA and Smart Dongle provide communication capabilities. Only either of them can be installed in a power plant for networking. Otherwise, communication between devices will be abnormal.

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2.1.1 PV+ESS System

Single Inverter



Note: The figure uses the LUNA2000-(5-30)-S0 as an example.

Table 2-1 Single-phase system configuration with the LUNA2000-(5-30)-S0

Inverter	LUNA2000-(5-30)-S0	Max. Number of Connected ESSs
SUN2000-(2KTL-6KTL)-L1	√	2
SUN2000-(8K, 10K)-LC0 Series	√	2

Table 2-2 Single-phase system configuration with the LUNA2000-(7, 14, 21)-S1

Inverter	LUNA2000-(7, 14, 21)-S1	Max. Number of Connected ESSs
SUN2000-(2KTL-6KTL)-L1	√	2*
SUN2000-(8K, 10K)-LC0 Series	√	2

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NOTE

If the SUN2000-(2KTL-6KTL)-L1 is connected to two ESSs (S1), the ESSs need to be connected to the EMMA directly using an FE network cable or through a router.

Table 2-3 Three-phase system configuration with the LUNA2000-(5-30)-S0

Inverter	LUNA2000-(5-30)-S0	Max. Number of Connected ESSs
SUN2000-(3KTL-10KTL)-M1	√	2
SUN2000-10KTL-BEM1	√	2
SUN2000-(12K-25K)-MB0	√	4
SUN2000-(5K-12K)-MAP0 Series	√	2
SUN5000-(8K, 12K)-MAP0 Series	√	2
SUN5000-(17K, 25K)-MB0 Series	√	4

Table 2-4 Three-phase system configuration with the LUNA2000-(7, 14, 21)-S1

Inverter	LUNA2000-(7, 14, 21)-S1	Max. Number of Connected ESSs
SUN2000-(3KTL-10KTL)-M1	√	2
SUN2000-10KTL-BEM1	√	2
SUN2000-(12K-25K)-MB0	√	4
SUN2000-(5K-12K)-MAP0 Series	√	2
SUN5000-(8K, 12K)-MAP0 Series	√	2
SUN5000-(17K, 25K)-MB0 Series	√	4

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Multiple Inverters Cascaded

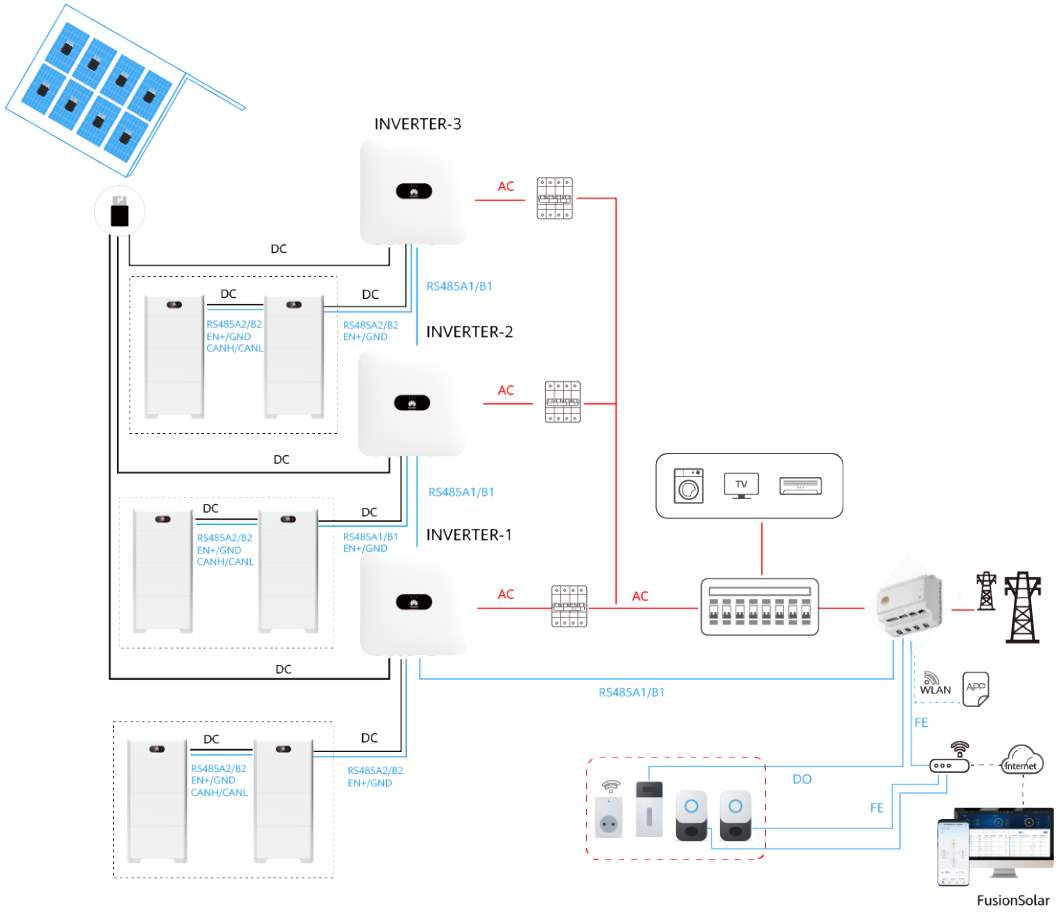


Table 2-5 Configuration description (single-phase system)

Inverter 1/2/3	Max. Number of Parallel Inverters
SUN2000-(2KTL-6KTL)-L1 SUN2000-(8K, 10K)-LC0	3

Table 2-6 Configuration description (three-phase system)

Inverter 1/2/3	Max. Number of Parallel Inverters
SUN2000-(3KTL-10KTL)-M1 SUN2000-10KTL-BEM1 SUN2000-(8KTL-20KTL)-M2 SUN2000-(12KTL-25KTL)-M5 SUN2000-(12K-25K)-MB0	3
SUN2000-(5K-12K)-MAP0 Series	3
SUN5000-(8K, 12K)-MAP0 Series	3

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Inverter 1/2/3	Max. Number of Parallel Inverters
SUN5000-(17K, 25K)-MB0 Series	3

NOTE

A maximum of **three** inverters and **12** ESSs can be connected under EMMA networking.

NOTE

If an inverter is added in a parallel system, perform the manual baud rate negotiation by referring to the section "Baud Rate Negotiation" in the **SUN2000-(12K-25K)-MB0 Series User Manual**.

2.2 Electrical Connections

For details about cable connections in typical scenarios, see the following table.

Table 2-7 Typical scenarios

Cable Connection Scenario	Documentation
Single-phase inverter + LUNA2000-(5-30)-S0 + EMMA	**Residential Smart PV Solution Quick Guide (Single-Phase PV+ESS Scenario + EMMA Networking)**
Single-phase inverter + LUNA2000-(7, 14, 21)-S1 + EMMA	
Three-phase inverter + LUNA2000-(5-30)-S0 + EMMA	**Residential Smart PV Solution Quick Guide (Three-Phase PV+ESS Scenario + EMMA Networking)**
Three-phase inverter + LUNA2000-(7, 14, 21)-S1 + EMMA	

2.3 System Power-On

DANGER

- Wear personal protective equipment and use dedicated insulated tools to avoid electric shocks or short circuits.

NOTICE

Before the equipment is put into operation for the first time, ensure that the parameters are set correctly by professional personnel. Incorrect parameter settings may result in noncompliance with local grid connection requirements and affect the normal operations of the equipment.

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NOTICE

Before turning on the AC switch between the inverter and the grid, check that the AC voltage is within the specified range using a multimeter.

Check Before Power-On

Table 2-8 Checklist

No.	Check Item	Expected Result
1	Device installation	The device is installed correctly and securely.
2	Cable routing	Cables are routed properly as required by the customer.
3	Cable binding	Cable ties are evenly distributed and no sharp edge exists.
4	Grounding	The PE cable is connected correctly, securely, and reliably.
5	Switch	All switches are in the **OFF** state.
6	Cable connection	All cables are correctly and securely connected.
7	Unused terminal and port	Unused terminals and ports are locked by waterproof glands.
8	Installation environment	The installation space is proper, and the installation environment is clean and tidy.

Power-on Procedure

Step 1 Turn on the ESS switch.

Step 2 Turn on the main circuit breaker between the EMMA and the grid.

Step 3 At the AC switch between the inverter and the EMMA, use a multimeter to measure the grid voltage and ensure that the voltage is within the allowed operating voltage range of the inverter. If the voltage is not in the allowed range, check the circuits.

Step 4 Turn on the AC switch between the inverter and the EMMA.

Step 5 Turn on the DC switch (if any) between the PV strings and the inverter.

Step 6 (Optional) Remove the knob locking screw next to the DC switch on the inverter.

Step 7 Turn on the DC switch on the inverter.

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Step 8 Observe the LED indicators on the device to check the running status.

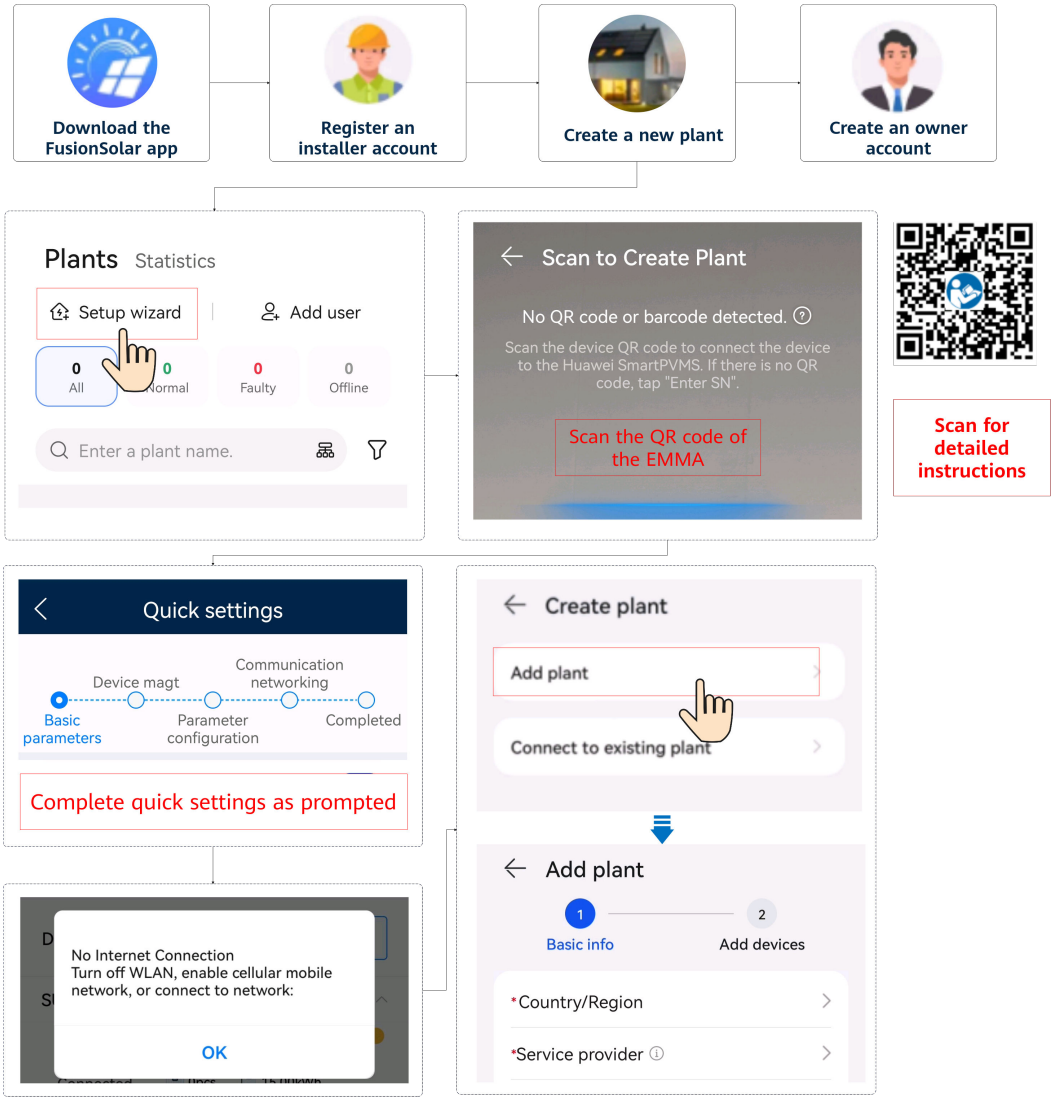
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2.4 Deploying a New Plant

Prerequisites

The charger must be upgraded to the FusionCharge V100R023C10 to match the EMMA networking. Otherwise, the EMMA cannot find the charger. **Connect to the charger** as an installer. For details about the upgrade operations, see **E Upgrading the Charger**.

Setup Wizard

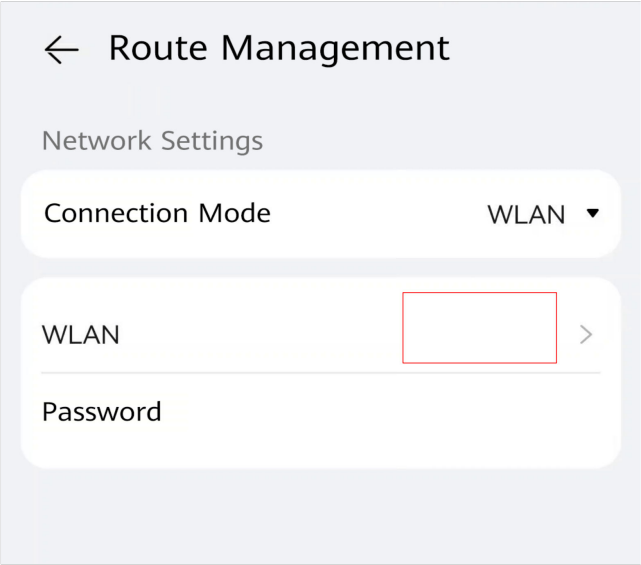


NOTE

For details, see **FusionSolar App Quick Guide (EMMA)**.

If the charger connects to the router over WLAN, you need to log in to the charger to set the WLAN information before deploying the EMMA.

Connect to the charger as an installer, choose **O&M** > **Route Management**, select **WLAN** in **Connection Mode**, and enter the WLAN information.

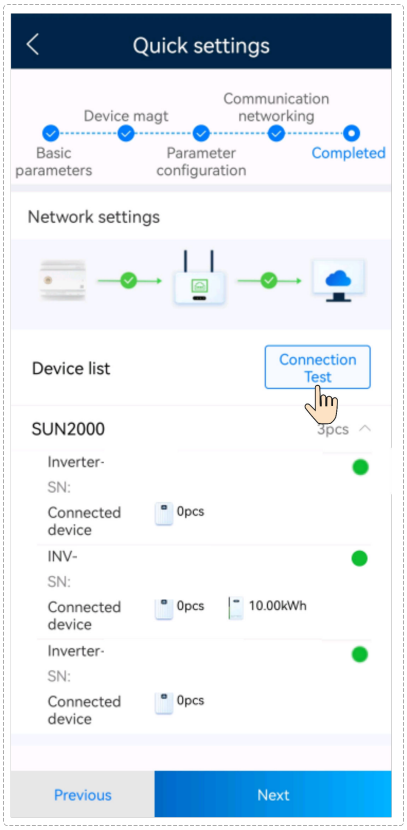


Connection Test

Connection Test is supported in quick settings. You can perform this step to check whether the cable connections are correct, avoiding site visits for rectification.

Tap **Connection Test** and wait until the test is complete. If the test fails, rectify the fault in a timely manner.

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2.5 Parameter Settings

NOTE

The app is being updated. The actual UI may vary.

Table 2-9 Setting process

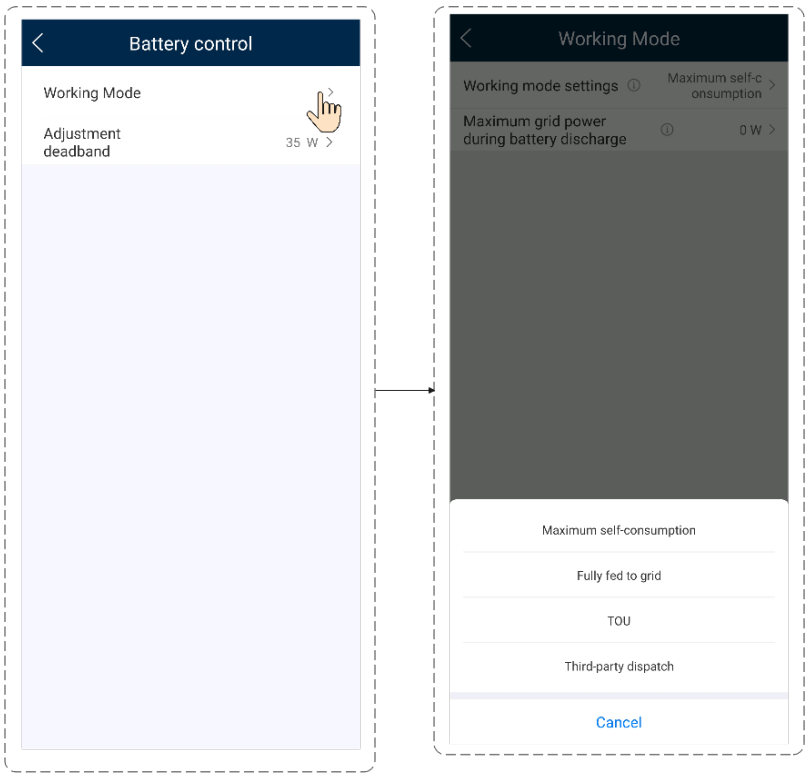
Procedure	Step	
1. Deploying a new plant	(1) Download and install the FusionSolar app.	
	(2) Register an installer account. (Optional, required during initial registration)	
	(3) Follow the setup wizard.	a. Scan the QR code.
		b. Perform quick settings.
		c. Connect to the plant.
		d. Create an owner account.
		e. View the plant status.
	(4) View the device status.	
2. Grid-tied point control (to be configured if limited feed-in is required; EMMA required)		

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Procedure	Step
3. Physical layout of optimizers (to be configured if optimizers are used)	
4. ESS end-of-discharge SOC	

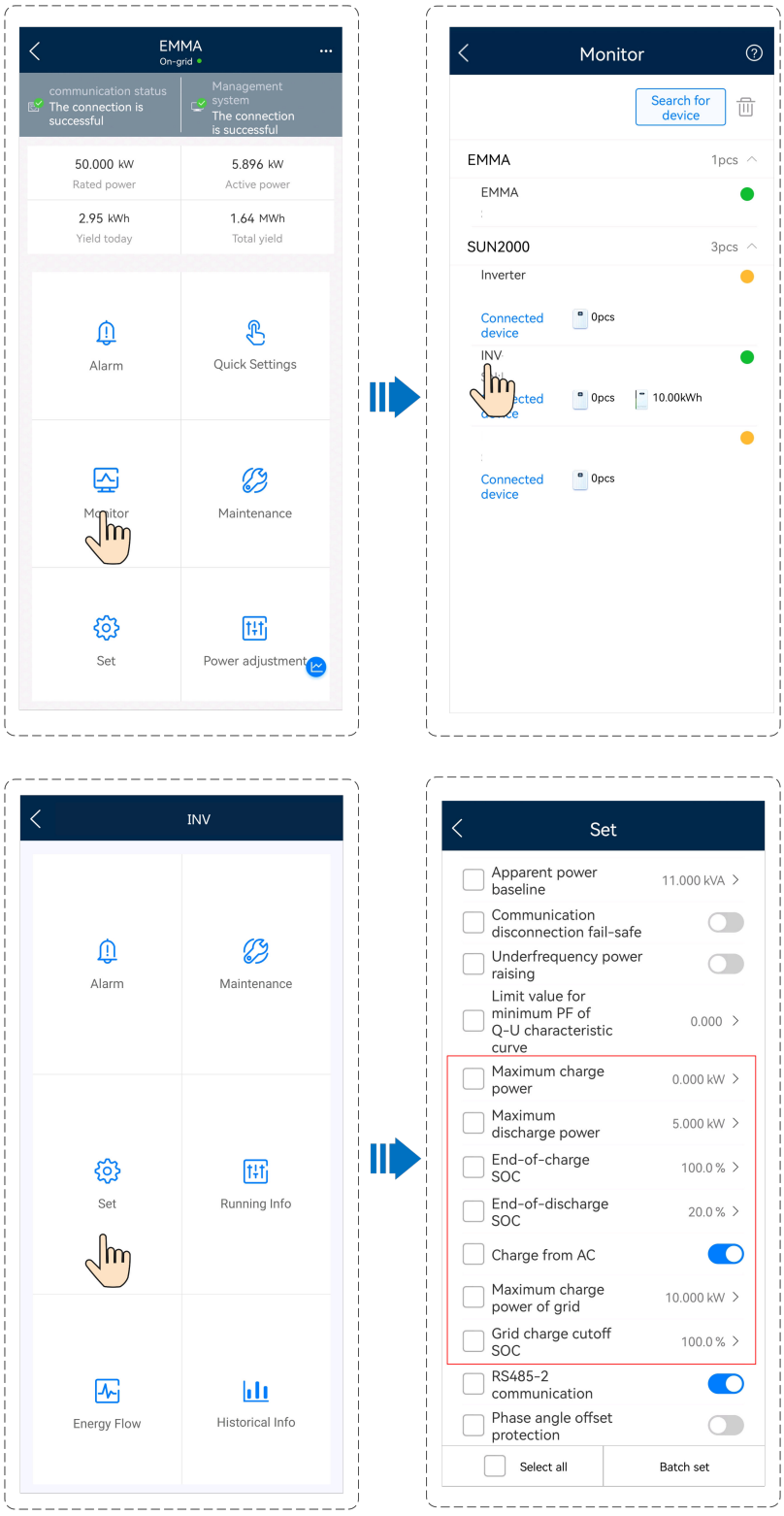
2.5.1 Setting ESS Parameters

Connect the EMMA on the app. Choose **Power adjustment** > **Battery control** on the home screen to set related parameters.



Connect the EMMA on the app. Tap **Monitor** on the home screen, tap the corresponding inverter, tap **Set**, and set related parameters.

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EMMA
On-grid
communication status
The connection is successful
Management system
The connection is successful
50.000 kW
Rated power
5.896 kW
Active power
2.95 kWh
Yield today
1.64 MWh
Total yield
Alarm
Quick Settings
Monitor
Maintenance
Set
Power adjustment
Monitor
Search for device
EMMA
1pcs
EMMA
SUN2000
3pcs
Inverter
Connected device
0pcs
INV
0pcs
10.00kWh
Connected device
0pcs
INV
Alarm
Maintenance
Set
Running Info
Energy Flow
Historical Info
Set
Apparent power baseline
11.000 kVA
Communication disconnection fail-safe
Underfrequency power raising
Limit value for minimum PF of Q-U characteristic curve
0.000
Maximum charge power
0.000 kW
Maximum discharge power
5.000 kW
End-of-charge SOC
100.0 %
End-of-discharge SOC
20.0 %
Charge from AC
Maximum charge power of grid
10.000 kW
Grid charge cutoff SOC
100.0 %
RS485-2 communication
Phase angle offset protection
Select all
Batch set

Battery Control

Table 2-10 Battery control parameters

Parameter	Description	Value Range
Working Mode	If this parameter is set to TOU, the system will enable **Charge from AC**. For details about other settings, see **Setting TOU Parameters**.	• Maximum self-consumption • TOU • Fully fed to grid • Third-party dispatch: Only a third-party platform controls battery charge and discharge. **NOTE** To implement third-party dispatch on the ESS, the inverter shall connect to the third-party management system.
Adjustment deadband (W)	The EMMA does not adjust the battery power within the adjustment deadband range.	[0, 35]
Maximum charge power (kW)	Set the maximum charge power of the ESS.	Charge: [0, Maximum charge power]
Maximum discharge power (kW)	Set the maximum discharge power of the ESS.	Discharge: [0, Maximum discharge power]
End-of-charge SOC (%)	Set the end-of-charge SOC.	[90%, 100%]
End-of-discharge SOC (%)	Set the end-of-discharge SOC. If the battery SOC decreases to 0%, charge the battery in time. Otherwise, the battery capacity will attenuate irreversibly, and the resulting battery fault is not covered by the warranty. You are advised not to set the battery **End-of-discharge SOC** to 0.	[0, 20%]

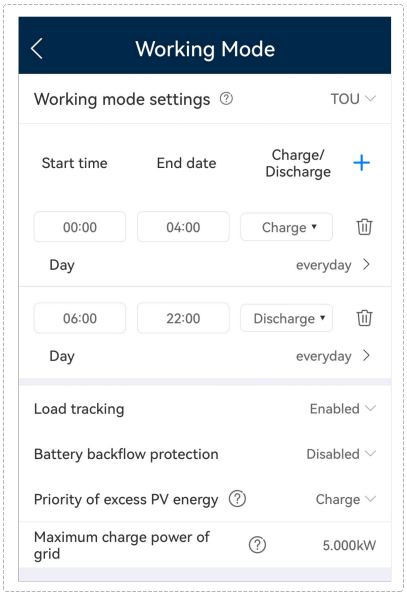
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Parameter	Description	Value Range
Charge from AC	**Charge from AC** is disabled by default. After this function is enabled, power can be purchased from the grid. Comply with the grid charge requirements stipulated in local laws and regulations when this function is enabled.	• Disabled (default) • Enabled
Maximum charge power of grid	Set the maximum power for charging from the grid.	[0, Maximum charge power of grid]
Grid charge cutoff SOC	Set the grid charge cutoff SOC.	[20%, 100%]
Maximum grid power during battery discharge	When the power purchased from the grid exceeds the preset threshold, the ESS starts discharging. The default value is 0. For example, if this parameter is set to 50 W and the load power is 40 W, 40 W power is purchased from the grid and the ESS does not discharge. If the load power is 100 W, 50 W power is purchased from the grid, and the ESS discharge power is 50 W.	[0, 1000]

NOTE

If no PV modules are installed or the system has not detected sunlight for at least 24 hours, the minimum end-of-discharge SOC is 15%.

Setting TOU Parameters



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Parameter	Description	Value Range
Priority of excess PV energy	• Charge: When the PV power is greater than the load power, the surplus PV energy is used to charge the batteries. After the maximum charge power is reached or the batteries are fully charged, the surplus PV energy is fed to the grid. • Fed to grid: When the PV power is greater than the load power, the surplus PV energy is preferentially fed to the grid. When the maximum output power of the inverter is reached, the surplus energy is used to charge the batteries. This setting is applicable to the scenario where the feed-in tariff (FIT) is higher than the electricity price. The batteries are used only for backup power.	• Charge • Fed to grid
Maximum charge power of grid (kW)	Maximum charge power allowed by the grid. The value is determined by the local grid company. If there is no requirement, the value is the maximum charge power of the ESS by default.	[0, Maximum charge power of grid]

2.5.2 Peak Shaving

Function

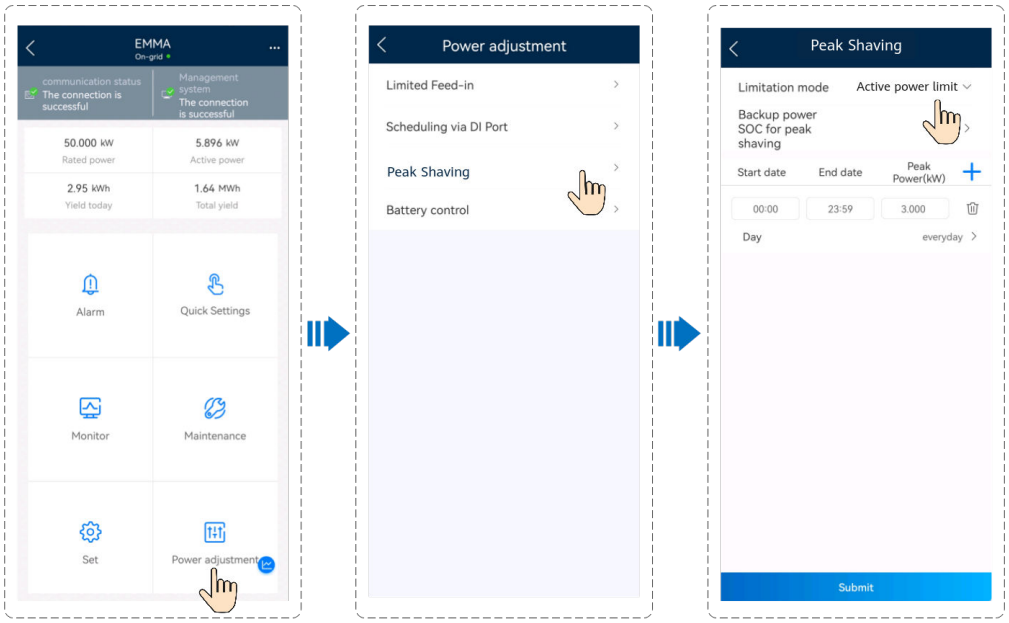
This function applies to areas that have peak demand charges. The peak shaving function allows you to lower the peak power drawn from grid in **Maximum self-consumption** or **TOU** mode during peak hours, reducing electricity fees.

NOTE

The peak shaving function cannot be used when the ESS working mode is set to **Fully fed to grid**.

Procedure

1. Log in to the local commissioning screen.
2. Choose **Power adjustment > Peak Shaving**, and set the working mode for peak shaving.



Parameter	Description	Value Range
Peak Shaving	To use **Peak Shaving**, you need to enable Charge from AC first.	• No control • Active power limit • Apparent power limit
Backup power SOC for peak shaving (%)	The value of this parameter affects the peak shaving capability. A larger value indicates stronger peak shaving capability.	Backup power SOC for peak shaving > Backup power SOC (when **Off-grid mode** is enabled) > End-of-discharge SOC
Start date	• Set the peak power range based on the start time and end time. The peak power is configured based on electricity prices in different time segments. You are advised to set the peak power to a low value when the electricity price is high. • A maximum of 14 time segments can be set.	-
End date		
Peak Power (kW)		[0.000, 1000.000]

NOTE

For details about the peak shaving function, see the **Introduction to Peak Shaving**.

2.5.3 Grid-tied Point Control

Many regions impose a limit on the feed-in power of a power generation system. Therefore, the power at the grid-tied point should be measured to control the

output of the inverter in real time, ensuring that the feed-in power meets the power requirement allowed by the grid.

Prerequisites

The EMMA has been correctly installed at the grid-tied point. If an external CT is required, ensure that it is correctly installed.

Implementation

- **Control mode**: **Grid connected with zero power**, **Power-limited grid connected（%）** or **Limited feed-in (kW)**
- **Limitation mode**: **Single-phase power** or **Total power** (Select a mode based on the local grid requirements.)

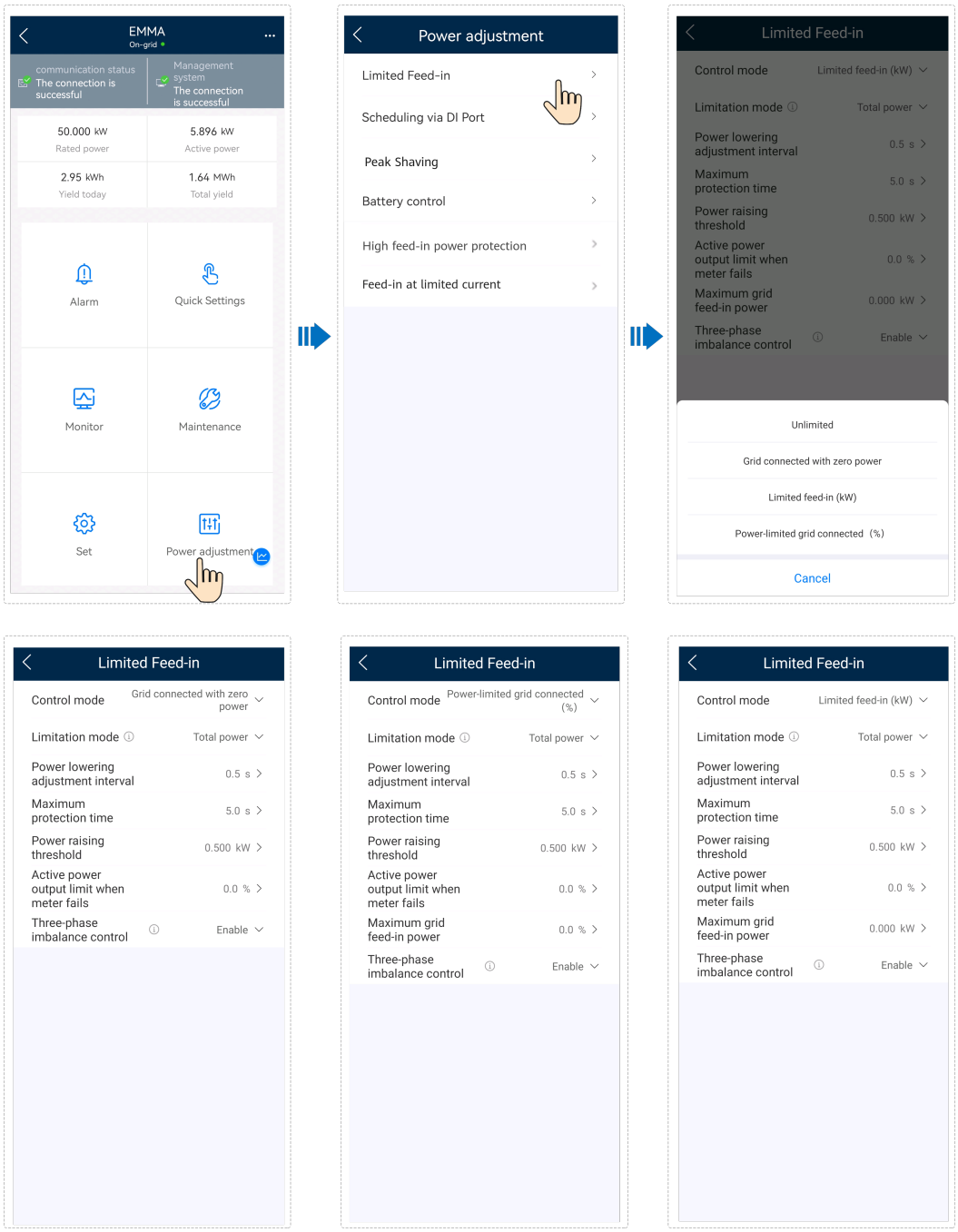
  Single-phase power: The power of each phase cannot exceed the preset limit. **Total power** (default): The total power of three phases cannot exceed the preset limit.

  NOTE

  In a three-phase system, if **Limitation mode** at the grid-tied point is set to **Total power**, a phase may have feed-in power. However, if **Control mode** is set to **Grid connected with zero power**, **Limitation mode** is set to **Single-phase power**, and only L1 has single-phase loads while the other two phases do not have loads, the loads on L1 can only be powered by the grid because the inverter sets the output of each phase to be 0.

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Procedure



Parameter Description

NOTE

If you select limited feed-in, you need to set **Maximum grid feed-in power**.

Parameter			Description
Active power	**Unlimited**	-	If this parameter is set to **Unlimited**, the output power of the inverter is not limited and the inverter can connect to the grid at the rated power.
	Grid connected with zero power	**Limitation mode**	**Total power** indicates feed-in prevention of the total power at the grid-tied point. **Single-phase power** indicates feed-in prevention of the power in each phase at the grid-tied point.
		Power lowering adjustment interval	Interval for lowering the inverter output power.
		Maximum protection time	Maximum duration from the time when the EMMA detects feed-in power to the time when the inverter output power is adjusted to 0.
		Power raising threshold	Inverter output power increase threshold. The recommended value is 1% to 2% Pn. Pn is the total rated power of the inverter.
		Active power output limit when meter fails	Derating value of the inverter active power in percentage when the EMMA does not detect the meter data.
		Three-phase imbalance control	For details, see **2.5.5 Three-Phase Imbalance Control**.
	Limited feed-in (kW)	**Limitation mode**	**Total power** indicates feed-in prevention of the total power at the grid-tied point. **Single-phase power** indicates feed-in prevention of the power in each phase at the grid-tied point.
		Power lowering adjustment interval	Interval for lowering the inverter output power.
		Maximum protection time	Maximum duration from the time when the EMMA detects feed-in power to the time when the inverter output power is adjusted to 0.
		Power raising threshold	Inverter output power increase threshold. The recommended value is 1% to 2% Pn. Pn is the total rated power of the inverter.
		Active power output limit when meter fails	Derating value of the inverter active power in percentage when the EMMA does not detect the meter data.
		Maximum grid feed-in power	Specifies the maximum active power transmitted from the grid-tied point to the power grid.

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Parameter			Description
		Three-phase imbalance control	For details, see **2.5.5 Three-Phase Imbalance Control**.
	Power-limited grid connected (%)	**Limitation mode**	**Total power** indicates feed-in prevention of the total power at the grid-tied point. **Single-phase power** indicates feed-in prevention of the power in each phase at the grid-tied point.
		Power lowering adjustment interval	Interval for lowering the inverter output power.
		Maximum protection time	Maximum duration from the time when the EMMA detects feed-in power to the time when the inverter output power is adjusted to 0.
		Power raising threshold	Inverter output power increase threshold. The recommended value is 1% to 2% Pn. Pn is the total rated power of the inverter.
		Active power output limit when meter fails	Derating value of the inverter active power in percentage when the EMMA does not detect the meter data.
		Maximum grid feed-in power	Percentage of the maximum active power to the maximum active power at the grid-tied point.
		Three-phase imbalance control	For details, see **2.5.5 Three-Phase Imbalance Control**.
High feed-in power protection[a]	**Shutdown at high feed-in power**		• The default value is **Disable**. • If this parameter is set to **Enable**, the inverter shuts down for protection when the power at the grid-tied point exceeds the threshold and remains in this condition for the specified time threshold.
	Upper feed-in power threshold for inverter shutdown		The default value is **0**. This parameter specifies the power threshold of the grid-tied point for triggering inverter shutdown.

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Parameter		Description
	High feed-in power duration threshold for triggering inverter shutdown	The default value is **20**. This parameter specifies the duration threshold of high feed-in power for triggering inverter shutdown. ● When **High feed-in power duration threshold for triggering inverter shutdown** is set to **5**, **Shutdown at high feed-in power** takes precedence. ● When **High feed-in power duration threshold for triggering inverter shutdown** is set to **20**, **Limited Feed-in** takes precedence (when **Active power control** is set to **Limited Feed-in**).
Feed-in at limited current	**Max. feed-in current**	Value range: [0, 100 A] ● Due to external disturbances, the feed-in current may exceed the specified value by 2%. In this case, the inverter will adjust the current to a value within the range limit. ● After the user changes the maximum feed-in current, the inverter will adjust the current to a value within the range limit. If the maximum feed-in current is not adjusted to a value within the range limit within 15s, the inverter will shut down and report an alarm.
	Max. grid supply current	Value range: [0, 100 A] If the grid supply current exceeds the specified value by 2%, the inverter will adjust the current to a value within the range limit.
	Restrict number of inverter startups	● If this parameter is set to **Disable**, the inverter does not limit the number of manual startups after shutdown due to current adjustment failure. ● If this parameter is set to **Enable**, the number of manual startups by choosing **Enable** after shutdown due to current adjustment failure cannot exceed three within 30 days.
	Array startup	All inverters in the array can be started manually.
Note a: This parameter is supported only for the AS4777 or G99-TYPEA-LV grid code.		

NOTE

To use the **Feed-in at limited current** function, the following version mapping requirements must be met.

Table 2-11 Version mapping

Device	Version
SUN2000-(2KTL-6KTL)-L1	SUN2000L V200R001C00SPC137 or later
EMMA	SmartHEMS V100R023C10SPC103 or later
FusionSolar app	24.6.0 or later

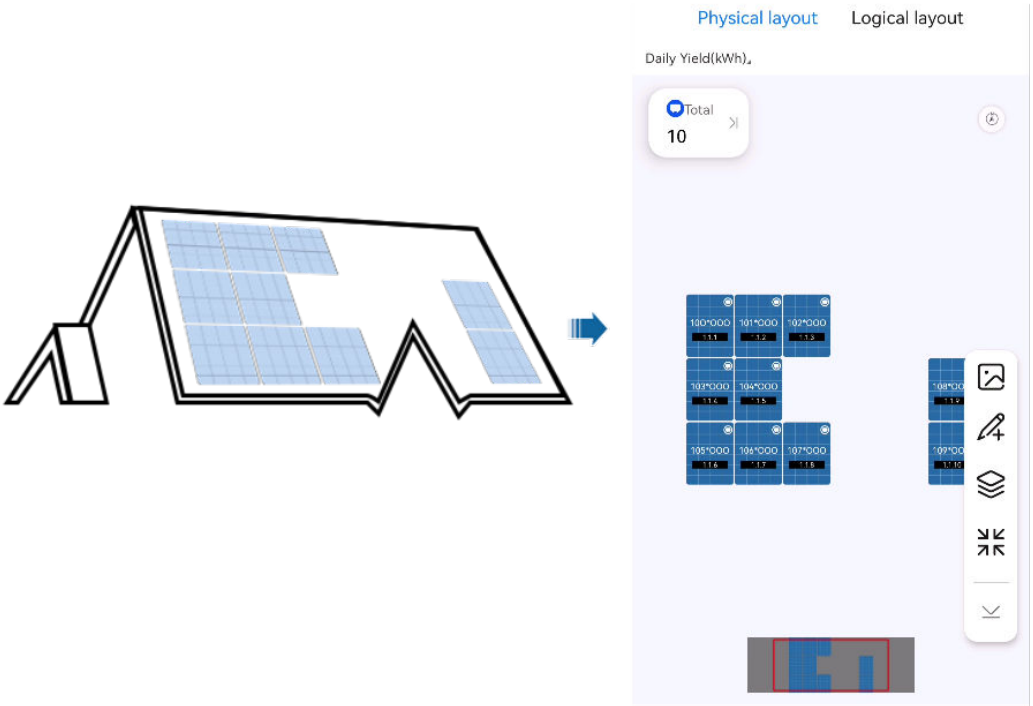
2.5.4 Physical Layout of Optimizers

The Smart PV Optimizer is a DC-DC converter which implements maximum power point tracking (MPPT) of each PV module to improve the energy yield of the PV system. It also supports the module-level shutdown and monitoring functions.

If optimizers are configured for PV modules, you can view the physical location of each optimizer after creating a physical layout. If a PV module is faulty, you can quickly locate the faulty PV module from the physical layout to rectify the fault. If a PV module without an optimizer is faulty, you need to check the PV modules one by one to locate the faulty one, which is time-consuming and inefficient.

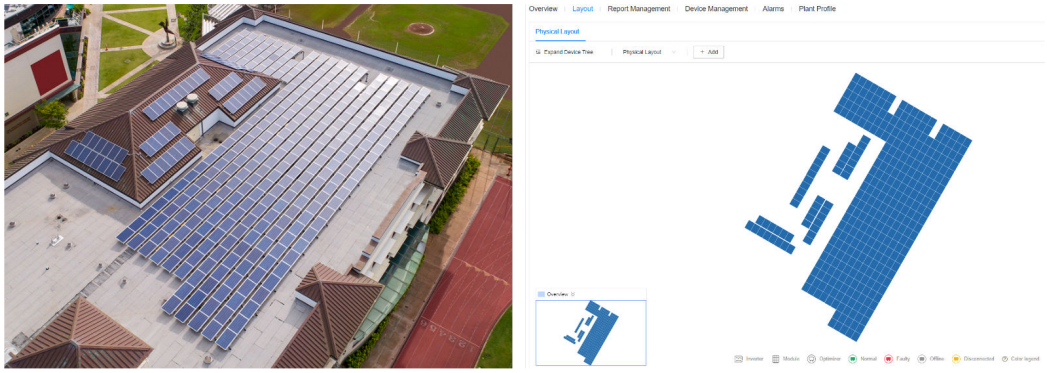
For details about the physical location layout of the optimizers, see **FusionSolar Physical Layout User Guide**.

Figure 2-1 Viewing a physical layout on the FusionSolar app



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Figure 2-2 Viewing a physical layout on the SmartPVMS



2.5.5 Three-Phase Imbalance Control

NOTE

Only the SUN2000-(5K-12K)-MAP0 and SUN5000-(8K, 12K)-MAP0 inverters support three-phase imbalance control.

Function Description

Three-phase imbalance control applies to the following scenarios:

- Asymmetric phase feeding with feed-in limitation: The feed-in power of each phase in the three-phase power grid cannot exceed the preset threshold. The inverter outputs different power for each phase based on the loads of each phase to ensure that the feed-in power of each phase does not exceed the preset threshold.
- PV+ESS asymmetric phase feeding for self-consumption: When the ESS discharges power to the loads, the inverter outputs phase-specific power based on the load of each phase and tracks the loads on each phase to ensure that no ESS discharge power is fed to the grid while the PV power can be fed to the grid.

The preceding two scenarios are supported concurrently.

NOTE

Three-phase imbalance control is supported in the EMMA networking scenario where only one inverter is applied or multiple inverters are connected in parallel.

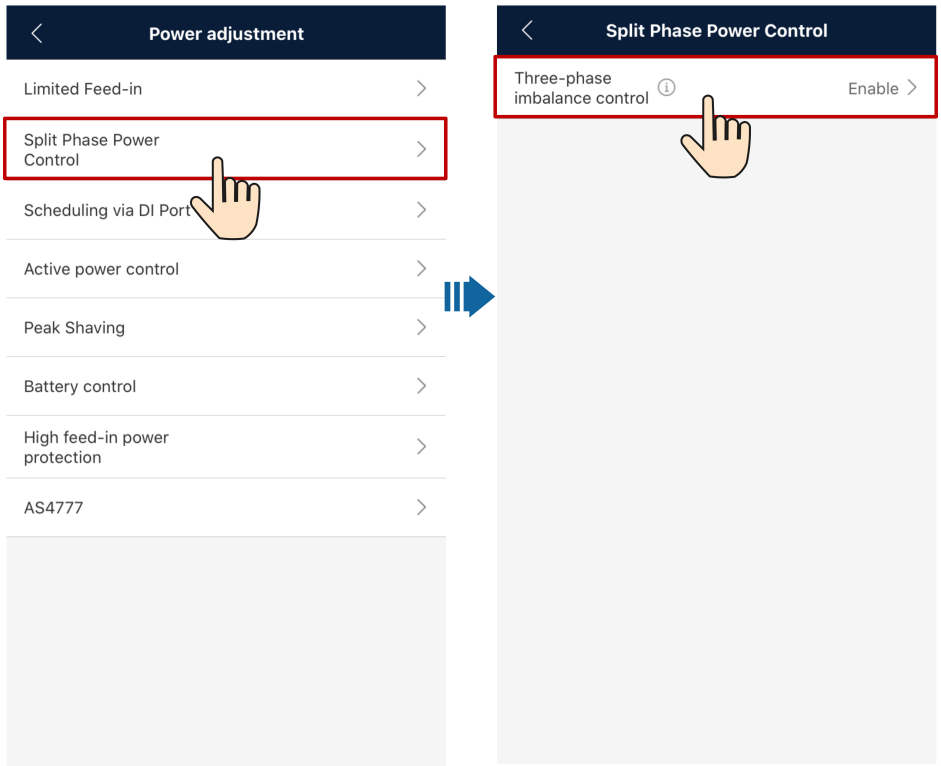
Prerequisites

- Choose **Device monitoring** > **Inverter** > **Settings** and check that **Output mode** is set to **Three-phase, four-wire** and **Meter Connection Mode** in **Settings** is set to **Three-phase four-wire**.
- In the asymmetric phase feeding with feed-in limitation scenario, choose **Power adjustment** > **Limited Feed-in** and check that **Limitation mode** is set to **Single phase power**.
- In the PV+ESS asymmetric phase feeding for self-consumption scenario, choose **Power adjustment** > **Battery control** and check that **Working Mode** is set to **Maximum self-consumption** or **TOU**.

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Procedure

1. Log in to the local commissioning screen.
2. Choose **Power adjustment** > **Split Phase Power Control** and set **Three-phase imbalance control** to **Enable**.



2.5.6 Third-Party Management System Settings (Connecting to Two Management Systems)

Prerequisites

If the EMMA connects to a third-party management system, you also need to connect the EMMA to Huawei management system to facilitate inverter O&M.

NOTE

The FusionSolar app 24.6.0 or later can connect to a third-party management system.

Connecting to the EMMA Built-in WLAN and Setting Third-Party Management System Parameters

Step 1 Connect to the EMMA by referring to **B Connecting the EMMA on the App**, choose **Set** > **Communication settings** > **Third-Party Management System Configuration** and set third-party management system parameters.

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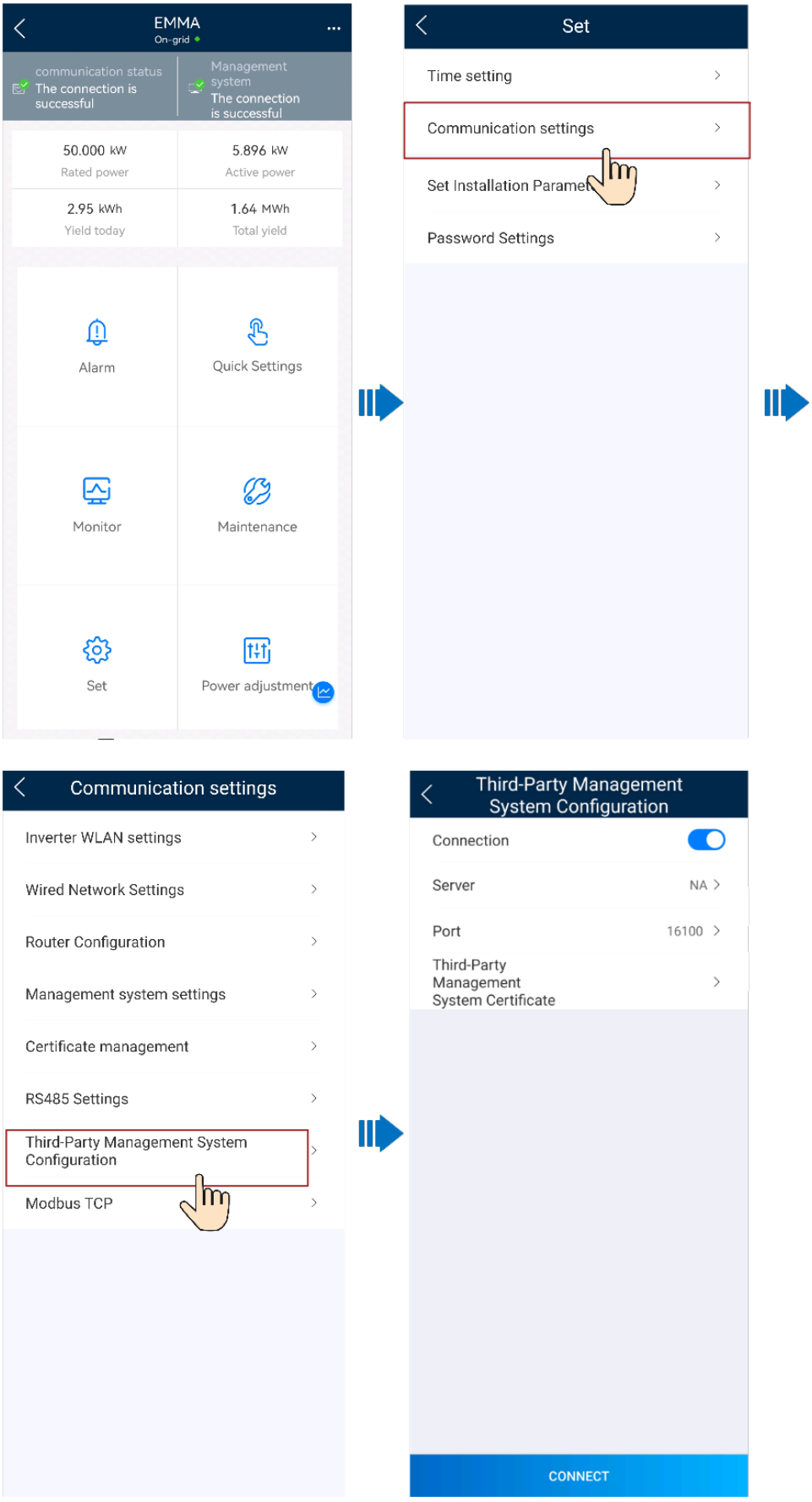

EMMA
On-grid
communication status
The connection is successful
Management system
The connection is successful
50.000 kW
Rated power
5.896 kW
Active power
2.95 kWh
Yield today
1.64 MWh
Total yield
Alarm
Quick Settings
Monitor
Maintenance
Set
Power adjustment
Set
Time setting
Communication settings
Set Installation Paramet
Password Settings
Communication settings
Inverter WLAN settings
Wired Network Settings
Router Configuration
Management system settings
Certificate management
RS485 Settings
Third-Party Management System Configuration
Modbus TCP
Third-Party Management System Configuration
Connection
Server
NA
Port
16100
Third-Party Management System Certificate
CONNECT

Table 2-12 Parameter settings

Parameter	Description	Value Range
Connection	• The default value is **Disable**, meaning that a third-party management system cannot be connected. • When this parameter is set to **Enable**, a third-party management system can be connected.	• Disable • Enable
Server	Domain name or IP address.	-
Port	Server port.	[1, 65535]
Third-Party Management System Certificate	-	[Root certificate, Customer certificate, Key file, Key password]

----End

2.6 System Power-Off

Precautions

WARNING

- After the system powers off, the remaining electricity and heat may still cause electric shocks and burns. Therefore, wait for 5 minutes after the system is powered off, wear protective gloves, and then perform operations on the ESS. You can maintain the ESS only when all indicators on the ESS are off.
- When the ESS is running, if you only turn off the DC switch of the ESS, the system is not completely powered off. In this case, do not maintain the ESS.

Procedure

Step 1 Turn off the main switch between the EMMA and the grid.

Step 2 Turn off the AC switch between the inverter and the EMMA.

Step 3 Power off the inverter.

1. Send a shutdown command to the inverter on the app.
2. Set the **DC SWITCH** of the inverter to **OFF**.

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3. (Optional) Install the locking screw for the **DC SWITCH**.
4. (Optional) Turn off the DC switch between the inverter and PV strings.

Step 4 Shut down the ESS.

1. Set the **DC SWITCH** of the ESS to **OFF**.
2. (Optional) Install the locking screw for the **DC SWITCH** of the ESS.

----End

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3 Single-Phase SmartGuard Networking

3.1 Networking Application

CAUTION

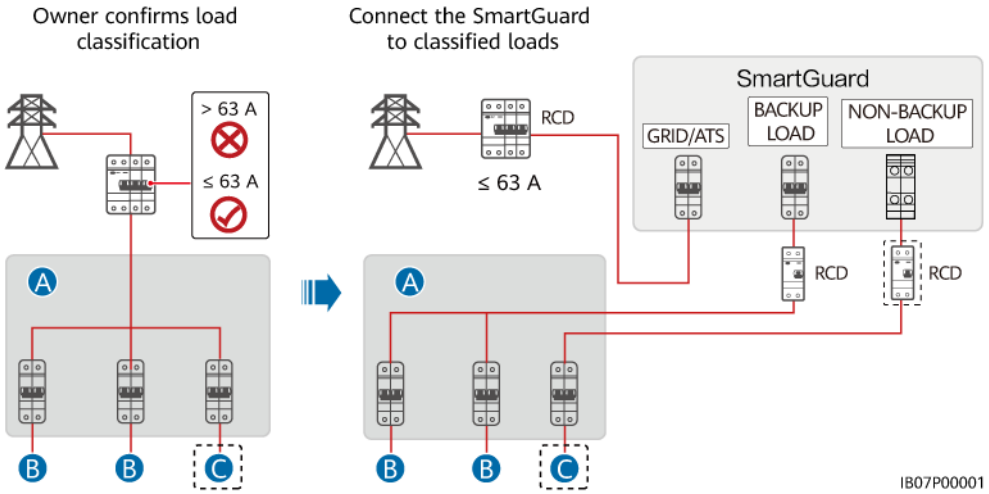
- The SmartGuard-63A-(S0, AUS0) applies to scenarios where the specification of the main circuit breaker for home appliances is less than or equal to 63 A. Do not install the SmartGuard-63A-(S0, AUS0) if the specification is greater than 63 A.
- If the power of backup loads exceeds the maximum off-grid output power of the inverter, the inverter may be shut down due to overload. In this case, you need to shut down some loads.

NOTICE

- If a charger is configured, the charger must be installed on a non-backup power port.

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Figure 3-1 Residential load classification (dashed boxes indicate optional components)



(A) AC power distribution box

(B) Backup load

(C) Non-backup load

3.1.1 PV+ESS System

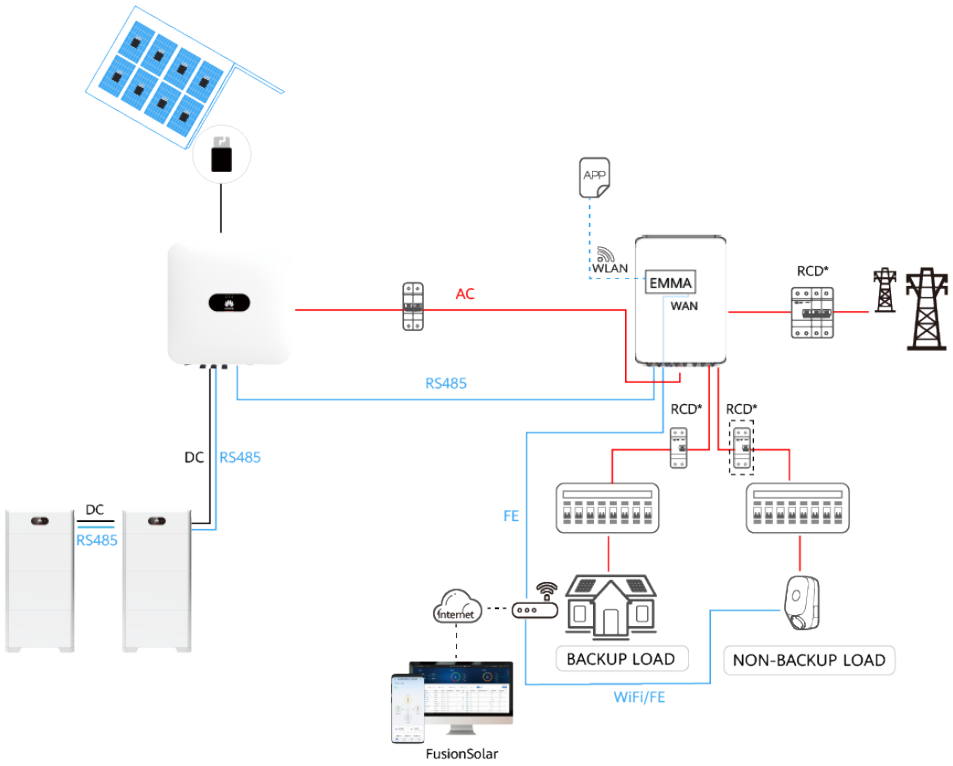
DANGER

- An RCD must be installed before the backup load. During off-grid operation, the main circuit breaker does not provide protection. Electric leakage on the loads may result in electric shocks. The rated leakage current must be greater than or equal to the number of inverters multiplied by 100 mA.
- The main circuit breaker with the leakage protection function must be installed. The rated leakage current must be greater than or equal to the number of inverters multiplied by 100 mA.

NOTE

- The EMMA in the SmartGuard can be connected to the router over FE or WLAN. If WLAN is used, the SmartGuard must be installed close to the router.
- It is recommended that the charger and the EMMA in the SmartGuard be connected to the router in wired network (FE) mode. If the charger is connected to the router in WLAN mode, the communication may be interrupted due to unstable signals.
- The SmartGuard-63A-(S0, AUS0) can be connected to only one inverter.
  - Connect the SUN2000-(8K, 10K)-LC0 or SUN2000-(8K, 10K)-LC0-ZH to the INV1 63A port of the SmartGuard.
  - Connect the SUN2000-(2KTL-6KTL)-L1 to the INV2 32A port of the SmartGuard.

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Note: The figure uses the LUNA2000-(5-30)-S0 as an example.

Table 3-1 SmartGuard networking with the LUNA2000-(5-30)-S0

Inverter	LUNA2000-(5-30)-S0	Max. Number of Connected ESSs
SUN2000-(2KTL-6KTL)-L1	√	2
SUN2000-(8K, 10K)-LC0/ SUN2000-(8K, 10K)-LC0-ZH	√	2

Table 3-2 SmartGuard networking with the LUNA2000-(7, 14, 21)-S1

Inverter	LUNA2000-(7, 14, 21)-S1	Max. Number of Connected ESSs
SUN2000-(2KTL-6KTL)-L1	√	2*
SUN2000-(8K, 10K)-LC0/ SUN2000-(8K, 10K)-LC0-ZH	√	2

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NOTE

If the SUN2000-(2KTL-6KTL)-L1 is connected to two ESSs (S1), the ESSs need to be connected to the EMMA directly using an FE network cable or through a router.

3.2 Electrical Connections

For details about cable connections in typical scenarios, see the following table.

Table 3-3 Single-phase PV+ESS system + SmartGuard networking

Cable Connection Scenario	Documentation
Single-phase inverter + LUNA2000-(5-30)-S0 + SmartGuard-63A-S0/AUS0	**Residential Smart PV Solution Quick Guide (Single-Phase PV+ESS Scenario + SmartGuard Networking)**
Single-phase inverter + LUNA2000-(7, 14, 21)-S1 + SmartGuard-63A-S0/AUS0	

3.3 Powering On the System

3.3.1 Powering On the SmartGuard

NOTICE

If a charger is configured, you must power on the system in on-grid mode for commissioning. When the SmartGuard is off-grid, the charger cannot be detected during device commissioning because the charger is not powered on.

Method 1: On-Grid Power-On

Step 1 Use a multimeter to check whether the AC voltage in the power distribution box is within the allowed range and whether cables are correctly connected.

Step 2 Turn on the ESS switch.

1. (Optional) Remove the locking screw for the **DC SWITCH** of the ESS.
2. Set the **DC SWITCH** of the ESS to ON.
3. (Optional) If the PV string is equipped with an optimizer, hold down the black start button for 5s.

Step 3 Power on the inverter.

1. (Optional) Turn on the DC switch (if any) between the PV strings and the inverter.
2. (Optional) Remove the locking screw for the **DC SWITCH** of the inverter.
3. Set the **DC SWITCH** of the inverter to ON.

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Step 4 Turn on the main circuit breaker.

Step 5 Check that the SmartGuard is running in on-grid mode. Observe the LED indicators on the inverter, ESS, EMMA, and SmartGuard to check the running status.

----End

Method 2: Off-Grid Power-On (with PV Strings)

NOTE

If the PV strings are equipped with optimizers or receive no solar irradiance, power-on in off-grid mode is not supported.

Step 1 Keep the main circuit breaker off.

Step 2 Turn on the ESS switch.

1. (Optional) Remove the locking screw for the **DC SWITCH** of the ESS.
2. Set the **DC SWITCH** of the ESS to ON.
3. Press and hold the black start button for 5s.

Step 3 Power on the inverter.

1. (Optional) Turn on the DC switch (if any) between the PV strings and the inverter.
2. (Optional) Remove the knob locking screw for the **DC SWITCH** of the inverter.
3. Set the **DC SWITCH** of the inverter to ON.

Step 4 **Connect to the inverter**. Set the grid code of the inverter and then set off-grid mode of the inverter. For details, see method 2 in **3.5.3 Setting Off-Grid Mode for the Inverter**.

Step 5 (Optional) **Connect to the inverter**. Upgrade the SUN2000-(2KTL-6KTL)-L1 inverter. Otherwise, the SmartGuard may fail to identify the inverter. For details, see **D Upgrading the Inverter**.

Step 6 Check that the SmartGuard is running in off-grid mode. Observe the LED indicators on the inverter, ESS, EMMA, and SmartGuard to check the running status.

----End

Method 3: Power-On by Starting the Generator

Step 1 On the control panel of the generator, manually start the generator. Use a multimeter to check that the AC voltage in the power distribution box is within the allowed range and that cables are correctly connected.

Step 2 Turn on the main circuit breaker.

Step 3 Turn on the ESS switch.

1. (Optional) Remove the locking screw for the **DC SWITCH** of the ESS.
2. Set the **DC SWITCH** of the ESS to ON.

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Step 4 Power on the inverter.

1. (Optional) Turn on the DC switch (if any) between the PV strings and the inverter.
2. (Optional) Remove the locking screw for the **DC SWITCH** of the inverter.
3. Set the **DC SWITCH** of the inverter to ON.

Step 5 Check that the SmartGuard is running in off-grid mode. Observe the LED indicators on the inverter, ESS, EMMA, and SmartGuard to check the running status.

----End

LED Indicators on the EMMA and SmartGuard

Table 3-4 EMMA indicator description

Indicator	Status	Description
Running status indicator	Off	The system is not powered on.
	Steady green	The system is powered on and running.
Alarm indicator	Off	No alarm is raised.
	Blinking red slowly (on for 1s and then off for 4s)	The system raises a warning alarm.
	Blinking red fast (on for 0.5s and then off for 0.5s)	The system raises a minor alarm.
	Steady red	The system raises an urgent/critical alarm.
Communication status indicator	Off	The IP address of the management system server is not configured. (The indicator is off when the EMMA is not connected to the SmartPVMS.)
	Blinking green slowly (on for 1s and then off for 1s)	The communication with the management system is normal.
	Blinking green fast (on for 0.125s and then off for 0.125s)	The communication with the management system is interrupted.

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Table 3-5 Indicators on the SmartGuard

Indicator	Status	Description
	Steady green	The SmartGuard is in on-grid mode.
	Blinking green slowly	(Reserved) The SmartGuard is in DG off-grid mode.
	Steady orange	The SmartGuard is in inverter off-grid mode.
	Steady red	(Device replacement) A hardware alarm is generated on the SmartGuard.
	Blinking red slowly	An environment alarm is generated on the SmartGuard.

3.3.2 Powering On Loads

Method 1: Power-On in On-Grid Mode and Power-On by Starting the Generator

Step 1 Check that the inverter, ESS, EMMA, and SmartGuard are working properly in on-grid mode.

Step 2 (Optional) Turn off switches for high-power home appliances to avoid generator overload.

Step 3 After checking that the residential load circuit is not short-circuited, turn on the backup load and non-backup load switches.

Step 4 (Optional) Set charger route parameters.

----End

Method 2: Off-Grid Power-On (with PV Strings)

CAUTION

- The power and current of backup loads cannot exceed the maximum off-grid power and current of the system. You are advised to shut down high-power loads and unnecessary loads connected to the backup load port.
- If the battery SOC is less than the end-of-discharge SOC, charge the ESS from the PV strings until the ESS is charged to **End-of-discharge SOC** plus 10% or higher.

Step 1 Check that the inverter, ESS, EMMA, and SmartGuard are working properly in off-grid mode.

Step 2 Check that the residential backup load power does not exceed the off-grid operating power of the inverter.

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Step 3 After checking that the residential load circuit is not short-circuited, turn on the backup load and non-backup load switches.

----End

3.4 Deploying a New Plant

Deploying a New Plant



NOTE

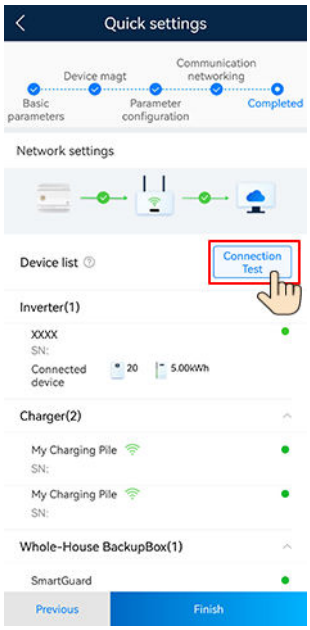
- For details about new plant deployment and existing plant reconstruction, see **FusionSolar App Quick Guide (EMMA)** or scan the QR code.
- In the existing plant revamping scenario, the SmartGuard and Dongle cannot be used at the same time. You need to remove the Dongle from the inverter. The SmartGuard has a built-in meter. The original meter in the plant is removed.
- For details about how to set ESS parameters, inverter parameters, and physical layout of optimizers, see **Residential Smart PV Solution Quick Guide (Single-Phase PV+ESS Scenario + SmartGuard Networking)**.

Connection Test

Connection Test is supported in quick settings. You can perform this step to check whether the cable connections are correct, avoiding site visits for rectification.

Tap **Connection Test** and wait until the test is complete. If the test fails, rectify the fault in a timely manner.

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3.5 Device Commissioning

3.5.1 Commissioning Functions

Commission the following functions as needed:

Table 3-6 Commissioning functions

Function	Scenario Description	Procedure
Adding Intelligent Electrical Equipment	Intelligent electrical equipment (such as SG Ready heat pumps and electrical devices controlled by smart switches) in your home can be added to the FusionSolar app for management.	For details, see **FusionSolar App Quick Guide (EMMA)**, or scan the QR code to download the quick guide.
Limited Feed-in	If surplus PV power is fed into the grid, the parameter of limited feed-in power can be set to ensure that the feed-in power is within the range specified by the grid company.	

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Function	Scenario Description	Procedure
Scheduling via DI Port	Applies to scenarios where the grid company performs remote scheduling through dedicated ripple control receivers. The grid company remotely delivers a scheduling command (%) to the plant with a wireless transmitting apparatus. Then, the wireless receiving apparatus receives the scheduling command and converts it into a DI signal. The EMMA controls the inverter to output the corresponding power.	
Peak Shaving	Applies to areas that have peak demand charges. The capacity control function allows you to lower the peak power drawn from grid in maximum self-consumption or TOU mode during peak hours, reducing electricity fees.	
Setting External WLAN Antenna Parameters	By default, the EMMA has a built-in WLAN antenna. If the signal quality of the power distribution box is poor, install an external antenna to enhance WLAN signals. If an external antenna is used, set the antenna in the built-in WLAN parameters to an external antenna.	

For details about app operations, see **FusionSolar App User Manual**.

3.5.2 Whole-House Power Backup Settings (Seamless Switchover)

Connect to the EMMA. On the home screen, choose **Set** > **Whole-House Power Backup Settings**, enable **Seamless switchover**, and set other parameters.

CAUTION

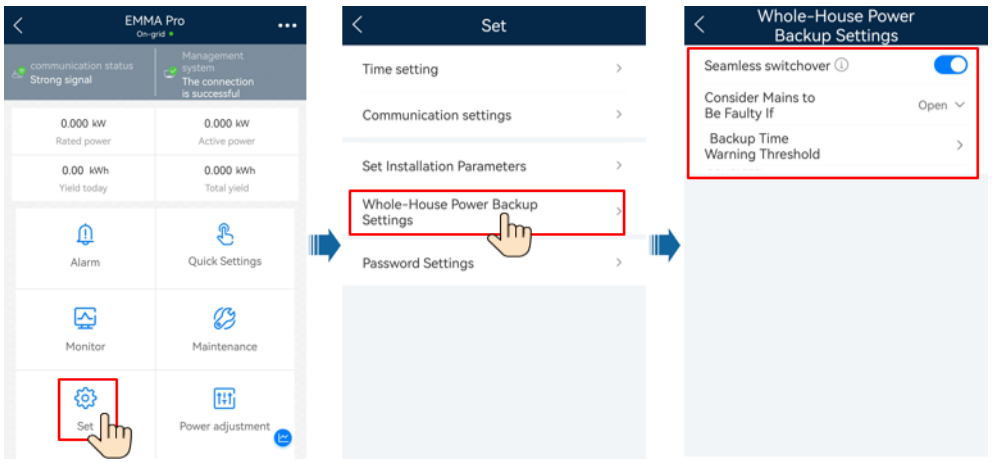
- The seamless switching function of the SmartGuard needs to be manually enabled. If the function is enabled, the system will switch to off-grid mode within 20 ms after the grid fails or becomes abnormal, ensuring uninterruptible power supply to IT equipment such as computers connected to the backup load port.
- The seamless switching function of the SmartGuard can be used to switch from on-grid mode to off-grid mode or from off-grid mode to generator off-grid mode.

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Table 3-7 Parameters for whole-house power backup settings

Parameter	Value Range	Description
Seamless switchover	Disabled (default)	• When the grid fails, loads will be powered off for a short while during on/off-grid switching. • The SmartGuard slowly switches to off-grid mode.
	Enabled	• When the grid fails or is abnormal, the system switches to off-grid mode within 20 ms. • The low voltage ride-through (LVRT) function does not take effect.
Consider Mains to Be Faulty If (optional)	• Open (default) • Closed	This parameter can be set only if an ATS is installed. • **Open**: When the grid is connected, the circuit for the position feedback signal upon grid connection has low impedance. When the grid is disconnected, the circuit has high impedance. • **Closed**: When the grid is connected, the circuit for the position feedback signal upon grid connection has high impedance. When the grid is disconnected, the circuit has low impedance.
Backup Time Warning Threshold (min)	5–60	Warning of battery backup time in off-grid scenarios.

Figure 3-2 Whole-house power backup settings



3.5.3 Setting Off-Grid Mode for the Inverter

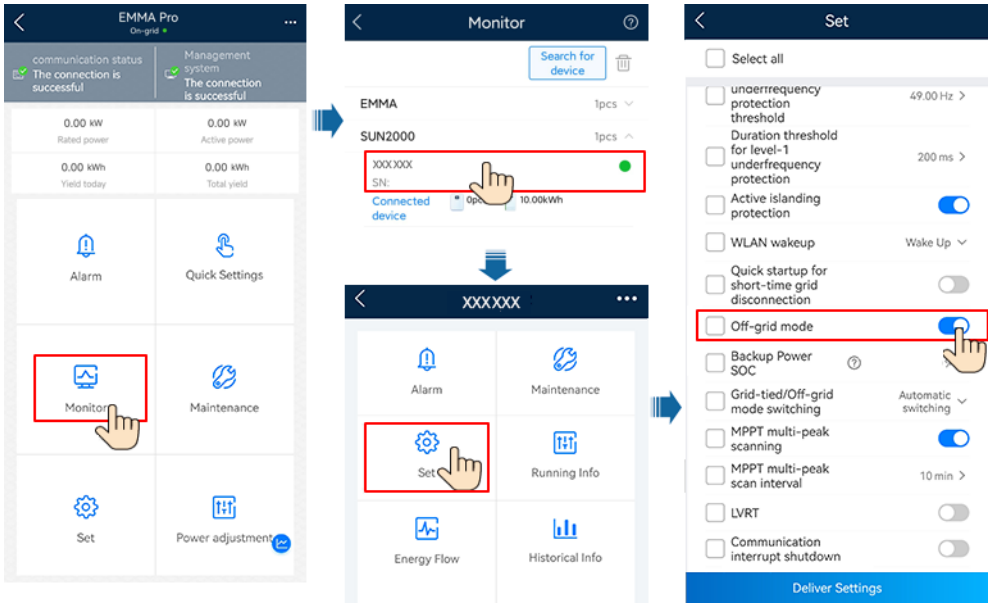
After the off-grid mode is set, the inverter supports off-grid operation.

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Method 1: Setting Off-Grid Mode for the Inverter Using the SmartGuard

Connect to the EMMA by referring to **B Connecting the EMMA on the App**, choose **Monitor > SUN2000**, tap **Set**, and enable **Off-grid mode**.

Figure 3-3 Setting off-grid mode



Method 2: Directly Setting Off-Grid Mode for the Inverter

Connect to the inverter by referring to **A Connecting the Inverter on the App**. On the home screen, choose **Set** > **Feature parameters** and enable **Off-grid mode**.

Figure 3-4 Setting off-grid mode

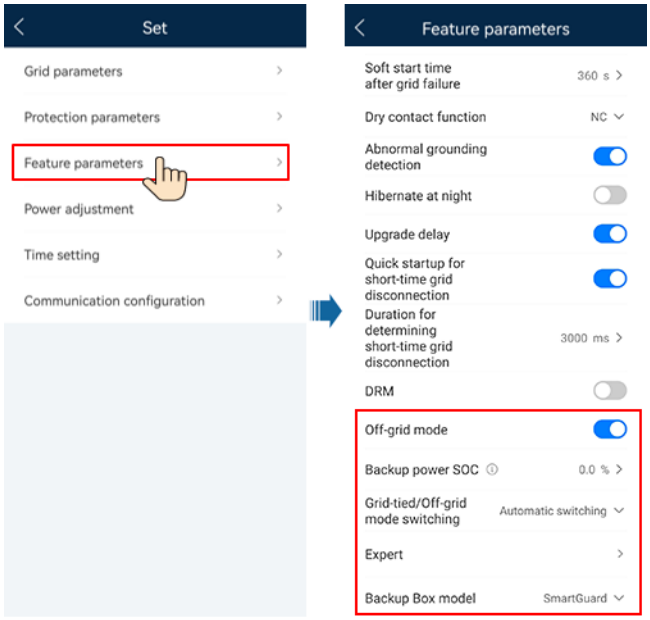


Table 3-8 On/Off-grid parameter settings

Parameter	Description	Value Range
Off-grid mode	If this parameter is enabled, the inverter switches to off-grid mode through the SmartGuard when the grid fails.	• Enabled • Disabled
Backup power SOC	Set the backup power SOC. In on-grid mode, the ESS does not discharge when it is discharged to the backup power SOC. When the grid fails, loads are powered in backup mode.	[0, 100%]
Backup Box model	SmartGuard must be selected when the system is powered on in off-grid mode. Otherwise, the system will not work.	• BackupBox-(B0,B1) • Compatible Third Party BackupBox • SmartGuard • No BackupBox

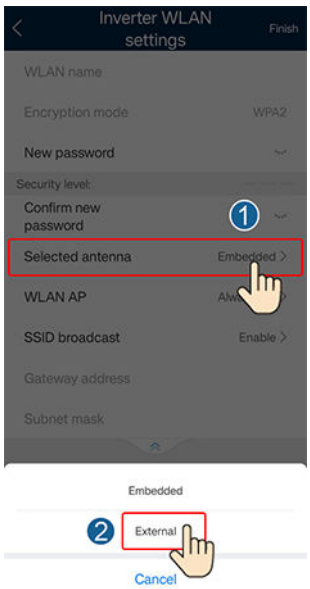
3.5.4 (Optional) Setting the External WLAN Antenna

CAUTION

An external WLAN antenna needs to be purchased from Huawei. To use the external WLAN antenna, set **Selected antenna** to **External signal**.

Connect to the EMMA. On the home screen, choose **Set** > **Communication settings** > **Inverter WLAN settings**, and select **Selected antenna** to **External**.

Figure 3-5 Setting the external antenna



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3.5.5 Generator Settings

Setting the Generator Control Mode

Connect to the EMMA. On the home screen, choose **Monitor** > **Generator** > **Maintenance**, and set the generator control mode to **Automatic**.

Figure 3-6 Setting the generator control mode

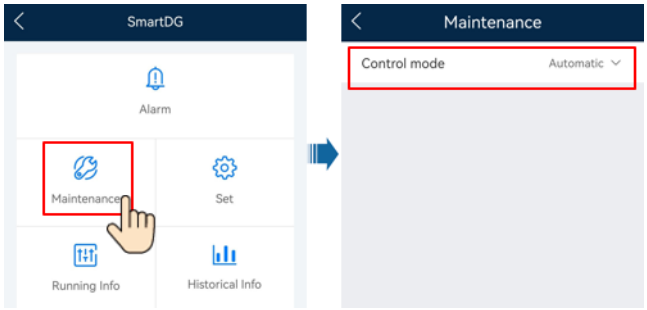


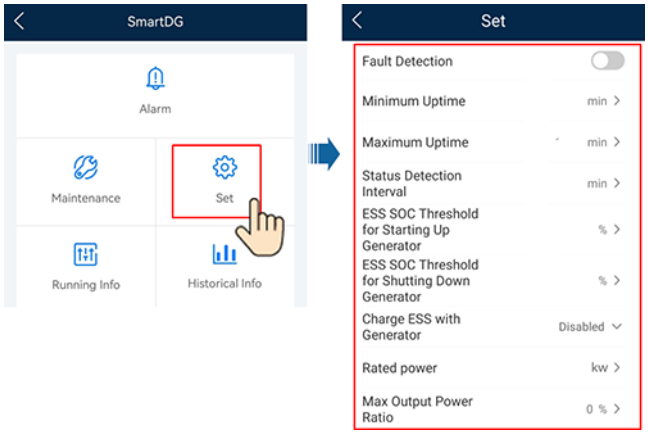
Table 3-9 Generator control parameters

Parameter	Value	Description
Control mode	Manual	• Shut Down • Power-on
	Automatic	You can set the battery SOC upper and lower thresholds. When the battery SOC reaches the specified upper or lower threshold, the generator automatically shuts down or starts.

Setting Generator Parameters

Connect to the EMMA. On the home screen, choose **Monitor** > **Generator** > **Set**, and set generator parameters.

Figure 3-7 Setting generator parameters



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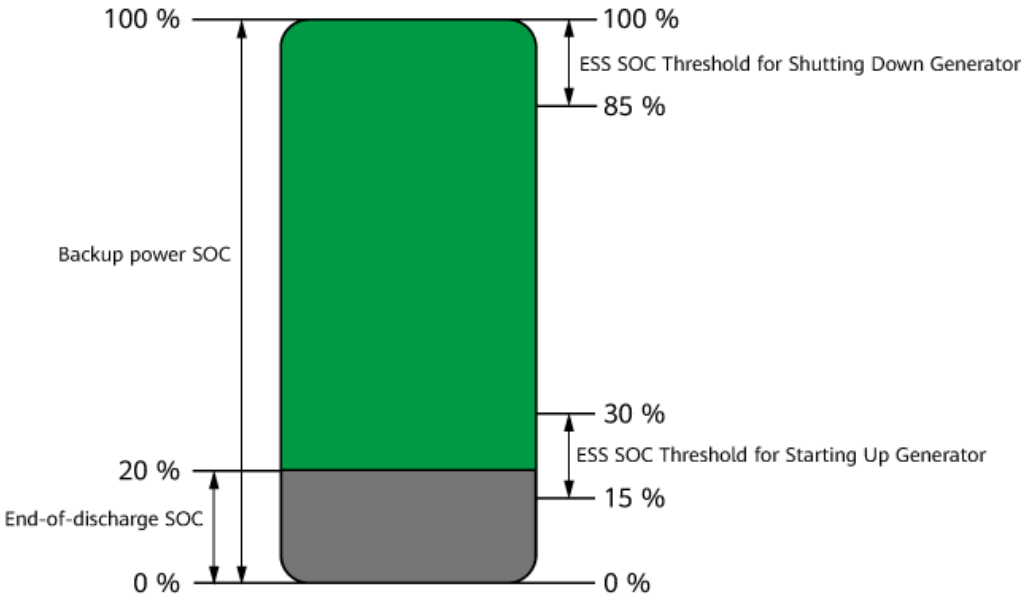
Table 3-10 Generator parameters

Parameter	Value Range	Description
Fault Detection	• Enabled • Disabled (default)	After **Fault Detection** is enabled, you need to set **Fault Detection Mode**.
Fault Detection Mode	• By ON signal (default) • By OFF signal	• **By ON signal**: When the generator fails to run, the generator alarm signal circuit has low impedance. When the generator is normal, the generator alarm signal circuit has high impedance. • **By OFF signal**: When the generator fails to run, the generator alarm signal circuit has high impedance. When the generator is normal, the generator alarm signal circuit has low impedance.
Minimum Uptime (min)	0–60	In auto control mode, the generator cannot automatically shut down if the specified minimum uptime is not reached.
Maximum Uptime (min)	60–2880	In auto control mode, the generator automatically shuts down upon reaching the specified maximum uptime.
Status Detection Interval (min)	1–10	After the generator startup or shutdown command is delivered, if the generator fails to start or shut down when **Status Detection Interval** is reached, a generator startup or shutdown failure alarm is reported.
ESS SOC Threshold for Starting Up Generator (%)	15–30	When the battery SOC is lower than **ESS SOC Threshold for Starting Up Generator**, the generator starts. • **ESS SOC Threshold for Starting Up Generator** ≥ **End-of-discharge SOC** + 10% (For example, if **End-of-discharge SOC** is 15%, set **ESS SOC Threshold for Starting Up Generator** to 25% or higher.) • If the generator startup fails, loads will be powered off after the ESS discharges to **End-of-discharge SOC**.
ESS SOC Threshold for Shutting Down Generator (%)	85–100	When the battery SOC is higher than **ESS SOC Threshold for Shutting Down Generator**, the generator shuts down.

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Parameter	Value Range	Description
Charge ESS with Generator	• Disabled (default) • Enabled	After this function is enabled, the generator is allowed to charge the ESS.
Rated power (kW)	1–500	Indicates the rated power of the generator.
Max Output Power Ratio (%)	0–100	Indicates the maximum output power ratio of the generator.

Figure 3-8 Battery SOC



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3.6 System Power-Off

Precautions

WARNING

- Before opening the maintenance compartment door, turn off the main circuit breaker on the grid side, and then turn off the switches for residential backup loads and non-backup loads. Shut down the inverter, and turn off the DC switches of the inverter and ESS.
- Only authorized personnel can open the maintenance compartment cover to perform electrical connections.
- Before opening the maintenance compartment cover, turn off the backup load circuit breaker, grid AC circuit breaker, and two inverter AC circuit breakers inside the SmartGuard.
- After the SmartGuard powers off, the remaining electricity and heat may still cause electric shocks and burns. Therefore, wait for at least 5 minutes and wear insulated gloves before working on the SmartGuard.

Procedure

Step 1 (Optional) On the generator control panel, manually shut down the generator.

Step 2 Turn off the main circuit breaker.

Step 3 Power off the inverter.

1. Send a shutdown command to the inverter on the app.
2. Set the **DC SWITCH** of the inverter to **OFF**.
3. (Optional) Install the locking screw for the **DC SWITCH**.
4. (Optional) Turn off the DC switch between the inverter and PV strings.

Step 4 Shut down the ESS.

1. Set the **DC SWITCH** of the ESS to **OFF**.
2. (Optional) Install the locking screw for the **DC SWITCH** of the ESS.

Step 5 Turn off the switches for residential backup loads and non-backup loads.

----End

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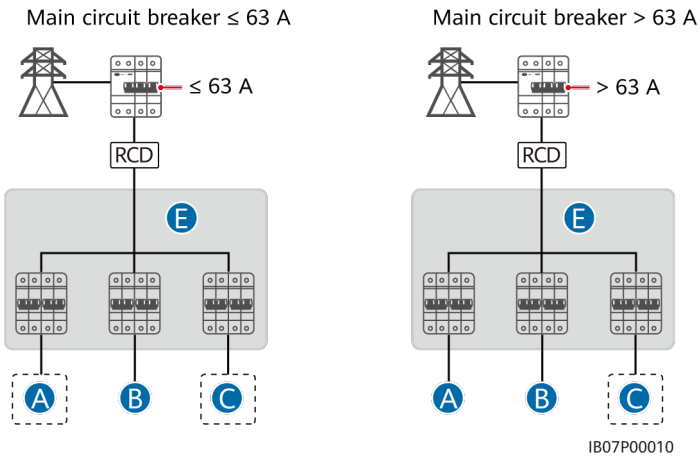
4 Three-Phase SmartGuard Networking

4.1 Networking Application

CAUTION

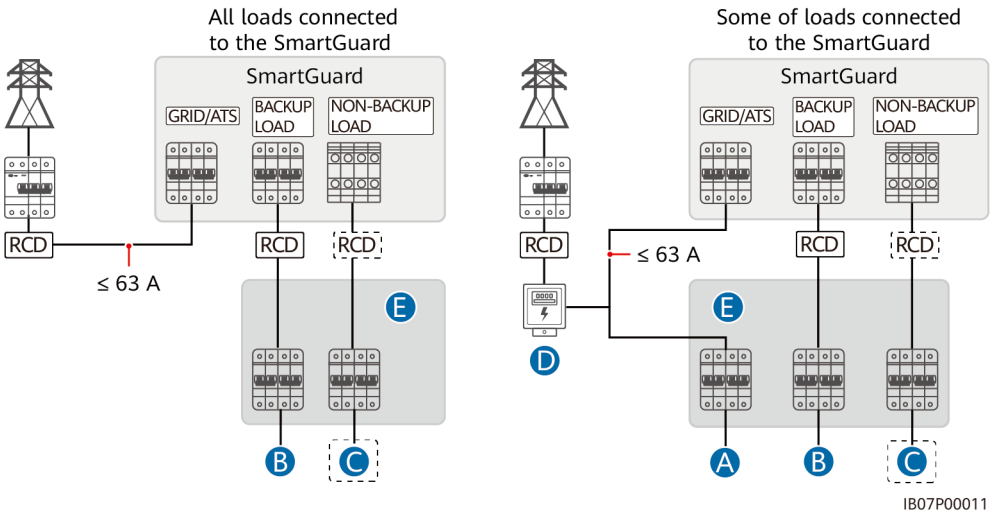
- If the power of backup loads exceeds the maximum off-grid power of the system, the inverter may be shut down due to overload. In this case, you need to shut down some loads. Alternatively, connect loads with lower priority to the non-backup load port.
- If the generator deployed in the power plant runs in off-grid mode and the load power exceeds the generator capacity, the generator may shut down due to overload. You are advised to shut down some loads.
- If the main circuit breaker's rating is 63 A or less, you can connect all or some of the loads to the SmartGuard. However, if the rating is greater than 63 A, you can connect only some of the loads to the SmartGuard.

Step 1 Residential load classification (dashed boxes indicate optional components)



Main Circuit Breaker	Connect All Loads to the SmartGuard	Connect Some of Loads to the SmartGuard
≤ 63 A	Supported	Supported
> 63 A	Not supported	Supported

Step 2 Classification of loads connected to the SmartGuard (dashed boxes indicate optional components)



(A) Load not connected to the SmartGuard
(B) Backup load
(C) Non-backup load
(D) Power meter
(E) AC power distribution box

----End

4.1.1 PV+ESS System

DANGER

- An RCD must be installed for the backup load. During off-grid operation, the main circuit breaker does not provide protection. Electric leakage on the loads may result in electric shocks. The rated voltage of the RCD must be at least 415 V AC. Its rated residual operating current must be ≥ Number of M1 or MAP0 inverters x 100 mA or ≥ Number of MB0 inverters x 300 mA.
- A main circuit breaker with the leakage protection function must be installed. Its rated voltage must be at least 415 V AC. Its rated residual operating current must be ≥ Number of M1 or MAP0 inverters x 100 mA or ≥ Number of MB0 inverters x 300 mA.
- A maximum of three MAP0 inverters can be connected in parallel. If two MAP0 inverters need to connect to the same port, connect them in parallel first.

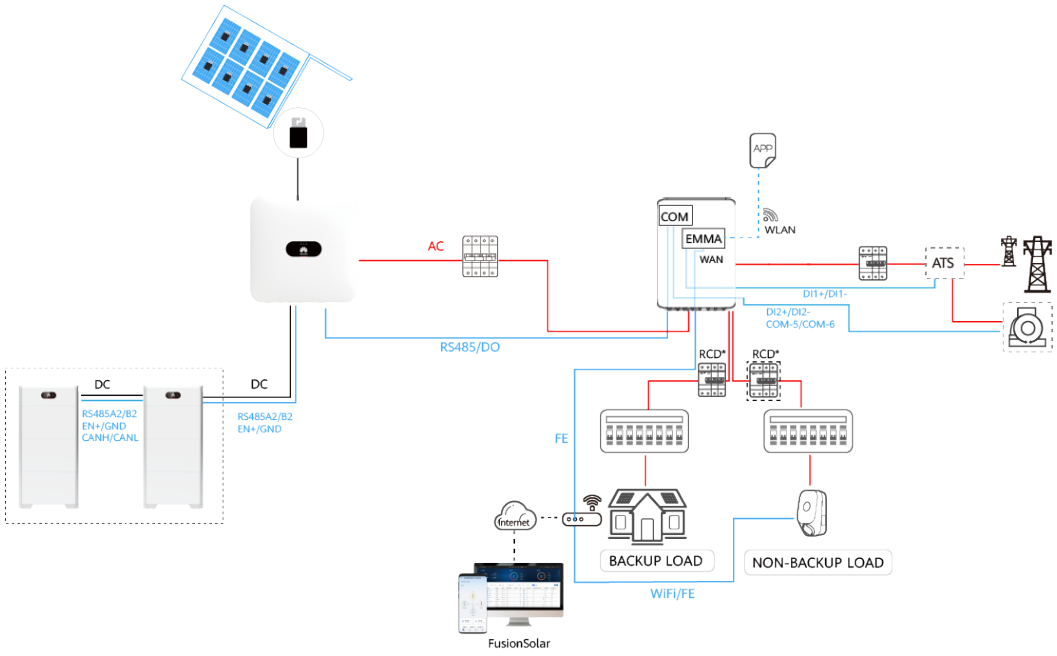
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NOTE

- The EMMA in the SmartGuard can be connected to the router over FE or WLAN. If WLAN is used, the SmartGuard must be installed close to the router.
- Both the EMMA in the SmartGuard and the Smart Dongle provide communication capabilities. Only either of them can be installed in a power plant for networking. Otherwise, communication between devices will be abnormal.
- It is recommended that the charger and the EMMA in the SmartGuard be connected to the router in wired network (FE) mode. If the charger is connected to the router in WLAN mode, the communication may be interrupted due to unstable signals.
- The three-phase SmartGuard supports a maximum load current of 63 A. If the load current exceeds 63 A, only some of loads can be connected to it. In addition, a power meter needs to be connected between the three-phase SmartGuard and the main circuit breaker.

Single Inverter

Figure 4-1 Connecting all loads to the SmartGuard



Note: The figure uses the LUNA2000-(5-30)-S0 as an example.

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Figure 4-2 Connecting some of loads to the SmartGuard

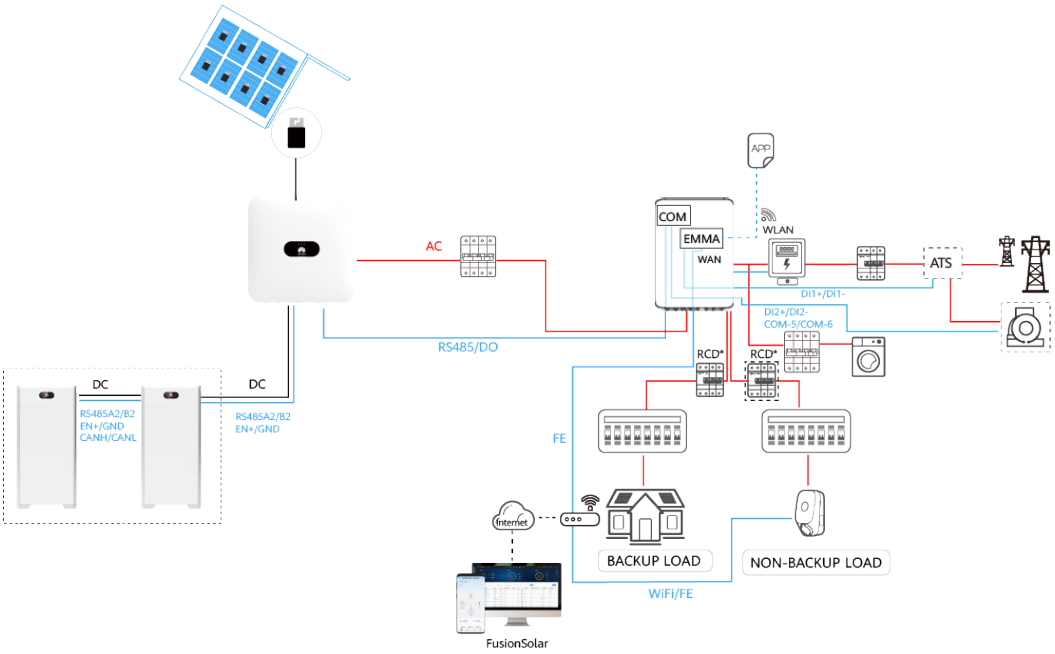


Table 4-1 System configuration with the LUNA2000-(5-30)-S0

Inverter	LUNA2000-(5-30)-S0	SmartGuard AC Port to Be Connected	Max. Number of Connected ESSs
SUN2000-(3KTL-10KTL)-M1	√	INV2	2
SUN2000-(12K-25K)-MB0	√	INV1	4
SUN5000-(17K, 25K)-MB0	√	INV1	4
SUN2000-(5K-12K)-MAP0	√	INV2	2
SUN5000-(8K, 12K)-MAP0	√	INV2	2

Table 4-2 System configuration with the LUNA2000-(7, 14, 21)-S1

Inverter	LUNA2000-(7, 14, 21)-S1	SmartGuard AC Port to Be Connected	Max. Number of Connected ESSs
SUN2000-(3KTL-10KTL)-M1	√	INV2	2

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Inverter	LUNA2000-(7, 14, 21)-S1	SmartGuard AC Port to Be Connected	Max. Number of Connected ESSs
SUN2000-(12K-25K)-MB0	√	INV1	4
SUN5000-(17K, 25K)-MB0	√	INV1	4
SUN2000-(5K-12K)-MAP0	√	INV2	2
SUN5000-(8K, 12K)-MAP0	√	INV2	2

Parallel Inverters

Figure 4-3 Connecting all loads to the SmartGuard

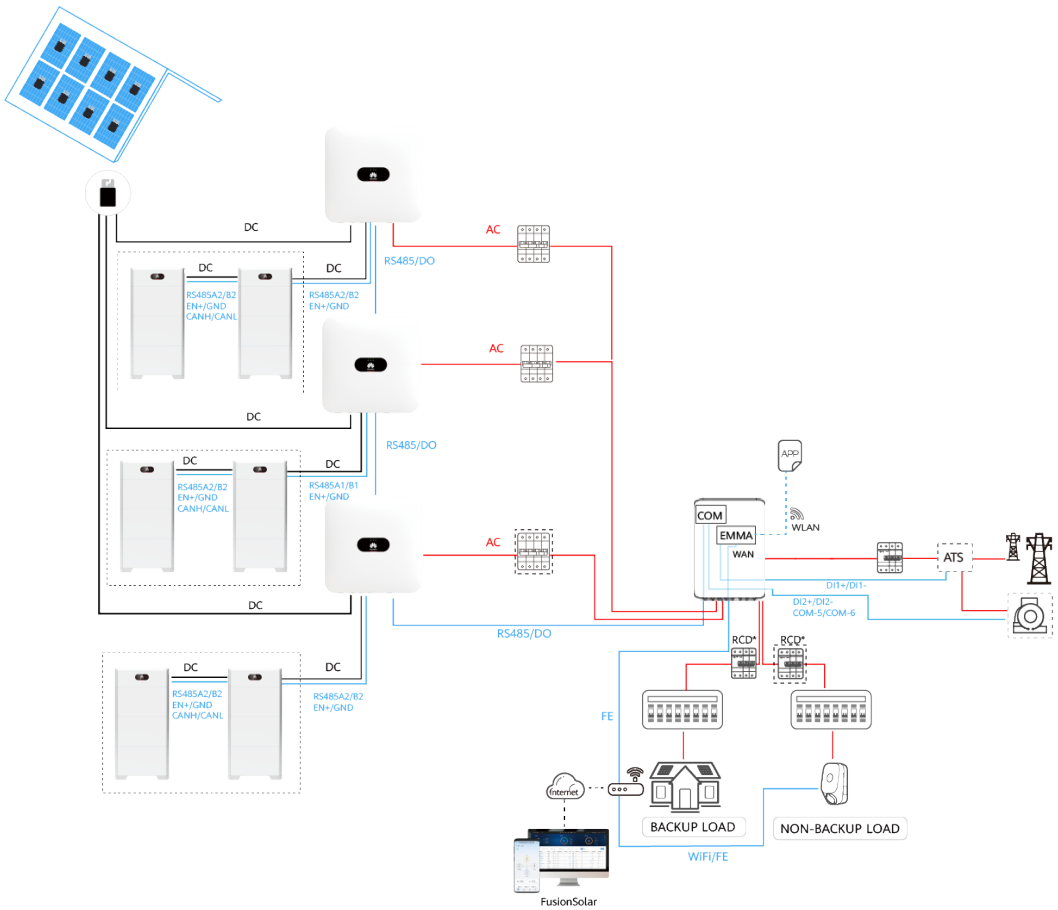


Figure 4-4 Connecting some of loads to the SmartGuard

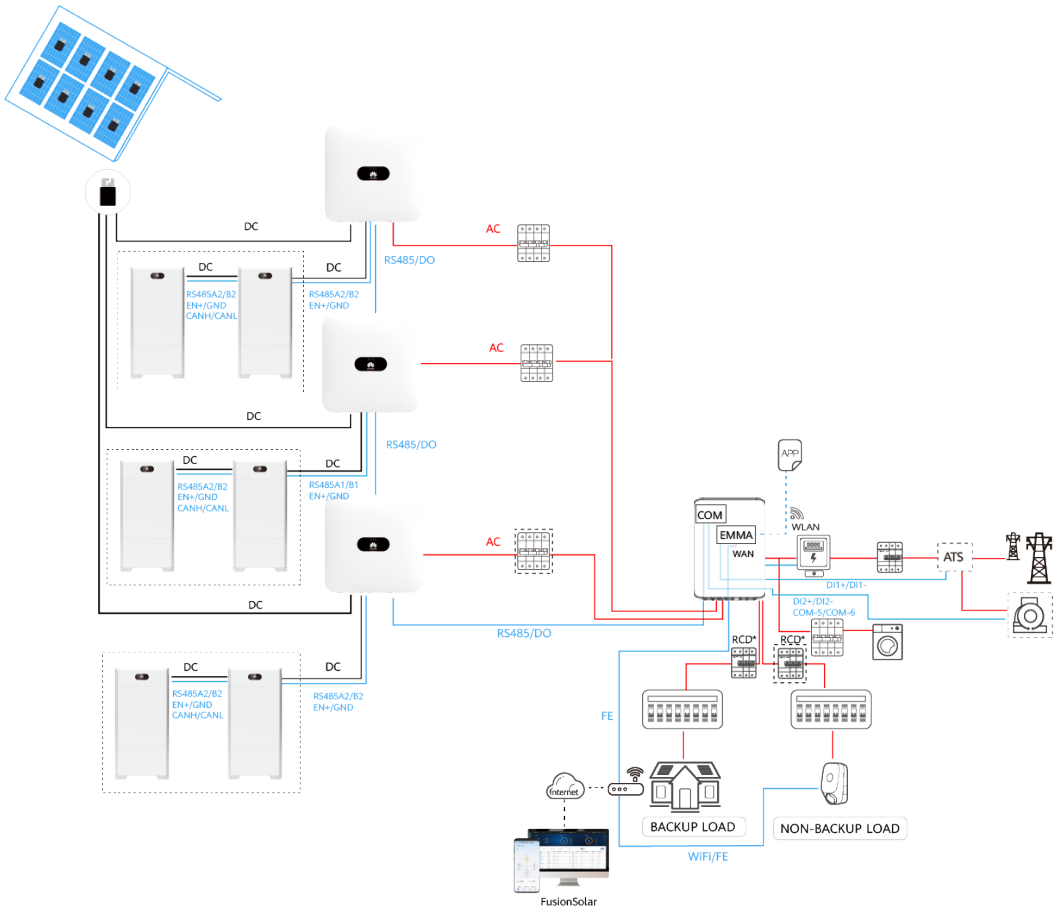


Table 4-3 System configuration

Inverter	Max. Number of Parallel Inverters
SUN2000-(5K-12K)-MAP0	3
SUN5000-(8K, 12K)-MAP0	3

NOTE

- The LUNA2000-(5-30)-S0 and LUNA2000-(7, 14, 21)-S1 cannot connect to the same inverter in a parallel system.
- If inverters are cascaded, the LUNA2000-(5-30)-S0 and LUNA2000-(7, 14, 21)-S1 cannot connect to different inverters.

4.2 Electrical Connections

For details about cable connections in typical scenarios, see the following table.

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Table 4-4 Three-phase PV+ESS system + SmartGuard networking

Cable Connection Scenario	Documentation
Three-phase inverter + LUNA2000-(5-30)-S0 + SmartGuard-63A-T0/AUT0	**Residential Smart PV Solution Quick Guide (Three-Phase PV+ESS Scenario + SmartGuard Networking)**
Three-phase inverter + LUNA2000-(7, 14, 21)-S1 + SmartGuard-63A-T0/AUT0	

4.3 System Power-On

4.3.1 (Optional) Power-On in On-Grid Mode or by Starting the Generator

Precautions

DANGER

- Wear personal protective equipment and use dedicated insulated tools to avoid electric shocks or short circuits.

NOTICE

Before the equipment is put into operation for the first time, ensure that the parameters are set correctly by professional personnel. Incorrect parameter settings may result in noncompliance with local grid connection requirements and affect the normal operations of the equipment.

4.3.1.1 Powering On the SmartGuard

NOTICE

- If a charger configured for the plant is connected to the non-backup load port, choose power-on in on-grid mode for device commissioning when the plant is powered on for the first time. If you choose power-on in off-grid mode, the charger cannot be detected during commissioning because it is not powered on.
- If the PV strings are equipped with optimizers or receive no solar irradiance, power on the system in on-grid mode or by starting the generator.
- During power-on and commissioning, ignore the alarm indicating that the bypass switch is on.

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Method 1: Power-On in On-Grid Mode

Step 1 Use a multimeter to check that the AC voltage in the power distribution box is within the allowed range and that cables are correctly connected.

Step 2 Turn on the main circuit breaker.

Step 3 Turn on the ESS switch.

1. (Optional) Remove the locking screw for the **DC SWITCH** of the ESS.
2. Set the **DC SWITCH** of the ESS to ON.

Step 4 Power on the inverter.

1. (Optional) Turn on the DC switch (if any) between the PV strings and the inverter.
2. (Optional) Remove the locking screw for the **DC SWITCH** of the inverter.
3. Set the **DC SWITCH** of the inverter to ON.

Step 5 Check that the SmartGuard is running in on-grid mode. Observe the LED indicators on the inverter, ESS, EMMA, and SmartGuard to check the running status.

----End

Method 2: Power-On by Starting the Generator

Step 1 On the control panel of the generator, manually start the generator. Use a multimeter to check that the AC voltage in the power distribution box is within the allowed range and that cables are correctly connected.

Step 2 Turn on the main circuit breaker.

Step 3 Turn on the ESS switch.

1. (Optional) Remove the locking screw for the **DC SWITCH** of the ESS.
2. Set the **DC SWITCH** of the ESS to ON.

Step 4 Power on the inverter.

1. (Optional) Turn on the DC switch (if any) between the PV strings and the inverter.
2. (Optional) Remove the locking screw for the **DC SWITCH** of the inverter.
3. Set the **DC SWITCH** of the inverter to ON.

Step 5 Check that the SmartGuard is running in on-grid mode. Observe the LED indicators on the inverter, ESS, EMMA, and SmartGuard to check the running status.

----End

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LED Indicators on the EMMA and SmartGuard

Table 4-5 EMMA indicator description

Indicator	Status	Description
Running status indicator 	Off	The system is not powered on.
	Steady green	The system is powered on and running.
Alarm indicator 	Off	No alarm is raised.
	Blinking red slowly (on for 1s and then off for 4s)	The system raises a warning.
	Blinking red fast (on for 0.5s and then off for 0.5s)	The system raises a minor alarm.
	Steady red	The system raises an urgent/critical alarm.
Communication status indicator 	Off	The IP address of the management system server is not configured. (The indicator is off when the EMMA is not connected to the SmartPVMS.)
	Blinking green slowly (on for 1s and then off for 1s)	The communication with the management system is normal.
	Blinking green fast (on for 0.125s and then off for 0.125s)	The communication with the management system is interrupted.

Table 4-6 Indicators on the SmartGuard

Indicator	Status	Description
	Steady green	The SmartGuard is in on-grid mode.
	Blinking green slowly	The SmartGuard is in generator off-grid mode.
	Steady orange	The SmartGuard is in inverter off-grid mode.

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Indicator	Status	Description
	Steady red	A hardware alarm is generated on the SmartGuard.
	Blinking red slowly	An environment alarm is generated on the SmartGuard.

4.3.1.2 Powering On Loads

Step 1 Check that the inverter, ESS, EMMA, and SmartGuard are working properly in on-grid mode.

Step 2 (Optional) Turn off switches for high-power home appliances to avoid generator overload.

Step 3 After checking that the residential load circuit is not short-circuited, turn on the backup load and non-backup load switches. Otherwise, the SmartGuard may be damaged.

Step 4 (Optional) Set charger route parameters.

Step 5 Commission the device. For details, see **4.5 Device Commissioning**.

Step 6 After the commissioning is complete, turn off the bypass switch. Otherwise, the system cannot run properly. For details, see **4.3.1.3 Turning Off the Bypass Switch**.

----End

4.3.1.3 Turning Off the Bypass Switch

DANGER

- During normal use, do not operate the bypass switch and ensure that it is off.
- Do not turn on the bypass switch when the power is on. Otherwise, the high voltage may result in electric shocks and damage to the equipment.
- If the bypass switch latch is not installed, the bypass switch may be misoperated, which may cause high-voltage electric shocks and damage to the equipment.

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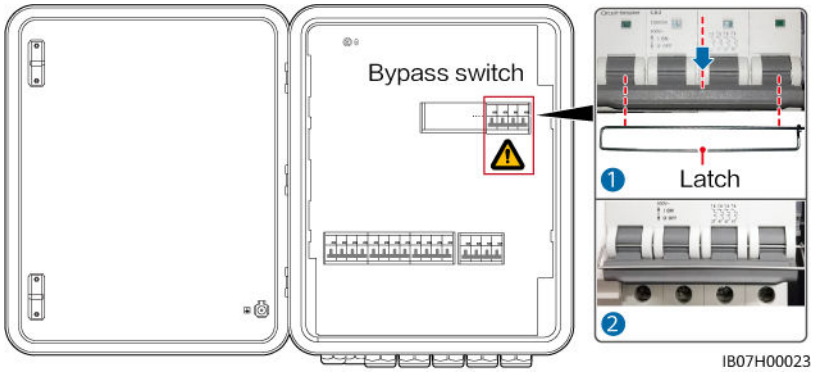
CAUTION

- The power and current of backup loads cannot exceed the maximum off-grid power and current of the system. You are advised to shut down high-power loads and unnecessary loads connected to the backup load port.
- If the battery SOC is less than **End-of-discharge SOC**, charge the ESS from the PV strings or enable **Charge ESS with Generator**, and wait until the ESS is charged to **End-of-discharge SOC** plus 10% or higher.

Step 1 Power off the system and open the maintenance compartment door.

Step 2 Turn off the bypass switch and install the bypass switch latch.

Figure 4-5 Turning off the bypass switch



Step 3 Close the maintenance compartment door and power on the system.

----End

4.3.2 (Optional) Power-On in Off-Grid Mode

Precautions

DANGER

- Wear personal protective equipment and use dedicated insulated tools to avoid electric shocks or short circuits.

NOTICE

Before the equipment is put into operation for the first time, ensure that the parameters are set correctly by professional personnel. Incorrect parameter settings may result in noncompliance with local grid connection requirements and affect the normal operations of the equipment.

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4.3.2.1 Powering On the SmartGuard

NOTICE

- If a charger configured for the plant is connected to the non-backup load port, choose power-on in on-grid mode for device commissioning when the plant is powered on for the first time. If you choose power-on in off-grid mode, the charger cannot be detected during commissioning because it is not powered on.
- If the PV strings are equipped with optimizers or receive no solar irradiance, power-on in off-grid mode is not supported.

Power-On in Off-Grid Mode (with PV Strings)

Step 1 Keep the main circuit breaker off.

Step 2 Power on the inverter.

1. (Optional) Turn on the DC switch (if any) between the PV strings and the inverter.
2. (Optional) Remove the knob locking screw for the **DC SWITCH** of the inverter.
3. Set the **DC SWITCH** of the inverter to ON.

Step 3 Turn on the ESS switch.

1. (Optional) Remove the locking screw for the **DC SWITCH** of the ESS.
2. Set the **DC SWITCH** of the ESS to ON.
3. Press and hold the black start button for 5s.

Step 4 Connect to the inverter by referring to **A Connecting the Inverter on the App**, set the grid code for the inverter, and then set the off-grid mode and SmartGuard model for the inverter. For details, see **Method 2: Setting the Off-Grid Mode and SmartGuard Model for the Inverter**.

Step 5 (Optional) Connect to the inverter by referring to **A Connecting the Inverter on the App**. Upgrade the M1 and MB0 inverters to the latest version. Otherwise, the SmartGuard may fail to identify the inverters. For details, see **D Upgrading the Inverter**.

Step 6 Check that the SmartGuard is running in off-grid mode. Observe the LED indicators on the inverter, ESS, EMMA, and SmartGuard to check the running status.

----End

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LED Indicators on the EMMA and SmartGuard

Table 4-7 EMMA indicator description

Indicator	Status	Description
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	Steady green	The system is powered on and running.
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	Blinking red slowly (on for 1s and then off for 4s)	The system raises a warning.
	Blinking red fast (on for 0.5s and then off for 0.5s)	The system raises a minor alarm.
	Steady red	The system raises an urgent/critical alarm.
Communication status indicator 	Off	The IP address of the management system server is not configured. (The indicator is off when the EMMA is not connected to the SmartPVMS.)
	Blinking green slowly (on for 1s and then off for 1s)	The communication with the management system is normal.
	Blinking green fast (on for 0.125s and then off for 0.125s)	The communication with the management system is interrupted.

Table 4-8 Indicators on the SmartGuard

Indicator	Status	Description
	Steady green	The SmartGuard is in on-grid mode.
	Blinking green slowly	The SmartGuard is in generator off-grid mode.
	Steady orange	The SmartGuard is in inverter off-grid mode.

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Indicator	Status	Description
	Steady red	A hardware alarm is generated on the SmartGuard.
	Blinking red slowly	An environment alarm is generated on the SmartGuard.

4.3.2.2 Powering On Loads

CAUTION

- The power and current of backup loads cannot exceed the maximum off-grid power and current of the system. You are advised to shut down high-power loads and unnecessary loads connected to the backup load port.
- If the battery SOC is less than the end-of-discharge SOC, charge the ESS from the PV strings until the ESS is charged to **End-of-discharge SOC** plus 10% or higher.

Step 1 Check that the inverter, ESS, EMMA, and SmartGuard are working properly in off-grid mode.

Step 2 Check that the residential backup load power does not exceed the off-grid operating power of the system.

Step 3 After checking that the residential load circuit is not short-circuited, turn on the backup load and non-backup load switches.

----End

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4.4 Deploying a New Plant

Deploying a New Plant



NOTE

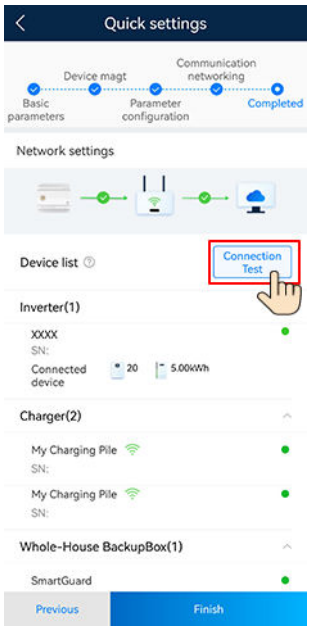
- For details about new plant deployment and existing plant revamping, see **FusionSolar App Quick Guide (EMMA)** or scan the QR code.
- In the existing plant revamping scenario, the SmartGuard and Dongle cannot be used at the same time. You need to remove the Dongle from the inverter. The SmartGuard has a built-in power meter. If all loads are connected to the SmartGuard, the original power meter in the power plant needs to be directly removed. If some of loads are connected to the SmartGuard, a power meter of the recommended model must be used.
- For details about how to set ESS parameters, inverter parameters, and physical layout of optimizers, see *Residential Smart PV Solution Quick Guide (Three-Phase PV+ESS Scenario + SmartGuard Networking)*.
- Before device commissioning, ensure that the router is powered on.

Connection Test

Connection Test is supported in quick settings. You can perform this step to check whether the cable connections are correct, avoiding site visits for rectification.

Tap **Connection Test** and wait until the test is complete. If the test fails, rectify the fault in a timely manner.

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4.5 Device Commissioning

4.5.1 Commissioning Functions

Commission the following functions as needed:

Table 4-9 Commissioning functions

Function	Scenario Description	Procedure
Adding Intelligent Electrical Equipment	Intelligent electrical equipment (such as SG Ready heat pumps and electrical devices controlled by smart switches) in your home can be added to the FusionSolar app for management.	For details, see **FusionSolar App Quick Guide (EMMA)**, or scan the QR code to download the quick guide.
Limited Feed-in	If surplus PV power is fed into the grid, the parameter of limited feed-in power can be set to ensure that the feed-in power is within the range specified by the grid company.	

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Function	Scenario Description	Procedure
Scheduling via DI Port	Applies to scenarios where the grid company performs remote scheduling through dedicated ripple control receivers. The grid company remotely delivers a scheduling command (%) to the plant with a wireless transmitting apparatus. Then, the wireless receiving apparatus receives the scheduling command and converts it into a DI signal. The EMMA controls the inverter to output the corresponding power.	
Peak Shaving	Applies to areas that have peak demand charges. The capacity control function allows you to lower the peak power drawn from grid in maximum self-consumption or TOU mode during peak hours, reducing electricity fees.	
Setting External WLAN Antenna Parameters	By default, the EMMA has a built-in WLAN antenna. If the signal quality of the power distribution box is poor, install an external antenna to enhance WLAN signals. If an external antenna is used, set the antenna in the built-in WLAN parameters to an external antenna.	

For details about app operations, see **FusionSolar App User Manual**.

4.5.2 Whole-House Power Backup Settings (Seamless Switchover)

Connect to the EMMA. On the home screen, choose **Set** > **Whole-House Power Backup Settings**, enable **Seamless switchover**, and set other parameters.

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CAUTION

- The seamless switching function of the SmartGuard needs to be manually enabled. If the function is enabled, the system where an MAP0 inverter is installed will switch to off-grid mode within 20 ms after the grid fails or becomes abnormal, ensuring uninterruptible power supply to IT equipment such as computers connected to the backup load port. Other devices may be intermittently disconnected, powered off, or restarted.
- The seamless switching function of the SmartGuard can be used to switch from on-grid mode to off-grid mode or from generator off-grid mode to inverter off-grid mode.

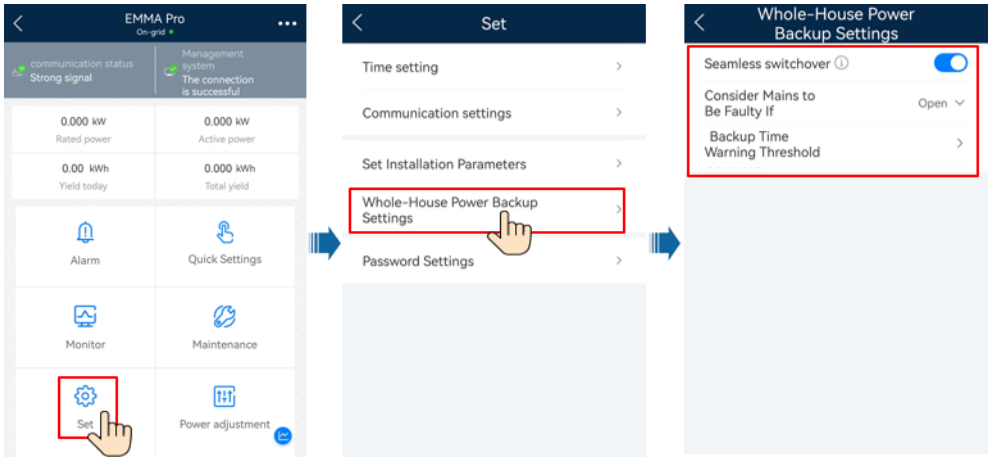
Table 4-10 Parameters for whole-house power backup settings

Parameter	Value Range	Description
Seamless switchover	Disabled (default)	• When the grid fails, loads will be powered off for a short while during on/off-grid switching. • The SmartGuard slowly switches to off-grid mode.
	Enabled	• When the grid fails or is abnormal, the system where an MAP0 inverter is installed switches to off-grid mode within 20 ms. • When the grid fails or is abnormal, the system where an M1 or MB0 inverter is installed switches to off-grid mode within 100 ms. • The low voltage ride-through (LVRT) function does not take effect.
Consider Mains to Be Faulty If (optional)	• Open (default) • Closed	This parameter can be set only if an ATS is installed. • **Open**: When the grid is connected, the circuit for the position feedback signal upon grid connection has low impedance. When the grid is disconnected, the circuit has high impedance. • **Closed**: When the grid is connected, the circuit for the position feedback signal upon grid connection has high impedance. When the grid is disconnected, the circuit has low impedance.

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Parameter	Value Range	Description
Backup Time Warning Threshold (min)	5–60	Warning of battery backup time in off-grid scenarios.

Figure 4-6 Whole-house power backup settings



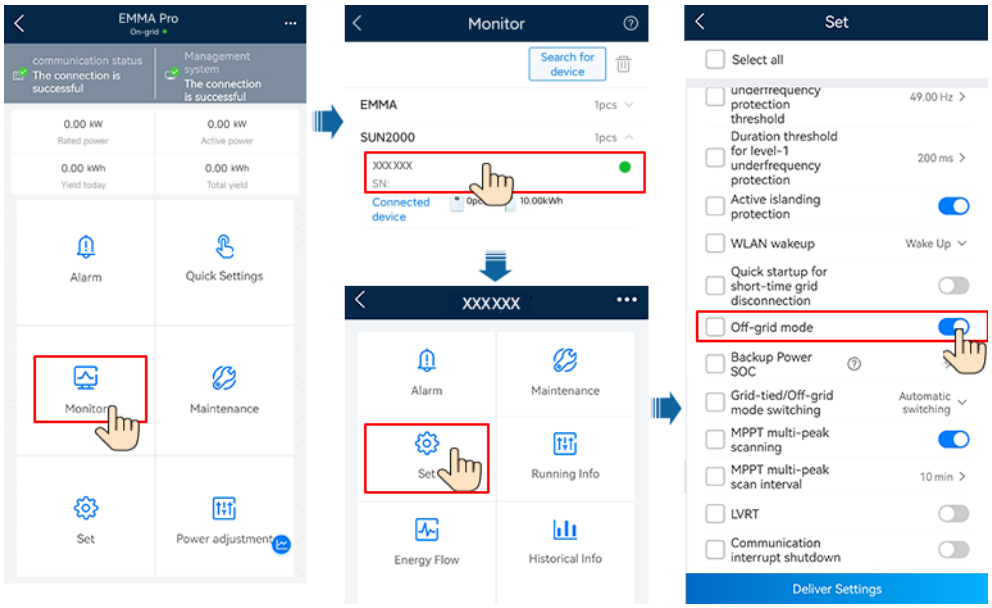
4.5.3 Setting Off-Grid Mode for the Inverter

After the off-grid mode is set, the inverter supports off-grid operation.

Method 1: Setting Off-Grid Mode for the Inverter Using the SmartGuard

Connect to the EMMA. On the home screen, choose **Monitor > SUN2000**, tap **Set**, and enable **Off-grid mode**.

Figure 4-7 Setting off-grid mode



Method 2: Setting the Off-Grid Mode and SmartGuard Model for the Inverter

Connect to the inverter by referring to **A Connecting the Inverter on the App**. On the home screen, choose **Set** > **Feature parameters** and enable **Off-grid mode**. SmartGuard must be selected when the system is powered on for the first time in off-grid mode. Otherwise, the system will not work.

Figure 4-8 Setting off-grid mode

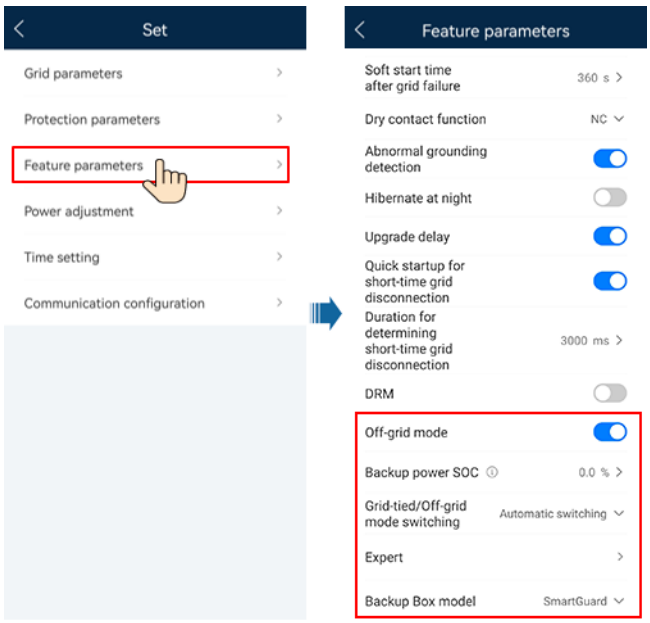


Table 4-11 On/Off-grid parameter settings

Parameter	Description	Value Range
Off-grid mode	If this parameter is enabled, the inverter switches to off-grid mode through the SmartGuard when the grid fails.	• Enabled • Disabled
Backup power SOC	Set the backup power SOC. In on-grid mode, the ESS does not discharge when it is discharged to the backup power SOC. When the grid fails, loads are powered in backup mode.	[0, 100%]
Backup Box model	SmartGuard must be selected when the system is powered on in off-grid mode. Otherwise, the system will not work.	• BackupBox-(B0,B1) • Compatible Third Party BackupBox • SmartGuard • No BackupBox

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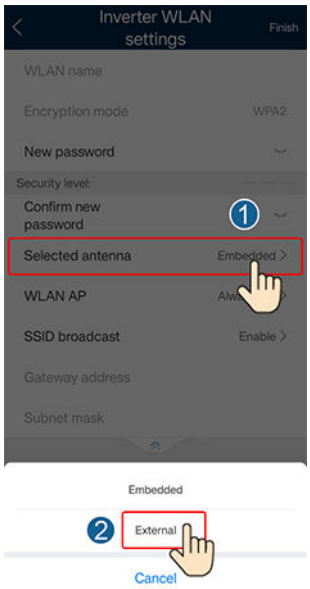
4.5.4 (Optional) Setting the External WLAN Antenna

CAUTION

An external WLAN antenna needs to be purchased from Huawei. To use the external WLAN antenna, set **Selected antenna** to **External signal**.

Connect to the EMMA. On the home screen, choose **Set** > **Communication settings** > **Inverter WLAN settings**, and select **Selected antenna** to **External**.

Figure 4-9 Setting the external antenna

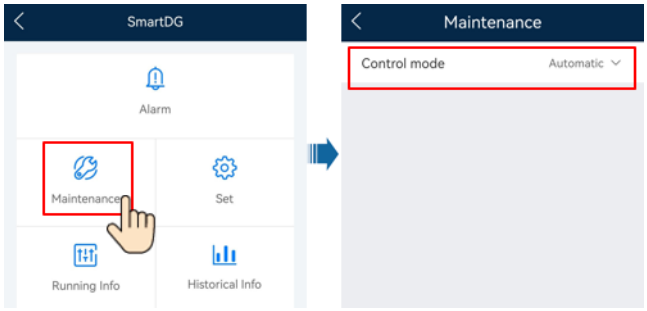


4.5.5 Generator Settings

Setting the Generator Control Mode

Connect to the EMMA. On the home screen, choose **Monitor** > **Generator** > **Maintenance**, and set the generator control mode to **Automatic**.

Figure 4-10 Setting the generator control mode



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Table 4-12 Generator control parameters

Parameter	Value	Description
Control mode	Manual	• Shut Down • Power-on
	Automatic	You can set the battery SOC upper and lower thresholds. When the battery SOC reaches the specified upper or lower threshold, the generator automatically shuts down or starts.

Setting Generator Parameters

Connect to the EMMA. On the home screen, choose **Monitor** > **Generator** > **Set**, and set generator parameters.

Figure 4-11 Setting generator parameters

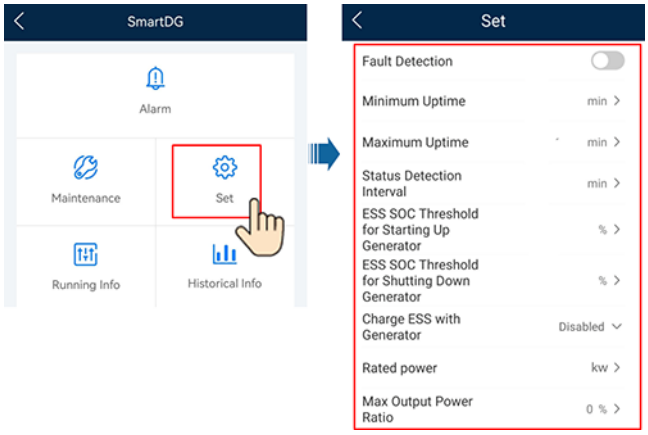


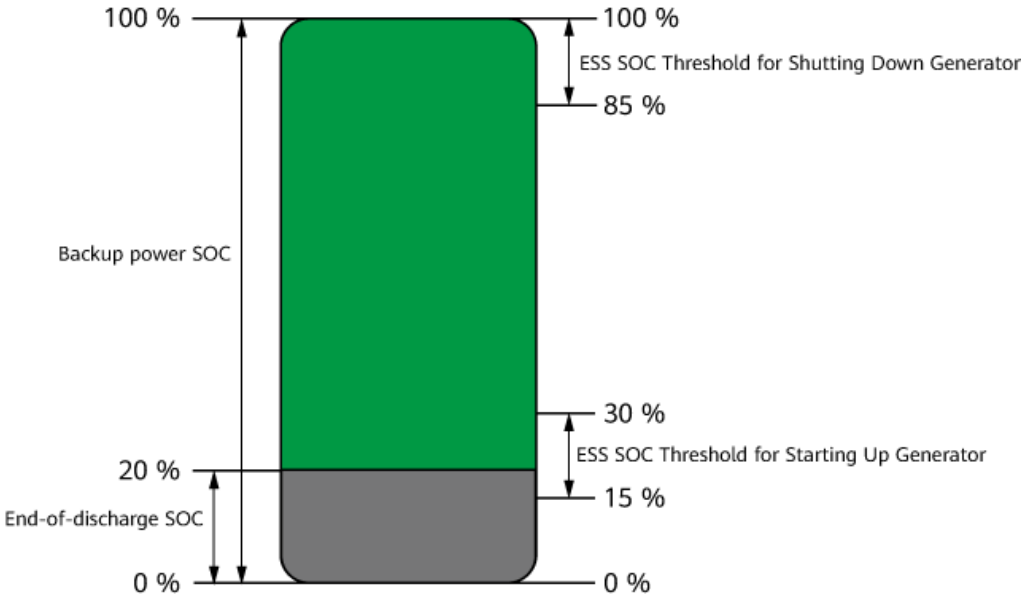
Table 4-13 Generator parameters

Parameter	Value Range	Description
Fault Detection	• Enabled • Disabled (default)	After **Fault Detection** is enabled, you need to set **Fault Detection Mode**.
Fault Detection Mode	• By ON signal (default) • By OFF signal	• **By ON signal**: When the generator fails to run, the generator alarm signal circuit has low impedance. When the generator is normal, the generator alarm signal circuit has high impedance. • **By OFF signal**: When the generator fails to run, the generator alarm signal circuit has high impedance. When the generator is normal, the generator alarm signal circuit has low impedance.

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Parameter	Value Range	Description
Minimum Uptime (min)	0–60	In auto control mode, the generator cannot automatically shut down if the specified minimum uptime is not reached.
Maximum Uptime (min)	60–2880	In auto control mode, the generator automatically shuts down upon reaching the specified maximum uptime.
Status Detection Interval (min)	1–10	After the generator startup or shutdown command is delivered, if the generator fails to start or shut down when **Status Detection Interval** is reached, a generator startup or shutdown failure alarm is reported.
ESS SOC Threshold for Starting Up Generator (%)	15–30	When the battery SOC is lower than **ESS SOC Threshold for Starting Up Generator**, the generator starts. • **ESS SOC Threshold for Starting Up Generator** ≥ **End-of-discharge SOC** + 10% (For example, if **End-of-discharge SOC** is 15%, set **ESS SOC Threshold for Starting Up Generator** to 25% or higher.) • If the generator startup fails, loads will be powered off after the ESS discharges to **End-of-discharge SOC**.
ESS SOC Threshold for Shutting Down Generator (%)	85–100	When the battery SOC is higher than **ESS SOC Threshold for Shutting Down Generator**, the generator shuts down.
Charge ESS with Generator	• Disabled (default) • Enabled	After this function is enabled, the generator is allowed to charge the ESS.
Rated power (kW)	1–500	Indicates the rated power of the generator.
Max Output Power Ratio (%)	0–100	Indicates the maximum output power ratio of the generator.

Figure 4-12 Battery SOC



4.6 System Power-Off

Precautions

WARNING

- Before opening the maintenance compartment door, turn off the main circuit breaker, and then turn off the switches for residential backup loads and non-backup loads. Shut down the inverter, and turn off the DC switches of the inverter and ESS.
- Only authorized personnel can open the maintenance compartment cover to perform electrical connections.
- Before opening the maintenance compartment cover, turn off the backup load circuit breaker, the grid AC circuit breaker, and two inverter AC circuit breakers inside the SmartGuard. Ensure that the bypass switch is off.
- After the SmartGuard powers off, the remaining electricity and heat may still cause electric shocks and burns. Therefore, wait for at least 5 minutes and wear insulated gloves before working on the SmartGuard.

Procedure

Step 1 (Optional) On the generator control panel, manually shut down the generator.

Step 2 Turn off the main circuit breaker.

Step 3 Power off the inverter.

1. Send a shutdown command to the inverter on the app.
2. Set the **DC SWITCH** of the inverter to **OFF**.

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3. (Optional) Install the locking screw for the **DC SWITCH**.
4. (Optional) Turn off the DC switch between the inverter and PV strings.

Step 4 Shut down the ESS.

1. Set the **DC SWITCH** of the ESS to **OFF**.
2. (Optional) Install the locking screw for the **DC SWITCH** of the ESS.

Step 5 Turn off the switches for residential backup loads and non-backup loads.

----End

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5 Smart Appliance Networking

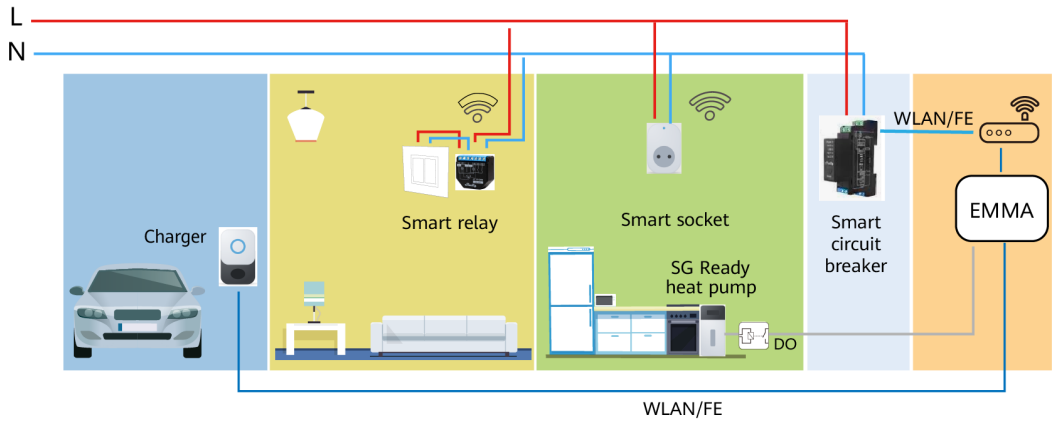
Table 5-1 Smart appliances

Smart Appliance	Maximum Quantity
Charger	2
Smart switch	20
Heat pump	1

NOTE

In the EMMA networking scenario, only the EMMA-A02 can connect to smart appliances.

Figure 5-1 Smart appliances

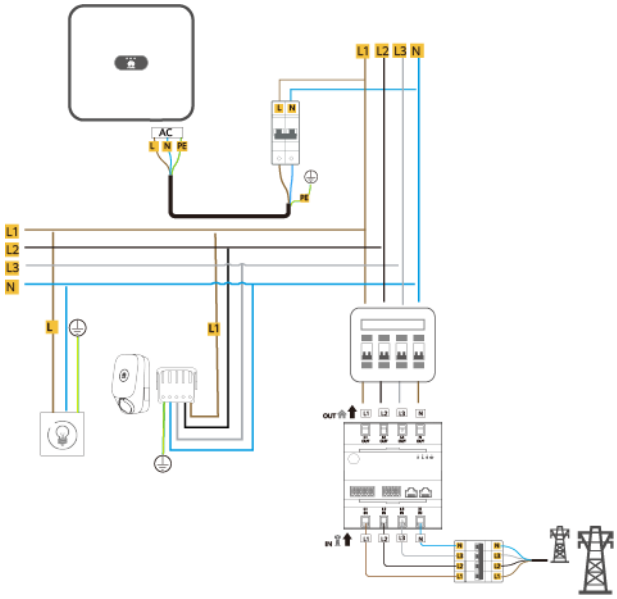


Note: The figure uses a single-phase system as an example.

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NOTE

The following figure shows a three-phase residential scenario. If a single-phase inverter is installed, the AC power cable L of the single-phase inverter, cable L of the single-phase home appliance, and L1 input cable of the three-phase charger must be connected to the L1 phase of the grid.



5.1 Charger Networking

The charger can be connected to the router over WLAN or FE and then to the EMMA, or directly connected to the LAN port of the EMMA through the FE port. If there are two chargers, connect them to the router over WLAN or FE. Do not connect one charger to the LAN port of the EMMA and the other to the router.

Table 5-2 Charger models

Item	Model
Charger	SCharger-7KS-S0 (single-phase) SCharger-22KT-S0 (three-phase)

5.2 Smart Switch Networking

NOTE

When the SG Ready heat pump provides 12 V power supply, the EMMA directly controls the heat pump. When the SG Ready heat pump cannot provide 12 V power supply, the EMMA controls the heat pump through an external relay.

- The EMMA controls the SG Ready heat pump directly or through an external relay.
- Smart switches (including smart relays, smart sockets, or smart circuit breakers) can connect to the same router as the EMMA does over WLAN or FE.

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Table 5-3 List of smart appliances

Item	Model
Smart socket	Shelly Plus Plug S
Smart relay	Shelly Plus 2PM
Smart circuit breaker	Shelly Pro 2PM
Heat pump	SG Ready heat pump

NOTE

EMMA V100R023C10 (V100R023C10SPCXX) supports only the Shelly versions listed in the following table. To check the Shelly version, perform the following steps:

1. Power on Shelly and connect to the WLAN of Shelly.

2. Enter the IP address for connecting to Shelly in the address box of the browser to check the firmware version of Shelly. For details, see the Shelly user manual.

Table 5-4 Supported Shelly versions

Type	Model	Version
Smart socket	Shelly Plus Plug S	0.12.99-plugsprod1, 0.14.4, 1.0.8, 1.1.0-beta3
Smart relay	Shelly Plus 2PM	0.10.2-beta4, 1.0.8, 1.1.0-beta3
Smart circuit breaker	Shelly Pro 2PM	0.10.2-beta1, 1.0.3, 1.0.8, 1.1.0-beta3

5.3 Using Smart Appliances (Owner)

5.3.1 PV Power Preferred (EMMA)

NOTE

If **Peak Power** set in **Peak Shaving** is less than **Maximum Mains Power**, the system will set the actual value of **Maximum Mains Power** to the value of **Peak Power** to meet the peak shaving requirement preferentially.

- Assume that your home has installed PV and ESS devices. In a season with sufficient sunlight, there is still surplus PV power in addition to power supplied to loads without smart switches. Then, you connect the smart appliances including the charger, heat pump, and dishwasher (controlled by smart sockets) to the SmartPVMS to consume surplus PV power and save home energy expenses.
- Assume that the ESS works in **Maximum self-consumption** mode, and the surplus PV power is preferentially supplied to smart appliances. When PV power is insufficient, the ESS discharges for smart loads.

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Table 5-5 Parameters

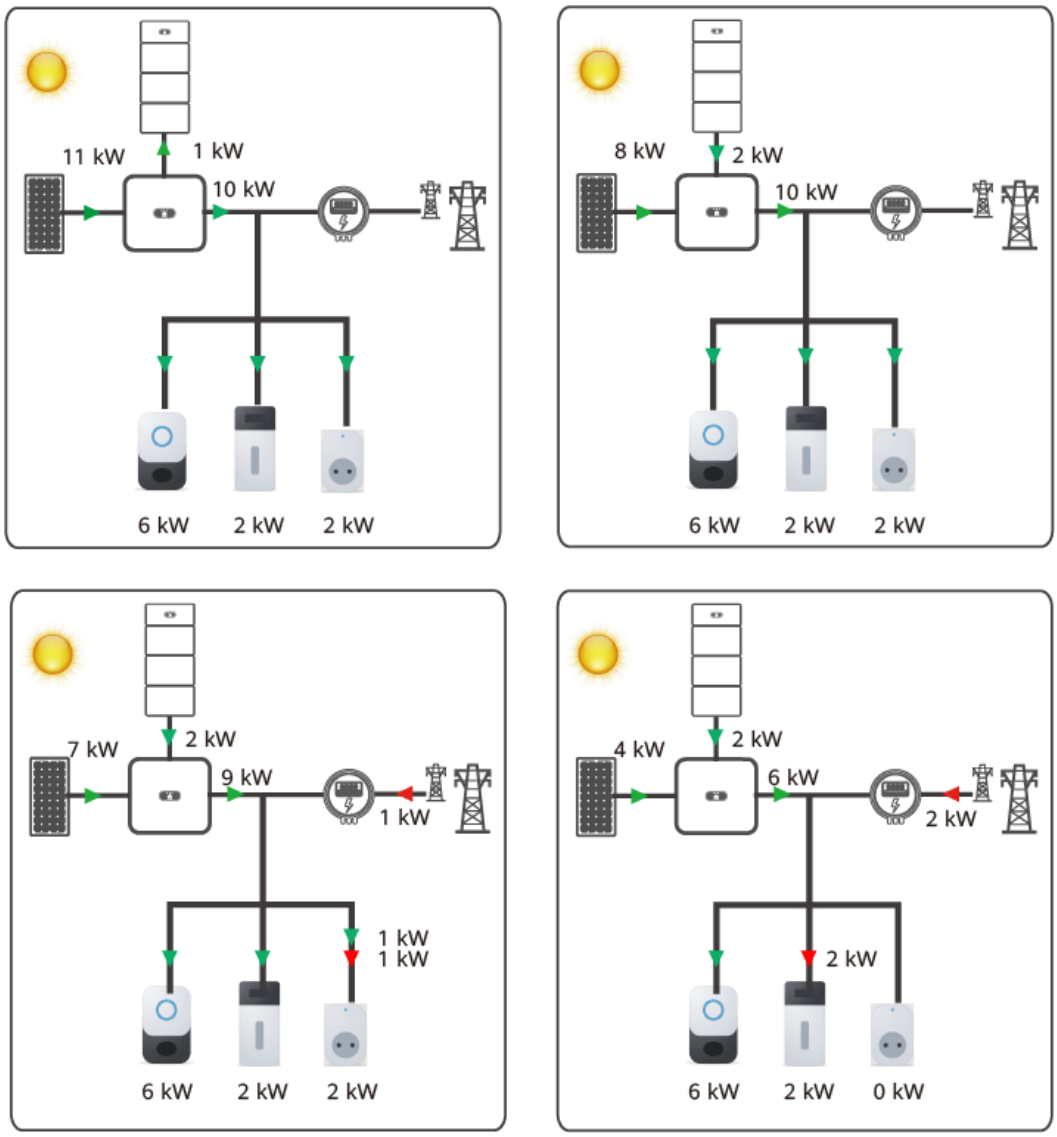
Parameter	Description
Minimum charging power of the charger	Take a single-phase charger as an example. The minimum operating current is 6 A. When the voltage is 230 V, the charging power is about 1.38 kW.
Maximum Dynamic Power (Maximum charging power of the charger)	6 kW
Maximum Mains Power (Maximum power purchased by smart appliances from the power grid)	2 kW
Surplus PV Power Threshold for Power-On* for the heat pump	1 kW
Surplus PV Power Threshold for Power-On* for the dishwasher	1 kW
Maximum discharge power of the ESS	2 kW

NOTE

- Note*: In the **PV Power Preferred** scenario, when the surplus PV power is greater than **Surplus PV Power Threshold for Power-On**, loads will be powered on. If the rated load operating power is not met, the supplemental power will be purchased from the grid to power on the loads.
- Assume that the rated power of the dishwasher is 2 kW. If you want to use PV power as much as possible, set **Surplus PV Power Threshold for Power-On** to 2 kW. If you are willing to purchase some power from the grid, you can set **Surplus PV Power Threshold for Power-On** to 1 kW. When the surplus PV power reaches 1 kW, the dishwasher will be powered on with 1 kW supplemental power from the grid. After power-on, if the PV power is decreasing, you can purchase supplemental power from the grid to keep the dishwasher running until the **Maximum Mains Power** is reached.
- If you enable the mode that the ESS is preferentially charged, the surplus PV will be preferentially supplied to charge the ESS. If there is still sufficient power, the surplus PV power will be supplied to smart appliances.

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Figure 5-2 PV Power Preferred (EMMA)



Scenario 1: The surplus PV power is 11 kW. The smart appliances consume 10 kW power, and the remaining 1 kW is used to charge the ESS.

Table 5-6 Scenario 1

Load Priority	Appliance	Surplus PV Power Threshold for Power-On	Operating Power	Status
1	Charger	1.38 kW (Retain the default value: minimum startup power)	1.38–6 kW	Running, **6 kW**
2	Heat pump	1 kW	2 kW	Running
3	Dishwasher	1 kW	2 kW	Running

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Scenario 2: The smart appliances consume 10 kW power, with 8 kW from the surplus PV power, and 2 kW from the ESS discharge power.

Table 5-7 Scenario 2

Load Priority	Appliance	Surplus PV Power Threshold for Power-On	Operating Power	Status
1	Charger	1.38 kW (Retain the default value: minimum startup power)	1.38–6 kW	Running, **6 kW**
2	Heat pump	1 kW	2 kW	Running
3	Dishwasher	1 kW	2 kW	Running

Scenario 3: The smart appliances consume 10 kW power, with 7 kW from the surplus PV power, 2 kW from the ESS discharge power, and 1 kW purchased from the grid.

Table 5-8 Scenario 3

Load Priority	Appliance	Surplus PV Power Threshold for Power-On	Operating Power	Status
1	Charger	1.38 kW (Retain the default value: minimum startup power)	1.38–6 kW	Running, **6 kW**
2	Heat pump	1 kW	2 kW	Running
3	Dishwasher	1 kW	2 kW	Running 1 kW power is purchased from the grid to meet the minimum operating power of the dishwasher.

Scenario 4: The smart appliances consume 8 kW power, with 4 kW from the surplus PV power, 2 kW from the ESS discharge power, and 2 kW purchased from the grid. According to the load priority, the dishwasher is shut down.

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Table 5-9 Scenario 4

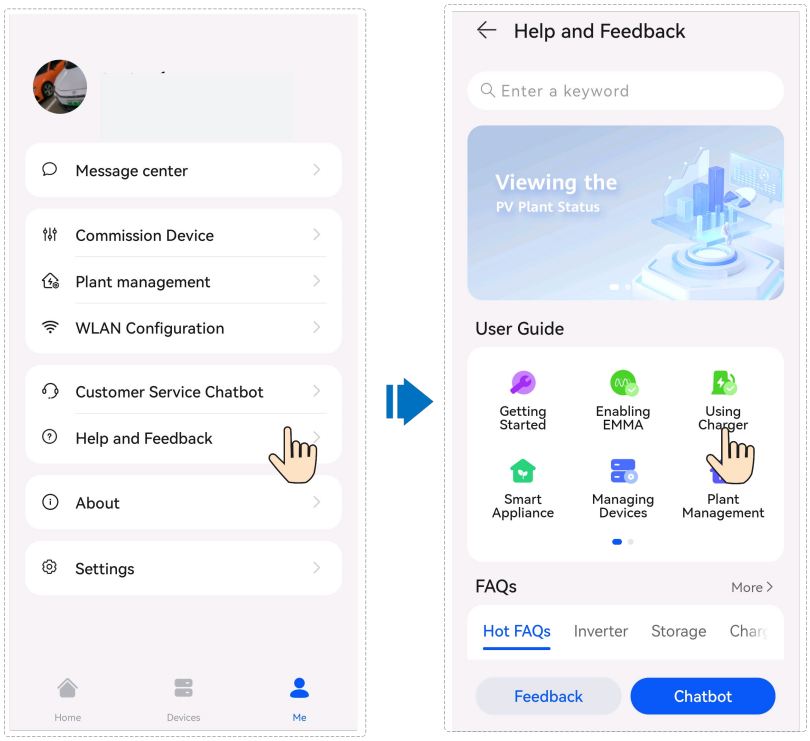
Load Priority	Appliance	Surplus PV Power Threshold for Power-On	Operating Power	Status
1	Charger	1.38 kW (Retain the default value: minimum startup power)	1.38–6 kW	Running, **6 kW**
2	Heat pump	1 kW	2 kW	Running 2 kW power is purchased from the grid to meet the minimum operating power of the heat pump.
3	Dishwasher	1 kW	2 kW	Shut down

NOTE

After smart appliances are shut down by priority, if you manually start an appliance, it will be supplied with power until you manually shut it down without being affected by the priority.

5.3.2 Commissioning the Charger

Log in to the FusionSolar app as an owner, tap the charger on the **Home** screen, and set charger parameters. For details about how to use the charger, go to **Help and Feedback**.



5.3.3 Smart Switch Commissioning

NOTE

If functions related to PV power control, such as PV power preferred, are involved, you are advised to configure smart appliances with the rated power greater than 100 W.

NOTE

EMMA V100R023C10 (V100R023C10SPCXX) supports only the Shelly versions listed in the following table. To check the Shelly version, perform the following steps:

1. Power on Shelly and connect to the WLAN of Shelly.

2. Enter the IP address for connecting to Shelly in the address box of the browser to check the firmware version of Shelly. For details, see the Shelly user manual.

Table 5-10 Supported Shelly versions

Type	Model	Version
Smart socket	Shelly Plus Plug S	0.12.99-plugsprod1, 0.14.4, 1.0.8, 1.1.0-beta3
Smart relay	Shelly Plus 2PM	0.10.2-beta4, 1.0.8, 1.1.0-beta3
Smart circuit breaker	Shelly Pro 2PM	0.10.2-beta1, 1.0.3, 1.0.8, 1.1.0-beta3

Appliance Settings

NOTE

- The smart switches can work properly only when there are stable WLAN signals. If the signals are unstable, the switches may fail to connect to WLAN or frequently go offline. Different brands of smart switches may have different WLAN requirements. For details, see the product manuals or contact your supplier.
- Before the installation, ensure that the home router can cover the position of the smart switches with stable network connection, and perform the commissioning and verification.

1. Connect a smart switch to the same router as the EMMA. For details, see the quick guide delivered with the smart switch.

2. Open the FusionSolar app, choose **Device** > **Appliances**, add the smart switch, and set the parameters such as the PV power parameters and power consumption priorities.

NOTE

In the SmartGuard networking scenario, **Off-grid Load Control** does not take effect for smart appliances connected to non-backup power ports.

Connecting to Multiple Smart Switches

To avoid confusion when multiple smart switches are powered on at the same time, power on and commission them one by one.

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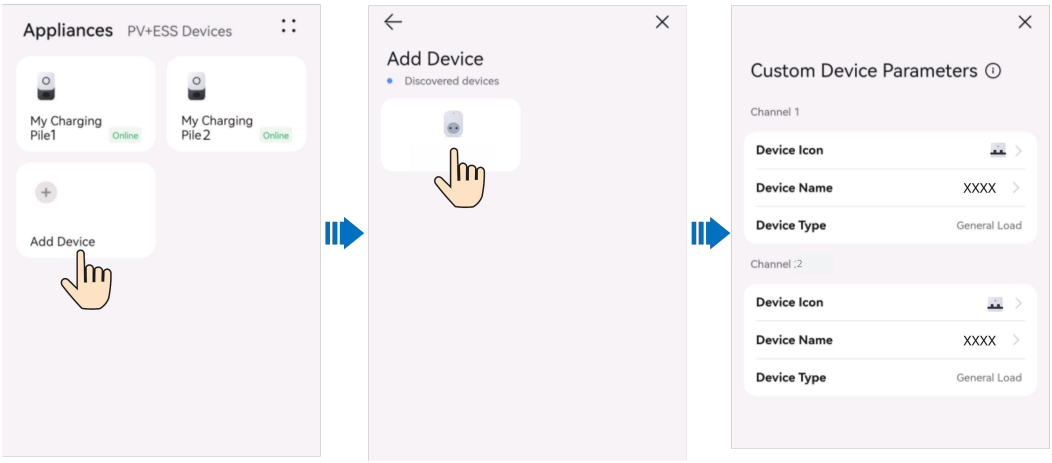
For example, if two smart circuit breakers (Shelly Pro 2PM) are installed in the living room, perform the following steps:

1. When installing the smart circuit breakers, record their positions by taking photos and notes, and number them.

Table 5-11 Recording the names of the smart switches

Shelly Pro 2PM	Shelly Pro 2PM
Living room 1	Living room 2

2. Power on the smart circuit breaker "Living room 1," search for it in the Shelly app, and connect it to the router.
3. Log in to the FusionSolar app as an owner, search for it, and change its name. Bind it to the corresponding load based on the actual cable connection.



4. Repeat steps 2 and 3 to power on and commission the smart circuit breaker "Living room 2."

NOTE

If multiple smart switches have been powered on without records in advance, you can power them on or off on the Shelly app to distinguish them.

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6 Maintenance and Replacement

6.1 Routine Maintenance

To ensure that the system operates properly for a long term, you are advised to perform routine maintenance as described in this section.

CAUTION

Before cleaning the system, connecting cables, and checking the grounding reliability, power off the system.

Table 6-1 Maintenance checklist

Check Item	Check Method	Maintenance Interval
System cleanliness	Heat sinks are free from obstacles and dust.	Once every 6 to 12 months
System status	• Check that the SmartGuard is not damaged or deformed. • Check that the SmartGuard does not generate abnormal sound when it is in operation. • Check that ESS parameters are correctly set when the device is running.	Once every 6 months

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Check Item	Check Method	Maintenance Interval
Electrical connections	• Check that cables are securely connected. • Check that cables are intact, especially that the cable sheath contacting a metal surface is intact. • Check that unused AC input ports, COM ports, and waterproof covers on the appliances are locked.	6 months after the first commissioning and once every 6 to 12 months after that
Grounding reliability	Check that the PE cable is securely connected.	6 months after the first commissioning and once every 6 to 12 months after that

6.2 Troubleshooting

If an alarm is generated, rectify the fault by referring to the alarm list in the user manual of the related component.

6.3 Replacing a Charger

1. Remove the old charger.
   a. Turn off the upstream switch and ensure that the following operations are performed with power off.
   b. Remove the security torx screws from the bottom of the charger. (Use a TT20 security torx torque screwdriver.)
   c. Push the charger upwards to separate the charger from its rear cover.
   d. Remove the communication cable and power cables in sequence.
   e. Remove the wall-mounting screws and then the rear cover. (Use an M6 torque screwdriver.)
2. Install a new charger. For details, see **Smart Charger User Manual (SCharger-7KS-S0, SCharger-22KT-S0)**.
3. If the charger uses an FE network cable, connect the network cable to the LAN port on the EMMA or the router. If the charger connects to the router over WLAN, log in as the installer user, **connect to the charger**, choose **O&M > Route Management**, select **WLAN** in **Connection Mode**, and set the WLAN information.

6.4 Scenario Reconstruction

NOTE

- The EMMA networking cannot be reconstructed to the Smart Dongle networking.

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NOTICE

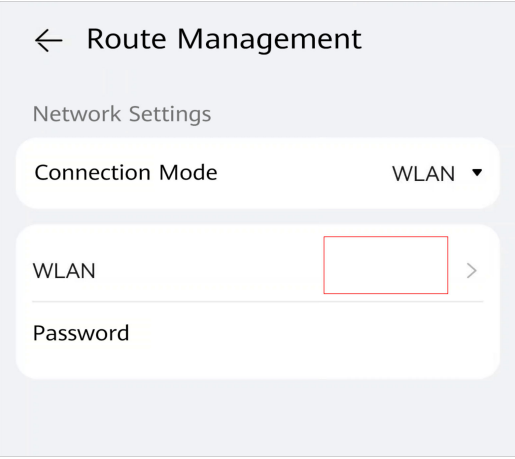
Two chargers can only be connected to the router at the same time. Do not connect one charger to the EMMA and the other charger to the router respectively at the same time.

6.4.1 By the Same Installer

EMMA Networking Reconstruction

The PV devices, charger, and meter have been installed at home and connected to plant A.

1. The charger must be upgraded to the FusionCharge V100R023C10 to match the EMMA networking. Otherwise, the EMMA cannot find the charger. **Connect to the charger** as an installer. For details about the upgrade operations, see **E Upgrading the Charger**.
2. Power off the system.
3. Remove the installed meter.
4. If a Smart Dongle is installed, remove it from the inverter.
5. Install the EMMA and connect cables to the system by referring to **2.2 Electrical Connections**.
6. If the charger is used in WLAN mode, log in to the FusionSolar app as the installer, **connect the charger** to the app, and set the WLAN of the router.



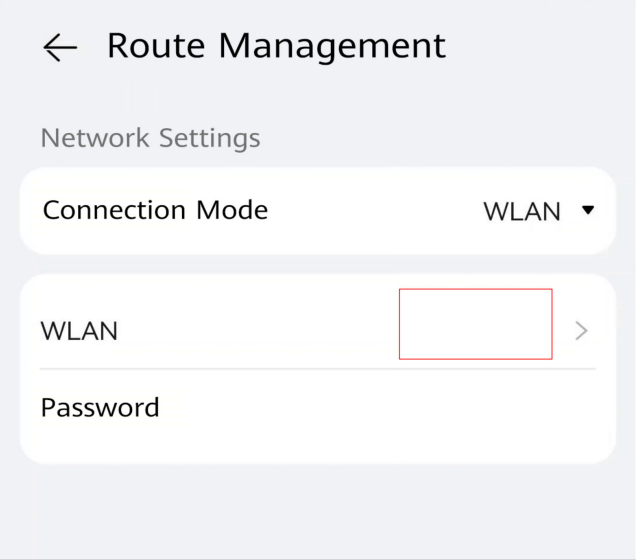
If the charger is used in wired network mode through an FE network cable, connect the FE network cable of the charger to the LAN port of the router or EMMA.

7. Connect the EMMA to the existing plant A and commission the device.
8. Connect the app to the inverter as the installer by referring to **A Connecting the Inverter on the App**, choose **Maintenance** > **Subdevice management** on the home screen, and delete the offline meter. Alternatively, log in to the WebUI of the SmartPVMS, choose **Monitoring** > **Subdevice management**, and delete the offline meter.

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Installing a Charger in the EMMA Networking Scenario

1. Power off the system.
2. Install a new charger. For details, see **Smart Charger User Manual (SCharger-7KS-S0, SCharger-22KT-S0)**.
3. The charger must be upgraded to the FusionCharge V100R023C10 to match the EMMA networking. Otherwise, the EMMA cannot find the charger. **Connect to the charger** as an installer. For details about the upgrade operations, see **E Upgrading the Charger**.
4. If the charger is used in WLAN mode, log in to the FusionSolar app as the installer, **connect the charger** to the app, and set the WLAN of the router.



If the charger is used in wired network mode through an FE network cable, connect the FE network cable of the charger to the LAN port of the router or EMMA.

5. **Connect the charger** as the installer and set the maximum dynamic power.

6.4.2 By Different Installers

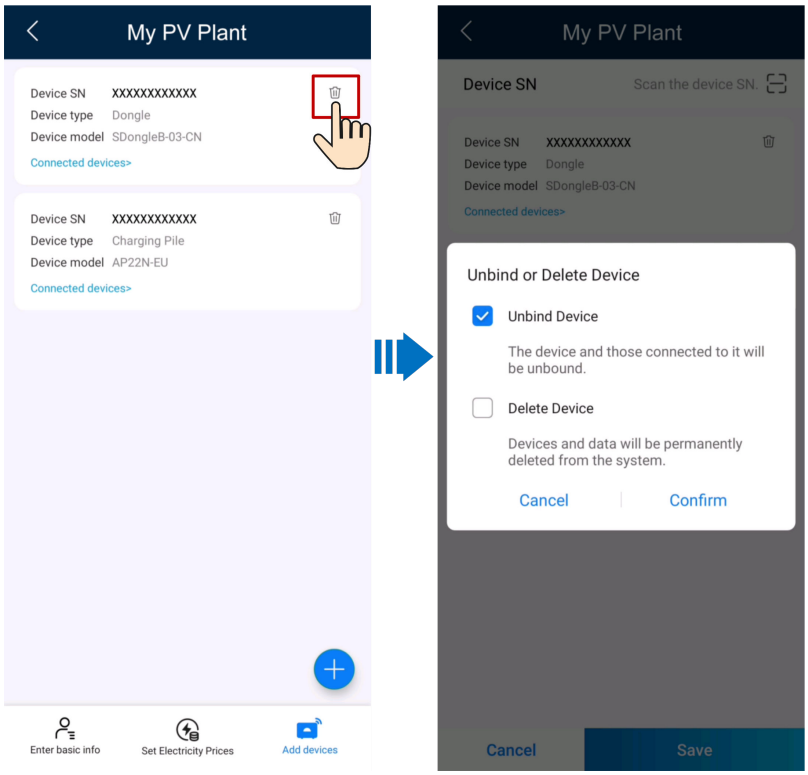
NOTE

When the current scenario is reconstructed to the EMMA networking scenario, the owner unbinds the original devices which were bound to plant A by installer A. Then, installer B creates a new plant and reconnects the devices to the plant. The data in plant A is not inherited.

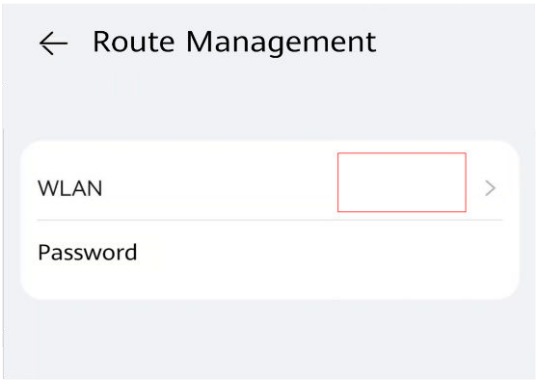
Assume that the PV devices, charger, and FE meter have been installed at home and connected to plant A.

1. Log in to the FusionSolar app as an owner and unbind the devices from plant A.
   a. Choose **Me** > **Plant management** and tap the target plant.
   b. Tap **Add Devices**.
   c. Tap and select **Unbind Device** or **Delete Device** based on the site requirements.

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2. The charger must be upgraded to the FusionCharge V100R023C10 to match the EMMA networking. Otherwise, the EMMA cannot find the charger. **Connect to the charger** as an installer. For details about the upgrade operations, see **E Upgrading the Charger**.
3. Power off the system.
4. If a Smart Dongle is installed, remove it from the inverter.
5. Remove the original meter.
6. Install the EMMA and connect cables by referring to **2.2 Electrical Connections**.
7. If the charger is used in WLAN mode, log in to the FusionSolar app as the installer, **connect the charger** to the app, and set the WLAN of the router.



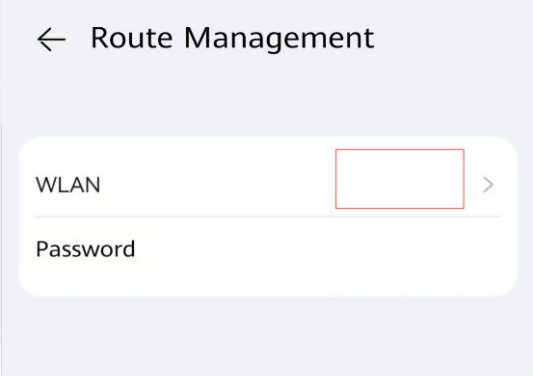
If the charger is used in wired network mode through an FE network cable, connect the FE network cable of the charger to the LAN port of the router or EMMA.

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8. Perform deployment and device commissioning again by referring to **2.4 Deploying a New Plant** and **2.5 Parameter Settings**.

Installing a Charger in the EMMA Networking Scenario

1. Power off the system.
2. Install a new charger. For details, see **Smart Charger User Manual (SCharger-7KS-S0, SCharger-22KT-S0)**.
3. The charger must be upgraded to the FusionCharge V100R023C10 to match the EMMA networking. Otherwise, the EMMA cannot find the charger. **Connect to the charger** as an installer. For details about the upgrade operations, see **E Upgrading the Charger**.
4. If the charger is used in WLAN mode, log in to the FusionSolar app as the installer, **connect the charger** to the app, and set the WLAN of the router.



If the charger is used in wired network mode through an FE network cable, connect the FE network cable of the charger to the LAN port of the router or EMMA.

5. **Connect the charger** as the installer and set the maximum dynamic power.

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7 Contact Us

If you have any questions about this product, please contact us.

https://digitalpower.huawei.com

Path: **About Us** > **Service Hotlines**

To ensure faster and better services, we kindly request your assistance in providing the following information:

- Device model
- Serial number (SN)
- Software version
- Alarm ID or name
- Brief description of the fault symptom

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A Connecting the Inverter on the App

Step 1 Access the **Commission Device** screen.

Figure A-1 Method 1: before login (not connected to the Internet)

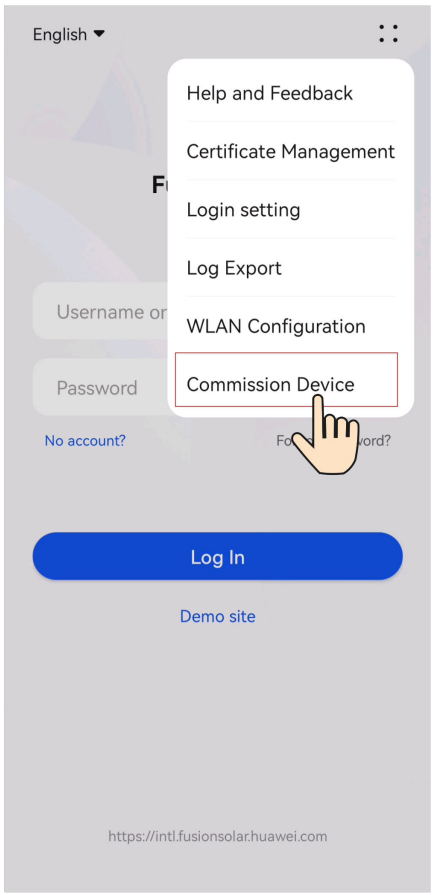
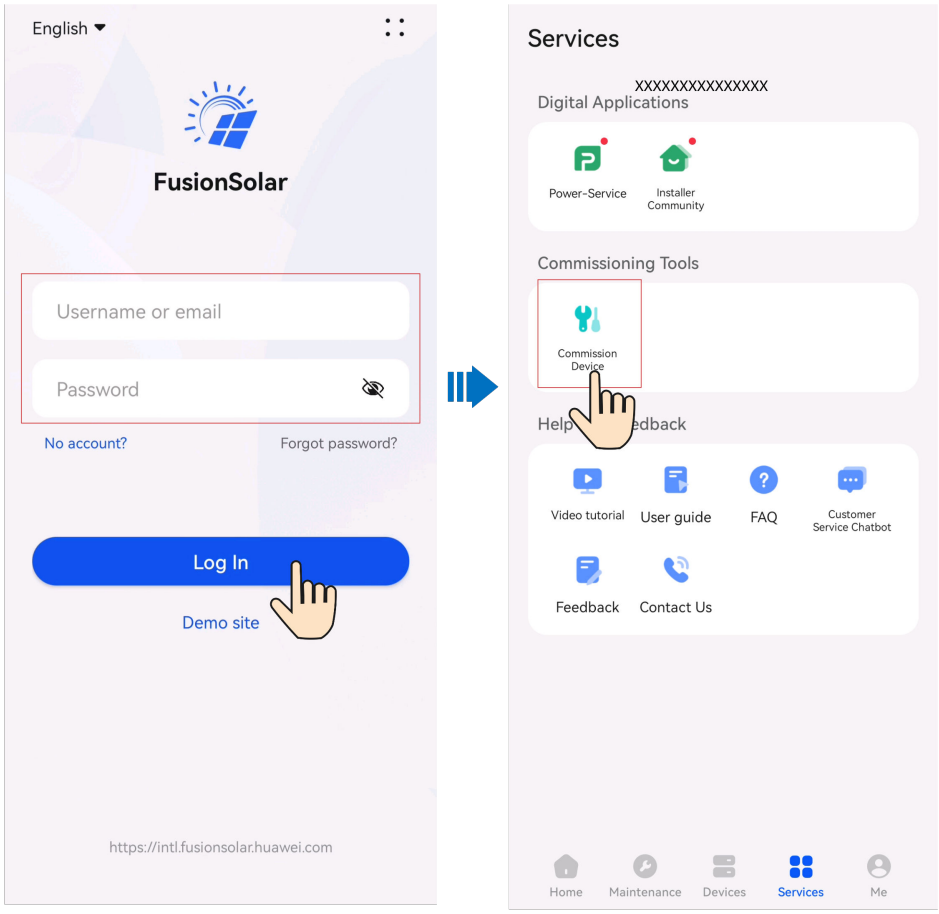
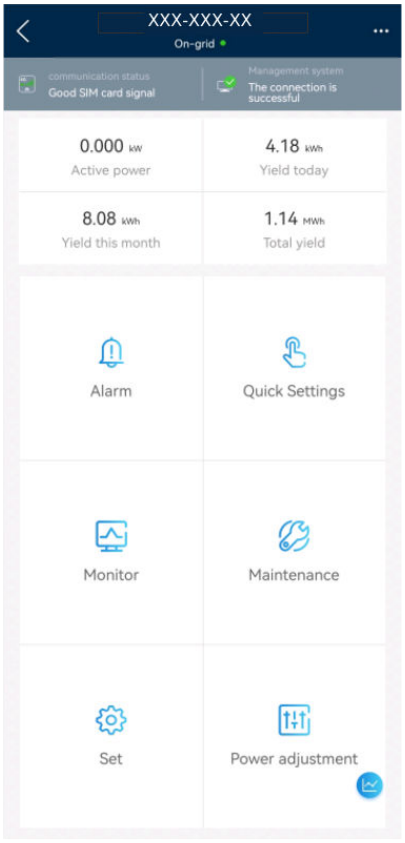


Figure A-2 Method 2: after login (connected to the Internet)



Step 2 Connect to the inverter WLAN, log in as **Installer**, and access the device commissioning screen.

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NOTICE

- When directly connecting your phone to a device, ensure that your phone is within the WLAN coverage of the device.
- When connecting the device to the router over WLAN, ensure that the device is within the WLAN coverage of the router and the signal is stable and good.
- The router supports WLAN (IEEE 802.11 b/g/n, 2.4 GHz) and the WLAN signal reaches the inverter.
- The WPA, WPA2, or WPA/WPA2 encryption mode is recommended for routers. The Enterprise mode is not supported (such as airport WLAN and other public hotspots that require authentication). WEP and WPA TKIP are not recommended because they have serious security vulnerabilities. If the access fails in WEP mode, log in to the router and change the encryption mode of the router to WPA2 or WPA/WPA2.

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NOTE

- The last six digits of the product WLAN name are the same as the last six digits of the product SN.
- For the first connection, log in with the initial password. You can obtain the initial password from the label on the device.
- To ensure account security, protect the password by changing it periodically, and keep it secure. Your password might be stolen or cracked if it is left unchanged for extended periods. If a password is lost, devices cannot be accessed. In these cases, the Company shall not be liable for any loss.
- If the login screen is not displayed after you scan the QR code, check whether your phone is correctly connected to the device WLAN. If not, manually select and connect to the WLAN.
- If the **This WLAN network has no Internet access. Connect anyway?** message is displayed when you connect to the built-in WLAN, tap **CONNECT**. Otherwise, you cannot log in to the system. The actual UI and messages may vary with mobile phones.

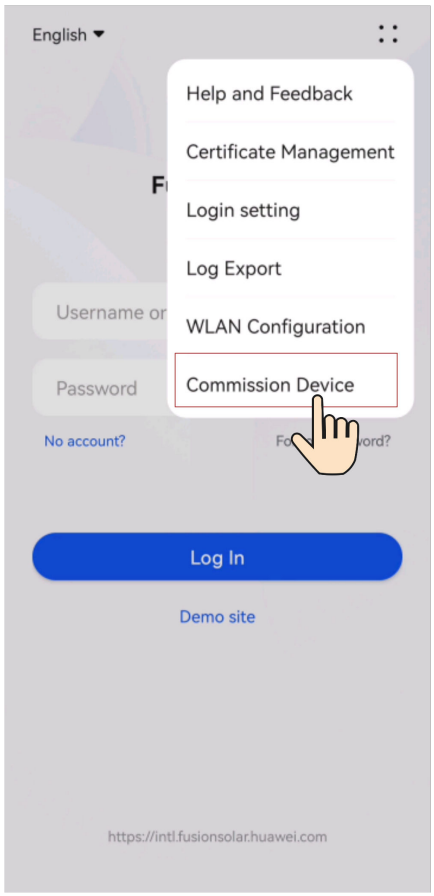
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B Connecting the EMMA on the App

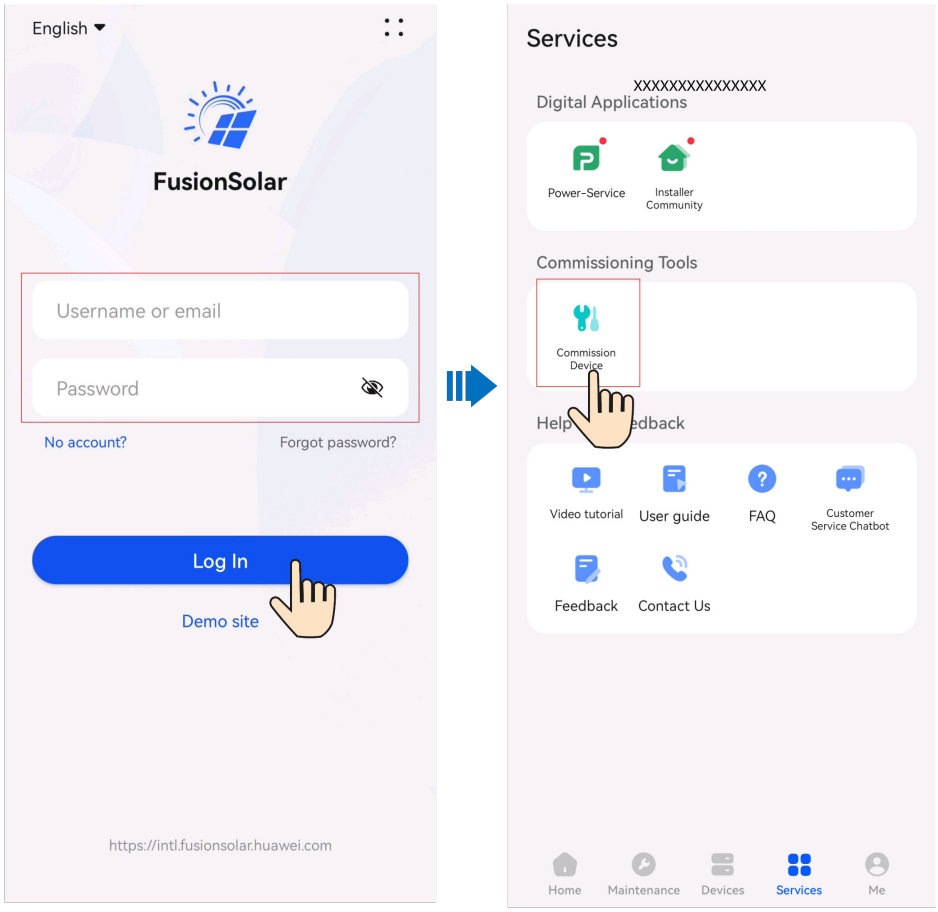
Step 1 Access the **Commission Device** screen.

Figure B-1 Method 1: before login (not connected to the Internet)

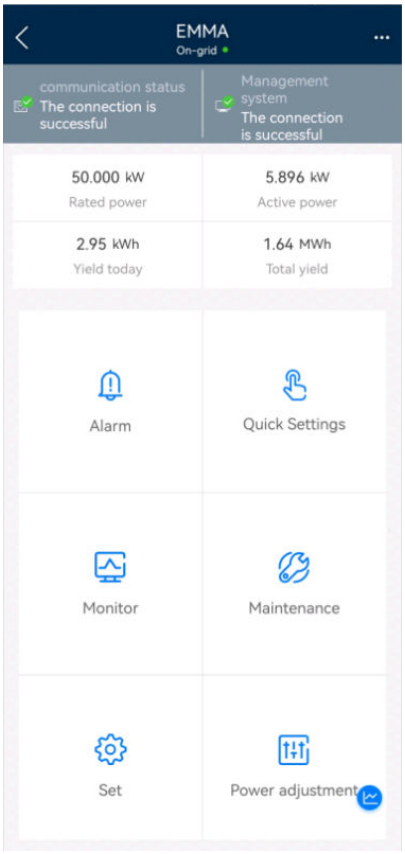


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Figure B-2 Method 2: after login (connected to the Internet)



Step 2 Connect to the EMMA WLAN, log in as **Installer**, and access the device commissioning screen.



NOTICE

- When directly connecting your phone to a device, ensure that your phone is within the WLAN coverage of the device.
- When connecting the device to the router over WLAN, ensure that the device is within the WLAN coverage of the router and the signal is stable and good.
- The router supports WLAN (IEEE 802.11 b/g/n, 2.4 GHz) and the WLAN signal reaches the inverter.
- The WPA, WPA2, or WPA/WPA2 encryption mode is recommended for routers. The Enterprise mode is not supported (such as airport WLAN and other public hotspots that require authentication). WEP and WPA TKIP are not recommended because they have serious security vulnerabilities. If the access fails in WEP mode, log in to the router and change the encryption mode of the router to WPA2 or WPA/WPA2.

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NOTE

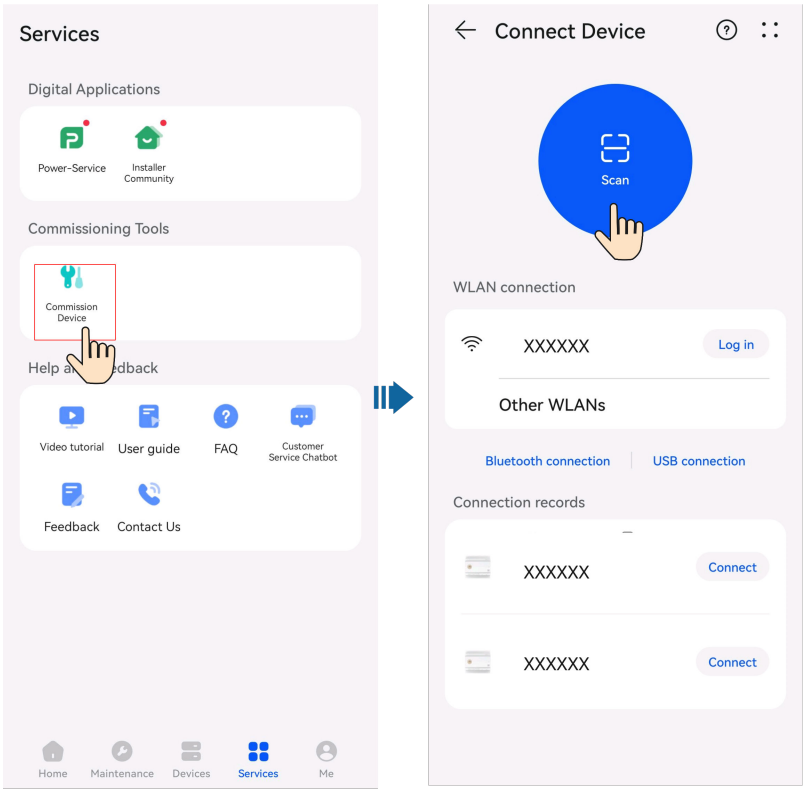
- The last six digits of the product WLAN name are the same as the last six digits of the product SN.
- For the first connection, log in with the initial password. You can obtain the initial password from the label on the device.
- To ensure account security, protect the password by changing it periodically, and keep it secure. Your password might be stolen or cracked if it is left unchanged for extended periods. If a password is lost, devices cannot be accessed. In these cases, the Company shall not be liable for any loss.
- If the login screen is not displayed after you scan the QR code, check whether your phone is correctly connected to the device WLAN. If not, manually select and connect to the WLAN.
- If the **This WLAN network has no Internet access. Connect anyway?** message is displayed when you connect to the built-in WLAN, tap **CONNECT**. Otherwise, you cannot log in to the system. The actual UI and messages may vary with mobile phones.

----End

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C Connecting to a Charger

1. Log in to the FusionSolar app and tap **Me** > **Commissioning Device**.
2. Tap **Charger** and connect to the WLAN of the charger as prompted.



NOTE

- The last six digits of the product WLAN name are the same as the last six digits of the product SN.
- Use the initial password upon the first power-on and change the password immediately after login. To ensure account security, protect the password by changing it periodically, and keep it secure. Your password might be stolen or cracked if it is left unchanged for extended periods. If a password is lost, devices cannot be accessed. In these cases, the Company shall not be liable for any loss.

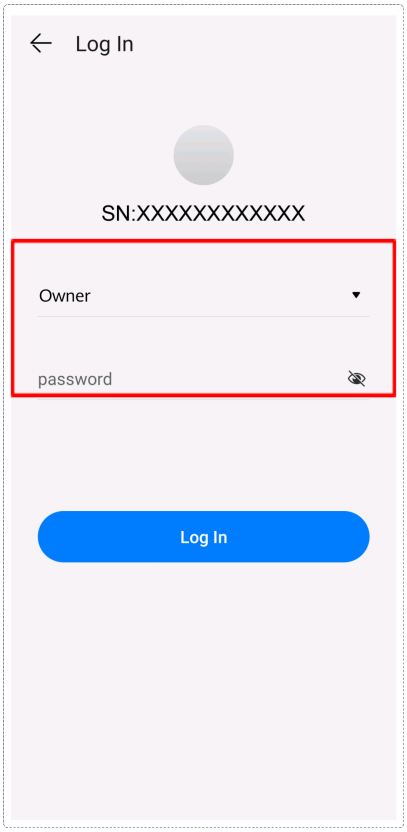
3. Log in to the app as an **Installer** or **Owner**.

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NOTE

For the first login, the initial password is **Changeme**. If the system prompts you to set a password, set the login password as prompted.

Figure C-1 Connecting to a charger



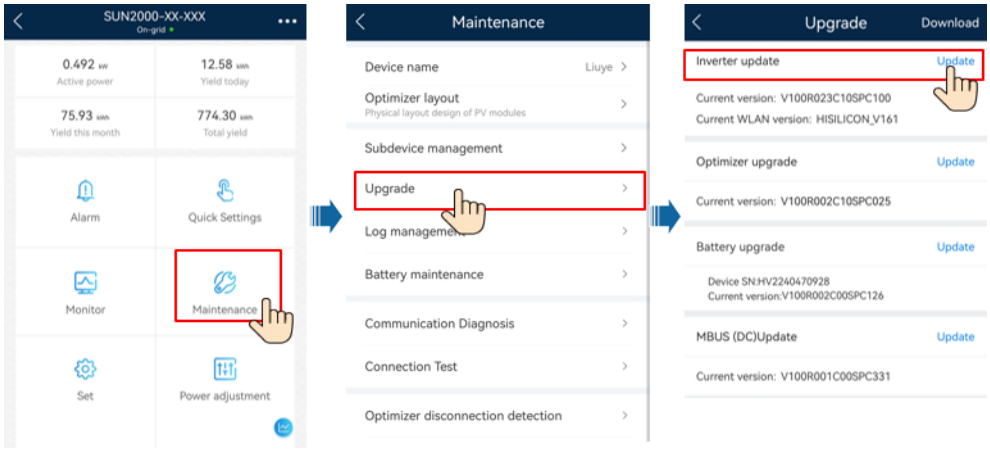
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D Upgrading the Inverter

NOTE

If the phone is not connected to a network, prepare the upgrade package before upgrading the inverter.

Connect to the inverter, choose **Maintenance** > **Upgrade** on the home screen, and select the corresponding inverter version.



E Upgrading the Charger

E.1 Upgrading the Charger Software Version

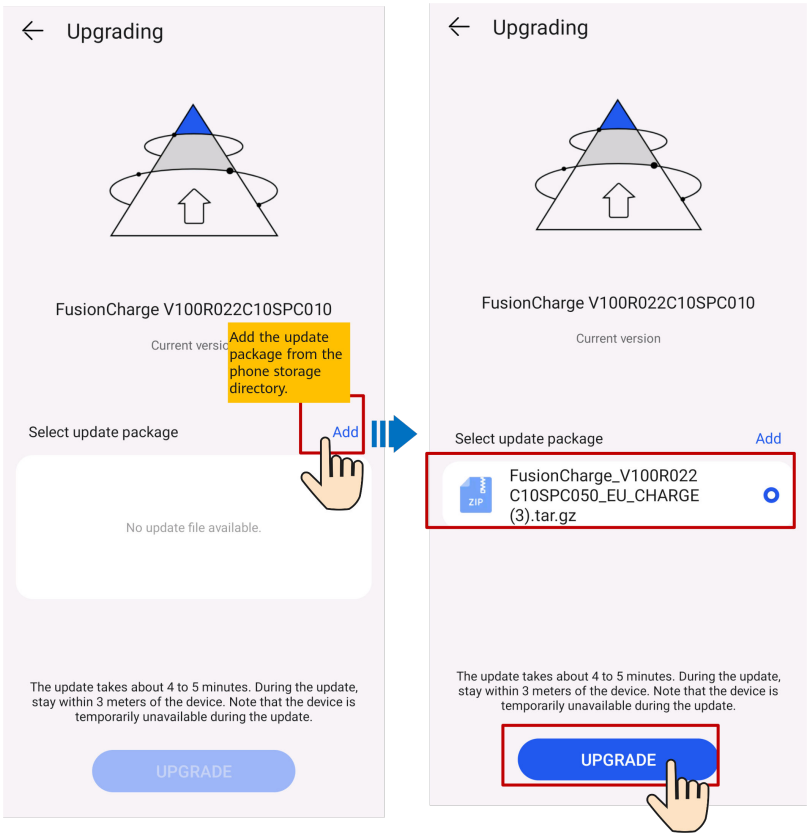
Prerequisites

- You have obtained the upgrade package from your supplier or Huawei engineers. After the download is complete, use the digital certificate and verification tool available at Huawei technical support website to verify the digital signature of the software package.
  a. Log in to Huawei enterprise technical support website (**http://support.huawei.com/enterprise**).
  b. Navigate to or search for **PGP Verify**.
- You have copied the upgrade package to the storage directory of the mobile phone that connects to the charger.

Procedure

1. On the home screen, choose **Maintenance** > **Upgrade Management**.

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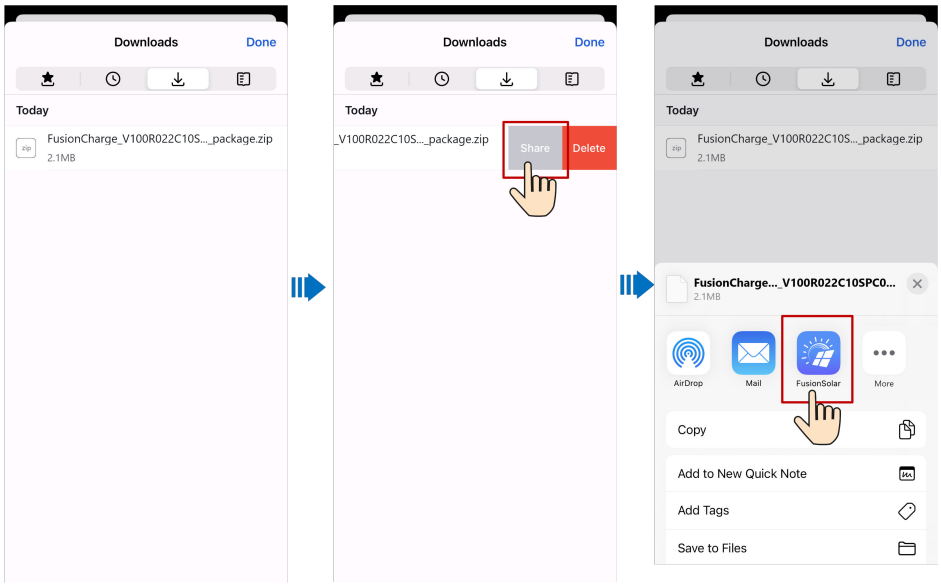
E.2 What Should I Do If the Upgrade Package Obtained from an iPhone Cannot Be Selected on the Upgrade Screen?

Cause

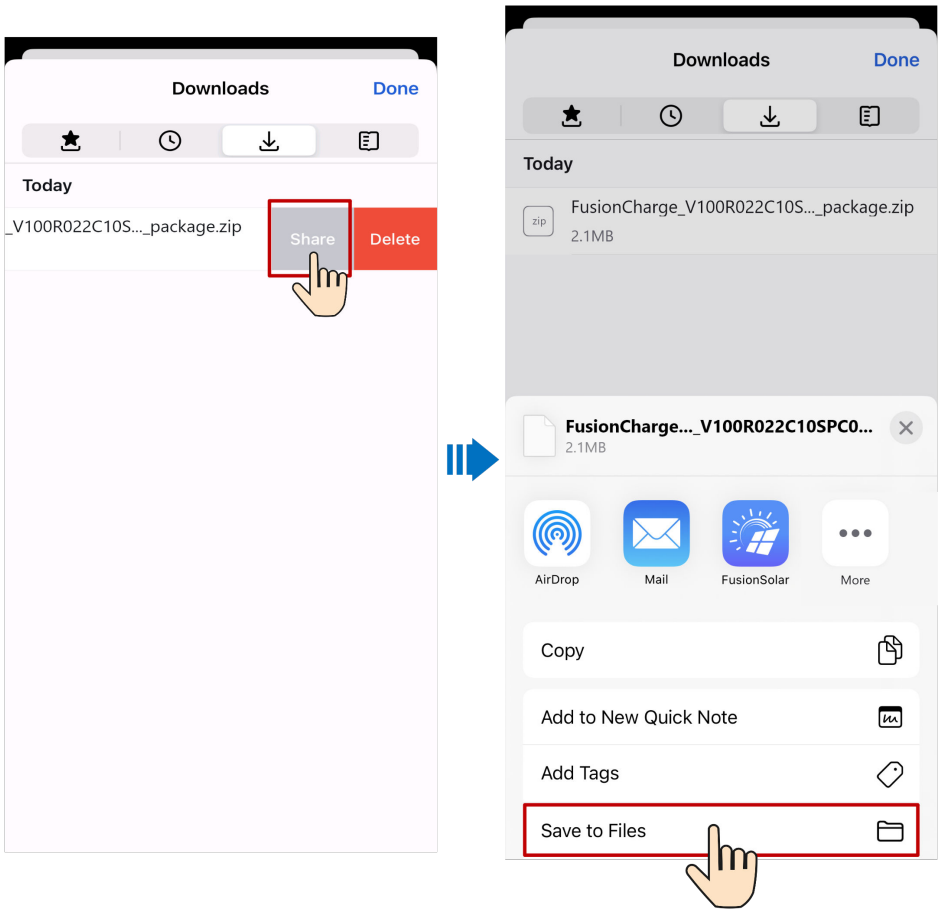
In the iOS system, the upgrade package can be selected only from the software installation path. If the upgrade package is not in the software installation path, the upgrade cannot be performed. You need to place the upgrade package in the installation path before the upgrade.

Procedure

Method 1: Share the upgrade package to the FusionSolar app.



Method 2: Save the upgrade package to the specified path (FusionSolar/SolarMate/upGradePatch) of the FusionSolar app.



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