HUAWEI LUNA2000-(107-241) Series Commercial and Industrial Hybrid Cooling Grid Forming ESS Solution

User Manual (Microgrid, SmartMGC5000B)

Issue 07

Date 2026-06-30

HUAWEI DIGITAL POWER TECHNOLOGIES CO., LTD.

Huawei Digital Power Technologies Co., Ltd.

Address: Huawei Digital Power Antuoshan Headquarters
Futian, Shenzhen 518043
People's Republic of China

Website: https://digitalpower.huawei.com

More Information

Huawei Digital Power Information Experience Center

https://info.support.huawei.com/Energy/info

About This Document

Purpose

This document describes the networking architecture, communication logic, system power-on and commissioning, and operation and maintenance (O&M) of the commercial and industrial grid-forming energy storage system (C&I GFM ESS) microgrid solution based on the SmartMGC5000B (referred to as SmartMGC).

The C&I microgrid solution, including the off-grid scenario, seamed on/off-grid scenario, and seamless on/off-grid scenario, supports only networking based on the SmartMGC5000B.

The safety precautions, product introduction, site selection requirements, and maintenance information of the devices involved in the solution are described in the user manuals or maintenance manuals of the corresponding devices. For details, see **F Reference Documents**.

"Grid forming" refers to grid forming operation in off-grid mode.

Statement

In this document, LUNA only refers to a specific model of Huawei Smart String Grid Forming ESS.

In this document, MERC only refers to a specific model of Huawei Smart PV Optimizer.

The information (such as signal names, ranges, and default values) displayed on the SmartMGC WebUI may vary depending on the software version or account permission.

Intended Audience

This document is intended for:

- Technical support engineers
- Hardware installation engineers
- Commissioning engineers

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

Change History

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

Issue 07 (2026-06-30)

Updated the document structure, added descriptions of key functions, and refined deployment and commissioning content by scenario.

Updated **1.1.1 Solution Architecture**.

Updated **1.1.3 Electrical Connections**.

Issue 06 (2026-04-15)

Updated **1.1.1 Solution Architecture**.

Updated **2 Seamed On/Off-Grid Scenario (Single SmartLogger)**.

Updated **3 Seamless On/Off-Grid Scenario (Single SmartLogger)**.

Issue 05 (2026-03-30)

Updated **1.1.1 Solution Architecture**.

Updated **1.1.3 Electrical Connections**.

Updated **1.1.4 Application Constraints**.

Updated **1.3.1 Preparations and App Login**.

Updated **1.3.1.5 Updating the Software Version**.

Updated **F Reference Documents**.

Issue 04 (2026-01-08)

Updated **1.1.1 Solution Architecture**.

Updated **1.1.3 Electrical Connections**.

Updated **1.3 Deployment and Commissioning**.

Updated **2.5.5 Off-Grid Protection Parameter Description**.

Updated **1.3.4.2 Verifying Load Switches**.

Updated **1.3.2.3.4 Microgrid Configuration**.

Issue 03 (2025-12-08)

Updated **1.1.1 Solution Architecture**.

Updated **1.3 Deployment and Commissioning**.

Issue 02 (2025-10-25)

Updated **1.1.1 Solution Architecture**.

Updated **1.1.4 Application Constraints**.

Updated **1.1.3 Electrical Connections**.

Added **1.3 Deployment and Commissioning**.

Updated **1.3.1 Preparations and App Login**.

Updated **2.5.5 Off-Grid Protection Parameter Description**.

Updated **2.6 O&M**.

Issue 01 (2025-09-01)

This issue is used for first office application (FOA).

Contents

1 Off-Grid Scenario (Single SmartLogger)

NOTICE

This microgrid solution does not provide the system-level redundancy backup function. If a device fails or the ESS reaches the end-of-charge/discharge SOC, the microgrid may collapse. As this solution does not provide professional UPSs, it is not applicable to scenarios that have high requirements on uninterruptible power supply.

1.1 Solution Introduction

The off-grid system applies to remote areas and islands without electricity. The ESS and the PV system are controlled and coordinated to supply power. It is widely used in scenarios such as lithium extraction from salt lakes, offshore oil fields, and ports.

In this system, the SmartMGC functions as the core controller of the PV+ESS system and automatically controls the off-grid operation to prevent power supply interruption. The PV+ESS system is a stand-alone microgrid to implement cyclic power supply day and night. During the day, the PV system preferentially supplies power and charges the ESS. At night, the ESS discharges power and automatically shuts down when its SOC is low. The PV+ESS system automatically starts up in the early morning of the next day to resume power supply.

1.1.1 Solution Architecture

The off-grid system applies to the PV+ESS low-voltage coupling scenario. When the ESS is connected in three-phase four-wire mode, no isolation transformer is required, and the neutral point of the system is grounded. The system supports PV+ESS networking, PV+ESS+genset networking (genset grid forming), and PV+ESS+genset networking (genset grid following).

Table 1-1 Networking

Scenario	Description
Scenario 1: PV +ESS networking	The SmartMGC does not control the genset, but supports the scenario where no genset is deployed or the genset is used as the backup power supply and is connected through the ATS on the load side. Hierarchical load management is supported. The **Figure 1-1**, **Figure 1-2**, and **Figure 1-3** networking architectures are supported.
Scenario 2: PV +ESS+genset networking (genset grid forming)	The SmartMGC controls the startup and shutdown of the genset, and the genset runs in parallel with the PV+ESS system. When the ESS SOC is insufficient, the genset is started to run in grid-forming mode with loads, and the ESS runs in grid-following mode.
Scenario 3: PV +ESS+genset networking (genset grid following)	The SmartMGC controls the startup and shutdown of the genset, and the genset runs in parallel with the PV+ESS system. When the ESS SOC is insufficient, the genset is started to generate power in grid-following mode, and the ESS runs in grid-forming mode with loads.

Scenario 1: PV+ESS Networking

Figure 1-1 PV+ESS low-voltage networking without transformers

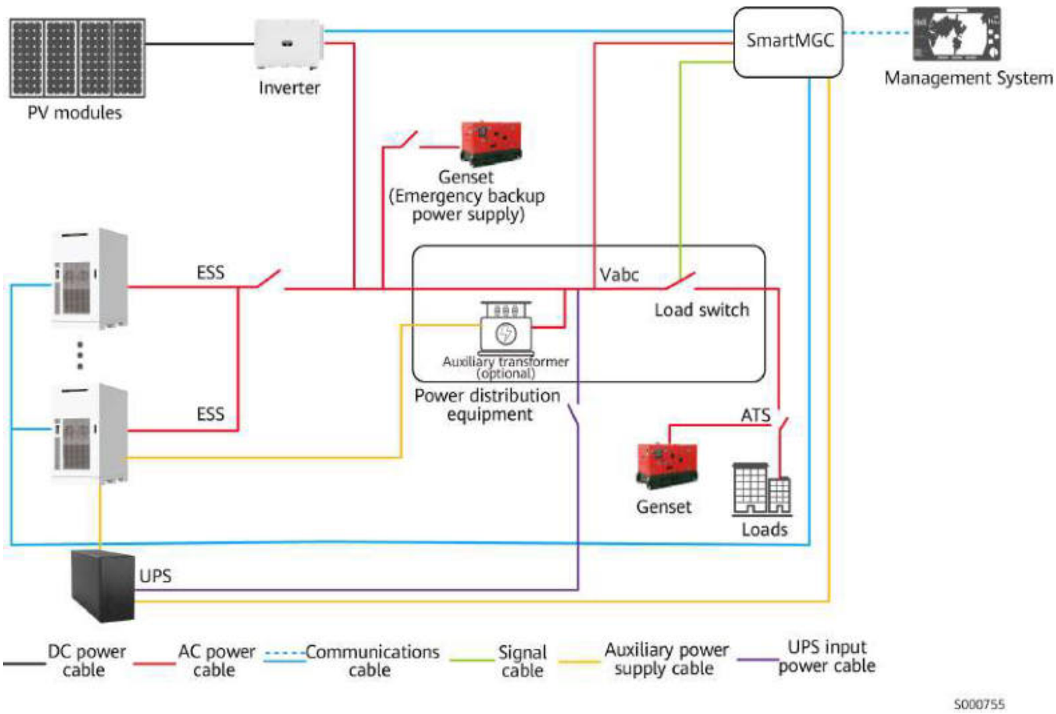


Figure 1-2 PV+ESS low-voltage networking with isolation transformers

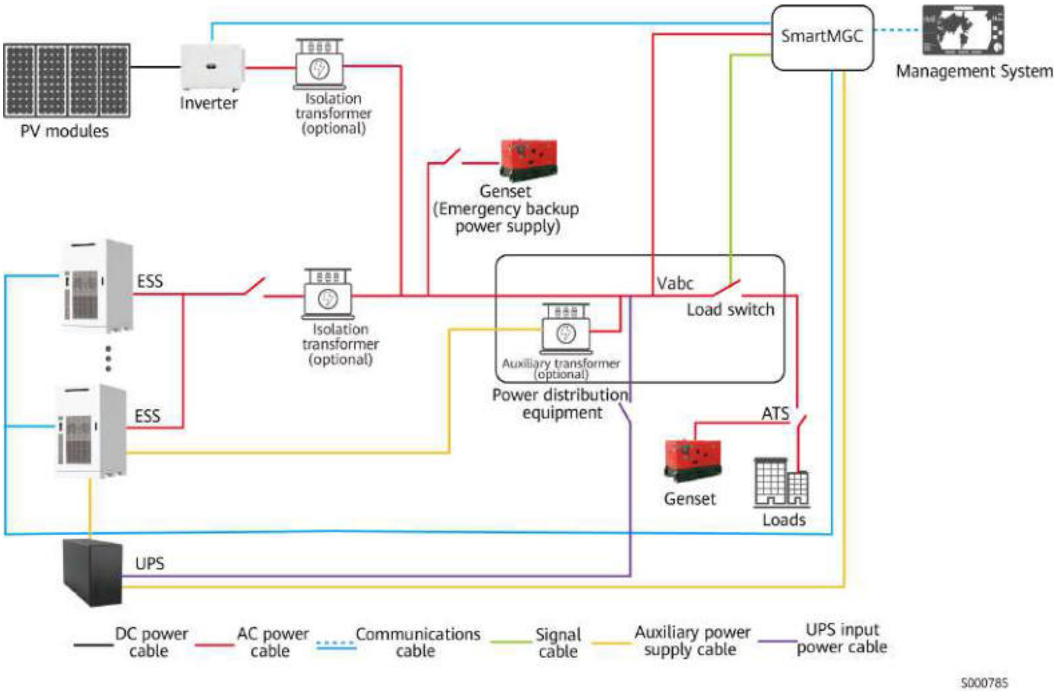
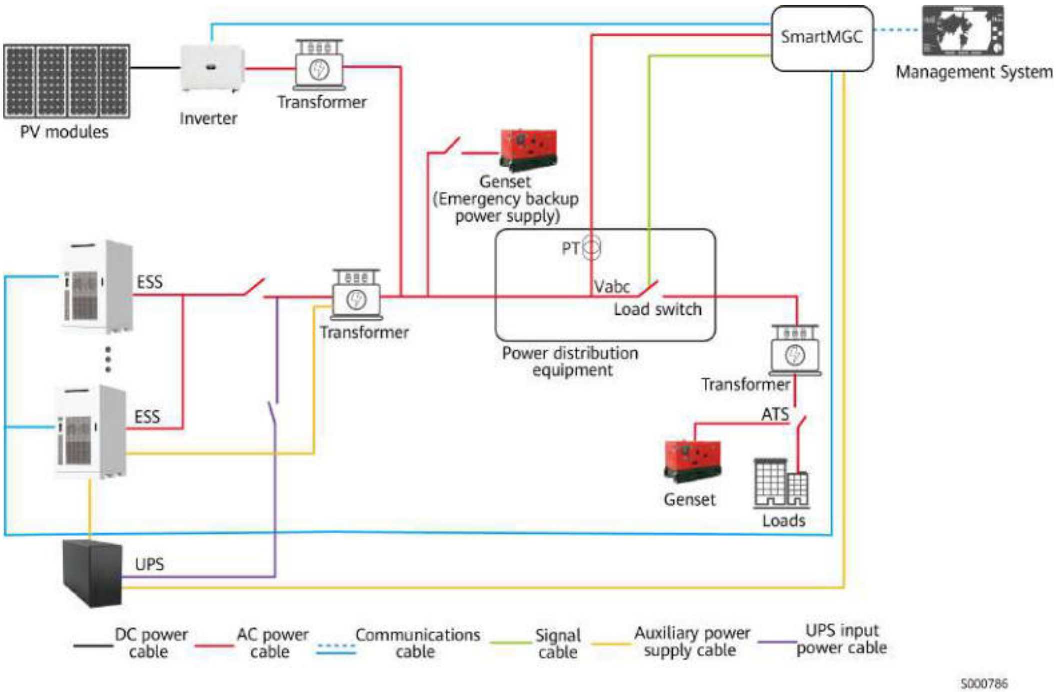


Figure 1-3 PV+ESS medium-voltage networking with isolation transformers



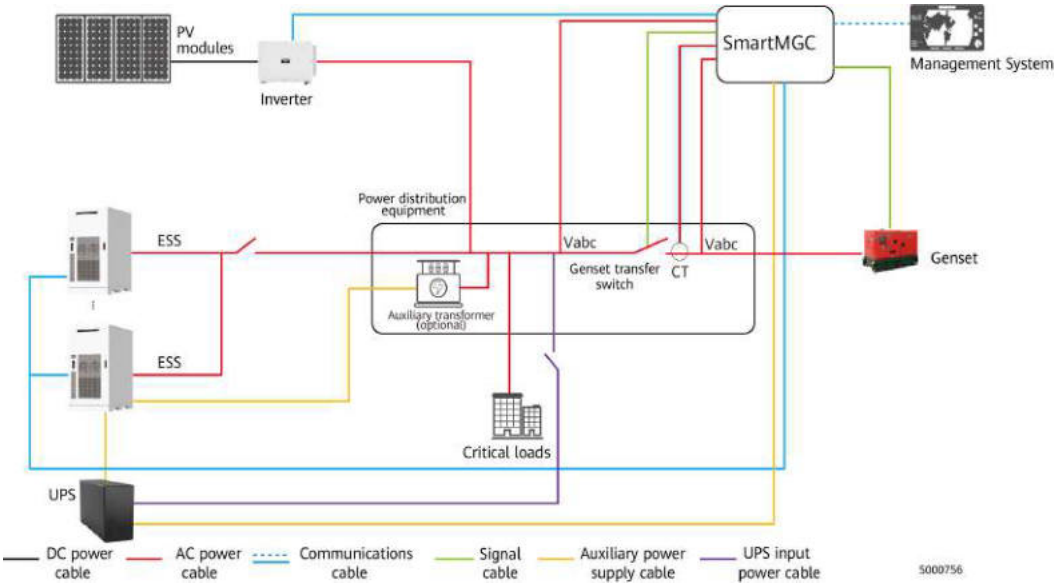
Scenario 2: PV+ESS+Genset Networking (Genset Grid Forming)

- When the ESS SOC is sufficient, the ESS runs in VSG grid-forming mode, the PV system runs in PQ grid-following mode, and the genset is shut down.
- When the ESS SOC is insufficient, the SmartMGC controls the genset transfer switch through DO to connect the genset to the system. The genset runs in grid-forming mode, and the ESS and PV system run in PQ grid-following

mode. When the ESS is being charged, you can determine whether to charge it from the genset based on the actual situation.

- The system must meet the functional requirements of the genset. The genset capacity shall be greater than the load capacity to meet the requirements for independent load carrying. Reserve sufficient spinning reserve margin to ensure load stability.

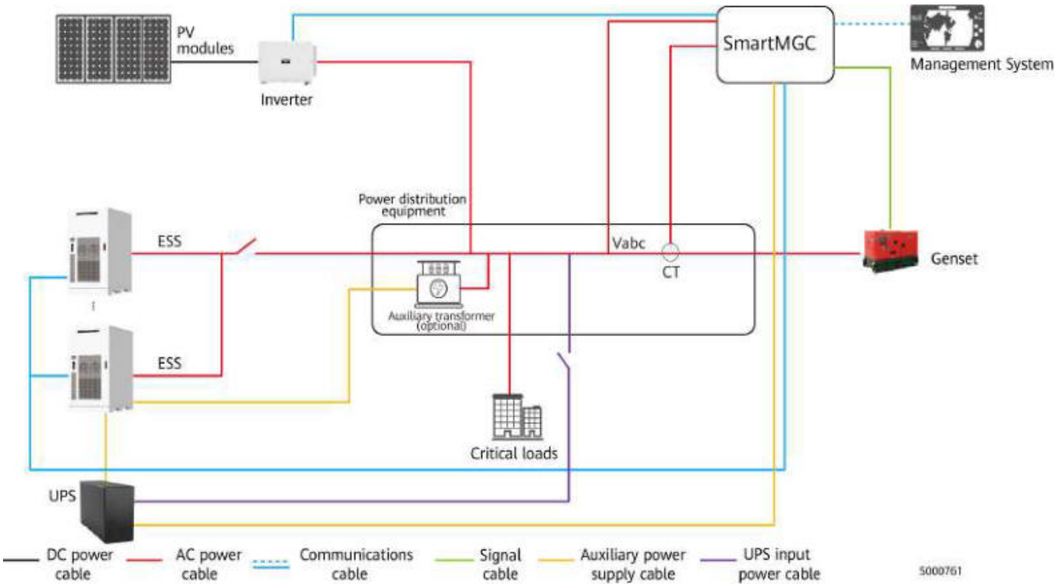
Figure 1-4 PV+ESS+genset networking (genset grid forming)



Scenario 3: PV+ESS+Genset Networking (Genset Grid Following)

- When the ESS SOC is sufficient, the ESS runs in VSG grid-forming mode, the PV system runs in PQ grid-following mode, and the genset is shut down.
- When the ESS SOC is insufficient, the SmartMGC starts the genset through DO. The genset runs in grid-following mode, and the ESS runs in grid-following mode with loads.
- The system must meet the functional requirements of the genset. The genset capacity shall be greater than the load capacity and the genset shall be capable of grid following.

Figure 1-5 PV+ESS+genset networking (genset grid forming)



Components

Table 1-2 lists the key components in the off-grid scenario.

Table 1-2 Components in the off-grid scenario

Name	Model/Specifications	Quantity	Remarks
Smart String Grid Forming Energy Storage System (ESS)	• LUNA2000-241-2S1-DS • LUNA2000-241-2S1 • LUNA2000-215-2S10 • LUNA2000-215-2S11 • LUNA2000-161-2S11 • LUNA2000-107-1S11	≤ 40	Purchased from the Company.
SmartMGC	SmartMGC5000B	1	Purchased from the Company.
Expansion module	SmartModule	1	Purchased from the Company (optional) The SmartModule is required when 20 to 40 ESSs are deployed.

<table>
<tr><th>Name</th><th>Model/Specifications</th><th>Quantity</th><th>Remarks</th></tr>
<tr><td rowspan="2">Power distribution equipment</td><td>CT</td><td>3</td><td rowspan="2">Prepared by the customer (optional).
Current transformer (CT) specifications requirements:
The rated current on the secondary side of the CT is 5 A, and the accuracy class is ≥ 0.5. If higher accuracy is required, the recommended accuracy class is ≥ 0.5S.
The recommended rated load capacity of the CT is ≥ 5 VA, and the cable length between the CT and the SmartMGC is ≤ 5 m.
The minimum rated load capacity of the CT is 2.5 VA, and the cable length between the CT and the SmartMGC is ≤ 2 m.
The secondary side cable is a copper cable, and the cross-sectional area of the CT secondary side cable is ≥ 1.5 mm^2. If a terminal block is available, it is recommended that the cross-sectional area of the cable between the secondary side of the CT and the terminal block be ≥ 2.5 mm^2.
Potential transformer (PT) specifications requirements:
The rated voltage on the secondary side of the PT is 100–480 V, the accuracy class is ≥ 0.2, and only the PT in YY wiring mode is supported. It is recommended that a disconnector be used together with the PT.
In a common three-phase measurement scenario, two groups of PTs are</td></tr>
<tr><td>PT</td><td>Depending on the actual networking</td></tr>
</table>

Name	Model/Specifications	Quantity	Remarks
			required to measure the bus voltage inside the plant and the grid voltage, respectively. ● In a medium-voltage scenario, the medium-voltage PT is required to measure the three-phase medium-voltage AC grid voltage. ● If the measured DC voltage ranges from 57.7 V to 277 V or the AC voltage ranges from 100 V to 480 V, PT connection is not required. **DANGER** ● **Installation position requirements**: The SmartMGC shall be installed inside the power distribution cabinet or box. Do not install it in an exposed position to prevent electrical safety risks caused by accidental contact. ● **Maintenance operation requirements**: Before replacing the SmartMGC or maintaining the CT/PT loop, ensure that the CT/PT loop is powered off and the CT terminal bridge is securely connected.
	Load switch (DI/DO control): Supports DI/DO status feedback and control.	1	Prepared by the customer (optional).

Name	Model/Specifications	Quantity	Remarks
	UPS: ● Power ≥ 1 kVA, 500 W x Number of ESSs (peak power), online UPS, 220 V AC ● Recommended power backup duration ≥ 48 hours.	1	Prepared by the customer. For details about the capacity configuration, see **D Off-Grid UPS Capacity Configuration**. **NOTICE** The specifications of the UPS must meet the power consumption requirements of the ESS auxiliary power supply. ● Dynamic performance: Transient peak power ≥ 500 W/cabinet (to cope with inrush current during device startup). ● Shutdown power consumption: ≤ 30 W/cabinet in standby mode (to reduce continuous power consumption). ● Steady-state power consumption: 30–100 W/cabinet in operating mode (to ensure basic monitoring functions).

Name	Model/Specifications	Quantity	Remarks
	Auxiliary transformer: ● Auxiliary transformer that converts the grid voltage to 220 V. ● Transformer capacity: 5 kVA x N (quantity of ESSs).	1	Prepared by the customer (optional). Depending on the actual networking architecture. ● When the rated AC grid voltage is > 415 V (420/440/480 V), the ESS auxiliary power supply must be a power supply connected from outside the ESS. An auxiliary transformer is added to convert the grid voltage into 220 V single-phase power and supply the power to the **MAINS** port of the ESS. ● When the rated AC grid voltage is ≤ 415 V, the **MAINS** port of the ESS can obtain power from the PCS terminal inside the ESS or from a power supply outside the ESS. The auxiliary transformer is not required (except for the 220 V single-phase grid in Japan).
	Power distribution cabinet: ● For details about the dimensions, IP rating, and color, see the description of the vendor or customer requirements. ● The length of the cables from the inverter and ESS to the power distribution cabinet shall be ≥ 5 m.	1	Prepared by the customer. **NOTICE** The power distribution cabinet shall have sufficient space for installing the meter, CT, **SmartMGC**, auxiliary transformer, and UPS.

Name	Model/Specifications	Quantity	Remarks
Management system	-	1	The management system displays the real-time and historical running status of the plant comprehensively and provides customers with intelligent alarm reporting, analysis, diagnosis, and O&M functions to improve power generation efficiency, reduce O&M costs, implement refined management, optimize operation, and increase potential benefits.

Name	Model/Specifications	Quantity	Remarks
Genset	Three-phase	1	(Optional) Prepared by the customer. Depending on the actual networking architecture. • **Scenario 1: PV+ESS Networking**: The SmartMGC does not control the genset. The genset is connected to the load side through the ATS, and the ATS controls the genset. • **Scenario 2: PV+ESS +Genset Networking (Genset Grid Forming)**: The SmartMGC controls the genset and the following requirements shall be met: – The **SmartMGC** controls the startup and shutdown of the genset through DO, and the frequency deviation is less than 0.1 Hz and the voltage deviation is less than 2% when the genset is running stably. – The genset capacity shall be greater than the load capacity to meet the requirements for independent load carrying. – The CT is required. – A genset transfer switch is required. • **Scenario 3: PV+ESS +Genset Networking (Genset Grid Following)**: The SmartMGC controls the genset and the following requirements shall be met: – The **SmartMGC** controls the startup
ATS	Dual power supply switching device	1	

Name	Model/Specifications	Quantity	Remarks
			and shutdown of the genset through DO, and the frequency deviation is less than 0.1 Hz and the voltage deviation is less than 2% when the genset is running stably. – The genset capacity shall be greater than the load capacity. – The CT is required. **NOTICE** In the off-grid scenario, ensure that an emergency power supply is available and the maintenance conditions are met.
Genset transfer switch	• Supports DI/DO signal feedback and remote control. • Works with a common switch (switch-on/off time < 80 ms).	1	Configured in **Scenario 2: PV +ESS+Genset Networking (Genset Grid Forming)**.

NOTE

If inverters and optimizers are involved in the networking, see **A Inverter and Optimizer Models** for the specific model list.

1.1.2 Communication Networking

One SmartMGC manages multiple ESSs, multiple inverters, and one meter at the grid connection point to form an array. In the array:

- The SmartMGC communicates with the ESSs over FE or optical fibers in star or ring topology.
- The inverters communicate with the SmartMGC over RS485 or MBUS.
- The meter communicates with the SmartMGC over RS485.

The maximum communication distances of the SmartMGC are as follows:

- RS485: 1000 m
- FE: 100 m
- Optical fiber: 12000 m (100M optical module)

Communication networking selection criteria: In actual networking, select a proper networking mode from the following typical scenarios based on the quantity of ESSs in the array and whether optical fiber deployment is supported.

Typical Scenario 1: FE Ring Topology (0–20 ESSs)

This topology is recommended when 0 to 20 ESSs are deployed and no optical fiber is used. In this scenario, the SmartMGC5000B is required.

- One FE ring network in the PV+ESS system supports a maximum of 20 ESSs.
- The ESSs are connected through FE communications ports (WAN1/LAN1 and WAN2/LAN2).
- The FE network cable shall meet the following technical specifications: CAT 5E outdoor shielded network cable, internal resistance ≤ 1.5 ohms/10 m, cable cross-sectional area (outer diameter) ≤ 9 mm, and shielded RJ45 connector.

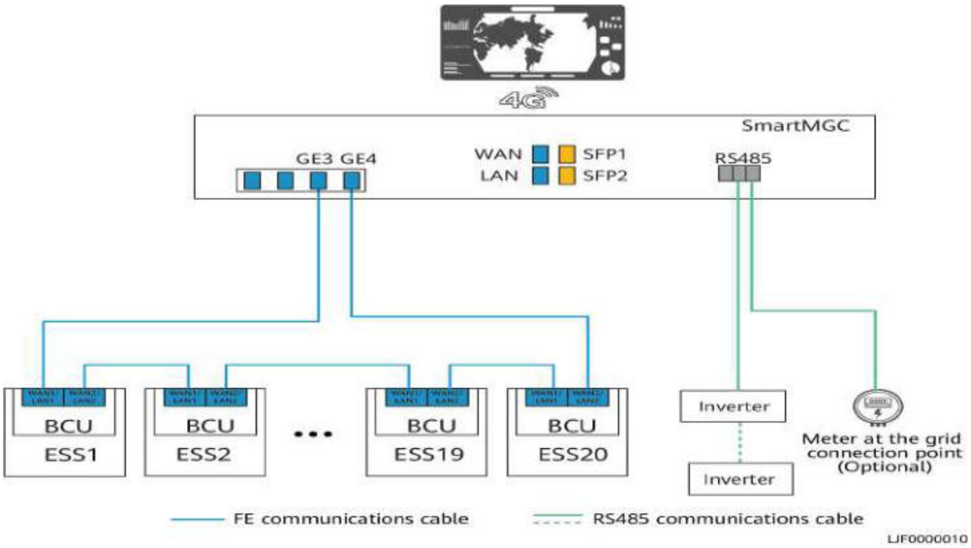
NOTICE

If the ESS FE ring topology is implemented, the ESSs must be connected to the GE3 and GE4 ports of the SmartMGC and **ESS ring network** shall be set to **GE3+GE4**. Otherwise, the SmartMGC cannot communicate with the ESSs properly.

Path for setting **ESS ring network**:

- App: **Set** > **Comm. parameters** > **Wired Network** > **Network Configuration**
- WebUI: **Settings** > **Port Settings** > **Ethernet** > **Network Configuration**

Figure 1-6 FE ring topology



Typical Scenario 2: Fiber Ring Topology (0–20 ESSs)

This topology is recommended when 0 to 20 ESSs are deployed and optical fibers are used. In this scenario, the SmartMGC5000B is required.

- One fiber ring network supports a maximum of 20 ESSs.
- One SmartMGC in the PV+ESS system supports a maximum of 20 ESSs.
- The ESSs are connected through optical fiber ports (TX1-SFP1-RX1 and RX2-SFP2-TX2).

- The optical fiber cables are provided by the customer and shall meet the following technical specifications: four-core or eight-core single-mode armored optical fiber cable with a transmission wavelength of 1310 nm and an outer diameter of ≤ 18 mm.

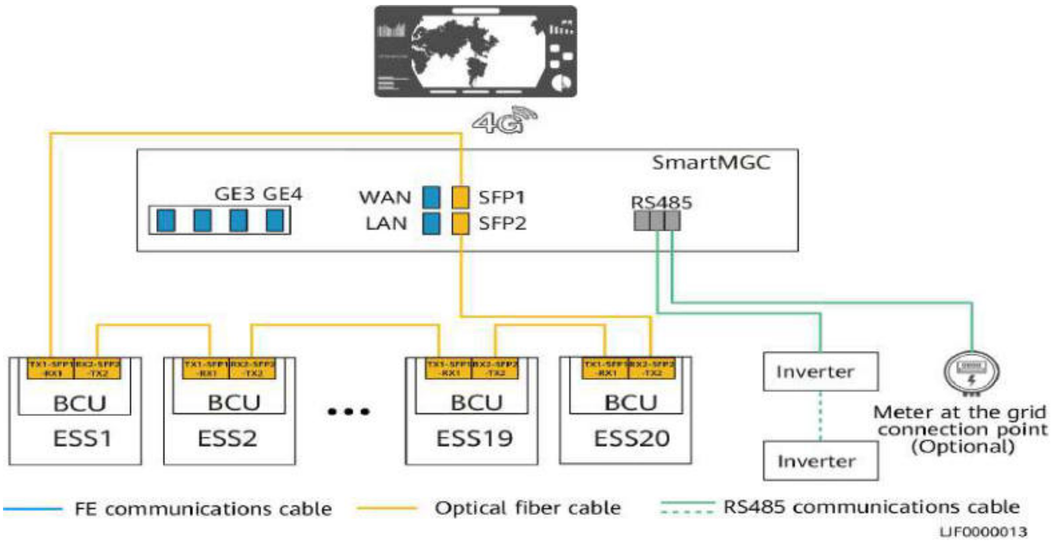
NOTICE

If the ESS fiber ring topology is implemented through the SmartMGC, set **ESS ring network** to **SFP1+SFP2**. Otherwise, the SmartMGC cannot communicate with the ESSs properly.

Path for setting **ESS ring network**:

- App: **Set** > **Comm. parameters** > **Wired Network** > **Network Configuration**
- WebUI: **Settings** > **Port Settings** > **Ethernet** > **Network Configuration**

Figure 1-7 Fiber ring topology



Typical Scenario 3: FE Ring Topology (20–40 ESSs)

This topology is recommended when 20 to 40 ESSs are deployed and no optical fiber is used. In this scenario, the SmartMGC5000B is required.

- In this scenario, the SmartModule is required to extend ports of the SmartMGC, supporting the connection of multiple devices.
- One FE ring network supports a maximum of 20 ESSs.
- The ESSs are connected through FE communications ports (WAN1/LAN1 and WAN2/LAN2).
- The FE network cable shall meet the following technical specifications: CAT 5E outdoor shielded network cable, internal resistance ≤ 1.5 ohms/10 m, cable cross-sectional area (outer diameter) ≤ 9 mm, and shielded RJ45 connector.

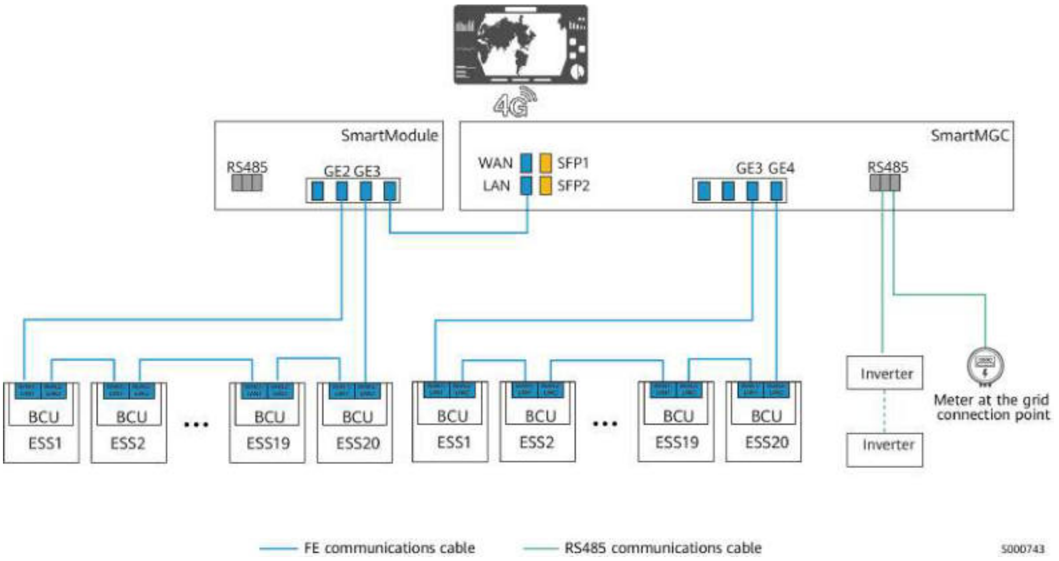
NOTICE

If the ESS fiber ring topology is implemented through the SmartMGC, set **ESS ring network** to **SFP1+SFP2**. Otherwise, the SmartMGC cannot communicate with the ESSs properly.

Path for setting **ESS ring network**:

- App: **Set** > **Comm. parameters** > **Wired Network** > **Network Configuration**
- WebUI: **Settings** > **Port Settings** > **Ethernet** > **Network Configuration**

Figure 1-8 FE ring topology (20–40 ESSs)



1.1.3 Electrical Connections

NOTICE

The power distribution and electrical connections of the PV+ESS system must comply with the installation regulations of the devices and the country or region where the devices are located. The following wiring diagrams show the connections between devices and are for reference only. In actual applications, design the wiring diagrams based on the local power distribution regulations.

The off-grid scenario supports multiple types of earthing systems, each with different earthing requirements. For details, see the following table.

Table 1-3 System earthing requirements

<table>
<tr><th>Earthing System</th><th>PE Wire (Protective Earthing) Requirement</th><th>Neutral Wire (Functional Earthing) Requirement</th></tr>
<tr><td>TN-C</td><td>The PE wire on the load or device side (such as the ESS and inverter) is connected to the PEN wire of the power distribution system.</td><td>• The PEN wire of the power distribution system must be grounded and does not require residual current protection.
• The neutral wire on the device side (such as the ESS and inverter) must be connected to the PEN wire of the power distribution system.
• The specifications of the PEN wire and neutral wire shall be the same as those of the general power cables.</td></tr>
<tr><td>TN-S</td><td>The PE wire on the load or device side (such as the ESS and inverter) is connected to the PE wire of the power distribution system.</td><td rowspan="3">• The neutral wire of the power distribution system must be grounded.
• The neutral wire on the device side (such as the ESS and inverter) must be connected to the neutral wire of the power distribution system.
• The specifications of the neutral wire shall be the same as those of the general power cables.</td></tr>
<tr><td>TN-C-S</td><td>The upstream power supply side (from the PV+ESS+genset to the AC bus section of the power distribution system) uses the TN-C system. After the power supply is routed into the customer's system, the PE wire is separated from the PEN wire to form the TN-S system. The PE wire and neutral wire on the load side are connected to the PE wire and neutral wire after the power supply is routed into the customer's system, respectively.</td></tr>
<tr><td>TT</td><td>The PE wire on the load or device side (such as the ESS and inverter) is grounded locally and is not connected to the neutral wire of the power distribution system.</td></tr>
<tr><td>IT</td><td>-</td><td>The ESS is connected to the isolation transformer in three-phase four-wire mode. The neutral wire of the ESS is connected to the neutral point of the isolation transformer, and the neutral point on the ESS side of the isolation transformer shall be grounded.</td></tr>
</table>

Scenario 1: PV+ESS Networking

Figure 1-9 PV+ESS low-voltage networking without transformers (TN-C)

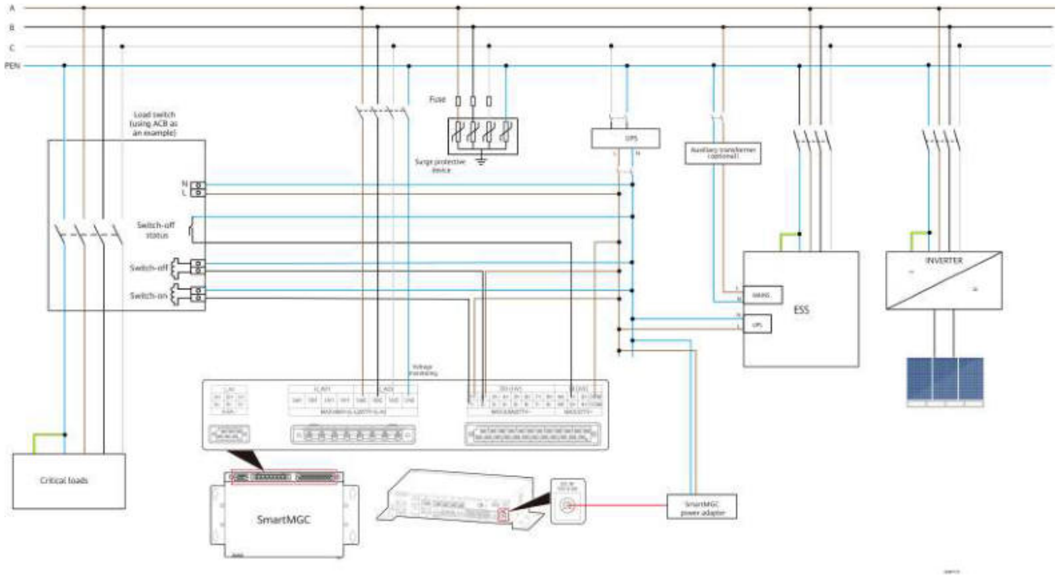


Figure 1-10 PV+ESS low-voltage networking with isolation transformers (TN-S)

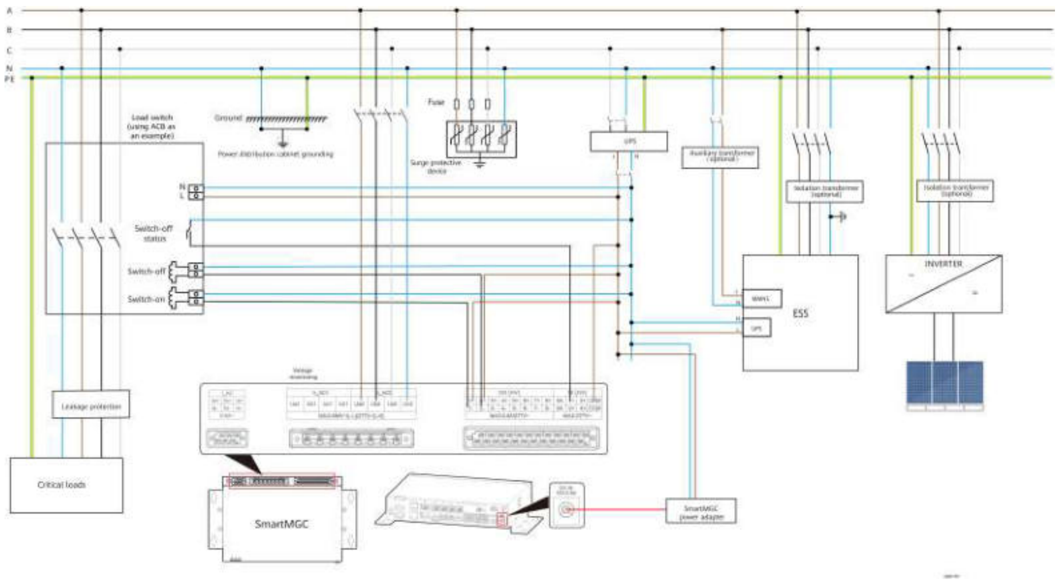
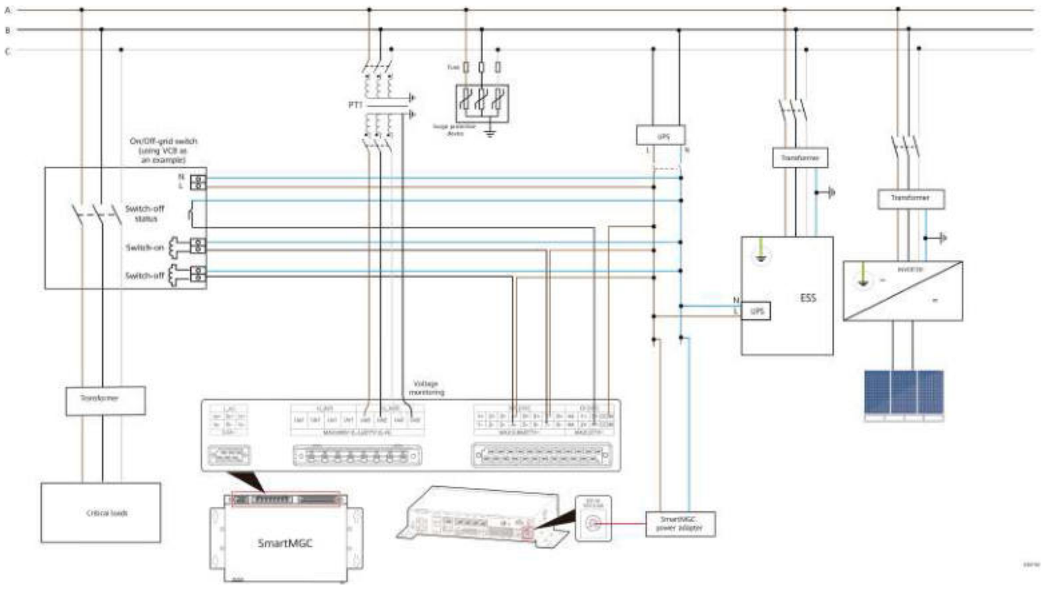


Figure 1-11 PV+ESS medium-voltage networking with transformers



The electrical connections of the PV+ESS system are described as follows:

- The SmartMGC is used as a controller to control the off-grid operation of the PV+ESS system.
- The DI1(HV) port (recommended) of the SmartMGC receives the actual working status of the critical load switch to monitor whether the critical loads have power supply.
- The DO1(HV) port of the SmartMGC controls the critical load switch to switch on, restoring the power supply to critical loads.
- The DO2(HV) port of the SmartMGC controls the critical load switch to switch off, performing load shedding of critical loads.
- (Optional) The DO3(HV) and DO4(HV) ports of the SmartMGC control the minor load switch to switch on and off.
- (Optional) The DI2(HV) port (recommended) of the SmartMGC receives the actual working status of the minor load switch to monitor whether the minor loads have power supply.
- (Optional) The DO5(HV) and DO6(HV) ports of the SmartMGC control the common load switch to switch on and off.
- (Optional) The DI3(HV) port (recommended) of the SmartMGC receives the actual working status of the common load switch to monitor whether the common loads have power supply.

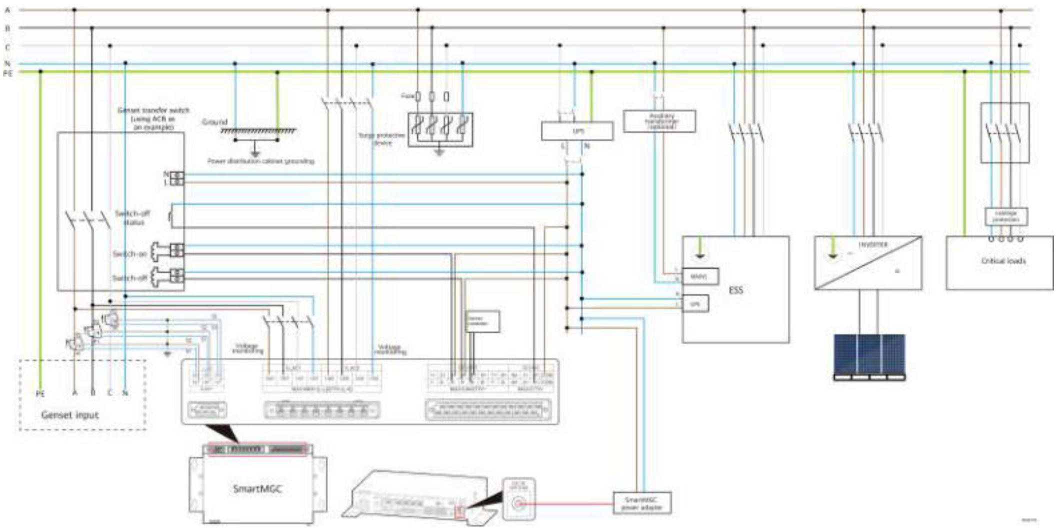
NOTE

Hierarchical load management is supported in the off-grid PV+ESS scenario, including critical, minor, and common loads. Determine whether to connect loads based on the actual application scenario.

If the default DI ports are not available for onsite cable connection, configure the required DI ports in **Settings** > **Microgrid Control** > **General Basic Settings** on the SmartMGC WebUI.

Scenario 2: PV+ESS+Genset Networking (Genset Grid Forming)

Figure 1-12 Wiring diagram of PV+ESS+genset networking (genset grid forming)



The electrical connections of PV+ESS+genset networking (genset grid forming) are described as follows:

- The DI4(HV) port (recommended) of the SmartMGC receives the actual working status of the genset transfer switch.
- The DO3(HV) port of the SmartMGC controls the genset transfer switch to switch on.
- The DO4(HV) port of the SmartMGC controls the genset transfer switch to switch off.
- The DO5(HV) port of the SmartMGC controls the genset startup and shutdown at high level. (This scenario uses high level for genset control as an example.) If pulse control is required, use DO5(HV) for startup control and DO6(HV) for shutdown control. The DO port of the SmartMGC is a dry contact and supports the loop working voltage of 24 V DC or 220 V AC. You need to configure the voltage based on the specifications of the genset controller.
- (Optional) The DO1(HV) and DO2(HV) ports of the SmartMGC control the critical load switch to switch on and off.
- (Optional) The DI1(HV) (recommended) port of the SmartMGC receives the actual working status of the critical load switch to monitor whether the critical loads have power supply.

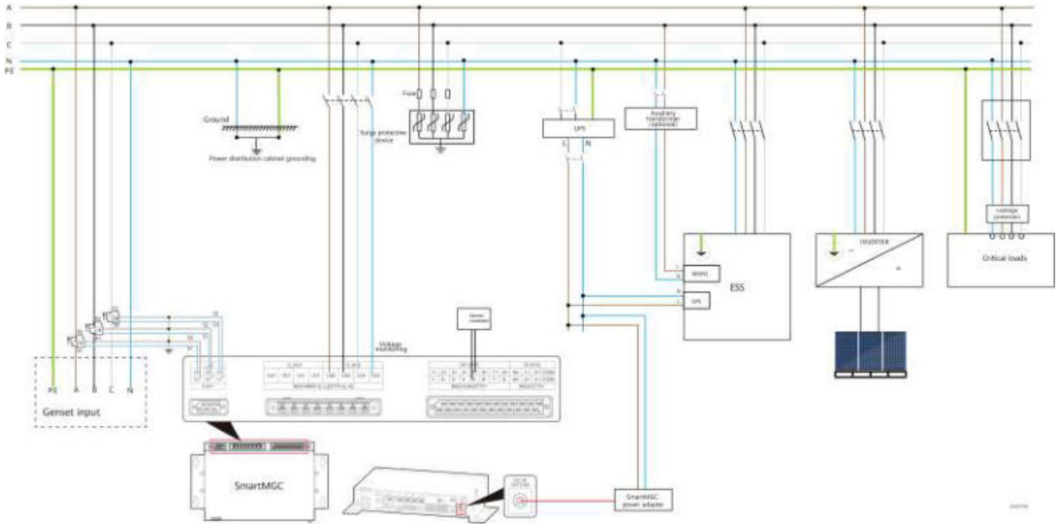
NOTE

In the PV+ESS+genset networking (genset grid forming) scenario, only the critical load switch is supported. Determine whether to connect critical loads based on the actual application scenario.

If the default DI ports are not available for onsite cable connection, configure the required DI ports in **Settings** > **Microgrid Control** > **General Basic Settings** on the SmartMGC WebUI.

Scenario 3: PV+ESS+Genset Networking (Genset Grid Following)

Figure 1-13 Wiring diagram of PV+ESS+genset networking (genset grid following)



The electrical connections of PV+ESS+genset networking (genset grid following) are described as follows:

- The DO5(HV) port of the SmartMGC controls the genset startup and shutdown at high level. (This scenario uses high level for genset control as an example.) If pulse control is required, use DO5(HV) for startup control and DO6(HV) for shutdown control. The DO port of the SmartMGC is a dry contact and supports the loop working voltage of 24 V DC or 220 V AC. You need to configure the voltage based on the specifications of the genset controller.
- (Optional) The DO1(HV) and DO2(HV) ports of the SmartMGC control the critical load switch to switch on and off.
- (Optional) The DI1(HV) (recommended) port of the SmartMGC receives the actual working status of the critical load switch to monitor whether the critical loads have power supply.

NOTE

In the PV+ESS+genset networking (genset grid following) scenario, only the critical load switch is supported. Determine whether to connect critical loads based on the actual application scenario.

If the default DI ports are not available for onsite cable connection, configure the required DI ports in **Settings** > **Microgrid Control** > **General Basic Settings** on the SmartMGC WebUI.

1.1.4 Application Constraints

For details about the application constraints in the off-grid scenario, see **Loading Capability Constraints**, **DI/DO Specifications of the SmartMGC**, and **PV-to-ESS Ratio Constraints**.

Loading Capability Constraints

The loading capability of the ESS varies depending on the load type. For details, see **Table 1-4**.

CAUTION

The load specifications shall meet the loading capability constraints. If the loading capability constraints are exceeded, the device may shut down due to overload protection when the load fluctuates.

Table 1-4 Loading capability constraints

Type	Specifications	Remarks
Total load	≤ (2/3) x Pn[a].	• Single-phase rated capacity = (1/3) x Pn. • Load of each phase ≤ (2/3) x Single-phase rated capacity, that is, Load of each phase ≤ (2/3) x (1/3) x Pn. • Total load of LUNA2000-107-1S11 ≤ (3/5) x Pn.
Non-linear load	• Half-wave rectification load ≤ (1/20) x Pn. • The total current harmonics of loads comply with specifications or standards..	-
Unbalanced load	• No load to two phases: ≤ (2/3) x (2/3) x Pn. • No load to one phase: ≤ (2/3) x (1/3) x Pn.	• Single-phase rated capacity = (1/3) x Pn. • Load of each phase ≤ (2/3) x Single-phase rated capacity, that is, Load of each phase ≤ (2/3) x (1/3) x Pn.

Type	Specifications	Remarks
Motor load	• Load of motors that use direct on line (DOL) starters, star-delta starters, or soft starters ≤ (1/10) x Pn. • Load of motors that use star-delta starters ≤ (1/5) x Pn. • Load of motors that use variable frequency drives ≤ (2/3) x Pn.	• If there are other basic loads, the load of motors to be connected and disconnected shall be decreased accordingly in the same proportion. (The inrush current of the asynchronous motor startup shall be ≤ 8 x Rated current. Otherwise, you are advised to add a frequency converter.) • If there are asynchronous motor loads and common non-impact loads in the system, the load capacity is calculated as follows: [A x 10 + (3/2) x B] ≤ Pn. – A: load capacity of the asynchronous motor – B: other common load capacity
Capacity of transformer switch-on/off	≤ 1.2 x Pn.	-

<table>
<tr><th>Type</th><th>Specifications</th><th>Remarks</th></tr>
<tr><td>Dynamic load of the medium-voltage cascaded system</td><td>After the medium-voltage cascaded transformer establishes a stable voltage (excluding the power on the medium-voltage line), the dynamic load shall meet the following requirements:
● Balanced resistive load (R load) step
– Supported condition: ≤ 50% balanced R load step.
– Performance requirements:
– Within 20 ms after the step: The root-mean-square (RMS) value deviation of the PCS output voltage is ≤ ±30% x Un[b].
– After 20 ms: The RMS value of the output voltage recovers to a steady-state voltage deviation of ≤ ±10% x Un.
● Balanced inductive/capacitive load (L/C load) step
– Supported conditions:
– ≤ 40% balanced inductive load (L load) step.
– ≤ 20% balanced capacitive load (C load) step.
– Performance requirement: The system shall remain connected to the grid during the step.
● Unbalanced RLC load step
– Supported conditions: The total load step of a single phase or two phases is ≤ 20%.
– Performance requirement: The system shall remain connected to the grid during the step.</td><td>-</td></tr>
<tr><td colspan="3">Note a: Pn is the rated capacity of the ESS.
Note b: Un is the steady-state voltage of the system after the step.</td></tr>
</table>

DI/DO Specifications of the SmartMGC

NOTICE

High-voltage DI/DO specifications:

- The pulse current capability of DO1(HV) to DO8(HV) is ≤ 5 A @ 200 ms.
- The switch-off control loop of DO8(HV) can operate at DC voltage (12–220 V).
- The control loop of DO1(HV) to DO7(HV) can operate at AC voltage (100–277 V) or DC voltage (12–30 V).
- The DO(HV) and DI(HV) ports are dry contacts. The DO(HV) ports control the switch-on and switch-off of the on/off-grid switch and load switch through pulse signals.
- The switch status feedback loop of DI4(HV) can operate only at 100 V/220 V/230 V/277 V AC voltage or 110 V/220 V DC voltage.

Low-voltage DI/DO specifications:

- DI port: supports passive dry contact signals.
- DO port: supports 12 V DC operating voltage for the control loop.

This section uses the high-voltage DI port as an example. If a low-voltage DI port is required, note that the low-voltage DI port is designed as a wet contact (with an internal power supply) and shall be connected to passive dry contact signals. Do not connect other power supplies to the external loop.

In the off-grid system, the DI/DO ports of the SmartMGC vary depending on the networking mode. The details are as follows:

- For details about the off-grid PV+ESS networking, see **Table 1-5**.
- For details about the off-grid PV+ESS+genset networking (genset grid forming), see **Table 1-6**.
- For details about the off-grid PV+ESS+genset networking (genset grid following), see **Table 1-7**.

Figure 1-14 High-voltage DI/DO ports

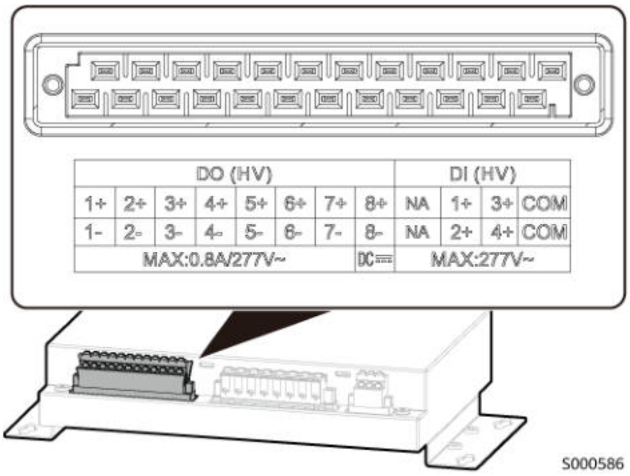


Table 1-5 DI/DO specifications of the SmartMGC (off-grid PV+ESS networking)

Port	Port Description	AC Control Loop	DC Control Loop (12–30 V)	High-Voltage DC Control Loop (110 V, 220 V)
DO1(HV)	Turns on the critical load switch.	√	√	Signal conversion using an intermediate relay: The DO output signal of the SmartMGC is converted into a high-voltage DC control signal through an intermediate relay.
DO2(HV)	Turns off the critical load switch.	√	√	
DO3(HV)	Turns on the minor load switch.	√	√	
DO4(HV)	Turns off the minor load switch.	√	√	
DO5(HV)	Turns on the common load switch.	√	√	
DO6(HV)	Turns off the common load switch.	√	√	
DI1(HV)[a] (recommended)	Reports the Off state of the critical load switch.	√	Signal conversion using an intermediate relay: The status signal sent from the external device is converted into a high-voltage DC feedback signal or AC feedback signal through an intermediate relay.	√
DI2(HV)[a] (recommended)	Reports the Off state of the minor load switch.	√		√
DI3(HV)[a] (recommended)	Reports the Off state of the common load switch.	√		√
Note a: If the default DI ports are not available for onsite cable connection, configure the required DI ports in **Settings** > **Microgrid Control** > **General Basic Settings** on the SmartMGC WebUI.				

Table 1-6 DI/DO specifications of the SmartMGC (PV+ESS+genset off-grid networking - genset grid forming)

Port	Port Description	AC Control Loop	DC Control Loop (12–30 V)	High-Voltage DC Control Loop (110 V, 220 V)
DO1(HV)	Turns on the critical load switch.	√	√	Signal conversion using an intermediate relay: The DO output signal of the SmartMGC is converted into a high-voltage DC control signal through an intermediate relay.
DO2(HV)	Turns off the critical load switch.	√	√	
DO3(HV)	Turns on the genset transfer switch.	√	√	
DO4(HV)	Turns off the genset transfer switch.	√	√	
DO5(HV)	Used based on the startup and shutdown control mode of the connected genset. ● Pulse: starts the genset. ● Level: starts the genset when closed.	√	√	
DO6(HV)	Used based on the startup and shutdown control mode of the connected genset. ● Pulse: shuts down the genset. ● Level: starts the genset when open.	√	√	
DI1(HV)[a] (recommended)	Reports the Off state of the critical load switch.	√	Signal conversion using an intermediate relay: The status signal sent from the external device is converted into a high-voltage DC feedback signal or AC feedback signal through an intermediate relay.	√
DI4(HV)[a] (recommended)	Reports the Off state of the genset transfer switch.			
Note a: If the default DI ports are not available for onsite cable connection, configure the required DI ports in **Settings** > **Microgrid Control** > **General Basic Settings** on the SmartMGC WebUI.				

Table 1-7 DI/DO specifications of the SmartMGC (PV+ESS+genset off-grid networking - genset grid following)

Port	Port Description	AC Control Loop	DC Control Loop (12–30 V)	High-Voltage DC Control Loop (110 V, 220 V)
DO1(HV)	Turns on the critical load switch.	√	√	Signal conversion using an intermediate relay: The DO output signal of the SmartMGC is converted into a high-voltage DC control signal through an intermediate relay.
DO2(HV)	Turns off the critical load switch.	√	√	
DO5(HV)	Used based on the startup and shutdown control mode of the connected genset. • Pulse: starts the genset. • Level: starts the genset when closed.	√	√	
DO6(HV)	Used based on the startup and shutdown control mode of the connected genset. • Pulse: shuts down the genset. • Level: starts the genset when open.	√	√	
DI1(HV)[a] (recommended)	Reports the Off state of the critical load switch.	√	Signal conversion using an intermediate relay: The status signal sent from the external device is converted into a high-voltage DC feedback signal or AC feedback signal through an intermediate relay.	√
Note a: If the default DI ports are not available for onsite cable connection, configure the required DI ports in **Settings** > **Microgrid Control** > **General Basic Settings** on the SmartMGC WebUI.				

PV-to-ESS Ratio Constraints

The maximum PV-to-ESS ratio varies depending on the ESS model and configuration. For details, see **Table 1-8**.

Table 1-8 Maximum PV-to-ESS ratio for different ESS models

Model	Maximum PV-to-ESS Ratio
LUNA2000-241-2S1-DS	2:1
LUNA2000-241-2S1	2:1
LUNA2000-215-2S10	2:1
LUNA2000-215-2S11	2:1
LUNA2000-161-2S11	1.8:1
LUNA2000-107-1S11	1.2:1

NOTE

The following conditions must be met for mixed use of ESS models with different C-rates:

- A maximum of two models can be used together.
- Preferentially configure the model with more battery packs. If the capacity needs to be supplemented, use a model with fewer battery packs (161 kWh or 107 kWh).
- The PV-to-ESS ratio and loading capability are configured based on the rated power of the model with more battery packs.

Examples:

Assume that x units of the 215 kWh model and y units of the 107 kWh model are configured. The following conditions shall be met:

- x ≥ y
- The loading capability is (x * 108 kW * 2/3).
- The maximum PV capacity is (x * 108 kW * 2).

1.2 System Power-On

DANGER

Wear personal protective equipment (PPE) strictly as required and use insulated tools to prevent electric shocks or short circuits.

CAUTION

During the power-on procedure, monitor the system for faults. If you detect any faults, power off the ESS, rectify the faults, and then continue with the procedure.

Power on the off-grid system when the UPS can supply power, the genset is not running, and the power distribution equipment has no power supply. Before power-on, perform the check by referring to the "Check Before Power-On" section in the user manual of each device.

Figure 1-15 Power-on process

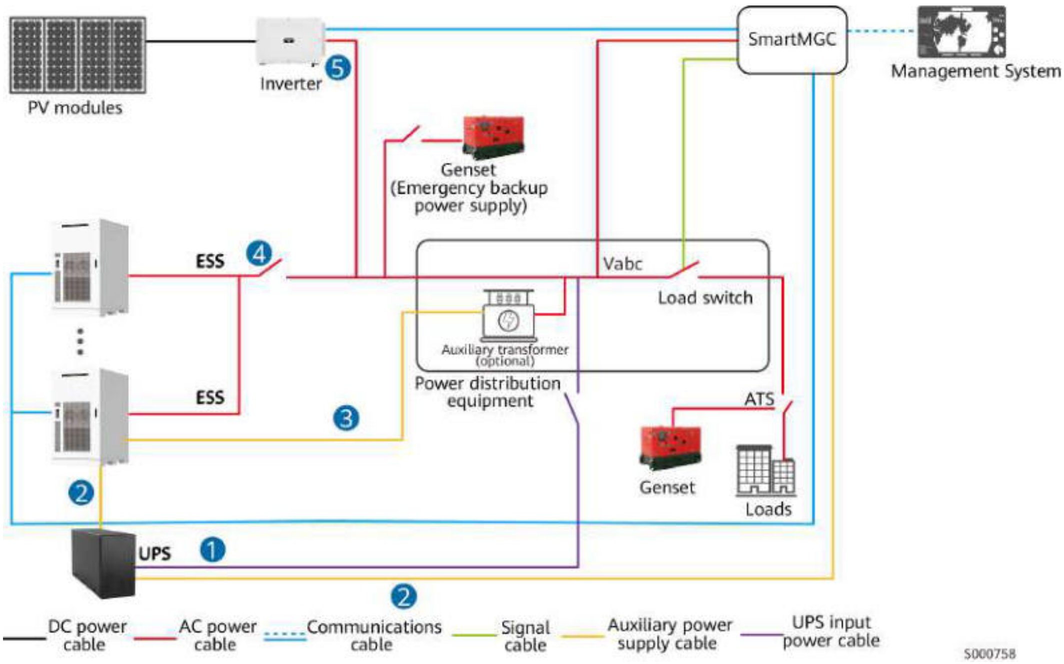


Table 1-9 Power-on process description

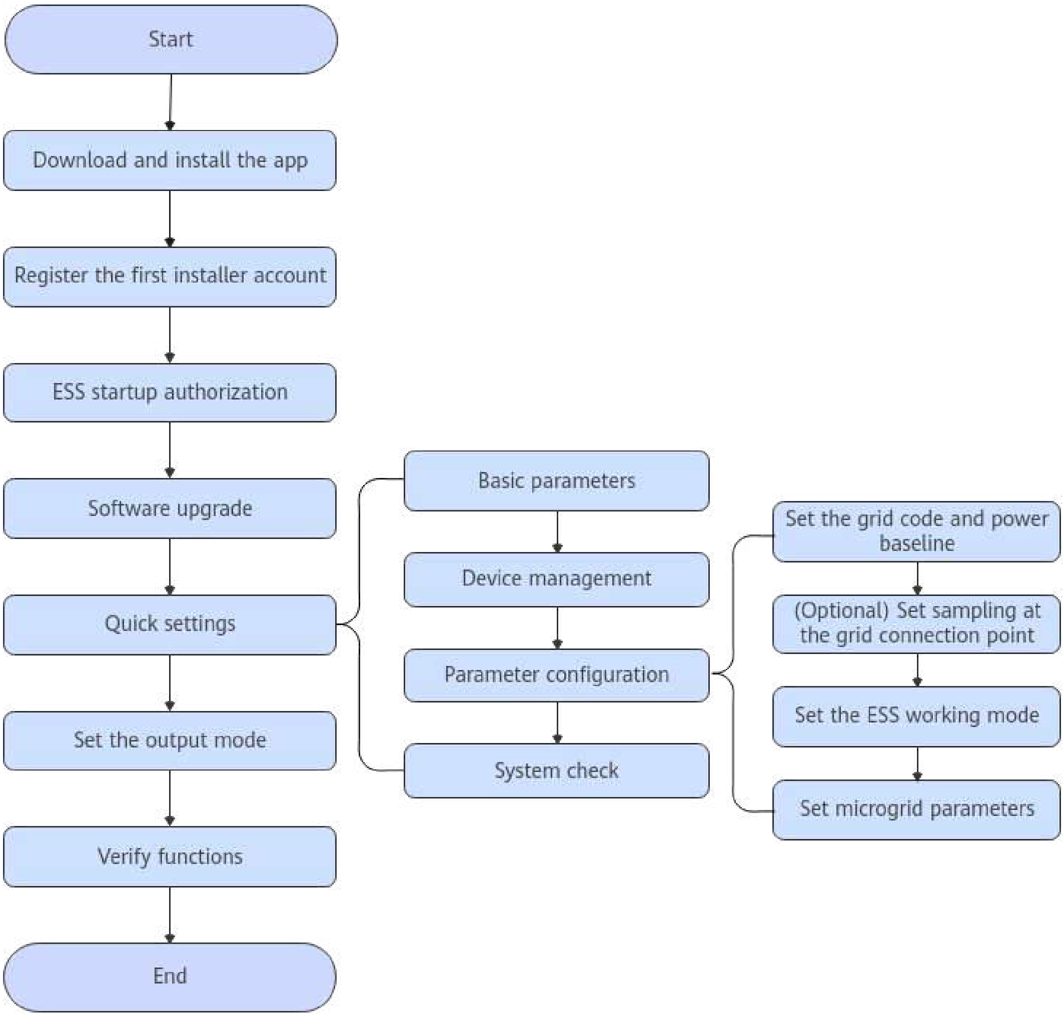
<table>
<tr><th>Step</th><th>Task</th><th>Power-On Operation</th></tr>
<tr><td>1</td><td>Starting the UPS</td><td>For details, see the documents provided by the vendor.</td></tr>
<tr><td rowspan="2">2</td><td>Powering on the UPS-SmartMGC auxiliary power supply</td><td>1. Turn on the SmartMGC power switch on the UPS side.
2. Turn on the power switch (if any) between the SmartMGC and the UPS.</td></tr>
<tr><td>Powering on the UPS-ESS auxiliary power supply (for black start)</td><td rowspan="3">For details, see Power-On Operations.
CAUTION
Before powering on the ESS auxiliary power supply (for LTMS and other devices), remove the jumper bar from 1–2 and insert it into 2–3 on the XT terminal block, and remove the jumper bar from 4–5 and insert it into 5–6 on the XT terminal block. Otherwise, the auxiliary power supply will fail.</td></tr>
<tr><td>3</td><td>Powering on the ESS auxiliary power supply (for LTMS and other devices)</td></tr>
<tr><td>4</td><td>Powering on the ESS AC side</td></tr>
</table>

Step	Task	Power-On Operation
5	Powering on the inverter	**If an inverter is involved in the networking, select a power-on method based on the inverter model:** **Method 1:** 1. Set the DC SWITCH to ON. When you hear a click, the switch is completely turned on. 2. Check that the indicators are not steady red. **Method 2:** 1. Set the DC SWITCH 1 (MAIN SWITCH) to ON. When you hear a click, the switch is completely turned on. 2. Check the status of the PV connection indicator. If it is steady green, set DC SWITCH 2 and DC SWITCH 3 to ON. 3. Check that other indicators are not steady red.
Note: For details about the switch layout and operations of the devices prepared by the customer, see the documents provided by the vendors.		

1.3 Deployment and Commissioning

This section describes how to connect to the SmartMGC locally using the app to complete the deployment and commissioning process. For details, see **Figure 1-16**.

Figure 1-16 Commissioning process in the off-grid scenario



1.3.1 Preparations and App Login

1.3.1.1 Downloading and Installing the App

NOTICE

The mobile phone operating system must be Android 8.0, iOS 13.0, or later. (iPhone 6 or later is supported for the iOS version.)

Scan the following QR code to download and install the app.

NOTE

If you select **Download via the Browser** and a security warning message is displayed indicating that the app is from an external source, tap **ALLOW**.

1.3.1.2 Registering the Company's First Installer Account

Context

When you register the first installer account, a company is registered at the same time.

Procedure

1. On the app login screen, tap **No account?**.
2. On the **Role** screen, tap **I'm an installer** and complete the registration as prompted.

1.3.1.3 Logging In to the App

After the app is correctly installed on a mobile phone, you can access the management system through the app.

Logging In to the App

1. On the mobile device, tap the app icon to access the login screen.
2. On the app login screen, enter the account information and tap **Log In**.

NOTE

- If a new user logs in to the app for the first time or a user logs in to the app for the first time after the password is reset, change the login password as prompted.
- If a user enters incorrect passwords for five consecutive times within 5 minutes, the account will be locked for 30 minutes. The user can log in again after the lockout period expires or contact the installer or administrator to unlock the account.
- 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. In these cases, the Company shall not be liable for any loss.

1.3.1.4 Setting ESS Startup Authorization

Prerequisites

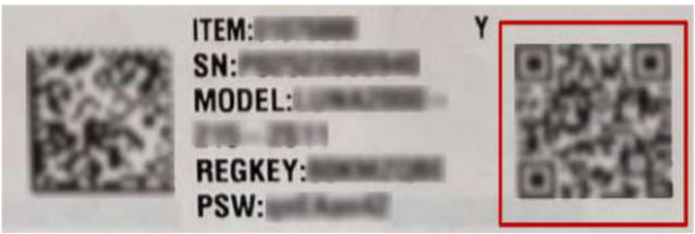
- Install the ESS and connect cables by referring to the sections of **Site Selection Requirements** and **Installing Cables** of the ESS. Failure to meet these requirements may result in the startup password not being issued. As a result, the ESS cannot be started.
- The WLAN function has been enabled on the mobile phone.
- Before connecting your mobile phone to the WLAN (or WiFi) of the ESS, ensure that the ESS is powered on and the ESS initialization is complete (the WLAN indicator is steady on).
- The mobile phone is within 5 m of the device. Otherwise, the communication quality between the app and the device may be poor.

Procedure

Figure 1-17 ESS startup authorization procedure

1. Obtain the **Verification code**.
   a. Log in to the app, scan the WLAN QR code on the ESS (the QR code on the right of the SN on the device), and connect to the WLAN of the ESS.

      Figure 1-18 QR code example (for reference only; the actual QR code on the device prevails)

      NOTE

      - For the first connection to the device WLAN, log in with the initial password. You can obtain the initial WLAN password from the device label, that is, the characters following "PSW".
      - 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 device WLAN. The WLAN name of the device consists of "device name-SN".
      - If **This WLAN network has no Internet access. Connect anyway?** message is displayed when you connect to the device WLAN, tap **CONNECT**. Otherwise, you cannot log in to the system. The actual UI and messages may vary with mobile phones.

   b. Log in to the local screen of the ESS as the **installer** user, and obtain **Verification code**.

      NOTE

      Set the password as prompted at the first login.
2. Apply for the **Startup password**.

   Contact the device vendor or its authorized supervision service provider to apply for the **Startup password** using the **Verification code** on the Power-Partner app.
3. Enter the **Startup password** to complete the ESS startup authorization.

a. (Optional) If the app is disconnected from the ESS, use the app to scan the WLAN QR code on the ESS to log in to the local screen of the ESS as the **installer** user.
b. Enter the **Startup password** and tap **Authorized**.

NOTE

Ensure account security by changing the password periodically. 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.

1.3.1.5 Updating the Software Version

NOTICE

Only the currently connected SmartMGC and its subordinate devices can be updated.

Prerequisites

- Ensure that you have completed the ESS startup authorization before updating the software version to prevent update failures or system alarms.

Downloading the Update Package (from the FusionSolar Software Download Website)

1. Log in to the **FusionSolar Software Download** website using the product customer account on a PC and download the latest software packages of the SmartLogger and ESS.

   NOTE

   To protect software integrity, mitigate the risk of software package implantation or tampering, and enhance software supply chain safety, you are advised to install **ICS Lite** on your PC, which can automatically verify the digital signature of the software package.

   Table 1-10 Software download paths

Device	Path
SmartLogger	**SmartLogger5000B**
ESS	**LUNA2000B**

2. After downloading the software update packages from the website, import them from the PC to the mobile phone where the update is to be performed.

Updating the Device Version (App)

1. Scan the WLAN QR code on the SmartMGC to connect to its WLAN.
2. Log in to the local commissioning screen and choose **Maintenance** > **Upgrade device**.

3. On the **Select device** screen, select the devices to be updated.
4. Tap **Select Update Package** under each device and select the update package as prompted.

 NOTE

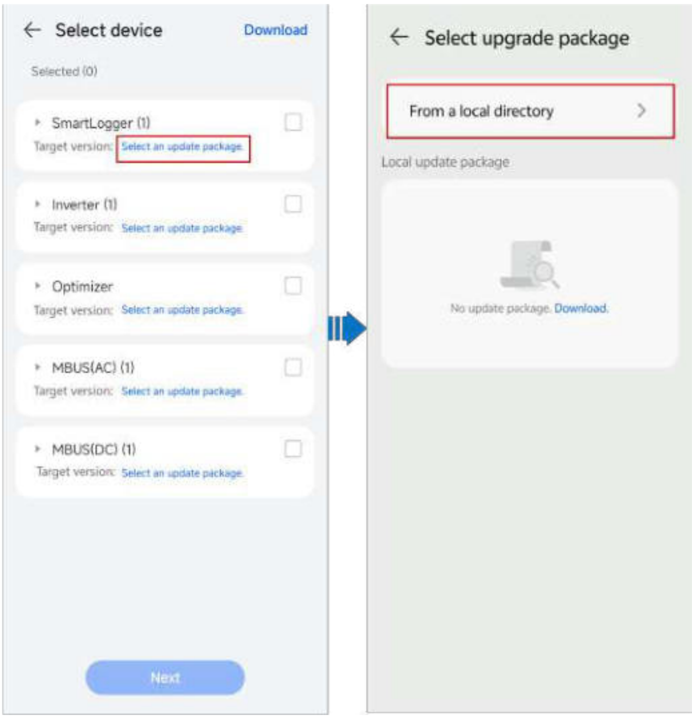
- iOS mobile phone: After downloading the update package from the website and storing it on the mobile phone, hold down the file to share it to the app. Then the update package is directly displayed on the screen for selecting the update package.
- Android mobile phone: Choose **Select Update Package** > **From a local directory** to access the phone folder and manually select the update package.

5. Tap **Next** and complete the update as prompted.

 NOTE

After the update is successful, the target version of the device will be refreshed. If the update fails, check whether the selected update package is correct and rectify the fault as prompted.

Figure 1-19 Device update



1.3.2 Quick Settings

Log in to the SmartMGC local commissioning screen as the **installer** user using the app and enter the **Quick Settings** screen.

For details about how to log in to the SmartMGC local commissioning screen, see **E Connecting the App to the SmartMGC**.

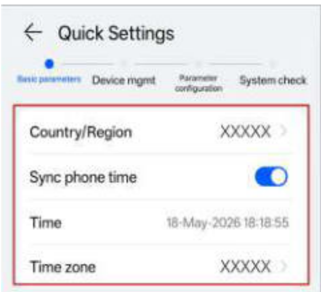
1.3.2.1 Basic Parameters

Set basic parameters such as the country/region, time zone, running configuration, and communication networking to ensure data accuracy and facilitate O&M management and fault locating.

Step 1 Set the basic parameters.

Set **Country/Region**, **Time**, and **Time zone** based on the location and local time of the plant.

Figure 1-20 Basic information



Step 2 Set the running configuration parameters.

Figure 1-21 Running configuration

Table 1-11 Running configuration parameters

Parameter	Description
Scenario	Set this parameter to **Off-grid**. The PV+ESS system is a stand-alone microgrid to supply power to loads and does not need the mains supply. The running scenario configuration is used to configure the array scenario as required to ensure that the system control function is correctly executed.

Step 3 Set **Networking** parameters.

1. Set network connection parameters for connecting to the management system.

   The SmartMGC can be connected through a mobile network or wired network. Tap **>** on the right of **Network Connection**, set **Mobile network** or **Wired Network** parameters as required, and tap **Submit**.

Figure 1-22 Network connection

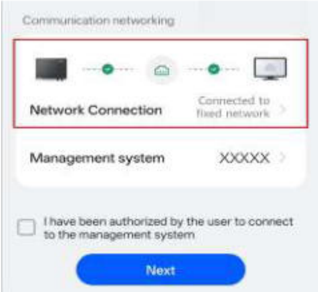


Table 1-12 Network connection parameters

Parameter	Description
Mobile network	
Network mode	Set this parameter based on the SIM card network mode.
APN mode	The default value is **Automatic**. Set this parameter to **Manual** if the dial-up connection cannot be set up in **Automatic** mode.
Identification type	This parameter is displayed when APN mode is set to **Manual**. It specifies the type of user identity authentication. – **PAP**: Password Authentication Protocol – **CHAP**: Challenge Handshake Authentication Protocol
APN	This parameter is displayed when **APN mode** is set to **Manual**. If this parameter is incorrectly set, the mobile network services will be affected. The parameter information comes from the SIM card carrier. If you have any questions about the parameter settings, contact the Company's engineers.
SIM access point number	
APN user name	
APN user password	
Wired network	
DHCP	This parameter is enabled by default. After it is enabled, IP addresses are automatically allocated. If the router does not support DHCP, disable **DHCP** and manually assign an IP address.
IP Address	Set this parameter when **DHCP** is disabled. Retain the default values or change them as required. The network ports are independent of each other and their configurations cannot conflict with each other.
Subnet mask	
Default Gateway	

Parameter	Description
Primary DNS Server	Set this parameter when **DHCP** is disabled. DNS server address, which is obtained from the router or carrier. You can ignore this parameter if the device connects to the LAN. If the device connects to the public network, for example, the management system, set this parameter to the IP address of the LAN router.
Secondary DNS Server	Set this parameter when **DHCP** is disabled. DNS server address, which is obtained from the router or carrier. This parameter does not need to be set in normal cases. If the primary DNS server cannot resolve the domain name, use the secondary DNS server.

2. Set parameters for connecting to the management system

   Connecting to the management system enables centralized monitoring and remote O&M of the plant. Tap **>** on the right of **Management system**, set parameters such as the domain name as required, and tap **Submit**.

Figure 1-23 Management system

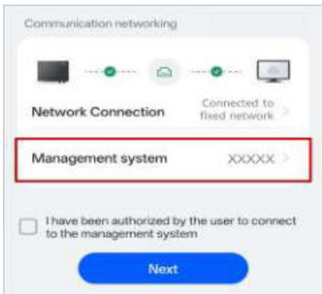


Table 1-13 Management system parameters

Parameter	Description	Remarks
Domain Name	Specifies the domain name of the management system.	The system has preset **Port** and **TLS encryption** for the default domain name. You do not need to set them. If you need to change the domain name, configure the corresponding **Port** and **TLS encryption**.
Port	Set the port number based on the domain name. The default port number is 27250.	
TLS encryption	You are advised to enable **TLS encryption** to ensure data security. – **Enable**: Data exchanged between the SmartMGC and the management system is encrypted. – **Disable**: Data exchanged between the SmartMGC and the management system is not encrypted, which poses security risks.	

If a third-party energy management system (EMS) is connected, set related parameters based on the corresponding communications protocol.

Figure 1-24 Management system connection

Table 1-14 Modbus TCP

Parameter	Description
Connection	Specifies whether to allow a third-party EMS to connect to the SmartMGC. – **Enable (restricted)**: The SmartMGC communicates with a third-party management system for which the client IP address (whitelist) has been configured. – **Enable (unrestricted)**: The SmartMGC communicates with a third-party management system with a valid IP address. – **Disable**: No IP address is allowed to connect to the SmartMGC.
Client 1 IP address	This parameter is displayed when **Connection** is set to **Enable (restricted)**. It specifies the IP address of the client.
Client 2 IP address	
Client 3 IP address	
Client 4 IP address	

Parameter	Description
Client 5 IP address	
Address mode	This parameter is displayed when **Connection** is set to **Enable (restricted)** or **Enable (unrestricted)**. If the communication address of the connected device is unique, you are advised to select **Physical address**. Otherwise, you must select **Logical address**.
SmartLogger address	This parameter is displayed when **Connection** is set to **Enable (restricted)** or **Enable (unrestricted)**. It specifies the slave address of the SmartLogger.

Table 1-15 Modbus RTU

Category	Parameter	Description
COM 1/2/3, M1.COM1/2/3	**Baud rate**	Specifies the communication rate of the RS485 port. Set this parameter to be consistent with the baud rate of the connected device.
	Parity	Specifies the error detection mechanism for data transmission over RS485. Set this parameter to be consistent with the parity mode of the connected device.
	Stop Bit	Specifies the interval after the transmission of each data byte is complete, which is equivalent to the terminator of a data frame. Set this parameter to be consistent with the stop bit of the connected device.

3. Connect to the management system authorized by the customer.

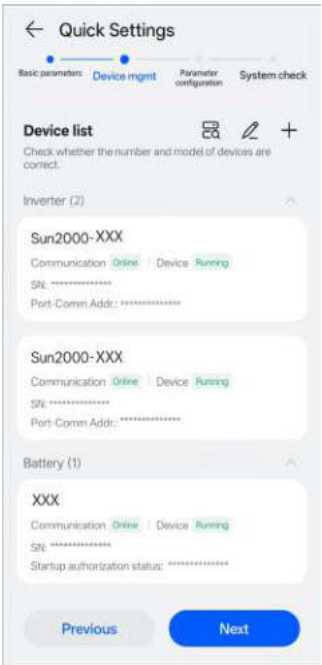
   Select **I have obtained the owner's authorization to access the management system.**.

----End

1.3.2.2 Device Management

Check whether the quantity and models of devices displayed on the current screen are consistent with those of the connected devices. If they are inconsistent, tap the search icon or check whether the device cables are properly connected.

Figure 1-25 Device management



Step 1 (Optional) Start the ESS auxiliary power supply. In the off-grid scenario, check whether the ESS auxiliary power supply is started. If not, click the search icon or **next** to automatically start the auxiliary power supply, preventing parameter setting failures caused by ESS power-off.

Step 2 (Optional) If the device is not displayed, tap the search icon to connect to a device or tap **+** to add a device. Auto discovery does not apply to third-party devices, such as the meter and environmental monitoring instrument (EMI). You need to tap **+** to add them manually.

NOTE

- The device list displays only the devices directly connected to the SmartMGC.
- If a device cannot be found, check whether the cable to the device is properly connected. After confirming that the cable connection is correct, tap **Search** or **+**.
- Meter: For details about the supported meter models, see **B Meter Model List**.
- EMI: For details about the supported EMI models, see **C EMI Model List**.

Table 1-16 Parameters for adding a meter

Parameter	Description
Device type	Set this parameter to **Power meter**.

Parameter	Description
Intelligent Power Meter Type	Select a value based on the model of the connected meter. ● If the power meter model is DTSU666-HW, select **DTSU666-HW**. ● If the power meter model is YDS60-80, select **YADA-YDS60-80**. ● If the power meter model is DHSU1079-ZT, select **DHSU1079-ZT**. ● If the power meter model is DTSU71C, select **DTSU71C**.
port	Select a port based on the SmartMGC COM port connected to the meter.
Address	Set the communications address of the meter as required, which must not conflict with the addresses of other devices on the same bus. The value ranges from 1 to 247. For details, see the user manual of the meter.
Baud rate	Set the RS485 communications rate of the meter as required. For details, see the user manual of the meter.
Parity	Set the RS485 communications parity mode of the meter as required. The options are **No parity**, **Odd parity** and **Even parity**. For details, see the user manual of the meter.
Stop Bit	Specifies the interval after the transmission of each data byte is complete, which is equivalent to the terminator of a data frame. Set this parameter of the meter as required. For details, see the user manual of the meter.
Meter purpose	Set the usage of the meter based on the actual connection position of the meter. ● **Feed-in meter**[1]: used for grid-connection point control. Each array allows only one feed-in meter to be connected. ● **Production meter**: PV output meter. Multiple production meters can be connected. ● **Consumption meter**: load consumption meter. Multiple consumption meters can be connected. ● **Charger meter**: charger consumption meter. Multiple charger meters can be connected. ● **Third-party production meter**: third-party PV output meter. Multiple third-party production meters can be connected. ● **Genset meter**: genset output meter. Only one genset meter can be connected to each array.

<table>
<tr><th>Parameter</th><th>Description</th></tr>
<tr><td>Voltage change ratio</td><td rowspan="2">● Set this parameter to 1 if the meter uploads the primary value.
● Set this parameter based on the actual transformer ratio if the meter uploads the secondary value.
● If both the meter and the SmartMGC support the settings of the voltage ratio and current ratio, you can only set them either on the meter or the SmartMGC. You are advised to set these parameters on the meter.
● If the meter connects to a transformer, set SPEC of the meter to 0, indicating that the meter connects to the system through a transformer.
● Examples:
– Scenario 1: When the voltage of the grid connection point is 400 V, the power meter must be connected to a CT, and the CT ratio is 400:5.
■ Set the voltage transformation ratio of the meter to 1.
■ Set the current transformation ratio of the meter to 80.
– Scenario 2: When the voltage of the grid connection point is 10 kV, the meter must be connected to both the CT and PT. The CT ratio is 400:5, and the PT ratio is 10000:100.
■ Set the voltage transformation ratio of the meter to 100.
■ Set the current transformation ratio of the meter to 80.</td></tr>
<tr><td>Current change ratio</td></tr>
<tr><td colspan="2">[1]: The Feed-in meter must be connected to a COM port of the SmartMGC separately to avoid affecting the dispatch performance of the system.</td></tr>
</table>

Step 3 (Optional) Perform ESS startup authorization. If the ESS is not authorized to start, tap the related prompt on the current screen to access the **Startup Authorization** screen, and enter **Startup password** to complete the ESS startup authorization.

NOTE

- How to obtain **Startup password**: Provide **Verification code** for the device supplier or its authorized supervision service provider. They will apply for **Startup password** for you using the Power-Partner app.
- If battery packs are added to the ESS in the network, the ESS automatically restart after you enter **Startup password** and submit the authorization.

Step 4 (Optional) Change the device name. To facilitate subsequent log export and fault locating, you can change the device name based on the device location. For example, if multiple ESSs are connected, you can add numbers for the ESSs, such as ESS_1 and ESS_2.

Tap  to go to the **Edit Device** screen. Tap  next to the target device and change the device name.

----End

1.3.2.3 Parameter Configuration

Set operation rules such as grid standards and ESS policies to ensure that the plant runs safely and efficiently in the expected mode.

1.3.2.3.1 Setting the Grid Code and Power Baseline

Step 1 Set the grid code.

Figure 1-26 Grid code

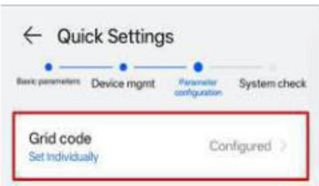
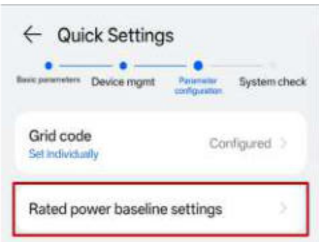


Table 1-17 Grid code parameter

Parameter	Description
Grid Code	Select the local grid code.

Step 2 Set the rated power baseline.

Figure 1-27 Rated power baseline



1. Tap **Rated power baseline settings**, select the target ESS device, and tap **Set**.
2. Tap **>** on the right of **Rated power baseline**, select the target power, and tap **Submit**.
3. Return to the **Select Device** screen and view the setting result.
4. Select the corresponding rated power on the device nameplate.

NOTICE

- To ensure safe operation of the device, after setting the power in the software, immediately draw a check mark on the device nameplate in the rated power option that is the same as the value set in the software to confirm the final configuration.
- To support this function, the following version mapping shall be met:
  - SmartMGC: SmartLogger5000B V100R026C10 or later
  - ESS: LUNA2000B V200R026C10 or later
  - App: 26.3.1 or later

Table 1-18 Rated power baseline parameter

Parameter	Description
Rated power baseline	The rated power baseline is the reference for calculating the system power. After **Rated power baseline** is set, the active power baseline and apparent power baseline will be adjusted accordingly.

Step 3 Set plant information.

Figure 1-28 Plant information

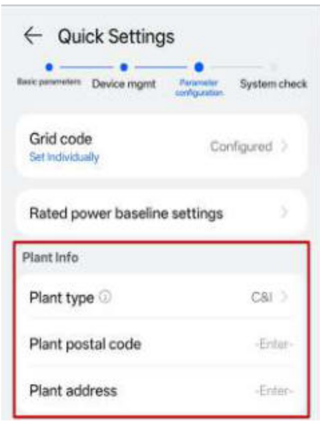


Table 1-19 Plant information parameters

Parameter	Description
Plant type	Select **C&I**.
Plant postal code	**Plant postal code** is displayed when the mobile phone is not connected to the Internet or it is connected to the Internet but the location function of the app is not enabled. Set this parameter to the actual postal code of the plant.

Parameter	Description
Plant address	Set this parameter to the address of the plant.

----End

1.3.2.3.2 Grid Connection Point Sampling Configuration

The SmartMGC can directly sample the current and voltage at the grid connection point. When used with the CT and PT, it can function as a meter at the grid connection point. In this case, you need to set the grid connection point sampling parameters. In addition, the SmartMGC can collect voltage signals through the U_AC2 port to implement secondary frequency and voltage regulation.

Step 1 Set the grid connection point sampling parameters.

Figure 1-29 Grid connection point sampling parameters (off-grid)

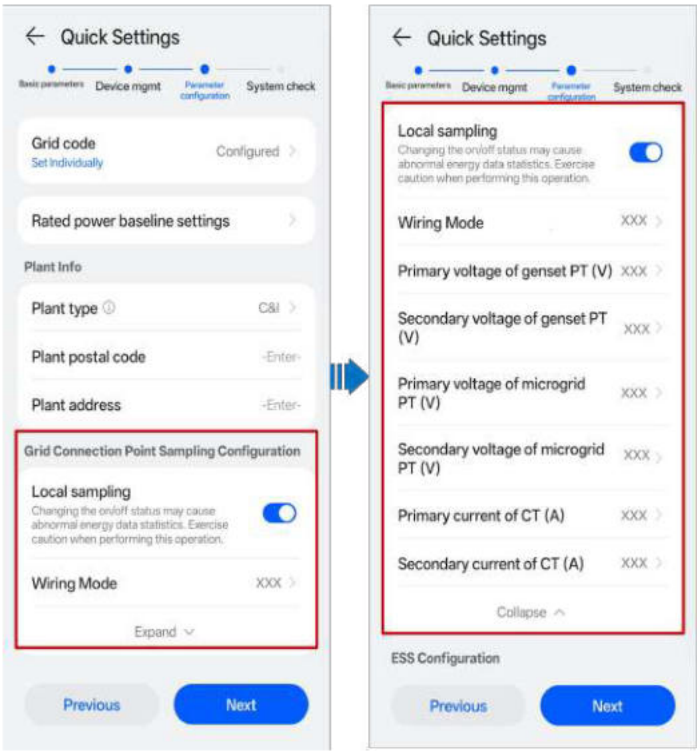


Table 1-20 Grid connection point sampling parameters

Parameter	Description
Local sampling	Enable this parameter.
Wiring mode	Set the output mode based on the actual cable connections of the CT and PT.

<table>
<tr><th>Parameter</th><th>Description</th></tr>
<tr><td>Primary voltage of genset PT (V)</td><td rowspan="2">This parameter is displayed when Genset control is enabled.
Voltage is sampled through the U_AC1 port.
● If PT voltage sampling is unavailable, set the primary and secondary voltages of the genset based on the actual rated voltage of the genset.
● If PT voltage sampling is available, set the primary and secondary voltages of the genset based on the actual specifications of the PT.
NOTICE
To ensure safety, a PT must be used for voltage sampling in the medium- and high-voltage system.</td></tr>
<tr><td>Secondary voltage of genset PT (V)</td></tr>
<tr><td>Primary voltage of microgrid PT (V)</td><td rowspan="2">Voltage is sampled through the U_AC2 port.
● If PT voltage sampling is unavailable, set the primary and secondary voltages on the microgrid side based on the actual rated voltage on the microgrid side.
● If PT voltage sampling is available, set the primary and secondary voltages on the microgrid side based on the actual specifications of the PT.
NOTICE
● To ensure safety, a PT must be used for voltage sampling in the medium- and high-voltage system.
● Connect the secondary voltage output cable of the microgrid PT to the U_AC2 port. The SmartMGC depends on this port to collect voltage signals to implement secondary frequency regulation. If the cable is not correctly connected, the system control will fail and the system stability cannot be maintained.</td></tr>
<tr><td>Secondary voltage of microgrid PT (V)</td></tr>
<tr><td>Primary current of CT (A)</td><td rowspan="2">The I_AC port is connected to the CT to sample current. Set this parameter based on the actual specifications of the CT.</td></tr>
<tr><td>Secondary current of CT (A)</td></tr>
</table>

----End

1.3.2.3.3 Setting the ESS Working Mode

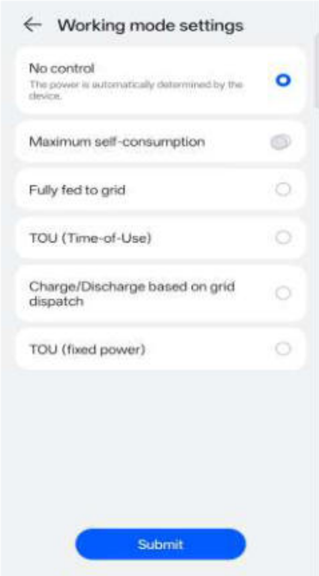
The ESS working mode allows the SmartMGC to control the power output of devices in an array according to different control modes, ensuring that the grid and loads work properly and maximizing the economic benefits of the plant.

Procedure

Step 1 In the off-grid scenario, set **Working mode settings** to **No control** for the ESS.

This mode is used only for commissioning. The SmartMGC does not control the power dispatch of the ESS.

Figure 1-30 Setting the ESS working mode



Step 2 Tap **Submit**.

----End

1.3.2.3.4 Microgrid Configuration

The SmartMGC has a built-in microgrid control function to independently dispatch the PV+ESS system to form an off-grid system. By adjusting the PV and ESS power in real time, it ensures stable system voltage and frequency, provides continuous and reliable power supply for critical loads, and supports the black start function.

In the off-grid system, parameter settings vary depending on the networking mode. Set the parameters by referring to the corresponding table based on the specific networking scenario.

- For details about the off-grid PV+ESS networking, see **Table 1-21**.
- For details about the off-grid PV+ESS+genset networking (genset grid forming), see **Table 1-22**.
- For details about the off-grid PV+ESS+genset networking (genset grid following), see **Table 1-23**.

NOTICE

- Connect cables strictly according to the following table. Otherwise, the related functions cannot be enabled.
- To support the **Allow ESS to charge from genset** and **Main power supply in off-grid mode** functions, the following version mapping shall be met:
  - SmartMGC: SmartLogger5000B V100R026C10 or later
  - ESS: LUNA2000B V200R026C10 or later
  - App: 26.3.1 or later
  - Management system: 26.2.0 or later

Figure 1-31 Microgrid configuration parameters (off-grid PV+ESS networking)

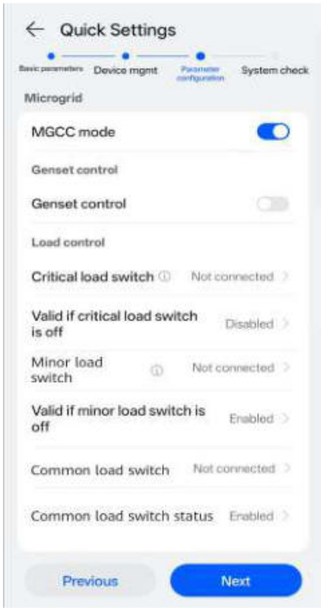


Table 1-21 Microgrid configuration parameters (off-grid PV+ESS networking)

Category	Parameter	Description
Microgrid basic settings	**MGCC mode**	Enable this parameter. The microgrid control function is enabled. When the microgrid is off-grid, the SmartEMO function and functions involved in power adjustment and ESS control will be invalid.
Genset control	**Genset control**	Set this parameter to **Disable**.
Load control	**Critical load switch**	Specify whether the critical load switch is connected. System cable connections: ● DI1(HV) (recommended)[a]: reports the Off state of the critical load switch. ● DO1(HV): turns on the critical load switch. ● DO2(HV): turns off the critical load switch.

<table>
<tr><th>Category</th><th>Parameter</th><th>Description</th></tr>
<tr><td></td><td>Valid if critical load switch is off</td><td>Set this parameter based on the actual status of the critical load switch and the status received by DI1(HV) (recommended)[a] (see in Set > Comm. parameters > AI/DI/DO). For details about the configuration criteria, see the following table.
<table>
<tr><th>Critical Load Switch Status</th><th>Status Received from DI1(HV) (Recommended)[a]</th><th>Parameter Setting</th></tr>
<tr><td rowspan="2">Off</td><td>Off</td><td>Off</td></tr>
<tr><td>On</td><td>On</td></tr>
<tr><td rowspan="2">On</td><td>Off</td><td>On</td></tr>
<tr><td>On</td><td>Off</td></tr>
</table></td></tr>
<tr><td></td><td>Minor load switch</td><td>

Specifies whether the minor load switch is connected.
System cable connections:

DI2(HV) (recommended)[a]: reports the Off state of the minor load switch.
DO3(HV): turns on the minor load switch.
DO4(HV): turns off the minor load switch.

</td></tr>
<tr><td></td><td>Valid if minor load switch is off</td><td>Set this parameter based on the actual status of the minor load switch and the status received by DI2(HV) (recommended)[a] (see in Set > Comm. parameters > AI/DI/DO). For details about the configuration criteria, see the following table.
<table>
<tr><th>Minor Load Switch Status</th><th>Status Received from DI2(HV) (Recommended)[a]</th><th>Parameter Setting</th></tr>
<tr><td rowspan="2">Off</td><td>Off</td><td>Off</td></tr>
<tr><td>On</td><td>On</td></tr>
<tr><td rowspan="2">On</td><td>Off</td><td>On</td></tr>
<tr><td>On</td><td>Off</td></tr>
</table></td></tr>
<tr><td></td><td>Common load switch</td><td>

Specifies whether the common load switch is connected.
System cable connections:

DI3(HV) (recommended)[a]: reports the Off state of the common load switch.
DO5(HV): turns on the common load switch.
DO6(HV): turns off the common load switch.

</td></tr>
</table>

<table>
<tr><th>Category</th><th>Parameter</th><th>Description</th></tr>
<tr><td></td><td>Common load switch status</td><td>Set this parameter based on the actual status of the common load switch and the status received by DI3(HV) (recommended)[a] (see in Set > Comm. parameters > AI/DI/DO). For details about the configuration criteria, see the following table.
<table>
<tr><th>Common Load Switch Status</th><th>Status Received from DI3(HV) (Recommended)[a]</th><th>Parameter Setting</th></tr>
<tr><td rowspan="2">Off</td><td>Off</td><td>Off</td></tr>
<tr><td>On</td><td>On</td></tr>
<tr><td rowspan="2">On</td><td>Off</td><td>On</td></tr>
<tr><td>On</td><td>Off</td></tr>
</table></td></tr>
<tr><td colspan="3">Note a: If the default DI port is not available for onsite cable connection, configure the required DI port through Settings > Microgrid Control > General Basic Settings on the SmartMGC WebUI and check the status received by the corresponding DI port.</td></tr>
</table>

Figure 1-32 Microgrid configuration parameters (off-grid PV+ESS+genset networking - genset grid forming)

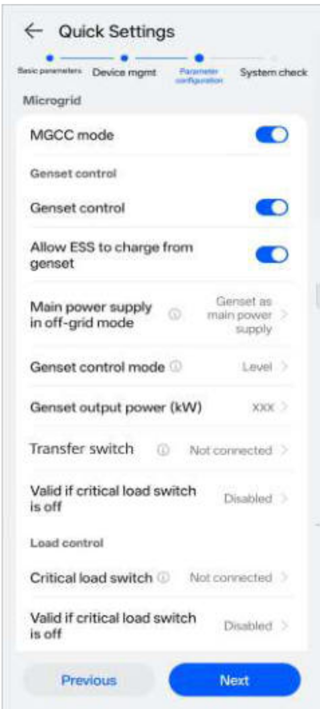


Table 1-22 Microgrid configuration parameters (off-grid PV+ESS+genset networking - genset grid forming)

Category	Parameter	Description
Microgrid basic settings	**MGCC mode**	Enable this parameter. The microgrid control function is enabled. When the microgrid is off-grid, the SmartEMO function and functions involved in power adjustment and ESS control will be invalid.
Genset control	**Genset control**	Set this parameter to **Enable**.
	Allow ESS to charge from genset	Specifies whether the ESS can be charged by the genset. ● Enable: This mode applies to scenarios where the ESS SOC is low and the estimated off-grid duration is long. The ESS can be charged by the genset. ● Disable: This mode applies to scenarios where the ESS has sufficient power or the genset needs to directly supply power to loads preferentially. The ESS cannot be charged by the genset.
	Main power supply in off-grid mode	Set this parameter to **Genset main power supply**. Set the grid-forming source of the genset+ESS system in off-grid scenarios. That is, set the primary power supply of the system in off-grid mode. The setting must be consistent with the actual situation. Otherwise, the system will malfunction. ● **Genset main power supply**: The genset is used as the primary power supply. ● **ESS as main power supply**: The ESS is used as the primary power supply.
	Genset control mode	Set this parameter based on the genset startup/shutdown control mode of the DO5(HV) and DO6(HV) terminals. ● **Pulse** control mode: – DO5(HV): starts the genset. – DO6(HV): shuts down the genset. ● **Level** control mode: – For genset startup control: DO5(HV) is closed (output high level), and DO6(HV) is open (output low level). – For genset shutdown control: DO5(HV) is open (output low level), and DO6(HV) is closed (output high level).
	Genset output power	Set the output power of the genset. **NOTE** Ensure that the value is the same as the output power on the genset nameplate.

<table>
<tr><th>Category</th><th>Parameter</th><th>Description</th></tr>
<tr><td></td><td>Transfer switch</td><td>Specifies whether the transfer switch is connected.
System cable connections:
DI4(HV) (recommended)[a]: reports the Off state of the genset transfer switch.
DO3(HV): turns on the genset transfer switch.
DO4(HV): turns off the genset transfer switch.</td></tr>
<tr><td></td><td>Valid if transfer switch is off</td><td>Set this parameter based on the actual status of the transfer switch and the status received by DI4(HV) (recommended)[a] (see in Set > Comm. parameters > AI/DI/DO). For details about the configuration criteria, see the following table.
<table>
<tr><th>Transfer Switch Status</th><th>Status Received from DI4(HV) (Recommended)[a]</th><th>Parameter Setting</th></tr>
<tr><td rowspan="2">Off</td><td>Off</td><td>Off</td></tr>
<tr><td>On</td><td>On</td></tr>
<tr><td rowspan="2">On</td><td>Off</td><td>On</td></tr>
<tr><td>On</td><td>Off</td></tr>
</table></td></tr>
<tr><td>Load control</td><td>Critical load switch</td><td>Specify whether the critical load switch is connected.
System cable connections:
DI1(HV) (recommended)[a]: reports the Off state of the critical load switch.
DO1(HV): turns on the critical load switch.
DO2(HV): turns off the critical load switch.</td></tr>
</table>

<table>
<tr><th>Category</th><th>Parameter</th><th>Description</th></tr>
<tr><td></td><td>Valid if critical load switch is off</td><td>Set this parameter based on the actual status of the critical load switch and the status received by DI1(HV) (recommended)[a] (see in Set > Comm. parameters > AI/DI/DO). For details about the configuration criteria, see the following table.
<table>
<tr><th>Load Switch Status</th><th>Status Received from DI1(HV) (Recommended)[a]</th><th>Parameter Setting</th></tr>
<tr><td rowspan="2">Off</td><td>Off</td><td>Off</td></tr>
<tr><td>On</td><td>On</td></tr>
<tr><td rowspan="2">On</td><td>Off</td><td>On</td></tr>
<tr><td>On</td><td>Off</td></tr>
</table></td></tr>
<tr><td colspan="3">Note a: If the default DI port is not available for onsite cable connection, configure the required DI port through Settings > Microgrid Control > General Basic Settings on the SmartMGC WebUI and check the status received by the corresponding DI port.</td></tr>
</table>

Figure 1-33 Microgrid configuration parameters (off-grid PV+ESS+genset networking - genset grid following)

Table 1-23 Microgrid configuration parameters (off-grid PV+ESS+genset networking - genset grid following)

Category	Parameter	Description
Microgrid basic settings	**MGCC mode**	Enable this parameter. The microgrid control function is enabled. When the microgrid is off-grid, the SmartEMO function and functions involved in power adjustment and ESS control will be invalid.
Genset control	**Genset control**	Set this parameter to **Enable**.
	Main power supply in off-grid mode	Set this parameter to **ESS as main power supply**. Set the grid-forming source of the genset+ESS system in off-grid scenarios. That is, set the primary power supply of the system in off-grid mode. The setting must be consistent with the actual situation. Otherwise, the system will malfunction. ● **Genset main power supply**: The genset is used as the primary power supply. ● **ESS as main power supply**: The ESS is used as the primary power supply.
	Genset control mode	Set this parameter based on the genset startup/shutdown control mode of the DO5(HV) and DO6(HV) terminals. ● **Pulse** control mode: – DO5(HV): starts the genset. – DO6(HV): shuts down the genset. ● **Level** control mode: – For genset startup control: DO5(HV) is closed (output high level), and DO6(HV) is open (output low level). – For genset shutdown control: DO5(HV) is open (output low level), and DO6(HV) is closed (output high level).
	Genset output power	Set the output power of the genset. **NOTE** Ensure that the value is the same as the output power on the genset nameplate.
Load control	**Critical load switch**	Specify whether the critical load switch is connected. System cable connections: ● DI1(HV) (recommended)[a]: reports the Off state of the critical load switch. ● DO1(HV): turns on the critical load switch. ● DO2(HV): turns off the critical load switch.

<table>
<tr><th>Category</th><th>Parameter</th><th>Description</th></tr>
<tr><td></td><td>Valid if critical load switch is off</td><td>Set this parameter based on the actual status of the critical load switch and the status received by DI1(HV) (recommended)[a] (see in Set > Comm. parameters > AI/DI/DO). For details about the configuration criteria, see the following table.
<table>
<tr><th>Load Switch Status</th><th>Status Received from DI1(HV) (Recommended)[b]</th><th>Parameter Setting</th></tr>
<tr><td rowspan="2">Off</td><td>Off</td><td>Off</td></tr>
<tr><td>On</td><td>On</td></tr>
<tr><td rowspan="2">On</td><td>Off</td><td>On</td></tr>
<tr><td>On</td><td>Off</td></tr>
</table>
</td></tr>
<tr><td colspan="3">Note a: If the default DI port is not available for onsite cable connection, configure the required DI port through Settings > Microgrid Control > General Basic Settings on the SmartMGC WebUI and check the status received by the corresponding DI port.</td></tr>
</table>

1.3.2.4 System Check

This function comprehensively diagnoses the system health status, covering network communication, device status, alarm information, software version, and device cable connections. If any exception is detected, rectify the fault as prompted and tap **Check Again** to confirm that the issue has been resolved. You are advised to complete the system check to ensure stable device operation.

Figure 1-34 System check

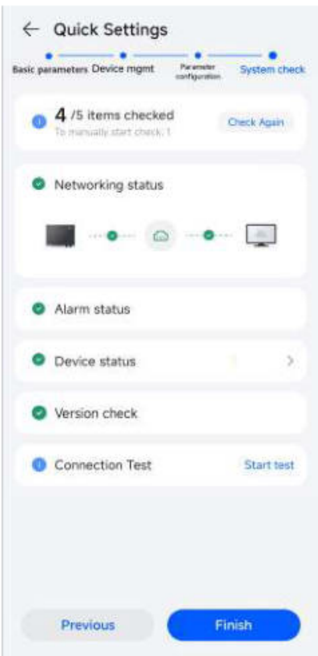


Table 1-24 System check

Check Type	Description	Triggering Method
Networking status	Check whether the management system is successfully connected and whether the mobile network signal is weak	The check is automatically started. You can tap **Check Again** to start the check again.
Alarm status	Check whether an alarm is generated. **NOTE** If an alarm is generated, rectify the fault by referring to **Possible Cause and Suggestion**.	
Device status	Check whether **Running status** is **Faulty**, or **communication status** is **Offline**. **NOTE** If **Offline** or **Offline** is displayed, check the networking connection status and hardware status of the device for exceptions and rectify the fault by referring to **Offline** of the corresponding alarm.	
Version check	Check whether all devices in the device list need to be updated. **NOTE** After the update is complete, you can return to the **System check** screen to continue the deployment. However, if the SmartMGC is restarted during the update, the app will be disconnected from the WLAN of the SmartMGC. As a result, the deployment cannot continue.	
Connection Test	Check whether the communication between devices is normal, whether the PT/CT cable connection and the A/B/C wire sequences of the PCS AC cables are normal, and identify possible faults. You can identify and rectify faults by viewing rectification suggestions to ensure that the system runs properly. **NOTE** ● This function applies only to the C&I Hybrid Cooling Grid Forming ESS and is displayed in the scenario with multiple cabinets. ● In the off-grid scenario, ensure that the load has been disconnected and then perform **Connection Test**.	Tap **Start test** to manually start the check. Tap **Check Again** to start the check again.

1.3.3 Setting the Output Mode

To ensure the normal operation of the devices, set the output mode of the inverter and ESS correctly based on the actual cable connections. If the settings are inconsistent with the actual cable connections, system alarms may be generated or the dispatch logic may be incorrect.

Procedure

Step 1 Set **Output mode** for the inverter.

Tap **Monitor**, select an inverter, choose **Set** > **Grid parameters**, and set **Output mode** to **Three-phase, four-wire** for the inverter.

Step 2 Set **Output mode** for the ESS.

Tap **Monitor**, select an ESS, choose **Set** > **Power Parameters** > **Grid parameters**, and set **Output mode** to **Three-phase, four-wire** for the ESS.

----End

1.3.4 Function Verification

1.3.4.1 Verifying the Cable Connections for Local Power Sampling

Verifying the cable connections for local power sampling ensures that the SmartMGC correctly samples the power of the genset branch for stable system operation. Verification is required only in the PV+ESS+genset scenario.

DANGER

- Before operation, ensure that the equipment is intact. Otherwise, electric shocks or fires may occur.
- During operation, wear insulated gloves and use insulated tools to prevent electric shocks or short circuits.
- Non-standard and improper operations may result in fires or electric shocks.
- Prevent foreign matter from entering the equipment during operations. Otherwise, short circuits, equipment damage, load power derating, power failure, or personal injury may occur.

Procedure

Step 1 Check whether the CT wiring position is correct. The CT must be connected to the metering point where the customer purchases electricity.

If the wiring position is inconsistent with that in the **Figure 1-35**, modify the CT wiring position.

Figure 1-35 Correct CT wiring position

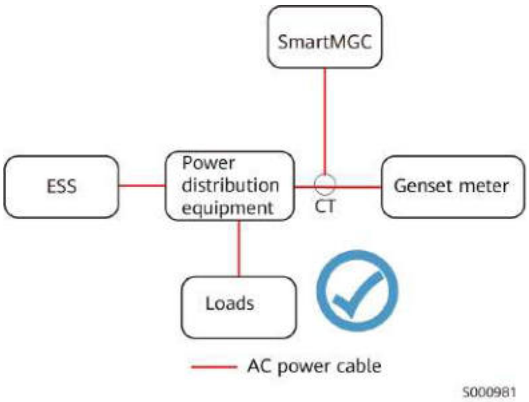
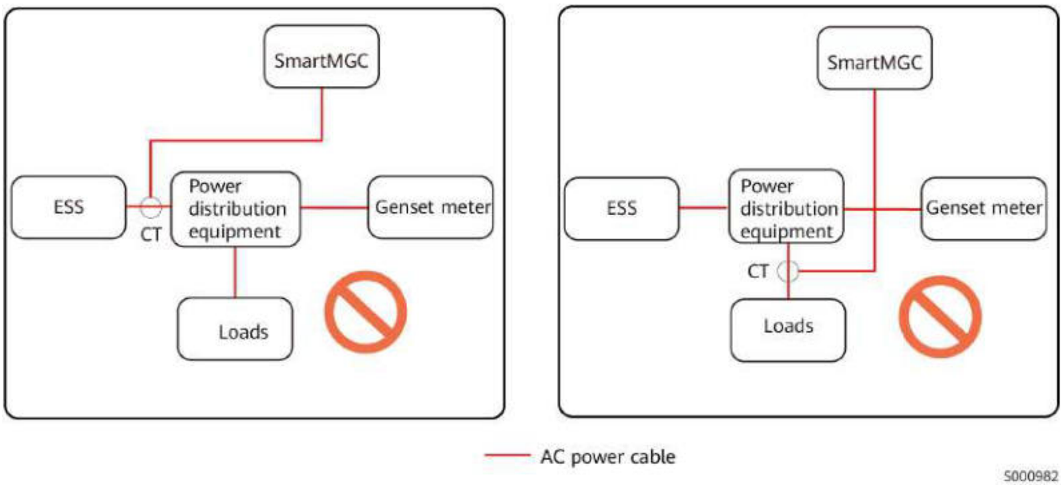


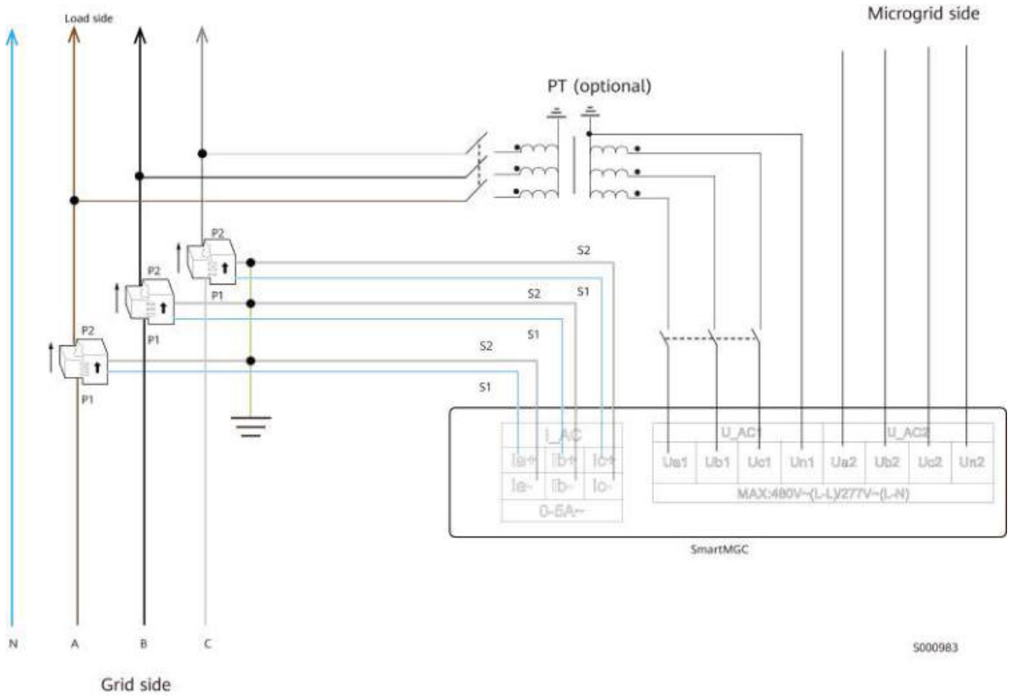
Figure 1-36 Incorrect CT wiring position



Step 2 Check whether the power sampling cable connection is correct. Check the cable connection by referring to **Figure 1-37**. If the cable connection is inconsistent with that shown in the figure, modify the meter cable connection.

- Current sampling: The I_AC port shall be connected to the CT. When the CT is connected in the positive direction, the power flows from the genset side (grid side) to loads. The wiring of each phase of the CT shall be consistent with that on the genset side (grid side).
- Voltage sampling: The U_AC1 port shall be connected to the PT or used for direct sampling. The wiring of each phase of the PT or direct sampling shall be consistent with that on the genset side (grid side).

Figure 1-37 Correct PT/CT wiring



Step 3 Check whether the power sampling parameters are correctly set. Choose **Settings** > **Port Settings** > **PT/CT** to check the parameter settings.

Table 1-25 CT parameter settings

<table>
<tr><th>Parameter</th><th>Description</th></tr>
<tr><td>PT/CT sampling</td><td>Enable the function of directly sampling the current and voltage at the grid connection point. When used with the CT and PT, it can function as a meter at the grid connection point.</td></tr>
<tr><td>PT/CT cable connection mode</td><td>This parameter is displayed when PT/CT sampling is set to Enable. Set this parameter to Three-phase three-wire or Three-phase four-wire based on the actual CT and PT wiring.</td></tr>
<tr><td>Primary current of CT</td><td rowspan="2">The I_AC port is connected to the CT to sample current. Set this parameter based on the actual specifications of the CT. If the current transformation ratio is 400:5:
● Set the primary current of the CT to 400 A.
● Set the secondary current of the CT to 5 A.</td></tr>
<tr><td>Secondary current of CT</td></tr>
<tr><td>Primary voltage of grid PT</td><td rowspan="2">This parameter is displayed when PT/CT sampling is enabled. The voltage on the grid side is sampled through the U_AC1 port.
● If PT sampling is unavailable, set the primary and secondary voltages on the grid side based on the actual rated voltage on the grid side.
● If PT sampling is available, set the primary and secondary voltages on the grid side based on the actual specifications of the PT. If the voltage transformation ratio is 10000:100:
– Set the primary voltage of the PT to 10000 V.
– Set the secondary voltage of the PT to 100 V.</td></tr>
<tr><td>Secondary voltage of grid PT</td></tr>
<tr><td>Primary voltage of microgrid PT</td><td rowspan="2">This parameter is displayed when PT/CT sampling is set to Enable and MGCC mode is set to Enable. Voltage is sampled through the U_AC2 port.
● If PT sampling is unavailable, set the primary and secondary voltages on the microgrid side based on the actual rated voltage on the microgrid side.
● If PT sampling is available, set the primary and secondary voltages on the microgrid side based on the actual specifications of the PT.</td></tr>
<tr><td>Secondary voltage of microgrid PT</td></tr>
<tr><td>CT wiring direction</td><td>Set this parameter to Positive. The power flows from the grid to loads.</td></tr>
</table>

Step 4 Test the power value. Check whether the power value is normal in the scenarios where loads are disconnected and connected.

Disconnecting loads:

1. (Optional) Shut down the inverters. The PV power is 0. If there are inverters in the array, perform this step.

Choose **Maintenance** > **Device Management** > **Startup/Shutdown** on the SmartMGC WebUI, click **All array inverters** under **Shut Down**, enter the login password, and confirm the shutdown.

2. Disconnect all loads from the system.
3. When the ESS is running in on-grid mode, it is charged at a fixed power.

   Choose **Monitoring** > **ESS** > **Running Parameters** on the SmartMGC WebUI, set **Active power (kW)** under **Power regulation** to 5 kW, and click **Settings**. If there are multiple ESSs in the array, click **Batch Sync**.
4. Check whether the power at the grid connection point is consistent with the ESS charge power.

Table 1-26 Power status diagnosis when loads are disconnected

Symptom		Status	Cause	Suggestion
The active power at the grid connection point is consistent with the ESS charge power.	CT installed on the grid side	Normal	-	-
	CT installed on the ESS side	Abnormal	CT installed on the ESS side	Adjust the CT wiring position to the grid side.
The active power at the grid connection point is inconsistent with the ESS charge power.	The active power at the grid connection point is not 0. The absolute values of the two are equal, but the polarity signs are opposite.	Abnormal	The CT wiring direction is reversed.	Choose **Settings** > **Port Settings** > **PT/CT**. Set **CT wiring direction** to the opposite direction.
	The active power at the grid connection point is not 0, and all single-phase power of phases A, B, and C is not 0.	Abnormal	● The phase sequence of the PT wiring is inconsistent. ● The CT wiring sequence is inconsistent. ● The primary/secondary current/voltage settings of the CT/PT are inconsistent with the actual situation.	● Check the phase sequence of the PT and CT wiring. Ensure that the phase sequence of the PT and CT wiring is the same. ● Check and modify the CT wiring sequence. ● Modify the settings based on the technical specifications of the CT/PT.

Symptom		Status	Cause	Suggestion
	The active power at the grid connection point is 0, and the all single-phase power of phases A, B, and C is 0.	Abnormal	CT installed on the load side	Adjust the CT wiring position to the grid side.
	The active power at the grid connection point is 0, and all or some of the single-phase currents of phases A, B, and C are 0.	Abnormal	Abnormal CT wiring	Check the CT wiring.
	The active power at the grid connection point is 0, and all or some of the voltages of phases A, B, and C are 0.	Abnormal	Abnormal PT wiring	Check the PT wiring.
To view the power at the grid connection point, single-phase currents and active power of phases A, B, and C, and three-phase voltage of phases A, B, and C, choose **Overview** > **Grid Connection Point Info**.				

Connecting loads:

1. (Optional) Shut down the inverters. The PV power is 0. If there are inverters in the array, perform this step.

   Choose **Maintenance** > **Device Management** > **Startup/Shutdown** on the SmartMGC WebUI, click **All array inverters** under **Shut Down**, enter the login password, and confirm the shutdown.
2. Shut down the ESS. The ESS power is 0.

   Choose **Maintenance** > **Device Management** > **Startup/Shutdown** on the SmartMGC WebUI, click **All array ESSs** under **Shut Down**, enter the login password, and confirm the shutdown.
3. Connect loads.
4. Check whether the power at the grid connection point is consistent with the load power.

Table 1-27 Power status diagnosis when loads are connected

Symptom	Status	Cause	Suggestion
The active power at the grid connection point is consistent with the load power.	Normal	-	-
The active power at the grid connection point is 0.	Abnormal	CT installed on the ESS side	Adjust the CT wiring position to the grid side.
To view the power at the grid connection point, choose **Overview** > **Grid Connection Point Info**.			

Step 5 Start the inverters and ESS. Choose **Maintenance** > **Device Management** > **Startup/Shutdown** on the SmartMGC WebUI.

- (Optional) To start the inverters, click **All array inverters** under **Start**, enter the login password, and confirm the startup. If there are inverters in the array, perform this step.
- To start the ESS, click **Start** under **All array ESSs**, enter the login password, and confirm the startup.

----End

1.3.4.2 Verifying Load Switches

Load switch verification is to manually turn on and off a switch to check whether the switch is correctly configured. This operation shall be performed on the WebUI.

In the off-grid PV+ESS scenario, critical, minor, and common loads can be managed hierarchically. In the off-grid PV+ESS+genset scenario, only the critical load switch can be connected. Perform verification based on the actual load connection.

DANGER

- Before switch operation, ensure that the equipment is intact. Otherwise, electric shocks or fires may occur.
- During switch operation, wear insulated gloves and use insulated tools to prevent electric shocks or short circuits.
- Non-standard and improper operations may result in fires or electric shocks.
- Prevent foreign matter from entering the equipment during operations. Otherwise, short circuits, equipment damage, load power derating, power failure, or personal injury may occur.

Procedure

Step 1 Log in to the SmartMGC WebUI, choose **Maintenance** > **Device Management** > **Startup/Shutdown**, click **Shut Down**, and click **All array devices** from the drop-down list to shut down the equipment.

Step 2 Check whether the critical load switch is properly configured.

1. Check whether the cable connection is normal for the DI1(HV) switch-off feedback port of the critical load switch.

   Manually turn on or off the critical load switch onsite, and choose **Overview** > **Sampling Info** to check whether the value of **DI1 status** changes.

   - If the status changes, the DI1(HV) cable is properly connected.
   - If the status does not change, check the DI1(HV) cable connection and rectify the fault.

2. Check whether **Valid if critical load switch is off** is correctly set.

   Choose **Settings** > **Microgrid Control** > **Scheduling Control** > **Manual control** and check whether the current **Critical load switch status** is consistent with the actual status of the critical load switch. If not, modify **Valid if critical load switch is off** to ensure consistency.

3. Check whether the cable connections are normal for the DO2(HV) switch-off control port and DO1(HV) switch-on control port of the critical load switch.

   Choose **Settings** > **Microgrid Control** > **Scheduling Control** > **Manual control**, and then click **Off** and **On** of **Critical load switch status**.

   - Click **On**, and then check whether the actual status of the critical load switch is on. If not, check the DO1(HV) cable connection and rectify the fault.
   - Click **Off**, and then check whether the actual status of the critical load switch is off. If not, check the DO2(HV) cable connection and rectify the fault.

Step 3 Check whether the minor load switch is properly configured.

1. Check whether the cable connection is normal for the DI2(HV) switch-off feedback port of the minor load switch.

   Manually turn on or off the minor load switch onsite, and choose **Overview** > **Sampling Info** to check whether the value of **DI2 status** changes.

   - If the status changes, the DI2(HV) cable is properly connected.
   - If the status does not change, check the DI2(HV) cable connection and rectify the fault.

2. Check whether **Valid if minor load switch is off** is correctly set.

   Choose **Settings** > **Microgrid Control** > **Scheduling Control** > **Manual control** and check whether the current **Minor load switch status** is consistent with the actual status of the minor load switch. If not, modify **Valid if minor load switch is off** to ensure consistency.

3. Check whether the cable connections are normal for the DO4(HV) switch-off control port and DO3(HV) switch-on control port of the minor load switch.

   Choose **Settings** > **Microgrid Control** > **Scheduling Control** > **Manual control**, and then click **Off** and **On** of **Minor load switch status**.

   - Click **On**, and then check whether the actual status of the minor load switch is on. If not, check the DO3(HV) cable connection and rectify the fault.
   - Click **Off**, and then check whether the actual status of the minor load switch is off. If not, check the DO4(HV) cable connection and rectify the fault.

Step 4 Check whether the common load switch is properly configured.

1. Check whether the cable connection is normal for the DI3(HV) switch-off feedback port of the common load switch.

   Manually turn on or off the common load switch onsite, and choose **Overview** > **Sampling Info** to check whether the value of **DI3 status** changes.

   - If the status changes, the DI3(HV) cable is properly connected.
   - If the status does not change, check the DI3(HV) cable connection and rectify the fault.
2. Check whether **Valid if common load switch is off** is correctly set.

   Choose **Settings** > **Microgrid Control** > **Scheduling Control** > **Manual control** and check whether the current **Common load switch status** is consistent with the actual status of the common load switch. If not, modify **Valid if common load switch is off** to ensure consistency.
3. Check whether the cable connections are normal for the DO6(HV) switch-off control port and DO5(HV) switch-on control port of the common load switch.

   Choose **Settings** > **Microgrid Control** > **Scheduling Control** > **Manual control**, and then click **Off** and **On** of **Common load switch status**.

   - Click **On**, and then check whether the actual status of the common load switch is on. If not, check the DO5(HV) cable connection and rectify the fault.
   - Click **Off**, and then check whether the actual status of the common load switch is off. If not, check the DO6(HV) cable connection and rectify the fault.

----End

1.3.4.3 Verifying Genset Functions

Genset function verification includes genset transfer switch verification and genset startup and shutdown verification. This operation shall be performed on the WebUI and is required only in the off-grid PV+ESS+genset grid forming scenario.

DANGER

- Before switch operation, ensure that the equipment is intact. Otherwise, electric shocks or fires may occur.
- During switch operation, wear insulated gloves and use insulated tools to prevent electric shocks or short circuits.
- Non-standard and improper operations may result in fires or electric shocks.
- Prevent foreign matter from entering the equipment during operations. Otherwise, short circuits, equipment damage, load power derating, power failure, or personal injury may occur.

Procedure

Genset transfer switch verification is to manually turn on and off a switch to check whether the switch is correctly configured.

Step 1 Log in to the WebUI, choose **Maintenance** > **Device Management** > **Startup/Shutdown**, click **Shut Down**, and click **All array devices** from the drop-down list to shut down the equipment.

Step 2 Check whether the cable connection is normal for the DI4(HV) switch-off feedback port of the genset transfer switch.

Manually turn on or off the genset transfer switch onsite, choose **Overview** > **Sampling Info**, and check whether the value of **DI4 status** changes.

- If the status changes, the DI4(HV) cable is properly connected.
- If the status does not change, check the DI4(HV) cable connection and rectify the fault.

Step 3 Check whether **Switch disconnection effective state** is correctly set.

Choose **Settings** > **Microgrid Control** > **Scheduling Control** > **Manual control** and check whether the current **Generator Set Switching Status** is consistent with the actual status of the genset transfer switch. If not, modify **Generator Set Switching Status** to ensure consistency.

Step 4 Check whether the cable connections are normal for the DO4(HV) switch-off control port and DO3(HV) switch-on control port of the genset transfer switch.

Choose **Settings** > **Microgrid Control** > **Scheduling Control** > **Manual control**, and then click **Off** and **On** of **Generator Set Switching Status**.

- Click **On**, and then check whether the actual status of the genset transfer switch is on. If not, check the DO3(HV) cable connection and rectify the fault.
- Click **Off**, and then check whether the actual status of the genset transfer switch is off. If not, check the DO4(HV) cable connection and rectify the fault.

Step 5 Check whether the cable connections are normal for the genset startup and shutdown control ports DO5(HV) and DO6(HV).

Choose **Settings** > **Microgrid Control** > **Scheduling Control** > **Manual control**, and then verify the **Start** and **Shut Down** of the genset based on the genset control mode.

When the genset is controlled in pulse mode:

- Click **Start**, and then check whether the actual genset status is started. If not, check the DO5(HV) cable connection and rectify the fault.
- Click **Shut Down**, and then check whether the actual genset status is shutdown. If not, check the DO6(HV) cable connection and rectify the fault.

When the genset is controlled in level mode, with high level for startup, and low level for shutdown:

Click **Start** or **Shut Down**, and then check whether the actual genset status is started or shutdown. If not, check the DO5(HV) cable connection and rectify the fault.

When the genset is controlled in level mode, with low level for startup, and high level for shutdown:

Click **Start** or **Shut Down**, and then check whether the actual genset status is started or shutdown. If not, check the DO6(HV) cable connection and rectify the fault.

Step 6 Choose **Maintenance** > **Device Management** > **Startup/Shutdown**, click **Start**, and click **All array devices** from the drop-down list to start the equipment.

----End

1.3.4.4 Verifying Charging and Discharging Functions

After verifying the meter functions, verify that the ESS charging and discharging functions of the entire array are normal to ensure stable system operation.

NOTICE

This function shall be verified only in scenarios with sufficient sunlight.

Procedure

Step 1 The SmartMGC automatically controls the inverter to generate power to charge the ESS and checks whether **ESS charge/discharge power** of the array is consistent with the difference (**Array load power – Inverter PV output power**) between the load consumption power and the PV power.

Choose **Monitoring** > **Logger** > **Running Parameters** and check the values of **ESS charge/discharge power**, **Array load power**, and **Inverter PV output power**.

- If the values are the consistent, the charging and discharging functions are normal.
- If the values are inconsistent, check and rectify the fault based on the alarm information.

----End

1.4 Connecting to a Plant

After devices are commissioned, you can create a plant and configure basic information on the app to implement unified device monitoring and O&M.

- If the owner does not have a plant in the management system or app, connect to a new plant by referring to **1.4.1 Adding a Plant**.
- If the owner has a plant in the management system or app, connect to the existing plant by referring to **1.4.2 Connecting to an Existing Plant**.
- When a device that supports the registration code is bound to a plant, the device registration code must be verified, ensuring access security.

1.4.1 Adding a Plant

1. If no plant has been created, tap **Add plant**.
2. Tap **Plant Info** and enter the basic plant information.
   - If a plant scheme has been designed on the Design Tool platform before plant deployment, you can tap the corresponding button on the screen to import the basic information about the corresponding plant from the Design Tool.
   - If no plant scheme has ever been designed, enter the basic plant information as prompted.
   - Plant owner: Enter the mobile number or email address of the plant owner to bind the plant to the owner account. (If the owner has not registered an account, the system will automatically send an SMS message or a registration invitation email to the owner after the plant is created.)
3. Tap **Create and Continue**.
4. On the screen for adding devices, view the added devices.
   - If multiple devices need to be connected to the same plant, tap **+** to scan the QR codes of the devices and add the devices one by one.

     NOTE

     The devices to be added must have been commissioned.
   - After the devices are added, tap **Total string capacity** and enter the total string capacity of the plant.
5. Tap **Save and Continue**.
6. Set the feed-in tariff, purchase price, and revenue unit (currency) of the plant as electricity price inputs for revenue calculation.
7. **Complete**.

1.4.2 Connecting to an Existing Plant

1. If a plant has been created, tap **Connect to existing plant**.
2. Select the plant to be bound.
3. Tap **OK** to complete the binding.

1.5 Function Commissioning

1.5.1 Black Start

The microgrid black start function allows the ESS with black start capability to energize first following a system blackout. It then sequentially restores power resources without self-start capability, enabling the microgrid to re-establish power supply independently. This solution uses the ESS as the core black start power source, enhancing the reliability of power supply for the microgrid when it operates in islanded mode.

In the microgrid scenario, a UPS is required to supply power to the SmartMGC and the ESS's CMU. If the UPS has power, log in to the local app to perform startup authorization and array deployment. If the UPS has no power, press the black start button on the ESS. After the ESS voltage is established, perform startup authorization and set the grid code before the first deployment.

The array can be black started only in the off-grid scenario or in the on/off-grid scenario when **On/Off-grid status** is set to .

Table 1-28 Black start description

Category	Scenario	Requirement
Array black start command (one-click black start)	The UPS has power.	• The SmartMGC and the ESS's CMU are powered by the UPS. • Ensure that the array grid code is consistent with the local grid code. You are advised to perform deployment before enabling the array black start command. • It is recommended that black start be performed only when the ESS SOC is greater than 2%. Otherwise, the black start may fail. If the ESS SOC is 0% or the **Battery Pack Undervoltage** alarm is generated, charge the ESS first.
Pressing the black start button	The UPS has no power.	• Disconnect all loads. • Before the first deployment, turn off the AC switch of the ESS. This prevents device damage caused by voltage and frequency non-compliance due to the inconsistency between the default grid code and the local grid code. • It is recommended that black start be performed only when the ESS SOC is greater than 2%. Otherwise, the black start may fail. If the ESS SOC is 0% or the **Battery Pack Undervoltage** alarm is generated, charge the ESS first. • Requirements for using the black start button on the ESS: – Press and hold the black start button for more than 10 seconds, close the cabinet door, and wait for the black start. – The interval between two presses of the black start button shall be at least 1 minute.

1.5.1.1 Array Black Start Command

If the UPS has power, send a black start command on the SmartMGC WebUI or SmartMGC local app.

Method 1: SmartMGC WebUI

Step 1 Manually initiate a black start.

Choose **Maintenance** > **Device Management** > **Black Start** and then click **Black Start**.

----End

Method 2: SmartMGC local app

Step 1 Choose **Set** > **Microgrid Parameters** > **Black Start** and then tap **Start**.

----End

NOTE

On the black start screen, you can view the **Current Battery SOC** value, black start progress, and status.

1.5.1.2 Pressing the Black Start Button

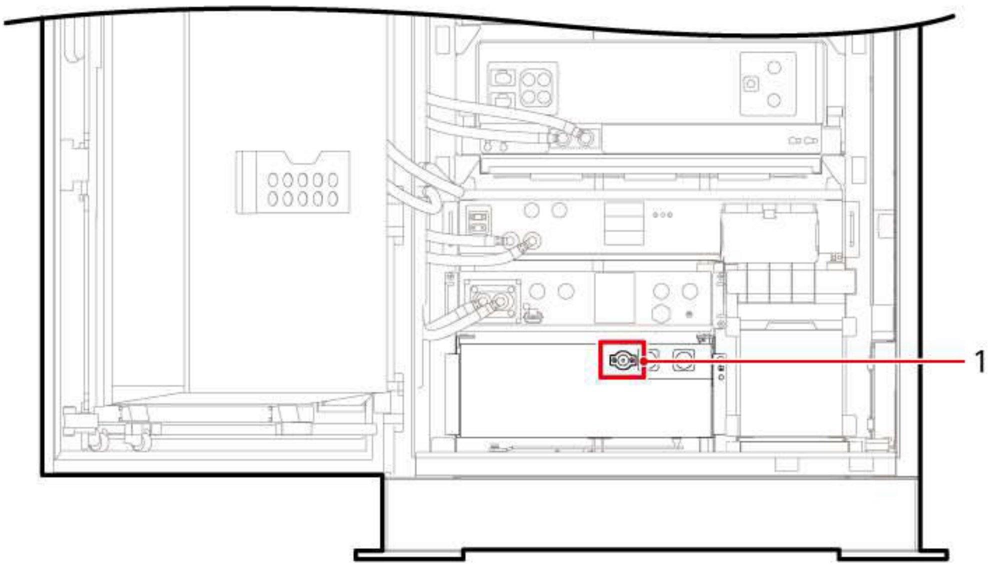
If the UPS has no power, press the black start button on the ESS. After the ESS voltage is established, perform startup authorization and set the grid code before the first deployment.

Scenario 1: Black Start Before the First Deployment

Step 1 Turn off the AC switch of the ESS to be black started.

Step 2 Open the ESS cabinet door. Press and hold the black start button on the RCM in the cabinet for more than 10 seconds.

Figure 1-38 Black start button



1	Black start button

Step 3 Close the cabinet door and wait until the black start is successful.

Step 4 Connect the SmartMGC to the ESS locally on the app and set the startup authorization code and grid code of the ESS.

- Set the startup authorization code by referring to **1.3.1.4 Setting ESS Startup Authorization**.
- Set the grid code by referring to **1.3.2.3.1 Setting the Grid Code and Power Baseline**.

Step 5 Turn on the AC switch of the ESS.

Step 6 Perform black start locally again. Open the ESS cabinet door. Press and hold the black start button on the RCM in the cabinet for more than 10 seconds.

NOTICE

The interval between two presses of the black start button shall be at least 1 minute.

Step 7 Close the cabinet door. After the black start is successful, perform quick settings on the local app. For details, see **1.3.2 Quick Settings**.

NOTE

If the humidity in the cabinet is high, dehumidification will be triggered after the black start is successful.

----End

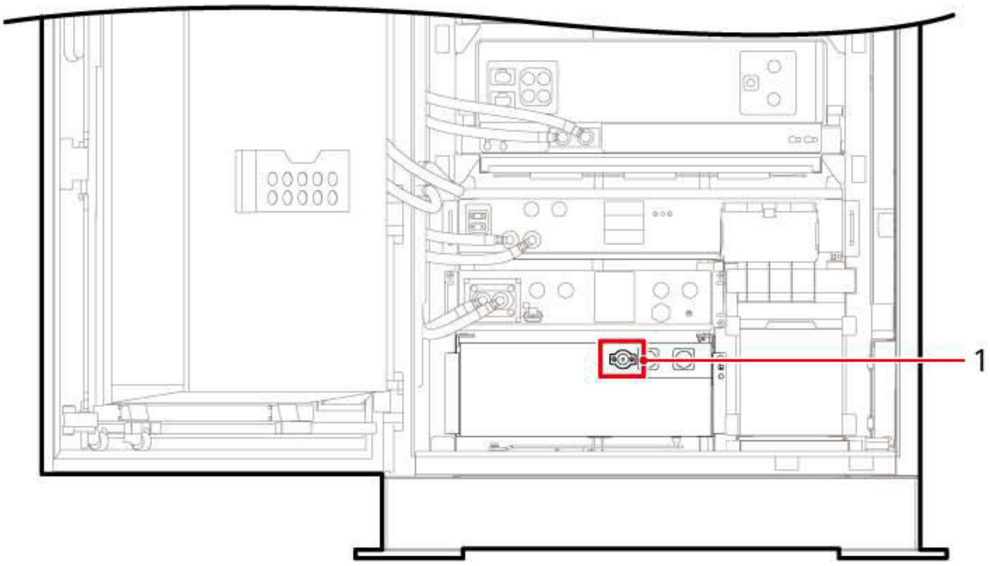
Scenario 2: Black Start After Deployment

Step 1 Open the ESS cabinet door. Press and hold the black start button on the RCM in the cabinet for more than 10 seconds.

NOTICE

The interval between two presses of the black start button shall be at least 1 minute.

Figure 1-39 Black start button



1	Black start button

Step 2 Close the cabinet door and wait until the black start is successful.

NOTE

If the humidity in the cabinet is high, dehumidification will be triggered after the black start is successful.

----End

1.5.2 ESS SOC Description

To ensure that the grid-forming ESS can reliably respond to power disturbances, the key is to always reserve charge and discharge margins. Properly set the SOC operating range to prevent the loss of regulation capability when the SOC reaches the limit. This ensures that the system can effectively maintain power balance when the load or PV power changes abruptly. It is crucial to prevent power outages or load shedding and ensure stable system operation.

CAUTION

Retain the default settings of the SOC parameters to ensure stable system operation. If you need to adjust the settings, contact the Company's engineers.

WARNING

Set the SOC parameters in strict accordance with the following principles to ensure the system's charge/discharge margin and power balance capability:

- **Array end-of-charge SOC** > **Max. SOC for charging off-grid ESS** > **Min. SOC for discharging off-grid ESS** > **Array end-of-discharge SOC**.
- **SOC for turning on common load switch** > **SOC for turning on minor load switch** > **SOC for turning on critical load switch**.
- **SOC for turning off common load switch** > **SOC for turning off minor load switch** > **SOC for turning off critical load switch**.

Table 1-29 SOC description in the off-grid scenario

Parameter	Description	Default Value (%)	Maximum Value (%)	Path
Array end-of-charge SOC	Array-level end-of-charge threshold. When the SOC of the ESS reaches this value, the charging stops and the ESS limits the charge capability to 0 for protection.	100	90–100	• SmartMGC WebUI: **Settings** > **Grid Connection Control** > **ESS Control** > **ESS SOC** • SmartMGC local app: **Set** > **Feature parameters**
Array end-of-discharge SOC	Array-level end-of-discharge threshold. When the SOC of the ESS reaches this value, the discharging stops and the ESS limits the discharge capability to 0 for protection.	1	0–15	
Max. SOC for charging off-grid ESS	ESS end-of-charge threshold in the off-grid scenario. When the SOC of the ESS reaches this value, the MGCC limits the ESS charge power to 0. To prevent switchover by mistake when the SOC of the ESS reaches **Array end-of-charge SOC** in off-grid VSG mode, you are advised to set this parameter to ≤ (**Array end-of-charge SOC** – 2)%.	95	Dynamically obtained: MAX((**Min. SOC for discharging off-grid ESS** + 1), 5) to MIN((**Array end-of-charge SOC** – 1), 98)	• SmartMGC WebUI: **Settings** > **Grid Connection Control** > **ESS Control** > **ESS SOC** • SmartMGC local app: **Set** > **Microgrid Parameters** > **Scheduling Control**

Parameter	Description	Default Value (%)	Maximum Value (%)	Path
Min. SOC for discharging off-grid ESS	ESS end-of-discharge threshold in the off-grid scenario. When the SOC of the ESS decreases to this value, the MGCC limits the ESS discharge power to 0. To prevent switchover by mistake when the SOC of the ESS decreases to **Array end-of-discharge SOC** in off-grid VSG mode, you are advised to set this parameter to ≥ (**Array end-of-discharge SOC** + 2)%.	5	Dynamically obtained: MAX((**Array end-of-discharge SOC** + 1), 5) to MIN((**Max. SOC for charging off-grid ESS** – 1), 98)	

Parameter	Description	Default Value (%)	Maximum Value (%)	Path
SOC for turning on critical load switch	• The critical load switch parameters (switch-on SOC/switch-off SOC) are used as the highest-priority control thresholds. When the array SOC is higher than the switch-on threshold, the switch is turned on to ensure power supply. When the array SOC is lower than the switch-off threshold, the switch is turned off to prevent overdischarge. • The minor load switch parameters (switch-on SOC/switch-off SOC) are used after the critical load switch parameters to provide the second level of protection. The array SOC shall reach a higher level before the switch can be turned on to supply power. When the SOC decreases, the minor load switch is turned off earlier than the critical load switch to implement hierarchical load shedding. • The common load switch parameters (switch-on SOC/switch-off SOC) are used with the lowest priority. The switch is turned on to supply power only when the SOC is sufficient, and is turned off first when the SOC starts to decrease, ensuring power supply to high-priority loads first. By setting **SOC for turning on common load switch** > **SOC for turning on minor load switch** > **SOC for turning on critical load switch** and **SOC**	30	10–98	
SOC for turning off critical load switch		20	10–98	
SOC for turning on minor load switch		40	10–98	
SOC for turning off minor load switch		30	10–98	
SOC for turning on common load switch		50	10–98	
SOC for turning off common load switch		40	10–98	

Parameter	Description	Default Value (%)	Maximum Value (%)	Path
	for turning off common load switch > **SOC for turning on minor load switch** > **SOC for turning off critical load switch**, a load connection/ disconnection policy based on the SOC status is established. This policy maximizes power supply reliability and ensures the stable operation of the system in different energy states. ● Hierarchical load management is supported only in the off-grid PV+ESS networking. ● In the PV+ESS+genset (genset grid forming or genset grid following) networking, only critical loads can be connected. ● When the critical load switch is connected, the critical load switch parameters (switch-on SOC/switch-off SOC) are displayed. ● When the minor load switch is connected, the minor load switch parameters (switch-on SOC/switch-off SOC) are displayed. ● When the common load switch is connected, the common load switch parameters (switch-on SOC/switch-off SOC) are displayed.			

Parameter	Description	Default Value (%)	Maximum Value (%)	Path
Generator Set Start-up Energy Storage SOC	Specifies the threshold for starting the genset. When the SOC of the ESS is lower than this value, the genset is automatically started to ensure power balance and power supply continuity. This parameter is displayed when **Generator set control** is set to **Enable**. It is supported only in the PV+ESS+genset (genset grid forming or genset grid following) networking.	20	10–98	• SmartMGC WebUI: **Settings** > **Grid Connection Control** > **ESS Control** > **ESS SOC** • SmartMGC local app: **Set** > **Microgrid Parameters** > **Microgrid**
Generator set stops energy storage SOC	Specifies the threshold for stopping the genset. When the SOC of the ESS is higher than this value, the genset is automatically stopped to ensure economical operation and maintain the optimal operating status of the ESS. This parameter is displayed when **Generator set control** is set to **Enable**. It is supported only in the PV+ESS+genset (genset grid forming or genset grid following) networking.	40	15–98	

1.5.3 Off-Grid Protection Parameter Description

To ensure stable off-grid operation, the ESS in off-grid VSG mode shall strictly comply with the protection parameters specified in **Table 1-30**.

CAUTION

Retain the default settings of the protection parameters to ensure stable system operation. If you need to adjust the settings, contact the Company's engineers.

Path for setting protection parameters:

Path on the SmartMGC WebUI:

- Protection parameters of the SmartMGC: **Settings** > **Microgrid Control** > **Advanced Control Configuration** > **Protective Relay Configuration**

- Off-grid protection parameters of the ESS: **Monitoring** > **ESS** > **Running Parameters**

Path on the SmartMGC local app:

Off-grid protection parameters of the ESS: Tap **Monitor**, select an ESS, and choose **Set** > **Power Parameters** > **Power Protection Parameters**.

Table 1-30 Protection parameter description

Working Condition	ESS	
Overvoltage protection	**Off-grid level-1 overvoltage protection threshold**	1.15 x Un[a]
	Duration threshold for off-grid level-1 overvoltage protection	15000
	Off-grid level-2 overvoltage protection threshold	1.2 x Un[a]
	Duration threshold for off-grid level-2 overvoltage protection	10500
	Off-grid level-3 overvoltage protection threshold	1.3 x Un[a]
	Duration threshold for off-grid level-3 overvoltage protection	300
	Off-grid level-4 overvoltage protection threshold	1.3 x Un[a]
	Duration threshold for off-grid level-4 overvoltage protection	300
Undervoltage protection	**Off-grid level-1 undervoltage protection threshold**	0.85 x Un[a]
	Duration threshold for off-grid level-1 undervoltage protection	10500
	Off-grid level-2 undervoltage protection threshold	0.75 x Un[a]
	Duration threshold for off-grid level-2 undervoltage protection	1000
	Off-grid level-3 undervoltage protection threshold	0.75 x Un[a]
	Duration threshold for off-grid level-3 undervoltage protection	1000
	Off-grid level-4 undervoltage protection threshold	0.75 x Un[a]

Working Condition	ESS	
	Duration threshold for off-grid level-4 undervoltage protection	1000
Overfrequency protection	**Off-grid level-1 overfrequency protection threshold**	1.08 x fn[b]
	Duration threshold for off-grid level-1 overfrequency protection	1000
	Off-grid level-2 overfrequency protection threshold	1.09 x fn[b]
	Duration threshold for off-grid level-2 overfrequency protection	800
	Off-grid level-3 overfrequency protection threshold	1.1 x fn[b]
	Duration threshold for off-grid level-3 overfrequency protection	700
	Off-grid level-4 overfrequency protection threshold	1.1 x fn[b]
	Duration threshold for off-grid level-4 overfrequency protection	700
Underfrequency protection	**Off-grid level-1 underfrequency protection threshold**	0.92 x fn[b]
	Duration threshold for off-grid level-1 underfrequency protection	1000
	Off-grid level-2 underfrequency protection threshold	0.91 x fn[b]
	Duration threshold for off-grid level-2 underfrequency protection	800
	Off-grid level-3 underfrequency protection threshold	0.9 x fn[b]
	Duration threshold for off-grid level-3 underfrequency protection	700
	Off-grid level-4 underfrequency protection threshold	0.9 x fn[b]
	Duration threshold for off-grid level-4 underfrequency protection	700
Frequency change rate protection	/	/
	/	/
	/	/

Working Condition	ESS	
	/	/
Rapid power loss detection	/	/
Note a: Rated voltage of the power grid. Note b: Rated frequency of the power grid.		

1.6 O&M

1.6.1 System Power-Off

After power-on and commissioning are complete, you can power off the system as required, and power it on and start devices when the system needs to be put into use.

Method 1: SmartMGC WebUI

Step 1 Send a shutdown command. Log in to the SmartMGC WebUI:

1. Choose **Maintenance** > **Device Management** > **Startup/Shutdown** and select the devices to be shut down.
2. Click **Shut Down** and click **Selected devices** from the drop-down list to shut down the devices.

Step 2 Power off the devices: Turn off the main power switches and then the auxiliary power switches of the devices by referring to the operations of **1.2 System Power-On** in the reverse order.

DANGER

Wear insulated gloves and use insulated tools to prevent electric shocks or short circuits.

NOTE

To prevent local operations on switches during subsequent power-on, you are advised not to turn off the auxiliary power switches.

----End

Method 2: SmartMGC local app

Step 1 Send a shutdown command. Connect the app to the SmartMGC:

1. On the home screen of the app, choose **Maintenance** > **Device management**.
2. On the **Device management** screen, tap the drop-down menu in the upper right corner.

3. Tap **Batch Control**.
4. Tap **Batch shutdown**, enter the app login password, and tap **OK**.

Step 2 Power off the devices: Turn off the main power switches and then the auxiliary power switches of the devices by referring to the operations of **1.2 System Power-On** in the reverse order.

DANGER

Wear insulated gloves and use insulated tools to prevent electric shocks or short circuits.

NOTE

To prevent local operations on switches during subsequent power-on, you are advised not to turn off the auxiliary power switches.

----End

1.6.2 Startup and Operation

In off-grid mode, the system is started through black start. For details, see **1.5.1 Black Start**.

1.6.3 Routine Maintenance

For details about the routine maintenance items of the devices involved in this solution, see the user manual or maintenance manual of the corresponding device. For details, see **F Reference Documents**.

2 Seamed On/Off-Grid Scenario (Single SmartLogger)

The seamed on/off-grid switching process is as follows: After a mains outage occurs, the AC side of the PV+ESS system shuts down, the switch between the system and the power grid is turned off, and the loads are disconnected. Then, the PCS switches from the PQ mode to the VSG mode for grid forming. After the startup is complete, the loads are connected.

NOTICE

This microgrid solution does not provide the system-level redundancy backup function. If a device fails or the ESS reaches the end-of-charge/discharge SOC, the microgrid may collapse. As this solution does not provide professional UPSs, it is not applicable to scenarios that have high requirements on uninterruptible power supply.

2.1 Solution Introduction

The seamed on/off-grid switching system applies to C&I campuses where the grid capacity is limited, capacity expansion is difficult, and power is limited during peak hours or short-term power outages occur occasionally. In scenarios such as grid faults or policy-based power rationing, the system ensures continuous and reliable power supply for critical loads.

In this system, the SmartMGC functions as the core controller of the PV+ESS system and controls the on/off-grid switch to switch between the on-grid and off-grid modes, preventing power supply interruption.

- On-grid mode: When the grid supplies power properly, the system works in on-grid mode. In this mode, both the inverter and ESS work in PQ mode and multiple economical operation policies are supported, such as peak staggering and demand management, reducing electricity costs. In addition, the system has the disaster recovery capability. You can set the backup power SOC to reserve a certain amount of power to cope with unexpected power outages and ensure off-grid emergency power supply.

- Off-grid operation: When the grid is abnormal or the system disconnects from the grid, the SmartMGC automatically detects the fault and performs on/off-grid switching. The system then enters the off-grid mode. In this mode, the ESS works in VSG mode and functions as the primary power source for grid forming to establish stable voltage and frequency support. The inverter works in PQ mode and collaborates with the ESS to provide continuous and reliable power supply for critical loads, ensuring uninterruptible power supply for key services.

NOTICE

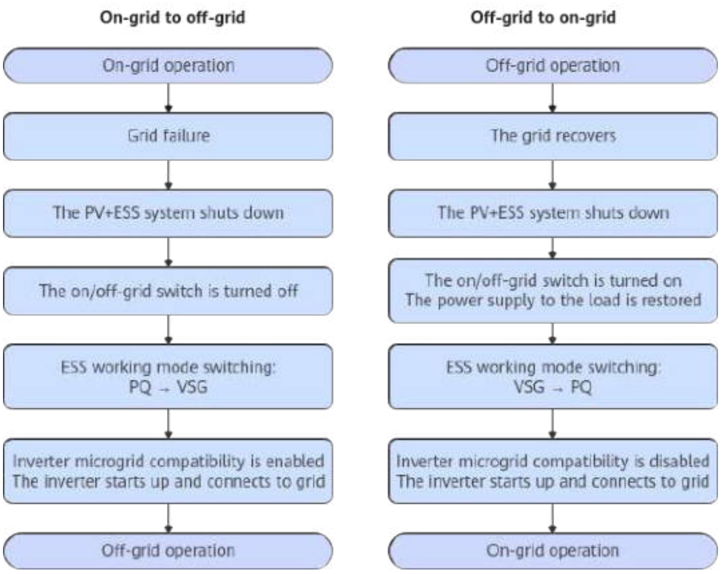
In the seamed on/off-grid switching mode, when the PV+ESS system is on-grid, do not disconnect it from the mains by turning off a switch. Otherwise, switching overvoltage may occur. You are advised to shut down the PV and ESS arrays and then disconnect the PV+ESS system from the mains if needed.

NOTE

In the seamed on/off-grid switching mode, if an ATS is available for connecting loads to the genset, the ATS may automatically perform transfer during on/off-grid switching because the SmartMGC does not detect the ATS and genset status. You can increase the ATS transfer delay to more than 15 seconds (for example, 20 seconds) to avoid overlapping with the seamed switching time. Otherwise, the ATS may be triggered or the genset may be started/shut down.

Figure 2-1 shows the on/off-grid switching process in seamed on/off-grid mode.

Figure 2-1 Seamed on/off-grid switching process



2.1.1 Solution Architecture

In the seamed on/off-grid switching system, the SmartMGC does not control the genset, but the genset can be used as the backup power supply and connected to the system through the ATS on the load side. The genset and the PV+ESS system do not run in parallel. The PV+ESS system supports low-voltage networking without transformers, low-voltage networking with isolation transformers, and medium-voltage networking with isolation transformers.

Table 2-1 Networking

Scenario	Description
Figure 2-2	If the grid voltage ranges from 380 V to 480 V, the ESS and inverter can directly connect to the grid.
Figure 2-3	If the grid voltage ranges from 200 V to 240 V, the ESS and inverter shall connect to isolation transformers to step down to low voltages (200 V to 240 V) before connecting to the grid.
Figure 2-4	If the grid voltage is greater than 480 V, the ESS and inverter shall connect to transformers to step up to medium voltages (greater than 480 V) before connecting to the grid.

In this system, the meter at the grid connection point is optional and can be deployed based on customer requirements. If the loads exceed the ESS load-carrying capacity, non-critical loads can be installed outside the on/off-grid switch. During on-grid operation, the meter monitors the power at the grid connection point.

If a genset is configured for critical loads, the genset shall be connected to the ATS on the critical load side to ensure uninterruptible power supply to critical loads.

During on-grid operation, a third-party EMS can be connected to implement power dispatch and SOC reservation for backup power. During on/off-grid switching and off-grid operation, the SmartMGC is used for control.

NOTICE

The third-party EMS performs power dispatch only during on-grid operation. Do not send other control instructions. Otherwise, on/off-grid switching failure or microgrid collapse may occur.

Figure 2-2 PV+ESS low-voltage networking without transformers

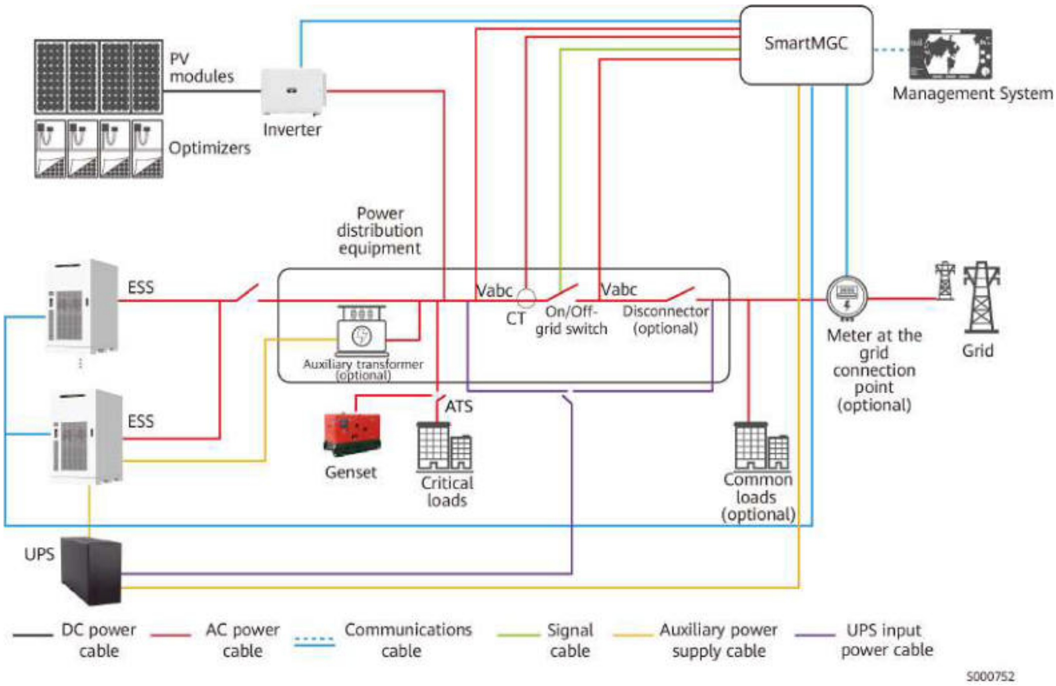


Figure 2-3 PV+ESS low-voltage networking with isolation transformers

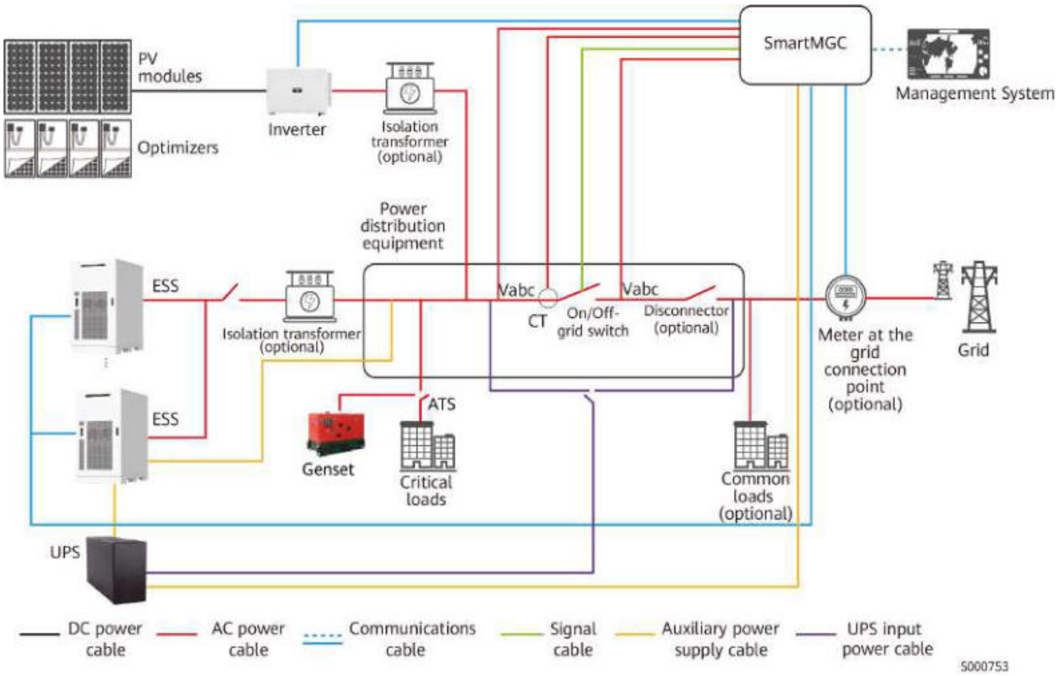
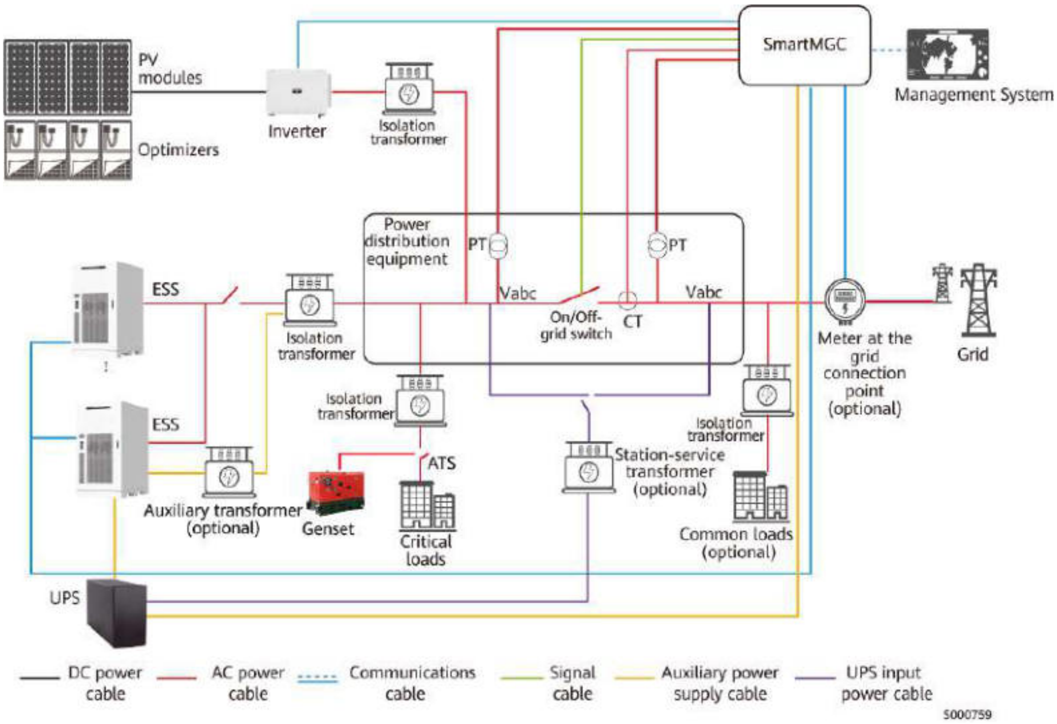


Figure 2-4 PV+ESS medium-voltage networking with transformers



Components

Table 2-2 lists the key components in the seamed on/off-grid scenario.

Table 2-2 Components in the seamed on/off-grid scenario

Name	Model/Specifications	Quantity	Remarks
Smart String Grid Forming Energy Storage System (ESS)	• LUNA2000-241-2S1-DS • LUNA2000-241-2S1 • LUNA2000-215-2S10 • LUNA2000-215-2S11 • LUNA2000-161-2S11 • LUNA2000-107-1S11	≤ 40	Purchased from the Company.
SmartMGC	SmartMGC5000B	1	Purchased from the Company.
Expansion module	SmartModule	1	Purchased from the Company (optional) The SmartModule is required when 20 to 40 ESSs are deployed.
Meter at the grid connection point	• DTSU666-HW • YDS60-80 • DHSU1079-ZT • DTSU71C	1	Purchased from the Company (optional).

Name	Model/Specifications	Quantity	Remarks
Power distribution equipment (including the on/off-grid switch)	CT	3	Prepared by the customer (optional). Current transformer (CT) specifications requirements: ● The rated current on the secondary side of the CT is 5 A, and the accuracy class is ≥ 0.5. If higher accuracy is required, the recommended accuracy class is ≥ 0.5S. ● The recommended rated load capacity of the CT is ≥ 5 VA, and the cable length between the CT and the SmartMGC is ≤ 5 m. ● The minimum rated load capacity of the CT is 2.5 VA, and the cable length between the CT and the SmartMGC is ≤ 2 m. ● The secondary side cable is a copper cable, and the cross-sectional area of the CT secondary side cable is ≥ 1.5 mm^2. If a terminal block is available, it is recommended that the cross-sectional area of the cable between the secondary side of the CT and the terminal block be ≥ 2.5 mm^2. Potential transformer (PT) specifications requirements: The rated voltage on the secondary side of the PT is 100–480 V, the accuracy class is ≥ 0.2, and only the PT in YY wiring mode is supported. It is recommended that a disconnector be used together with the PT. ● In a common three-phase measurement scenario, two groups of PTs are required to measure the
	PT	Depending on the actual networking	

Name	Model/Specifications	Quantity	Remarks
			bus voltage inside the plant and the grid voltage, respectively. ● In a medium-voltage scenario, the medium-voltage PT is required to measure the three-phase medium-voltage AC grid voltage. ● If the measured DC voltage ranges from 57.7 V to 277 V or the AC voltage ranges from 100 V to 480 V, PT connection is not required. **DANGER** ● **Installation position requirements**: The SmartMGC shall be installed inside the power distribution cabinet or box. Do not install it in an exposed position to prevent electrical safety risks caused by accidental contact. ● **Maintenance operation requirements**: Before replacing the SmartMGC or maintaining the CT/PT loop, ensure that the CT/PT loop is powered off and the CT terminal bridge is securely connected.
	On/Off-grid switch: ● Supports DI/DO signal feedback and remote control. ● Works with a switch (recommended switch-off time < 80 ms, including arc extinguishing) for automatic seamed switching. The switching time is 3–10s. ● Manual seamed switching (for example, in Japan) has no requirement on the switch-on/off time.	1	Prepared by the customer. The on/off-grid switch shall meet the local power distribution requirements.

<table>
<tr><th>Name</th><th>Model/Specifications</th><th>Quantity</th><th>Remarks</th></tr>
<tr><td rowspan="2"></td><td>Power distribution cabinet:
• For details about the dimensions, IP rating, and color, see the description of the vendor or customer requirements.
• The length of the cables from the inverter and ESS to the power distribution cabinet shall be ≥ 5 m.</td><td>1</td><td>Prepared by the customer.
NOTICE
The power distribution cabinet shall have sufficient space for installing the meter, CT, SmartMGC, auxiliary transformer, and UPS.</td></tr>
<tr><td>UPS:
• Power ≥ 1 kVA, 500 W x Number of ESSs (peak power), online UPS, 220 V AC
• Backup time ≥ 1 hour. If the system is off-grid for a long time, the backup time is ≥ 48 hours.
• To ensure reliable power supply to the UPS, it is recommended that the UPS power supply be provided from either side of the on/off-grid switch, whichever side is available, and automatically controlled by a relay.</td><td>1</td><td>Prepared by the customer. For details about the capacity configuration, see D Off-Grid UPS Capacity Configuration.
NOTICE
The specifications of the UPS must meet the power consumption requirements of the ESS auxiliary power supply.
• Dynamic performance: Transient peak power ≥ 500 W/cabinet (to cope with inrush current during device startup).
• Shutdown power consumption: ≤ 30 W/cabinet in standby mode (to reduce continuous power consumption).
• Steady-state power consumption: 30–100 W/cabinet in operating mode (to ensure basic monitoring functions).</td></tr>
</table>

Name	Model/Specifications	Quantity	Remarks
	Auxiliary transformer: ● Auxiliary transformer that converts the grid voltage to 220 V. ● Transformer capacity: 5 kVA x N (quantity of ESSs).	1	Prepared by the customer (optional). Depending on the actual networking architecture. ● When the rated AC grid voltage is > 415 V (420/440/480 V), the ESS auxiliary power supply must be a power supply connected from outside the ESS. An auxiliary transformer is added to convert the grid voltage into 220 V single-phase power and supply the power to the **MAINS** port of the ESS. ● When the rated AC grid voltage is ≤ 415 V, the **MAINS** port of the ESS can obtain power from the PCS terminal inside the ESS or from a power supply outside the ESS. The auxiliary transformer is not required (except for the 220 V single-phase grid in Japan).
	Isolation transformer/ Transformer: ● Supports the grid frequency of 50/60 Hz. ● Matches the ESS capacity in an array. ● Supports long-term stable operation carrying loads of 1.1 times its rated capacity.	1	Prepared by the customer (optional). Depending on the actual networking architecture. Applies to low-voltage isolation transformer or medium-voltage transformer scenarios. The ESS is connected to the transformer in three-phase four-wire mode to ensure a safe and stable connection between the ESS and the grid.

Name	Model/Specifications	Quantity	Remarks
Management system	-	1	The management system displays the real-time and historical running status of the plant comprehensively and provides customers with intelligent alarm reporting, analysis, diagnosis, and O&M functions to improve power generation efficiency, reduce O&M costs, implement refined management, optimize operation, and increase potential benefits.
Disconnector	Configured based on the capacity of the grid connection point.	1	Prepared by the customer (optional). Depending on the actual networking architecture. When repairing the on/off-grid switch, disconnect the microgrid from the grid to implement physical isolation for safety.
Genset	Three-phase	1	Prepared by the customer (optional). Depending on the actual networking architecture. The genset is connected to the ATS on the load side. The SmartMGC does not control the genset. The ATS independently controls the genset. To prevent ATS misoperations or genset startup or shutdown during PV+ESS switching, you are advised to set the ATS switching delay to more than 15 seconds (for example, 20 seconds) to avoid the time window of seamed PV+ESS switching.
ATS	Dual power supply switching device	1	

NOTE

If inverters and optimizers are involved in the networking, see **A Inverter and Optimizer Models** for the specific model list.

2.1.2 Communication Networking

One SmartMGC manages multiple ESSs, multiple inverters, and one meter at the grid connection point to form an array. In the array:

- The SmartMGC communicates with the ESSs over FE or optical fibers in star or ring topology.
- The inverters communicate with the SmartMGC over RS485 or MBUS.
- The meter communicates with the SmartMGC over RS485.

The maximum communication distances of the SmartMGC are as follows:

- RS485: 1000 m
- FE: 100 m
- Optical fiber: 12000 m (100M optical module)

Communication networking selection criteria: In actual networking, select a proper networking mode from the following typical scenarios based on the quantity of ESSs in the array and whether optical fiber deployment is supported.

Typical Scenario 1: FE Ring Topology (0–20 ESSs)

This topology is recommended when 0 to 20 ESSs are deployed and no optical fiber is used. In this scenario, the SmartMGC5000B is required.

- One FE ring network in the PV+ESS system supports a maximum of 20 ESSs.
- The ESSs are connected through FE communications ports (WAN1/LAN1 and WAN2/LAN2).
- The FE network cable shall meet the following technical specifications: CAT 5E outdoor shielded network cable, internal resistance ≤ 1.5 ohms/10 m, cable cross-sectional area (outer diameter) ≤ 9 mm, and shielded RJ45 connector.

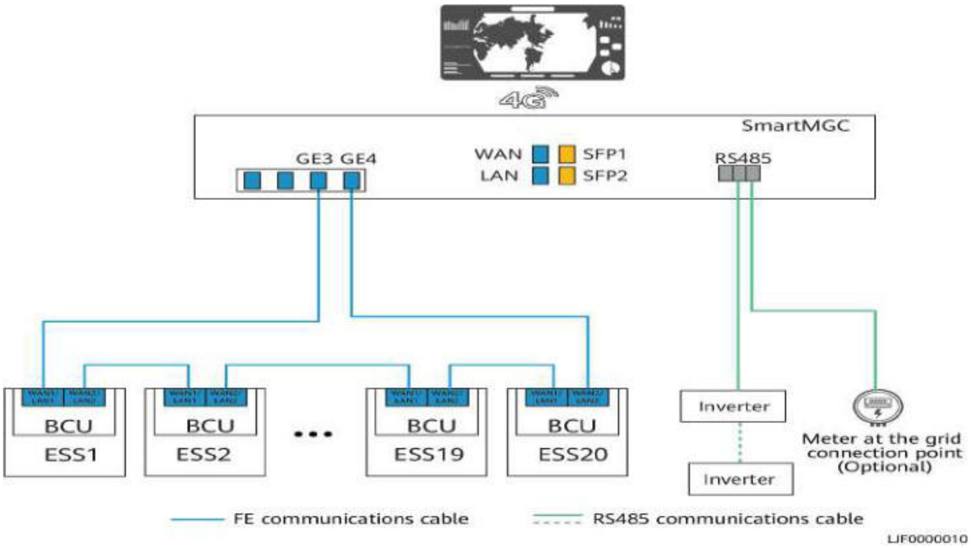
NOTICE

If the ESS FE ring topology is implemented, the ESSs must be connected to the GE3 and GE4 ports of the SmartMGC and **ESS ring network** shall be set to **GE3+GE4**. Otherwise, the SmartMGC cannot communicate with the ESSs properly.

Path for setting **ESS ring network**:

- App: **Set** > **Comm. parameters** > **Wired Network** > **Network Configuration**
- WebUI: **Settings** > **Port Settings** > **Ethernet** > **Network Configuration**

Figure 2-5 FE ring topology



Typical Scenario 2: Fiber Ring Topology (0–20 ESSs)

This topology is recommended when 0 to 20 ESSs are deployed and optical fibers are used. In this scenario, the SmartMGC5000B is required.

- One fiber ring network supports a maximum of 20 ESSs.
- One SmartMGC in the PV+ESS system supports a maximum of 20 ESSs.
- The ESSs are connected through optical fiber ports (TX1-SFP1-RX1 and RX2-SFP2-TX2).
- The optical fiber cables are provided by the customer and shall meet the following technical specifications: four-core or eight-core single-mode armored optical fiber cable with a transmission wavelength of 1310 nm and an outer diameter of ≤ 18 mm.

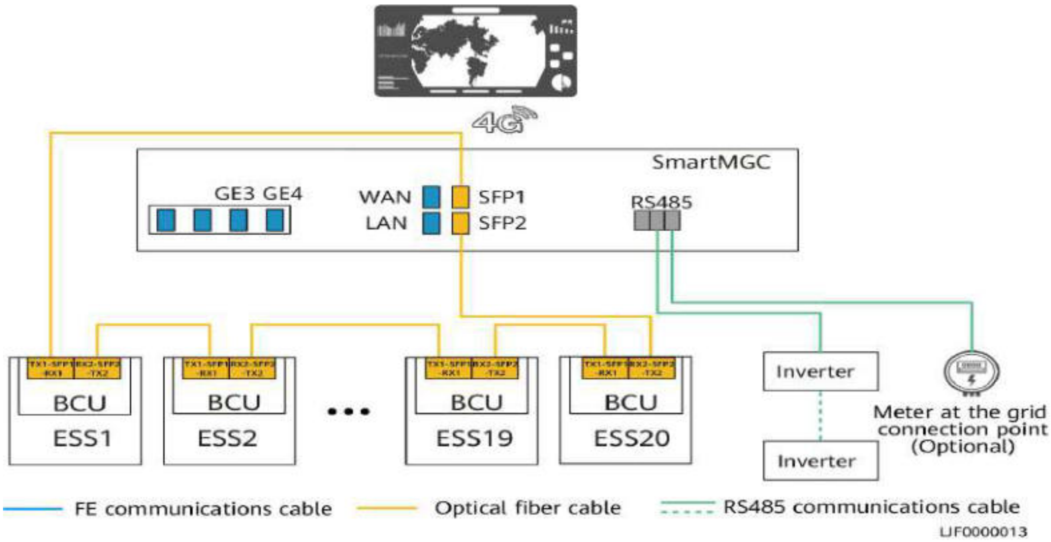
NOTICE

If the ESS fiber ring topology is implemented through the SmartMGC, set **ESS ring network** to **SFP1+SFP2**. Otherwise, the SmartMGC cannot communicate with the ESSs properly.

Path for setting **ESS ring network**:

- App: **Set** > **Comm. parameters** > **Wired Network** > **Network Configuration**
- WebUI: **Settings** > **Port Settings** > **Ethernet** > **Network Configuration**

Figure 2-6 Fiber ring topology



Typical Scenario 3: FE Ring Topology (20–40 ESSs)

This topology is recommended when 20 to 40 ESSs are deployed and no optical fiber is used. In this scenario, the SmartMGC5000B is required.

- In this scenario, the SmartModule is required to extend ports of the SmartMGC, supporting the connection of multiple devices.
- One FE ring network supports a maximum of 20 ESSs.
- The ESSs are connected through FE communications ports (WAN1/LAN1 and WAN2/LAN2).
- The FE network cable shall meet the following technical specifications: CAT 5E outdoor shielded network cable, internal resistance ≤ 1.5 ohms/10 m, cable cross-sectional area (outer diameter) ≤ 9 mm, and shielded RJ45 connector.

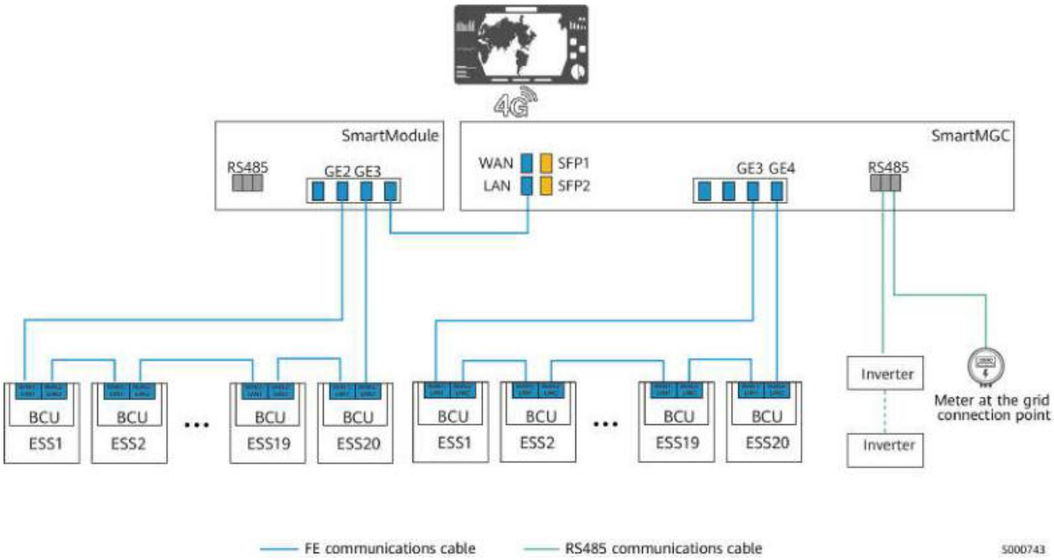
NOTICE

If the ESS fiber ring topology is implemented through the SmartMGC, set **ESS ring network** to **SFP1+SFP2**. Otherwise, the SmartMGC cannot communicate with the ESSs properly.

Path for setting **ESS ring network**:

- App: **Set** > **Comm. parameters** > **Wired Network** > **Network Configuration**
- WebUI: **Settings** > **Port Settings** > **Ethernet** > **Network Configuration**

Figure 2-7 FE ring topology (20–40 ESSs)



2.1.3 Electrical Connections

NOTICE

The power distribution and electrical connections of the PV+ESS system must comply with the installation regulations of the devices and the country or region where the devices are located. The following wiring diagrams show the connections between devices and are for reference only. In actual applications, design the wiring diagrams based on the local power distribution regulations.

The seamed on/off-grid scenario supports multiple types of earthing systems, each with different earthing requirements. For details, see **Table 3-3**.

Table 2-3 System earthing requirements and switch pole selection

Earthing System	PE Wire (Protective Earthing) Requirement	Neutral Wire (Functional Earthing) Requirement	On/Off-grid Switch Pole Selection
TN-C	The PE wire on the load or device side (such as the ESS and inverter) is connected to the PEN wire of the power distribution system.	● The PEN wire of the power distribution system must be grounded and does not require residual current protection. ● The neutral wire on the device side (such as the ESS and inverter) must be connected to the PEN wire of the power distribution system. ● The specifications of the PEN wire and neutral wire shall be the same as those of the general power cables.	3-pole switch.

Earthing System	PE Wire (Protective Earthing) Requirement	Neutral Wire (Functional Earthing) Requirement	On/Off-grid Switch Pole Selection
TN-S	The PE wire on the load or device side (such as the ESS and inverter) is connected to the PE wire of the power distribution system.	• The neutral wire of the power distribution system must be grounded. • The neutral wire on the device side (such as the ESS and inverter) must be connected to the neutral wire of the power distribution system. • The specifications of the neutral wire shall be the same as those of the general power cables.	During off-grid operation, the method of handling the neutral wire (depending on the local grid requirements) determines the quantity of poles of the on/off-grid switch. • Keep the neutral wire connected: Use a 3-pole switch or a 4-pole switch without connecting the neutral wire. • Disconnect the neutral wire: A 4-pole switch must be used.
TN-C-S	The upstream power supply side (from the PV +ESS+genset to the AC bus section of the power distribution system) uses the TN-C system. After the power supply is routed into the customer's system, the PE wire is separated from the PEN wire to form the TN-S system. The PE wire and neutral wire on the load side are connected to the PE wire and neutral wire after the power supply is routed into the customer's system, respectively.		
TT	The PE wire on the load or device side (such as the ESS and inverter) is grounded locally and is not connected to the neutral wire of the power distribution system.		

Earthing System	PE Wire (Protective Earthing) Requirement	Neutral Wire (Functional Earthing) Requirement	On/Off-grid Switch Pole Selection

			NOTICE
			● If a 4-pole switch is used, the neutral wire and PE wire of the power distribution system shall be connected to the earthing grid outside the cabinet, respectively. Do not short-circuit the two wires inside the cabinet.
			● To prevent the **PCS Grounding Abnormal** alarm from being triggered and the ESS from shutting down due to system earthing failure caused by the disconnection of the neutral wire after the 4-pole switch is turned off, a dedicated earthing switch shall be installed on the microgrid side and electrically linked with the 4-pole switch:
			  ● When the 4-pole switch is turned off (the system enters off-grid mode), the earthing switch will be turned on to ground the neutral wire on the microgrid side.
			  ● When the 4-pole switch is turned on (the system enters on-grid mode), the earthing switch will be turned off to ensure that the microgrid system is grounded through the neutral wire on the grid side.

IT	-	The ESS is connected to the isolation transformer in three-phase four-wire mode. The neutral wire of the ESS is connected to the neutral point of the isolation transformer, and the neutral point on the ESS side of the isolation transformer shall be grounded.	3-pole switch.

Table 2-4 Characteristics of the control loop for the on/off-grid switch

Switch Type	Characteristics of the Switch Control Loop	Reference Diagram
Common low-voltage switch	The switch DI is integrated with a power supply (wet contact) to implement on/off-grid switching in 60–150 ms.	Figure 2-9
	The switch DI is not integrated with a power supply (dry contact) and shall be powered externally to implement on/off-grid switching in 60–150 ms.	Figure 2-10 Figure 2-11 Figure 2-8 Figure 2-12 Figure 2-13
Common medium-voltage switch	The switch DI is not integrated with a power supply (dry contact) and shall be powered externally to implement on/off-grid switching in < 200 ms.	Figure 2-14

Figure 2-8 PV+ESS low-voltage networking without transformers (TN-C, with 3-pole ACB)

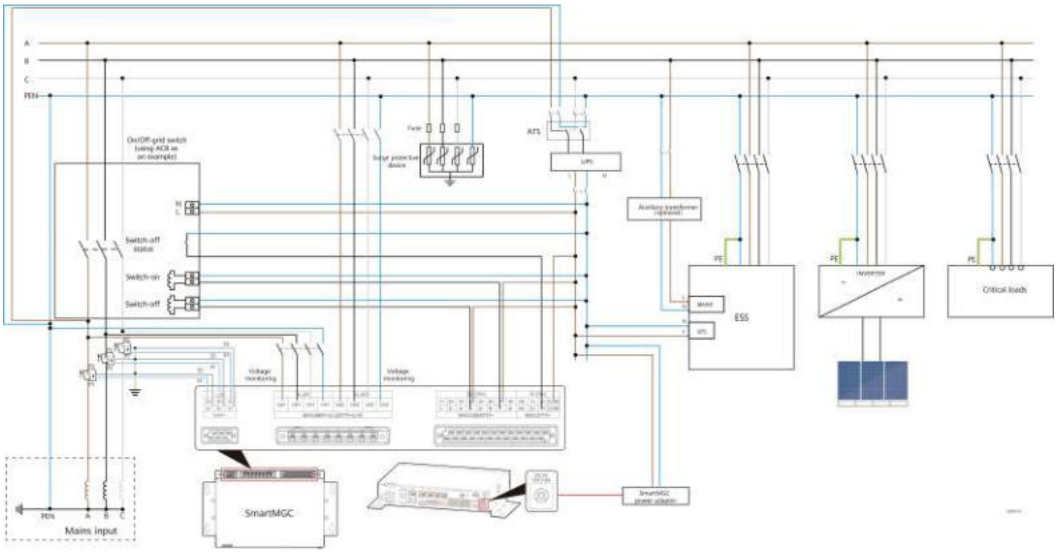


Figure 2-9 PV+ESS low-voltage networking without transformers (TN-S, with 4-pole MCCB)

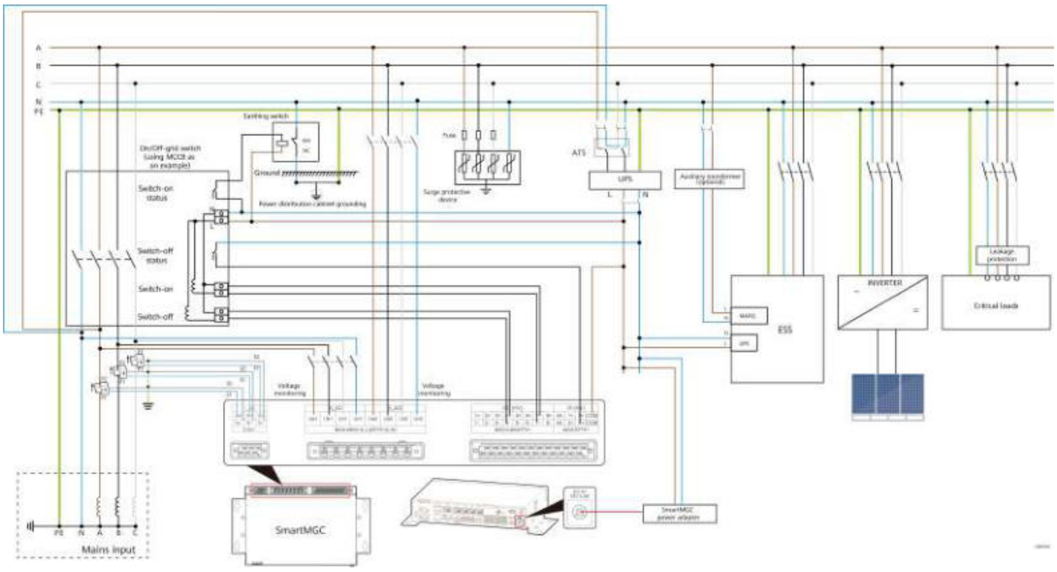


Figure 2-10 PV+ESS low-voltage networking without transformers (TN-S, with 4-pole ACB)

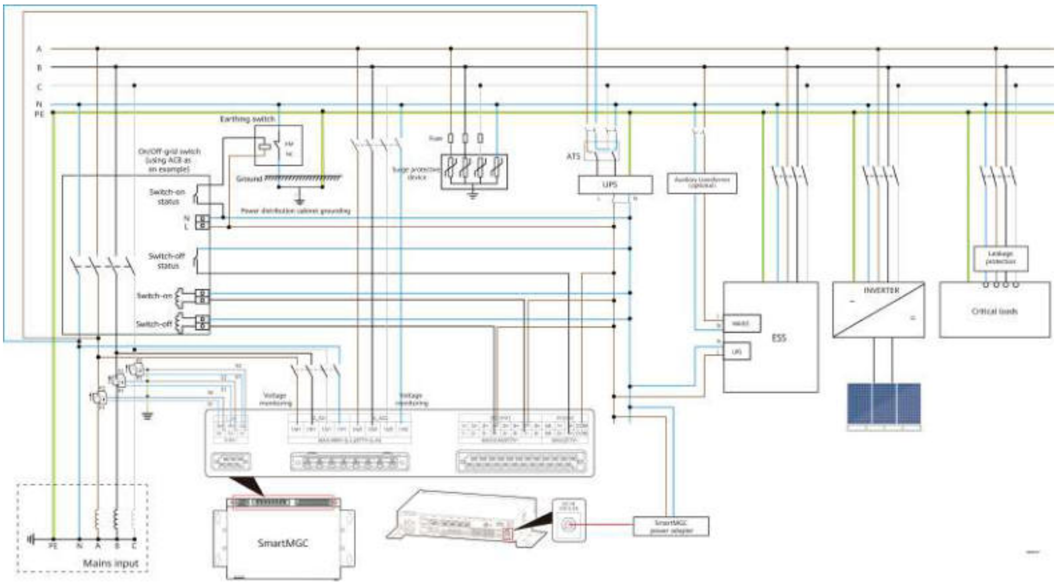


Figure 2-11 PV+ESS low-voltage networking without transformers (TN-C-S, with 4-pole ACB)

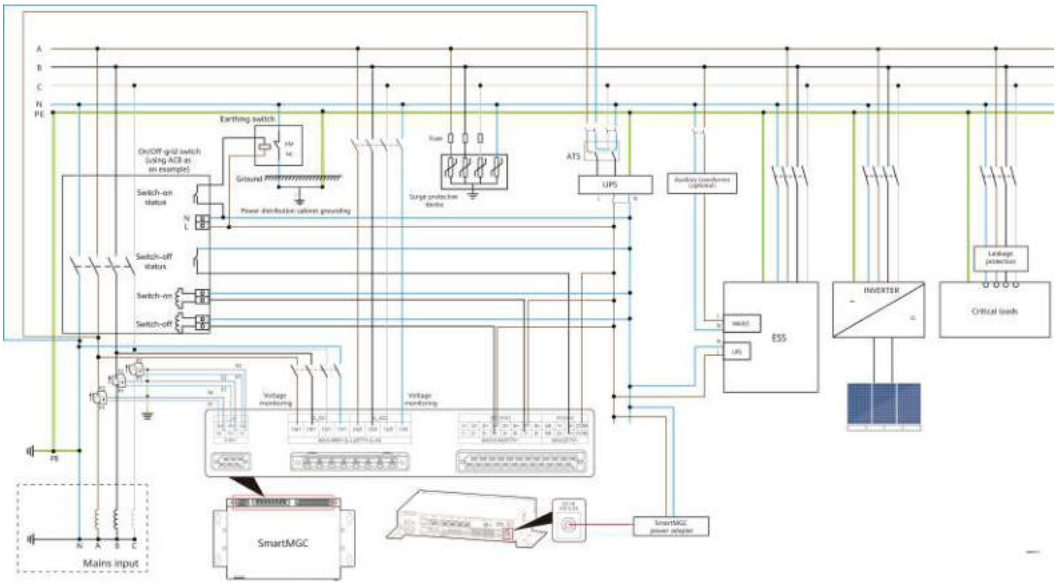


Figure 2-12 PV+ESS low-voltage networking without transformers (TT, with 3-pole ACB)

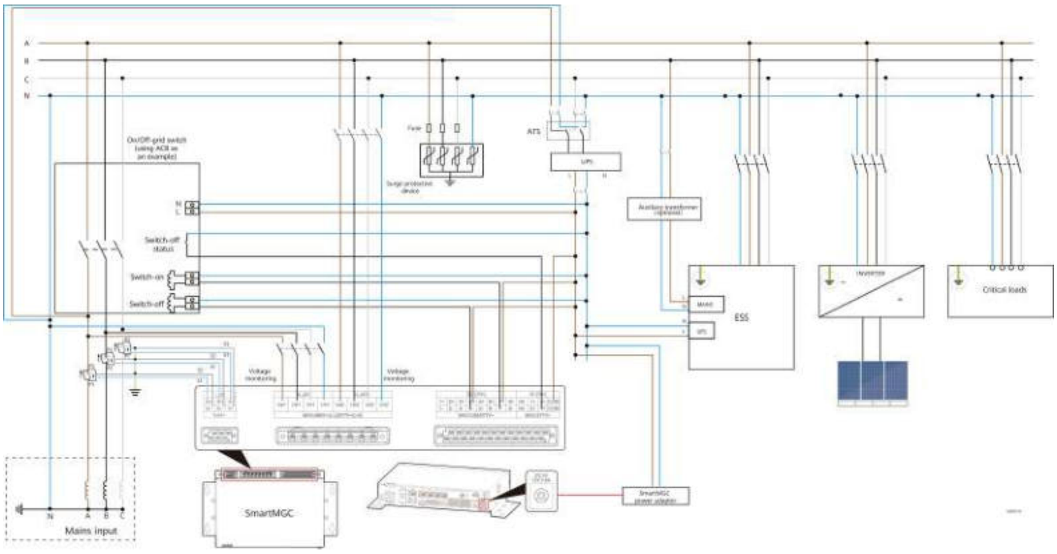


Figure 2-13 PV+ESS low-voltage networking with isolation transformers (TN-S, with 3-pole ACB)

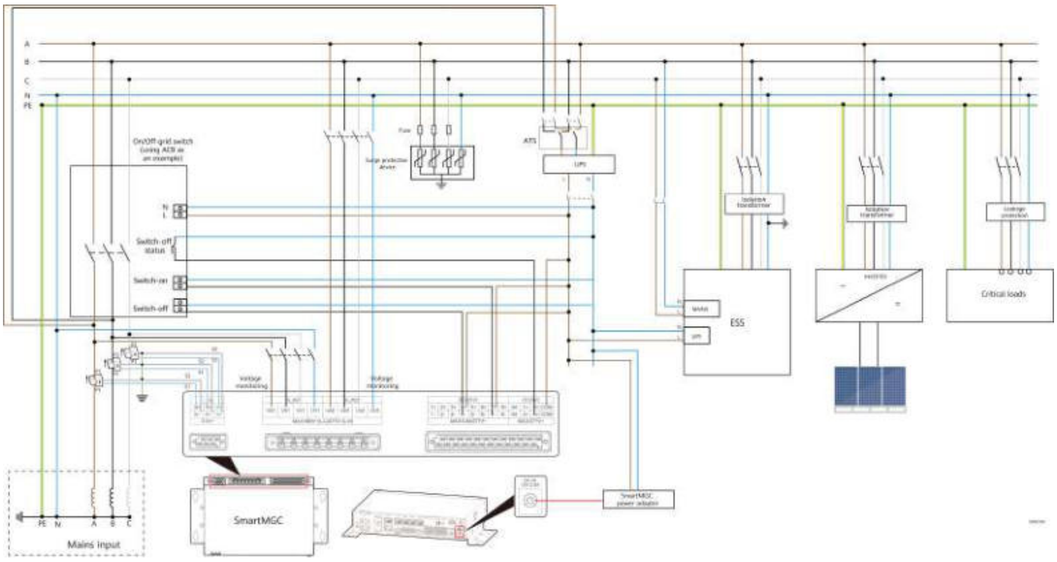
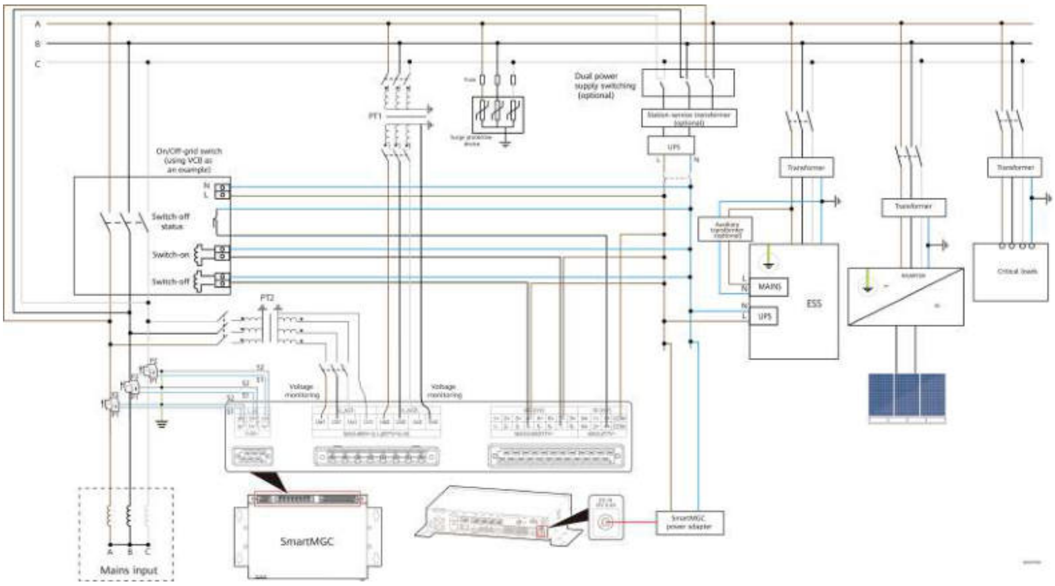


Figure 2-14 PV+ESS medium-voltage networking with transformers



The electrical connections are described as follows:

- The DO7(HV) port of the SmartMGC controls the on/off-grid switch to switch on.
- The DO4(HV) port of the SmartMGC controls the on/off-grid switch to switch off.
- The DI4(HV) port (recommended) of the SmartMGC receives the actual working status of the on/off-grid switch to monitor the on-grid or off-grid status of the grid connection point.
- (Optional) The DO1(HV) and DO2(HV) ports of the SmartMGC control the critical load switch to switch on and off.

- (Optional) The DI1(HV) (recommended) port of the SmartMGC receives the actual working status of the critical load switch to monitor whether the critical loads have power supply.
- The two power supplies for UPS are automatically switched to ensure the power supply of the UPS in on-grid and off-grid operations.

NOTE

If the default DI ports are not available for onsite cable connection, configure the required DI ports in **Settings** > **Microgrid Control** > **General Basic Settings** on the SmartMGC WebUI.

2.1.4 Application Constraints

For details about the application constraints in the seamed on/off-grid scenario, see **DI/DO Specifications of the SmartMGC**, **Loading Capability Constraints**, and **PV-to-ESS Ratio Constraints**.

DI/DO Specifications of the SmartMGC

NOTICE

High-voltage DI/DO specifications:

- The pulse current capability of DO1(HV) to DO8(HV) is ≤ 5 A @ 200 ms.
- The switch-off control loop of DO8(HV) can operate at DC voltage (12–220 V).
- The control loop of DO1(HV) to DO7(HV) can operate at AC voltage (100–277 V) or DC voltage (12–30 V).
- The DO(HV) and DI(HV) ports are dry contacts. The DO(HV) ports control the switch-on and switch-off of the on/off-grid switch and load switch through pulse signals.
- The switch status feedback loop of DI4(HV) can operate only at 100 V/220 V/230 V/277 V AC voltage or 110 V/220 V DC voltage.

Low-voltage DI/DO specifications:

- DI port: supports passive dry contact signals.
- DO port: supports 12 V DC operating voltage for the control loop.

This section uses the high-voltage DI port as an example. If a low-voltage DI port is required, note that the low-voltage DI port is designed as a wet contact (with an internal power supply) and shall be connected to passive dry contact signals. Do not connect other power supplies to the external loop.

Table 2-5 DI/DO Specifications of the SmartMGC

Port	Port Description	AC Control Loop	DC Control Loop (12–30 V)	High-Voltage DC Control Loop (110 V, 220 V)
DO1(HV)	Turns on the critical load switch.	√	√	Signal conversion using an intermediate relay: The DO output signal of the SmartMGC is converted into a high-voltage DC control signal through an intermediate relay.
DO2(HV)	Turns off the critical load switch.	√	√	
DO4(HV)	Turns off the switch at the grid connection point (common port).	√	√	
DO7(HV)	Turns on the switch at the grid connection point (fast port).	√	√	
DI1(HV)[a] (recommended)	Reports the Off state of the critical load switch.	√	Signal conversion using an intermediate relay: The status signal sent from the external device is converted into a high-voltage DC feedback signal or AC feedback signal through an intermediate relay.	√
DI4(HV)[a] (recommended)	Reports the Off state of the switch at the grid connection point.			
Note a: If the default DI ports are not available for onsite cable connection, configure the required DI ports in **Settings** > **Microgrid Control** > **General Basic Settings** on the SmartMGC WebUI.				

Loading Capability Constraints

The loading capability of the ESS varies depending on the load type. For details, see **Table 2-6**.

⚠ CAUTION

The load specifications shall meet the loading capability constraints. If the loading capability constraints are exceeded, the device may shut down due to overload protection when the grid or load fluctuates.

Table 2-6 Loading capability constraints

Type	Specifications	Remarks
Total load	≤ (2/3) x Pn[a].	• Single-phase rated capacity = (1/3) x Pn. • Load of each phase ≤ (2/3) x Single-phase rated capacity, that is, Load of each phase ≤ (2/3) x (1/3) x Pn. • Total load of LUNA2000-107-1S11 ≤ (3/5) x Pn.
Non-linear load	• Half-wave rectification load ≤ (1/20) x Pn. • The total current harmonics of loads comply with specifications or standards..	-
Unbalanced load	• No load to two phases: ≤ (2/3) x (2/3) x Pn. • No load to one phase: ≤ (2/3) x (1/3) x Pn.	• Single-phase rated capacity = (1/3) x Pn. • Load of each phase ≤ (2/3) x Single-phase rated capacity, that is, Load of each phase ≤ (2/3) x (1/3) x Pn.
Motor load	• Load of motors that use direct on line (DOL) starters, star-delta starters, or soft starters ≤ (1/10) x Pn. • Load of motors that use star-delta starters ≤ (1/5) x Pn. • Load of motors that use variable frequency drives ≤ (2/3) x Pn.	• If there are other basic loads, the load of motors to be connected and disconnected shall be decreased accordingly in the same proportion. (The inrush current of the asynchronous motor startup shall be ≤ 8 x Rated current. Otherwise, you are advised to add a frequency converter.) • If there are asynchronous motor loads and common non-impact loads in the system, the load capacity is calculated as follows: [A x 10 + (3/2) x B] ≤ Pn. – A: load capacity of the asynchronous motor – B: other common load capacity

<table>
<tr><th>Type</th><th>Specifications</th><th>Remarks</th></tr>
<tr><td>Capacity of transformer switch-on/off</td><td>≤ 1.2 x Pn.</td><td>-</td></tr>
<tr><td>Dynamic load of the medium-voltage cascaded system</td><td>After the medium-voltage cascaded transformer establishes a stable voltage (excluding the power on the medium-voltage line), the dynamic load shall meet the following requirements:
● Balanced resistive load (R load) step
– Supported condition: ≤ 50% balanced R load step.
– Performance requirements:
– Within 20 ms after the step: The root-mean-square (RMS) value deviation of the PCS output voltage is ≤ ±30% x Un[b].
– After 20 ms: The RMS value of the output voltage recovers to a steady-state voltage deviation of ≤ ±10% x Un.
● Balanced inductive/capacitive load (L/C load) step
– Supported conditions:
– ≤ 40% balanced inductive load (L load) step.
– ≤ 20% balanced capacitive load (C load) step.
– Performance requirement: The system shall remain connected to the grid during the step.
● Unbalanced RLC load step
– Supported conditions: The total load step of a single phase or two phases is ≤ 20%.
– Performance requirement: The system shall remain connected to the grid during the step.</td><td>-</td></tr>
<tr><td colspan="3">Note a: Pn is the rated capacity of the ESS.
Note b: Un is the steady-state voltage of the system after the step.</td></tr>
</table>

PV-to-ESS Ratio Constraints

The maximum PV-to-ESS ratio varies depending on the ESS model and configuration. For details, see **Table 2-7**.

Table 2-7 Maximum PV-to-ESS ratio for different ESS models

Model	Maximum PV-to-ESS Ratio
LUNA2000-241-2S1-DS	2:1
LUNA2000-241-2S1	2:1
LUNA2000-215-2S10	2:1
LUNA2000-215-2S11	2:1
LUNA2000-161-2S11	1.8:1
LUNA2000-107-1S11	1.2:1

NOTE

The following conditions must be met for mixed use of ESS models with different C-rates:

- A maximum of two models can be used together.
- Preferentially configure the model with more battery packs. If the capacity needs to be supplemented, use a model with fewer battery packs (161 kWh or 107 kWh).
- The PV-to-ESS ratio and loading capability are configured based on the rated power of the model with more battery packs.
- In on-grid (PQ) mode, the system operates at the minimum C-rate. (Choose **Settings** > **Grid Connection Control** > **ESS Control** > **Control Mode** > **ESS Parameters** and set **Scheduling mode** to **Energy first**)

Examples:

Assume that x units of the 215 kWh model and y units of the 107 kWh model are configured. The following conditions shall be met:

- $x \geq y$
- The loading capability is (x * 108 kW * 2/3).
- The maximum PV capacity is (x * 108 kW * 2).
- In on-grid mode, the system operates at 0.5CP. (Choose **Settings** > **Grid Connection Control** > **ESS Control** > **Control Mode** > **ESS Parameters** and set **Scheduling mode** to **Energy first**.)

2.2 System Power-On

DANGER

Wear personal protective equipment (PPE) strictly as required and use insulated tools to prevent electric shocks or short circuits.

CAUTION

During the power-on procedure, monitor the system for faults. If you detect any faults, power off the ESS, rectify the faults, and then continue with the procedure.

In the seamed on/off-grid scenario, power on the system when an external power supply is available. Before power-on, perform the check by referring to the "Check Before Power-On" section in the user manual of each device.

Figure 2-15 Power-on process

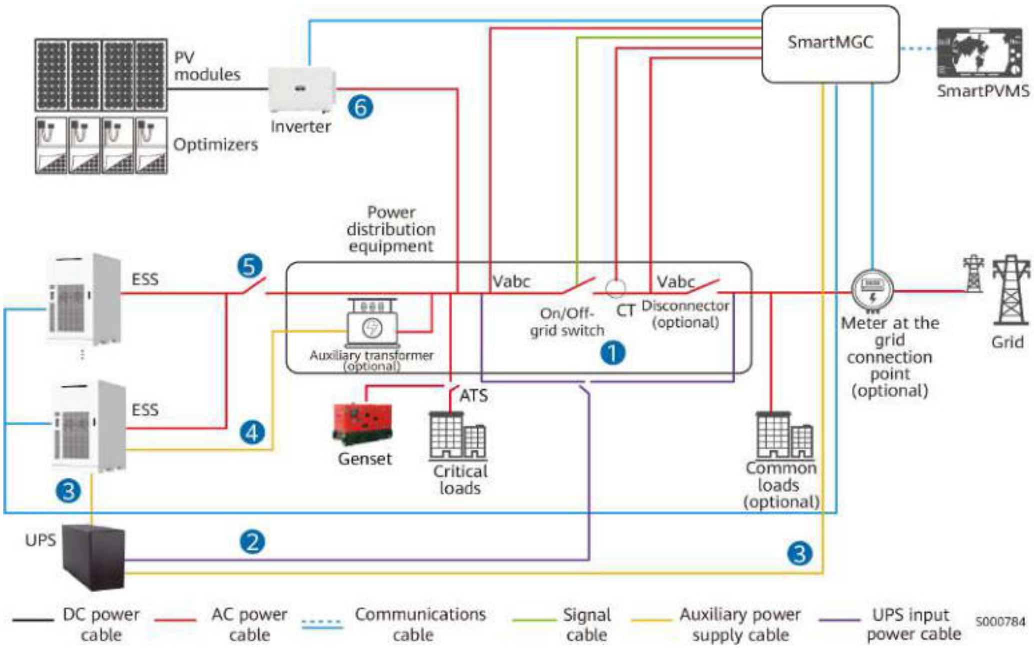


Table 2-8 Power-on process description

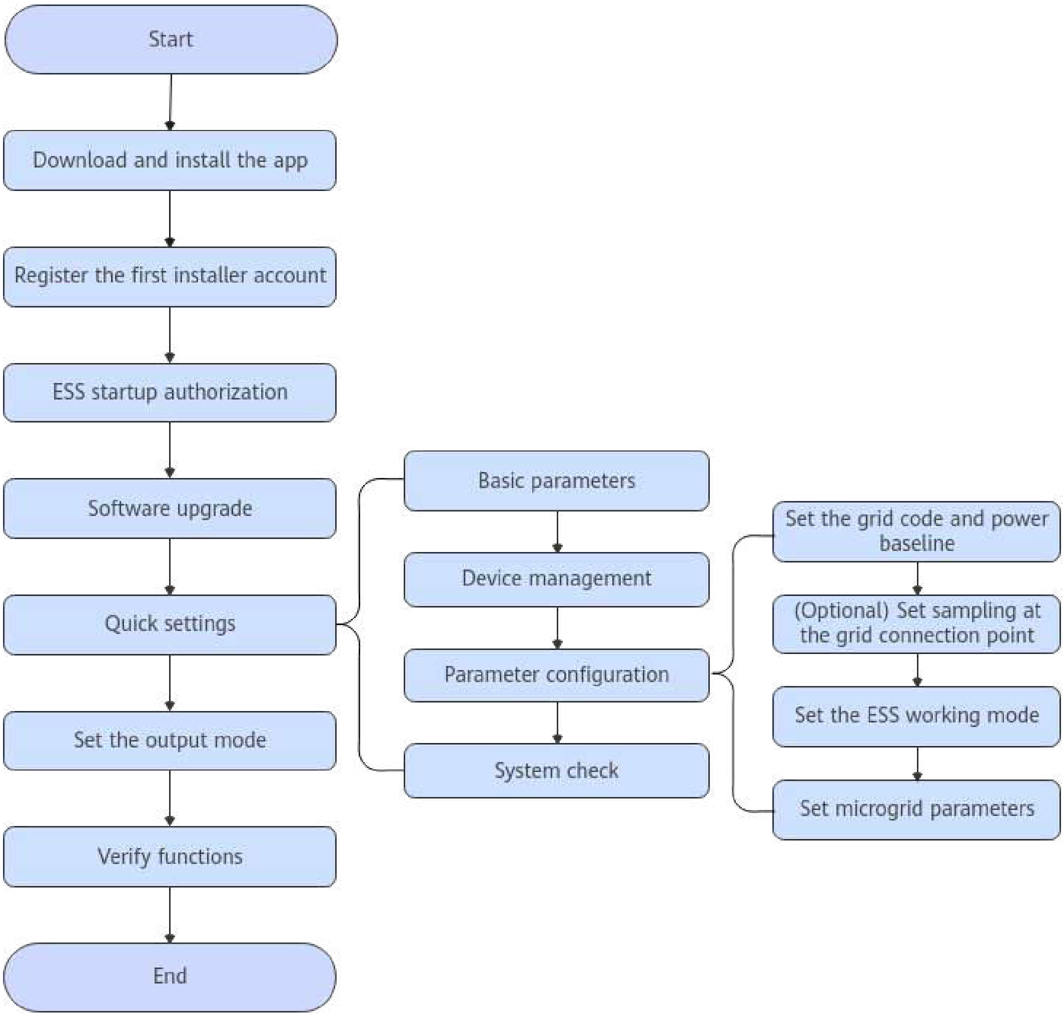
Step	Task	Power-On Operation
1	Powering on the power distribution equipment	Turn on the on/off-grid switch in the power distribution equipment.
2	Powering on the UPS	1. Turn on the UPS power switch on the power distribution equipment side. 2. Start the UPS.
3	Powering on the UPS-SmartMGC auxiliary power supply	1. Turn on the SmartMGC power switch on the UPS side. 2. Turn on the power switch (if any) between the SmartMGC and the UPS.
	Powering on the UPS-ESS auxiliary power supply	For details, see **Power-On Operations**. **CAUTION** Before powering on the ESS auxiliary power supply (for LTMS and other devices), remove the jumper bar from 1–2 and insert it into 2–3 on the XT terminal block, and remove the jumper bar from 4–5 and insert it into 5–6 on the XT terminal block. Otherwise, the auxiliary power supply will fail.
4	Powering on the ESS auxiliary power supply (for LTMS and other devices)	
5	Powering on the ESS AC side	

Step	Task	Power-On Operation
6	Powering on the inverter	**If an inverter is involved in the networking, select a power-on method based on the inverter model:** **Method 1:** 1. Set the DC SWITCH to ON. When you hear a click, the switch is completely turned on. 2. Check that the indicators are not steady red. **Method 2:** 1. Set the DC SWITCH 1 (MAIN SWITCH) to ON. When you hear a click, the switch is completely turned on. 2. Check the status of the PV connection indicator. If it is steady green, set DC SWITCH 2 and DC SWITCH 3 to ON. 3. Check that other indicators are not steady red.
Note: For details about the switch layout and operations of the devices prepared by the customer, see the documents provided by the vendors.		

2.3 Deployment and Commissioning

This section describes how to connect to the SmartMGC locally using the app to complete the deployment and commissioning process. For details, see **Figure 2-16**.

Figure 2-16 Commissioning process in the seamed on/off-grid scenario



2.3.1 Preparations and App Login

2.3.1.1 Downloading and Installing the App

NOTICE

The mobile phone operating system must be Android 8.0, iOS 13.0, or later. (iPhone 6 or later is supported for the iOS version.)

Scan the following QR code to download and install the app.

NOTE

If you select **Download via the Browser** and a security warning message is displayed indicating that the app is from an external source, tap **ALLOW**.

2.3.1.2 Registering the Company's First Installer Account

Context

When you register the first installer account, a company is registered at the same time.

Procedure

1. On the app login screen, tap **No account?**.
2. On the **Role** screen, tap **I'm an installer** and complete the registration as prompted.

2.3.1.3 Logging In to the App

After the app is correctly installed on a mobile phone, you can access the management system through the app.

Logging In to the App

1. On the mobile device, tap the app icon to access the login screen.
2. On the app login screen, enter the account information and tap **Log In**.

NOTE

- If a new user logs in to the app for the first time or a user logs in to the app for the first time after the password is reset, change the login password as prompted.
- If a user enters incorrect passwords for five consecutive times within 5 minutes, the account will be locked for 30 minutes. The user can log in again after the lockout period expires or contact the installer or administrator to unlock the account.
- 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. In these cases, the Company shall not be liable for any loss.

2.3.1.4 Setting ESS Startup Authorization

Prerequisites

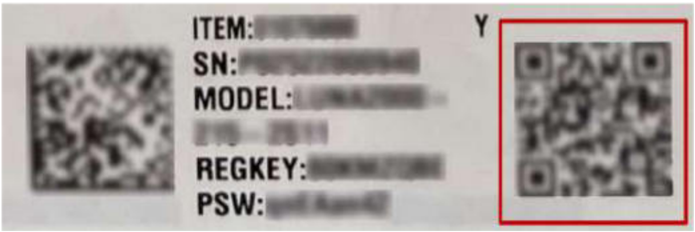
- Install the ESS and connect cables by referring to the sections of **Site Selection Requirements** and **Installing Cables** of the ESS. Failure to meet these requirements may result in the startup password not being issued. As a result, the ESS cannot be started.
- The WLAN function has been enabled on the mobile phone.
- Before connecting your mobile phone to the WLAN (or WiFi) of the ESS, ensure that the ESS is powered on and the ESS initialization is complete (the WLAN indicator is steady on).
- The mobile phone is within 5 m of the device. Otherwise, the communication quality between the app and the device may be poor.

Procedure

Figure 2-17 ESS startup authorization procedure

1. Obtain the **Verification code**.
   a. Log in to the app, scan the WLAN QR code on the ESS (the QR code on the right of the SN on the device), and connect to the WLAN of the ESS.

   Figure 2-18 QR code example (for reference only; the actual QR code on the device prevails)

   NOTE

   - For the first connection to the device WLAN, log in with the initial password. You can obtain the initial WLAN password from the device label, that is, the characters following "PSW".
   - 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 device WLAN. The WLAN name of the device consists of "device name-SN".
   - If **This WLAN network has no Internet access. Connect anyway?** message is displayed when you connect to the device WLAN, tap **CONNECT**. Otherwise, you cannot log in to the system. The actual UI and messages may vary with mobile phones.

   b. Log in to the local screen of the ESS as the **installer** user, and obtain **Verification code**.

   NOTE

   Set the password as prompted at the first login.

2. Apply for the **Startup password**.

   Contact the device vendor or its authorized supervision service provider to apply for the **Startup password** using the **Verification code** on the Power-Partner app.

3. Enter the **Startup password** to complete the ESS startup authorization.

a. (Optional) If the app is disconnected from the ESS, use the app to scan the WLAN QR code on the ESS to log in to the local screen of the ESS as the **installer** user.
b. Enter the **Startup password** and tap **Authorized**.

NOTE

Ensure account security by changing the password periodically. 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.

2.3.1.5 Updating the Software Version

NOTICE

Only the currently connected SmartMGC and its subordinate devices can be updated.

Prerequisites

- Ensure that you have completed the ESS startup authorization before updating the software version to prevent update failures or system alarms.

Downloading the Update Package (from the FusionSolar Software Download Website)

1. Log in to the **FusionSolar Software Download** website using the product customer account on a PC and download the latest software packages of the SmartLogger and ESS.

   NOTE

   To protect software integrity, mitigate the risk of software package implantation or tampering, and enhance software supply chain safety, you are advised to install **ICS Lite** on your PC, which can automatically verify the digital signature of the software package.

   Table 2-9 Software download paths

Device	Path
SmartLogger	**SmartLogger5000B**
ESS	**LUNA2000B**

2. After downloading the software update packages from the website, import them from the PC to the mobile phone where the update is to be performed.

Updating the Device Version (App)

1. Scan the WLAN QR code on the SmartMGC to connect to its WLAN.
2. Log in to the local commissioning screen and choose **Maintenance** > **Upgrade device**.

3. On the **Select device** screen, select the devices to be updated.
4. Tap **Select Update Package** under each device and select the update package as prompted.

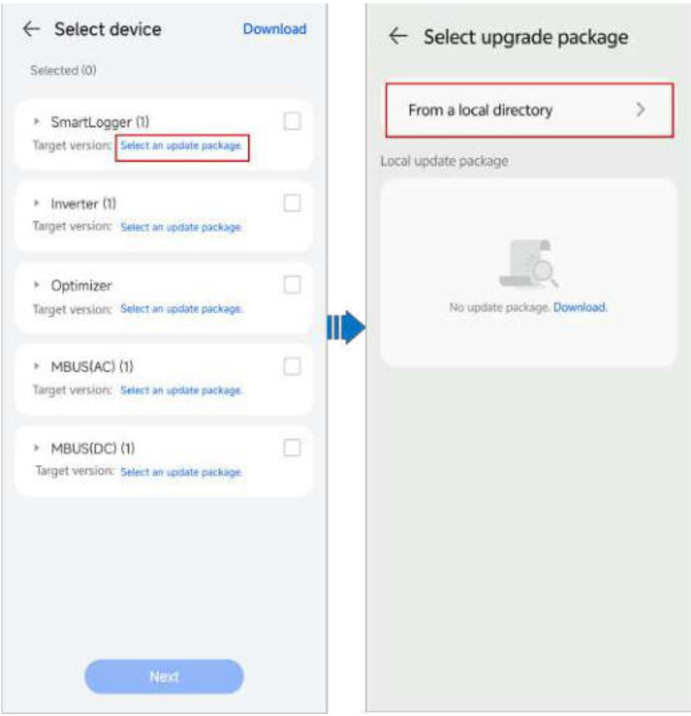
   NOTE

   - iOS mobile phone: After downloading the update package from the website and storing it on the mobile phone, hold down the file to share it to the app. Then the update package is directly displayed on the screen for selecting the update package.
   - Android mobile phone: Choose **Select Update Package** > **From a local directory** to access the phone folder and manually select the update package.
5. Tap **Next** and complete the update as prompted.

   NOTE

   After the update is successful, the target version of the device will be refreshed. If the update fails, check whether the selected update package is correct and rectify the fault as prompted.

Figure 2-19 Device update



2.3.2 Quick Settings

Log in to the SmartMGC local commissioning screen as the **installer** user using the app and enter the **Quick Settings** screen.

For details about how to log in to the SmartMGC local commissioning screen, see **E Connecting the App to the SmartMGC**.

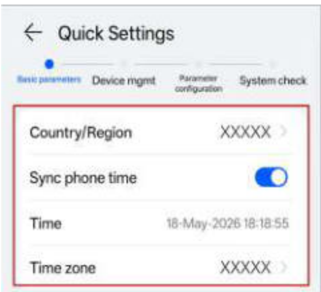
2.3.2.1 Basic Parameters

Set basic parameters such as the country/region, time zone, running configuration, and communication networking to ensure data accuracy and facilitate O&M management and fault locating.

Step 1 Set the basic parameters.

Set **Country/Region**, **Time**, and **Time zone** based on the location and local time of the plant.

Figure 2-20 Basic information



Step 2 Set the running configuration parameters.

Figure 2-21 Running configuration

Table 2-10 Running configuration parameters

Parameter	Description
Scenario	Set this parameter to **On/Off-grid**. The PV+ESS system can run in on-grid or off-grid mode. The system supports bidirectional switching between the two modes. The grid supply is required in this scenario. The running scenario configuration is used to configure the array scenario as required to ensure that the system control function is correctly executed.

Step 3 Set **Networking** parameters.

1. Set network connection parameters for connecting to the management system.

   The SmartMGC can be connected through a mobile network or wired network. Tap **>** on the right of **Network Connection**, set **Mobile network** or **Wired Network** parameters as required, and tap **Submit**.

Figure 2-22 Network connection

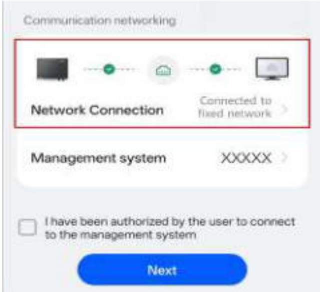


Table 2-11 Network connection parameters

Parameter	Description
Mobile network	
Network mode	Set this parameter based on the SIM card network mode.
APN mode	The default value is **Automatic**. Set this parameter to **Manual** if the dial-up connection cannot be set up in **Automatic** mode.
Identification type	This parameter is displayed when APN mode is set to **Manual**. It specifies the type of user identity authentication. – **PAP**: Password Authentication Protocol – **CHAP**: Challenge Handshake Authentication Protocol
APN	This parameter is displayed when **APN mode** is set to **Manual**. If this parameter is incorrectly set, the mobile network services will be affected. The parameter information comes from the SIM card carrier. If you have any questions about the parameter settings, contact the Company's engineers.
SIM access point number	
APN user name	
APN user password	
Wired network	
DHCP	This parameter is enabled by default. After it is enabled, IP addresses are automatically allocated. If the router does not support DHCP, disable **DHCP** and manually assign an IP address.
IP Address	Set this parameter when **DHCP** is disabled. Retain the default values or change them as required. The network ports are independent of each other and their configurations cannot conflict with each other.
Subnet mask	
Default Gateway	

Parameter	Description
Primary DNS Server	Set this parameter when **DHCP** is disabled. DNS server address, which is obtained from the router or carrier. You can ignore this parameter if the device connects to the LAN. If the device connects to the public network, for example, the management system, set this parameter to the IP address of the LAN router.
Secondary DNS Server	Set this parameter when **DHCP** is disabled. DNS server address, which is obtained from the router or carrier. This parameter does not need to be set in normal cases. If the primary DNS server cannot resolve the domain name, use the secondary DNS server.

2. Set parameters for connecting to the management system

   Connecting to the management system enables centralized monitoring and remote O&M of the plant. Tap **>** on the right of **Management system**, set parameters such as the domain name as required, and tap **Submit**.

Figure 2-23 Management system

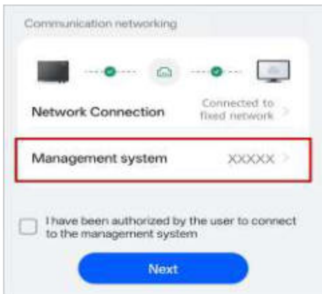


Table 2-12 Management system parameters

Parameter	Description	Remarks
Domain Name	Specifies the domain name of the management system.	The system has preset **Port** and **TLS encryption** for the default domain name. You do not need to set them. If you need to change the domain name, configure the corresponding **Port** and **TLS encryption**.
Port	Set the port number based on the domain name. The default port number is 27250.	
TLS encryption	You are advised to enable **TLS encryption** to ensure data security. – **Enable**: Data exchanged between the SmartMGC and the management system is encrypted. – **Disable**: Data exchanged between the SmartMGC and the management system is not encrypted, which poses security risks.	

If a third-party energy management system (EMS) is connected, set related parameters based on the corresponding communications protocol.

Figure 2-24 Management system connection

Table 2-13 Modbus TCP

Parameter	Description
Connection	Specifies whether to allow a third-party EMS to connect to the SmartMGC. – **Enable (restricted)**: The SmartMGC communicates with a third-party management system for which the client IP address (whitelist) has been configured. – **Enable (unrestricted)**: The SmartMGC communicates with a third-party management system with a valid IP address. – **Disable**: No IP address is allowed to connect to the SmartMGC.
Client 1 IP address	This parameter is displayed when **Connection** is set to **Enable (restricted)**. It specifies the IP address of the client.
Client 2 IP address	
Client 3 IP address	
Client 4 IP address	

Parameter	Description
Client 5 IP address	
Address mode	This parameter is displayed when **Connection** is set to **Enable (restricted)** or **Enable (unrestricted)**. If the communication address of the connected device is unique, you are advised to select **Physical address**. Otherwise, you must select **Logical address**.
SmartLogger address	This parameter is displayed when **Connection** is set to **Enable (restricted)** or **Enable (unrestricted)**. It specifies the slave address of the SmartLogger.

Table 2-14 Modbus RTU

Category	Parameter	Description
COM 1/2/3, M1.COM1/2/3	**Baud rate**	Specifies the communication rate of the RS485 port. Set this parameter to be consistent with the baud rate of the connected device.
	Parity	Specifies the error detection mechanism for data transmission over RS485. Set this parameter to be consistent with the parity mode of the connected device.
	Stop Bit	Specifies the interval after the transmission of each data byte is complete, which is equivalent to the terminator of a data frame. Set this parameter to be consistent with the stop bit of the connected device.

NOTE

If the SmartLogger communicates with a third-party EMS over IEC 104, set communication parameters by referring to **2.5.2.1 IEC 104 Protocol**.

3. Connect to the management system authorized by the customer.

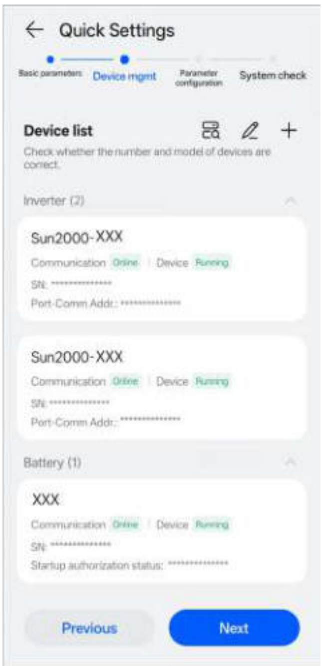
   Select **I have obtained the owner's authorization to access the management system.**.

----End

2.3.2.2 Device Management

Check whether the quantity and models of devices displayed on the current screen are consistent with those of the connected devices. If they are inconsistent, tap the search icon or check whether the device cables are properly connected.

Figure 2-25 Device management



Step 1 (Optional) If the device is not displayed, tap the search icon to connect to a device or tap **+** to add a device. Auto discovery does not apply to third-party devices, such as the meter and environmental monitoring instrument (EMI). You need to tap **+** to add them manually.

NOTE

- The device list displays only the devices directly connected to the SmartMGC.
- If a device cannot be found, check whether the cable to the device is properly connected. After confirming that the cable connection is correct, tap **Search** or **+**.
- Meter: For details about the supported meter models, see **B Meter Model List**.
- EMI: For details about the supported EMI models, see **C EMI Model List**.

Table 2-15 Parameters for adding a meter

Parameter	Description
Device type	Set this parameter to **Power meter**.
Intelligent Power Meter Type	Select a value based on the model of the connected meter. • If the power meter model is DTSU666-HW, select **DTSU666-HW**. • If the power meter model is YDS60-80, select **YADA-YDS60-80**. • If the power meter model is DHSU1079-ZT, select **DHSU1079-ZT**. • If the power meter model is DTSU71C, select **DTSU71C**.
port	Select a port based on the SmartMGC COM port connected to the meter.

Parameter	Description
Address	Set the communications address of the meter as required, which must not conflict with the addresses of other devices on the same bus. The value ranges from 1 to 247. For details, see the user manual of the meter.
Baud rate	Set the RS485 communications rate of the meter as required. For details, see the user manual of the meter.
Parity	Set the RS485 communications parity mode of the meter as required. The options are **No parity**, **Odd parity** and **Even parity**. For details, see the user manual of the meter.
Stop Bit	Specifies the interval after the transmission of each data byte is complete, which is equivalent to the terminator of a data frame. Set this parameter of the meter as required. For details, see the user manual of the meter.
Meter purpose	Set the usage of the meter based on the actual connection position of the meter. ● **Feed-in meter**[1]: used for grid-connection point control. Each array allows only one feed-in meter to be connected. ● **Production meter**: PV output meter. Multiple production meters can be connected. ● **Consumption meter**: load consumption meter. Multiple consumption meters can be connected. ● **Charger meter**: charger consumption meter. Multiple charger meters can be connected. ● **Third-party production meter**: third-party PV output meter. Multiple third-party production meters can be connected. ● **Genset meter**: genset output meter. Only one genset meter can be connected to each array.

<table>
<tr><th>Parameter</th><th>Description</th></tr>
<tr><td>Voltage change ratio</td><td rowspan="2">● Set this parameter to 1 if the meter uploads the primary value.
● Set this parameter based on the actual transformer ratio if the meter uploads the secondary value.
● If both the meter and the SmartMGC support the settings of the voltage ratio and current ratio, you can only set them either on the meter or the SmartMGC. You are advised to set these parameters on the meter.
● If the meter connects to a transformer, set SPEC of the meter to 0, indicating that the meter connects to the system through a transformer.
● Examples:
– Scenario 1: When the voltage of the grid connection point is 400 V, the power meter must be connected to a CT, and the CT ratio is 400:5.
■ Set the voltage transformation ratio of the meter to 1.
■ Set the current transformation ratio of the meter to 80.
– Scenario 2: When the voltage of the grid connection point is 10 kV, the meter must be connected to both the CT and PT. The CT ratio is 400:5, and the PT ratio is 10000:100.
■ Set the voltage transformation ratio of the meter to 100.
■ Set the current transformation ratio of the meter to 80.</td></tr>
<tr><td>Current change ratio</td></tr>
<tr><td colspan="2">[1]: The Feed-in meter must be connected to a COM port of the SmartMGC separately to avoid affecting the dispatch performance of the system.</td></tr>
</table>

Step 2 (Optional) Perform ESS startup authorization. If the ESS is not authorized to start, tap the related prompt on the current screen to access the **Startup Authorization** screen, and enter **Startup password** to complete the ESS startup authorization.

NOTE

- How to obtain **Startup password**: Provide **Verification code** for the device supplier or its authorized supervision service provider. They will apply for **Startup password** for you using the Power-Partner app.
- If battery packs are added to the ESS in the network, the ESS automatically restart after you enter **Startup password** and submit the authorization.

Step 3 (Optional) Change the device name. To facilitate subsequent log export and fault locating, you can change the device name based on the device location. For example, if multiple ESSs are connected, you can add numbers for the ESSs, such as ESS_1 and ESS_2.

Tap  to go to the **Edit Device** screen. Tap  next to the target device and change the device name.

----End

2.3.2.3 Parameter Configuration

Set operation rules such as grid standards and ESS policies to ensure that the plant runs safely and efficiently in the expected mode.

2.3.2.3.1 Setting the Grid Code and Power Baseline

Step 1 Set the grid code.

Figure 2-26 Grid code

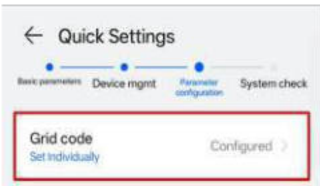
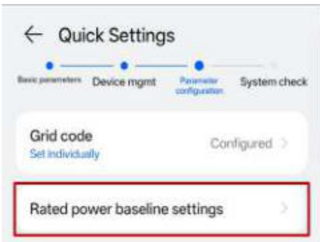


Table 2-16 Grid code parameter

Parameter	Description
Grid Code	Select the local grid code.

Step 2 Set the rated power baseline.

Figure 2-27 Rated power baseline



1. Tap **Rated power baseline settings**, select the target ESS device, and tap **Set**.
2. Tap **>** on the right of **Rated power baseline**, select the target power, and tap **Submit**.
3. Return to the **Select Device** screen and view the setting result.
4. Select the corresponding rated power on the device nameplate.

NOTICE

- To ensure safe operation of the device, after setting the power in the software, immediately draw a check mark on the device nameplate in the rated power option that is the same as the value set in the software to confirm the final configuration.
- To support this function, the following version mapping shall be met:
  - SmartMGC: SmartLogger5000B V100R026C10 or later
  - ESS: LUNA2000B V200R026C10 or later
  - App: 26.3.1 or later

Table 2-17 Rated power baseline parameter

Parameter	Description
Rated power baseline	The rated power baseline is the reference for calculating the system power. After **Rated power baseline** is set, the active power baseline and apparent power baseline will be adjusted accordingly.

Step 3 Set plant information.

Figure 2-28 Plant information

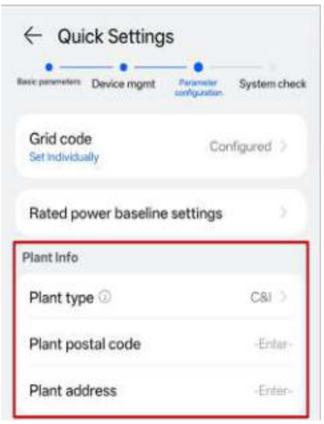


Table 2-18 Plant information parameters

Parameter	Description
Plant type	Select **C&I**.
Plant postal code	**Plant postal code** is displayed when the mobile phone is not connected to the Internet or it is connected to the Internet but the location function of the app is not enabled. Set this parameter to the actual postal code of the plant.

Parameter	Description
Plant address	Set this parameter to the address of the plant.

----End

2.3.2.3.2 Grid Connection Point Sampling Configuration

The SmartMGC can directly sample the current and voltage at the grid connection point. When used with the CT and PT, it can function as a meter at the grid connection point. In this case, you need to set the grid connection point sampling parameters. In addition, the SmartMGC can collect voltage signals through the U_AC2 port to implement secondary frequency and voltage regulation.

Step 1 Set the grid connection point sampling parameters.

Figure 2-29 Grid connection point sampling parameters (on/off-grid)

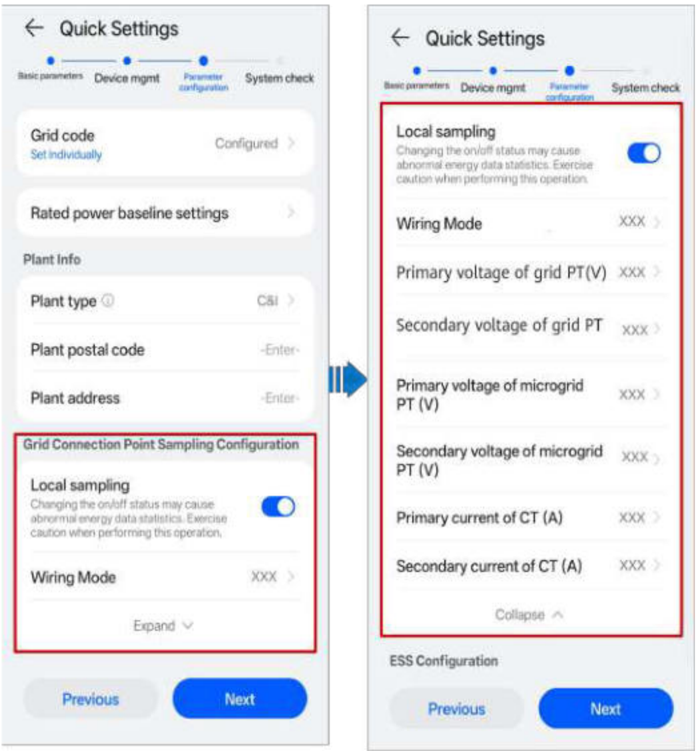


Table 2-19 Grid connection point sampling parameters

Parameter	Description
Local sampling	Enable this parameter.
Wiring mode	Set the output mode based on the actual cable connections of the CT and PT.

<table>
<tr><th>Parameter</th><th>Description</th></tr>
<tr><td>Primary voltage of grid PT (V)</td><td rowspan="2">Voltage is sampled through the U_AC1 port.
If PT voltage sampling is unavailable, set the primary and secondary voltages on the grid side based on the actual rated voltage on the grid side.
If PT voltage sampling is available, set the primary and secondary voltages on the grid side based on the actual specifications of the PT.
NOTICE
To ensure safety, a PT must be used for voltage sampling in the medium- and high-voltage system.</td></tr>
<tr><td>Secondary voltage of grid PT (V)</td></tr>
<tr><td>Primary voltage of microgrid PT (V)</td><td rowspan="2">Voltage is sampled through the U_AC2 port.
If PT voltage sampling is unavailable, set the primary and secondary voltages on the microgrid side based on the actual rated voltage on the microgrid side.
If PT voltage sampling is available, set the primary and secondary voltages on the microgrid side based on the actual specifications of the PT.
NOTICE
To ensure safety, a PT must be used for voltage sampling in the medium- and high-voltage system.
Connect the secondary voltage output cable of the microgrid PT to the U_AC2 port. The SmartMGC depends on this port to collect voltage signals to implement secondary frequency regulation. If the cable is not correctly connected, the system control will fail and the system stability cannot be maintained.</td></tr>
<tr><td>Secondary voltage of microgrid PT (V)</td></tr>
<tr><td>Primary current of CT (A)</td><td rowspan="2">The I_AC port is connected to the CT to sample current. Set this parameter based on the actual specifications of the CT.</td></tr>
<tr><td>Secondary current of CT (A)</td></tr>
</table>

----End

2.3.2.3.3 Setting the ESS Working Mode

The ESS working mode allows the SmartMGC to control the power output of devices in an array according to different control modes, ensuring that the grid and loads work properly and maximizing the economic benefits of the plant.

Set the working mode of the ESS based on the actual scenario.

- On-grid: Set **Working mode settings** to **Maximum self-consumption**, **TOU (Time-of-Use)**, **No control**, or **No control** based on the actual application scenario. **No control** is used only for commissioning.
- Off-grid operation: Set **Working mode settings** to **No control**.

Figure 2-30 Setting the ESS working mode

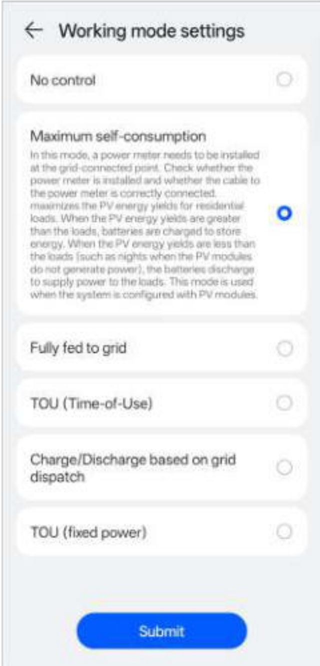


Table 2-20 describes the ESS control policies supported by the SmartLogger.

Table 2-20 ESS settings

Working Mode	Description
No Control	This mode is used only for commissioning. In this mode, the SmartMGC does not control the power dispatch of the ESS.
Maximum Self-Consumption	This mode applies to PV+ESS systems in areas where the electricity price is high and the feed-in-tariff (FIT) subsidy is low or unavailable. PV power is preferentially supplied to loads, and the surplus PV power is used to charge the ESS. When the ESS is fully charged or reaches the maximum charge power, the surplus power is fed to the grid. The grid can supply power to loads but cannot charge the ESS.
Time-of-Use (TOU)	This mode applies to PV+ESS or ESS-only systems in scenarios where the price difference is large between peak and off-peak hours and power meters are used. During off-peak hours, the grid supplies power to charge the ESS. During peak hours, the ESS discharges energy to loads.

Working Mode	Description
Charge/ Discharge Based on Grid Dispatch	This mode applies to the scenario where the northbound controller delivers active power dispatch commands. The purpose of discharge based on grid dispatch is to meet the active power dispatch target value at the grid connection point. PV energy is preferred. If the generated PV energy is insufficient, the ESS discharges energy and the energy is fed to the grid based on the active power dispatch target value. If the generated PV energy is sufficient, the energy is fed to the grid based on the active power dispatch target value, and the surplus PV energy is used to charge the ESS. The purpose of charge based on grid dispatch is to meet the active power dispatch target value at the grid connection point. If the ESS charge power is insufficient, the grid charges the ESS with the maximum capability. If the ESS is not fully charged when the dispatch target value is met, the PV energy is used to charge the ESS.
TOU (Fixed Power)	This mode applies to ESS-only or PV+ESS systems in scenarios where the price difference is large between peak and off-peak hours and the charge and discharge power needs to be set. During off-peak hours, the grid supplies power to charge the ESS. During peak hours, the ESS discharges energy to loads.

No Control

Function

This mode is used only for commissioning. In this mode, the SmartMGC does not control the power dispatch of the ESS.

Procedure

Step 1 Set **Working mode settings** to **No control** for the ESS.

Step 2 Tap **Submit**.

----End

Maximum Self-Consumption

Function

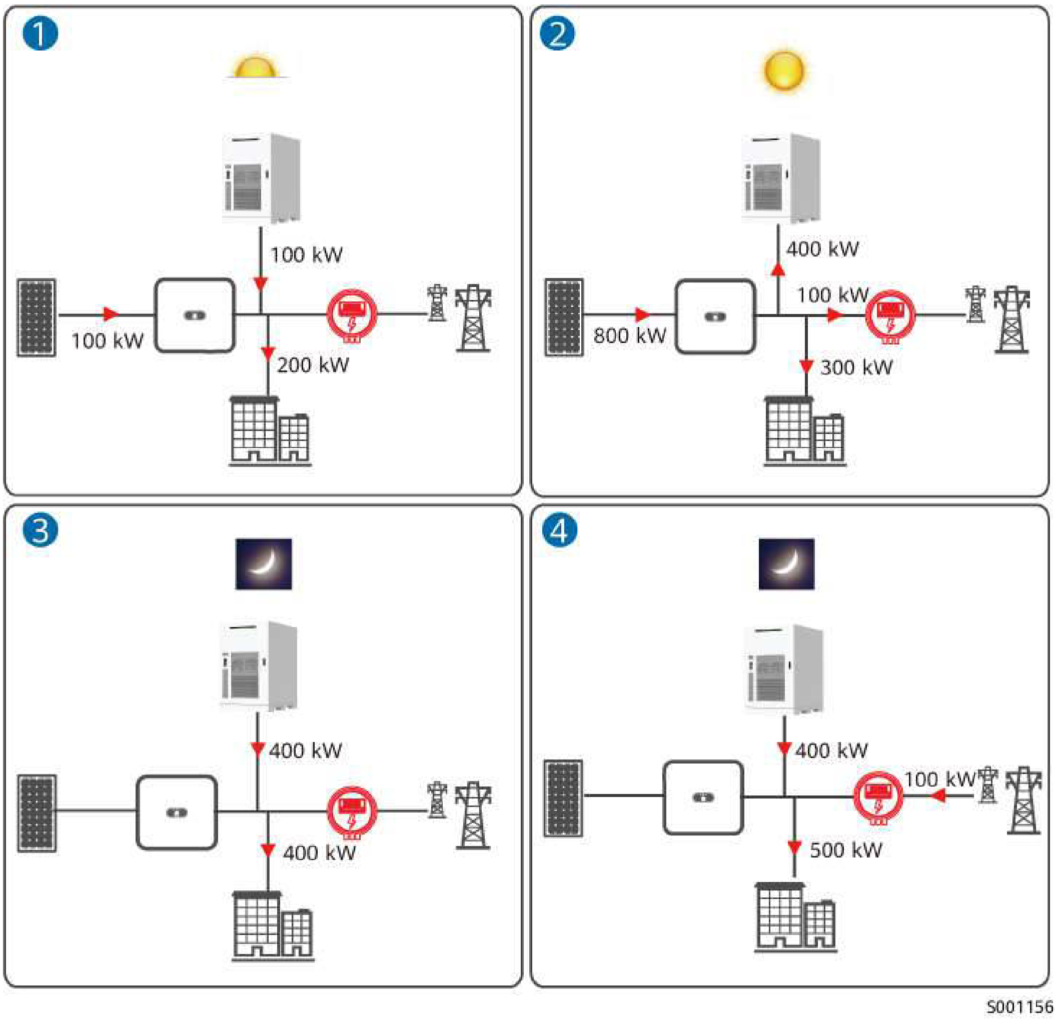
This mode applies to PV+ESS systems in areas where the electricity price is high and the feed-in-tariff (FIT) subsidy is low or unavailable. PV power is preferentially supplied to loads, and the surplus PV power is used to charge the ESS. When the ESS is fully charged or reaches the maximum charge power, the surplus power is fed to the grid. The grid can supply power to loads but cannot charge the ESS.

Energy priority:

- PV energy supply priority: load > ESS > power grid
- Load power consumption priority: PV > ESS > power grid

The following uses **Figure 2-31** (ESS capacity: 800 kWh/400 kW) as an example.

Figure 2-31 Maximum self-consumption description



(1) 06:00–08:00: Insufficient irradiance | (2) 10:00–14:00: Sufficient irradiance

(3) 19:00–20:00: No irradiance | (4) 21:00–22:00: No irradiance

Procedure

Step 1 Set **Working mode settings** to **Maximum self-consumption** for the ESS.

Step 2 Tap **Submit**.

----End

Time-of-Use (TOU)

Function

This mode applies to PV+ESS or ESS-only systems in scenarios where the price difference is large between peak and off-peak hours and power meters are used.

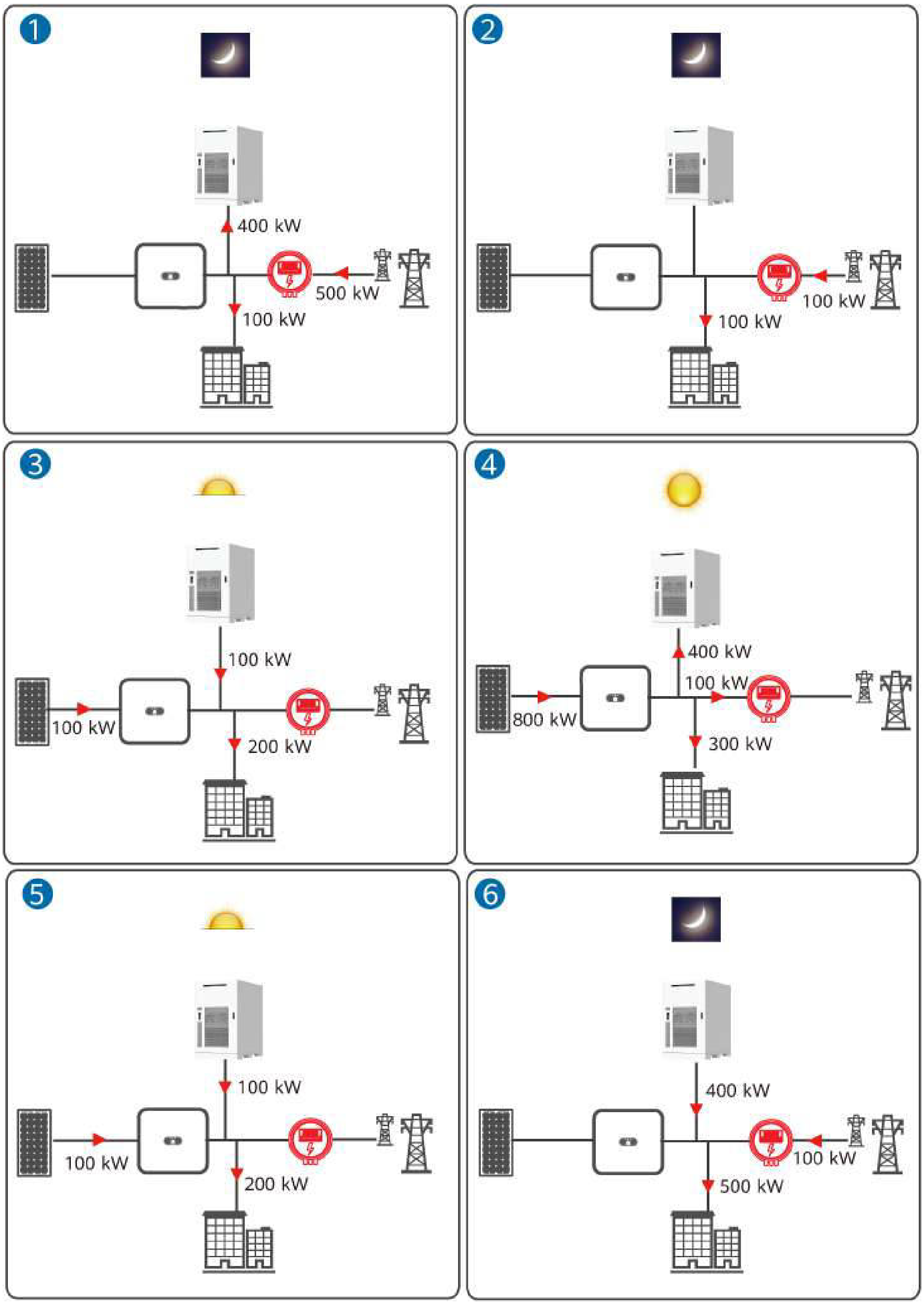
During off-peak hours, the grid supplies power to charge the ESS. During peak hours, the ESS discharges energy to loads.

In this mode, at least one charge or discharge period for the ESS needs to be set. For example, if you set the low electricity price period at night as the charge period, the system charges the ESS at the maximum power during this period. If you set the high electricity price period as the discharge period, the ESS discharges only according to the actual demand of load power. The ESS can discharge only during the discharge period, reducing electricity costs.

In some countries, the grid is not allowed to charge the ESS. In this case, this mode cannot be used.

The following uses **Figure 2-32** as an example (ESS capacity: 800 kWh/400 kW, **Maximum self-consumption** enabled).

Figure 2-32 TOU



(1) 00:00–06:00: Charge period

(2) 00:00–06:00: Charge period

(3) 06:00–08:30: Insufficient irradiance during the discharge period

(4) 10:00–14:00: Sufficient irradiance during the discharge period

(5) 17:00–18:00: Insufficient irradiance during the discharge period

(6) 21:00–22:00: Discharge period

Procedure

Step 1 Set **Working mode settings** to **TOU (Time-of-Use)** for the ESS.

Step 2 Set **TOU (Time-of-Use)** parameters.

Table 2-21 TOU

Parameter	Description
Start time End date **Day** **Charge/Discharge**	Specifies the start time and end time of charge/discharge. A maximum of 14 time segments can be set. The time segments cannot overlap. ● **Discharge**: The ESS is allowed to discharge energy to loads, but cannot feed energy to the grid. ● **Charge**: ESS charge is allowed.
Maximum self-consumption	When both **TOU (Time-of-Use)** and **Maximum self-consumption** are used, set this parameter to **Enable**. ● **Enable**: The maximum self-consumption function is enabled. When the PV power is greater than the load power, the surplus PV power is charged to the ESS. After the charge power reaches the maximum value or the ESS is fully charged, the surplus PV power is fed to the grid. ● **Disable**: The maximum self-consumption function is disabled. When the PV power is greater than the load power, the surplus PV power is preferentially fed to the grid. After the feed-in power reaches the maximum value, the surplus PV power is charged to the ESS.
Maximum charge power of grid	Specifies the maximum power at which the grid charges the ESS. The value is determined by the local power grid company. If there is no requirement, the value is the maximum charge power of the ESS by default. If **Draw power from grid for off-grid power backup** (choose **Set** > **Microgrid Parameters** > **Scheduling Control**) is triggered, **Charge power for off-grid power backup** determines the grid power charged to the ESS. You are advised to set this parameter to the same value as **Charge power for off-grid power backup**.

Step 3 After the parameters are set, tap **Submit**.

----End

Charge/Discharge Based on Grid Dispatch

Function

This mode applies to the scenario where the northbound controller delivers active power dispatch commands.

The purpose of discharge based on grid dispatch is to meet the active power dispatch target value at the grid connection point. PV energy is preferred. If the generated PV energy is insufficient, the ESS discharges energy and the energy is fed to the grid based on the active power dispatch target value. If the generated PV energy is sufficient, the energy is fed to the grid based on the active power dispatch target value, and the surplus PV energy is used to charge the ESS.

The purpose of charge based on grid dispatch is to meet the active power dispatch target value at the grid connection point. If the battery charge power is insufficient or the PCS limits the power, the grid charges the batteries with the maximum capability. If the batteries are not fully charged when the scheduling target value is met, the PV power is used to charge the batteries.

In some countries, the grid is not allowed to charge the ESS. In this case, this mode cannot be used.

Procedure

Step 1 Set **Working mode settings** to **Charge/Discharge based on grid dispatch** for the ESS.

Step 2 Tap **Submit**.

----End

TOU (Fixed Power)

Function

This mode applies to ESS-only systems in scenarios where the price difference is large between peak and off-peak hours and no power meters are used.

During off-peak hours, the grid supplies power to charge the ESS. During peak hours, the ESS discharges energy to loads.

In this mode, at least one charge or discharge period for the ESS needs to be set. For example, if you set the low electricity price period at night as the charge period, the system charges the ESS at the fixed power during this period. If you set the high electricity price period as the discharge period, the ESS can discharge energy only during the discharge period at the fixed power, reducing electricity costs.

In some countries, the grid is not allowed to charge the ESS. In this case, this mode cannot be used.

Procedure

Step 1 Set **Working mode settings** to **TOU (Fixed power)** for the ESS.

Step 2 Set **TOU (Fixed power)** parameters.

Table 2-22 TOU (fixed power)

<table>
<tr><th>Parameter</th><th>Description</th></tr>
<tr><td>Start time</td><td rowspan="2">Specifies the start time and end time of charge/discharge. A maximum of 14 time segments can be set. The time segments cannot overlap.</td></tr>
<tr><td>End date</td></tr>
<tr><td>Day</td><td>Specifies the charge/discharge interval.</td></tr>
<tr><td>Charge/Discharge</td><td>● Discharge:
– In the scenario with a power meter, the ESS is allowed to discharge energy to loads, but cannot feed energy to the grid.
– In the scenario without a power meter, the ESS is allowed to discharge energy to loads or feed energy to the grid.
● Charge: Charging the ESS with grid power is allowed.</td></tr>
<tr><td>Charge Power</td><td rowspan="2">Specifies the ESS charge/discharge power.</td></tr>
<tr><td>Discharge power</td></tr>
<tr><td>Maximum self-consumption</td><td>When both TOU (Fixed power) and Maximum self-consumption are used, set this parameter to Enable.
● Enable: The maximum self-consumption function is enabled. When the PV power is greater than the load power, the surplus PV power is charged to the ESS. After the charge power reaches the maximum value or the ESS is fully charged, the surplus PV power is fed to the grid.
● Disable: The maximum self-consumption function is disabled. When the PV power is greater than the load power, the surplus PV power is preferentially fed to the grid. After the feed-in power reaches the maximum value, the surplus power is charged to the ESS. (During charging, the charge power does not exceed the values of Charge Power and Discharge power.)</td></tr>
</table>

Step 3 After the parameters are set, tap **Submit**.

----End

2.3.2.3.4 Microgrid Configuration

The SmartMGC has a built-in microgrid control function to independently dispatch the PV+ESS system to form an off-grid system. By adjusting the PV and ESS power in real time, it ensures stable system voltage and frequency, provides continuous and reliable power supply for critical loads, and supports the black start function.

NOTICE

Connect cables strictly according to the following table. Otherwise, the related functions cannot be enabled.

Figure 2-33 Microgrid configuration parameters

Table 2-23 Microgrid configuration parameters

Category	Parameter	Description
Microgrid basic settings	**MGCC mode**	Enable this parameter. The microgrid control function is enabled. When the microgrid is off-grid, the SmartEMO function and functions involved in power adjustment and ESS control will be invalid.
	Automatic on/off-grid switching mode	Set the on/off-grid switching mode as required. Set this parameter to **Seamed switching**.

<table>
<tr><th>Cate gory</th><th>Parameter</th><th>Description</th></tr>
<tr><td rowspan="3"></td><td>Seamed on/ off-grid switching mode</td><td>Set the seamed on/off-grid switching mode as required. The Automatic or Manual mode is supported.
● Automatic: The on/off-grid switch is automatically turned on or off based on the mains status to implement on/off-grid switching. In this mode, the DI4(HV) and DO7(HV) ports of the on/off-grid switch shall be configured.
● Manual: It is equivalent to semi-automatic mode. The on/off-grid switch is automatically turned on or off based on the user's local operation to implement on/off-grid switching. In this mode, the DI4(HV) port of the on/off-grid switch shall be configured.
System cable connections:
● DI4(HV): reports the Off state of the switch at the grid connection point.
● DO7(HV): turns on the switch at the grid connection point.</td></tr>
<tr><td>Valid if grid connection point switch is off</td><td>● Set this parameter based on the actual status of the switch at the grid connection point and the status received by DI4(HV) (recommended)[a] (see in Set > Comm. parameters > AI/DI/DO). For details about the configuration criteria, see the following table.
<table>
<tr><th>Status of Switch at Grid Connection Point</th><th>Status Received from DI4(HV) (Recommended)[a]</th><th>Parameter Setting</th></tr>
<tr><td rowspan="2">Off</td><td>Off</td><td>Off</td></tr>
<tr><td>On</td><td>On</td></tr>
<tr><td rowspan="2">On</td><td>Off</td><td>On</td></tr>
<tr><td>On</td><td>Off</td></tr>
</table>
● System cable connections:
– DI4(HV) (recommended)[a]: reports the Off state of the switch at the grid connection point.
– DO7(HV): turns on the switch at the grid connection point.
– DO4(HV): turns off the switch at the grid connection point (common port); supports the DC or AC power supply.</td></tr>
<tr><td>Synchronous voltage</td><td>Specifies the voltage signal source used as the baseline for synchronization determination.
When Wiring mode is set to Three-phase four-wire, you can select Ua, Ub, Uc, Uab, Ubc, Uca, or Uabc. When Wiring mode is set to Three-phase three-wire, you can select only Uab, Ubc, or Uca.
Select an option based on the actual cable connections of the PTs on the power grid side of the grid connection point. If three PTs are configured on the power grid side of the grid connection point, Uabc is recommended.</td></tr>
</table>

<table>
<tr><th>Category</th><th>Parameter</th><th>Description</th></tr>
<tr><td>Genset control</td><td>Genset control</td><td>Set this parameter to Disable.</td></tr>
<tr><td rowspan="2">Load control</td><td>Critical load switch</td><td>Specify whether the critical load switch is connected.
System cable connections:
DI1(HV) (recommended)[a]: reports the Off state of the critical load switch.
DO1(HV): turns on the critical load switch.
DO2(HV): turns off the critical load switch.</td></tr>
<tr><td>Valid if critical load switch is off</td><td>Set this parameter based on the actual status of the critical load switch and the status received by DI1(HV) (recommended)[a] (see in Set > Comm. parameters > AI/DI/DO). For details about the configuration criteria, see the following table.
<table>
<tr><th>Load Switch Status</th><th>Status Received from DI1(HV) (Recommended)[a]</th><th>Parameter Setting</th></tr>
<tr><td rowspan="2">Off</td><td>Off</td><td>Off</td></tr>
<tr><td>On</td><td>On</td></tr>
<tr><td rowspan="2">On</td><td>Off</td><td>On</td></tr>
<tr><td>On</td><td>Off</td></tr>
</table></td></tr>
<tr><td colspan="3">Note a: If the default DI port is not available for onsite cable connection, configure the required DI port through Settings > Microgrid Control > General Basic Settings on the SmartMGC WebUI and check the status received by the corresponding DI port.</td></tr>
</table>

2.3.2.4 System Check

This function comprehensively diagnoses the system health status, covering network communication, device status, alarm information, software version, and device cable connections. If any exception is detected, rectify the fault as prompted and tap **Check Again** to confirm that the issue has been resolved. You are advised to complete the system check to ensure stable device operation.

Figure 2-34 System check

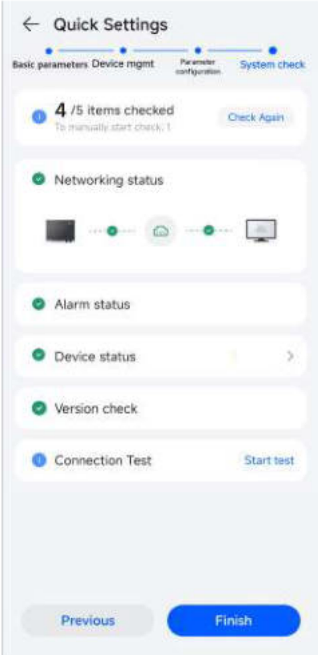


Table 2-24 System check

Check Type	Description	Triggering Method
Networking status	Check whether the management system is successfully connected and whether the mobile network signal is weak	The check is automatically started. You can tap **Check Again** to start the check again.
Alarm status	Check whether an alarm is generated. **NOTE** If an alarm is generated, rectify the fault by referring to **Possible Cause and Suggestion**.	
Device status	Check whether **Running status** is **Faulty**, or **communication status** is **Offline**. **NOTE** If **Offline** or **Offline** is displayed, check the networking connection status and hardware status of the device for exceptions and rectify the fault by referring to **Offline** of the corresponding alarm.	
Version check	Check whether all devices in the device list need to be updated. **NOTE** After the update is complete, you can return to the **System check** screen to continue the deployment. However, if the SmartMGC is restarted during the update, the app will be disconnected from the WLAN of the SmartMGC. As a result, the deployment cannot continue.	

Check Type	Description	Triggering Method
Connection Test	Check whether the communication between devices is normal, whether the PT/CT cable connection and the A/B/C wire sequences of the PCS AC cables are normal, and identify possible faults. You can identify and rectify faults by viewing rectification suggestions to ensure that the system runs properly. **NOTE** ● This function applies only to the C&I Hybrid Cooling Grid Forming ESS and is displayed in the scenario with multiple cabinets. ● For the on-grid operation, connection check is required in the zero feed-in scenario with three-phase imbalance phase-level power control.In the off-grid scenario, ensure that the load has been disconnected and then perform **Connection Test**.	Tap **Start test** to manually start the check. Tap **Check Again** to start the check again.

2.3.3 Setting the Output Mode

To ensure the normal operation of the devices, set the output mode of the inverter and ESS correctly based on the actual cable connections. If the settings are inconsistent with the actual cable connections, system alarms may be generated or the dispatch logic may be incorrect.

Procedure

Step 1 Set **Output mode** for the inverter.

Tap **Monitor**, select an inverter, choose **Set** > **Grid parameters**, and set **Output mode** to **Three-phase, four-wire** for the inverter.

Step 2 Set **Output mode** for the ESS.

Tap **Monitor**, select an ESS, choose **Set** > **Power Parameters** > **Grid parameters**, and set **Output mode** to **Three-phase, four-wire** for the ESS.

----End

2.3.4 Function Verification

2.3.4.1 Verifying the Cable Connections for Local Power Sampling

Verifying the cable connections for local power sampling ensures that the SmartMGC correctly samples the power at the grid connection point for stable system operation.

DANGER

- Before operation, ensure that the equipment is intact. Otherwise, electric shocks or fires may occur.
- During operation, wear insulated gloves and use insulated tools to prevent electric shocks or short circuits.
- Non-standard and improper operations may result in fires or electric shocks.
- Prevent foreign matter from entering the equipment during operations. Otherwise, short circuits, equipment damage, load power derating, power failure, or personal injury may occur.

Step 1 Check whether the CT wiring position is correct. The CT must be connected to the metering point where the customer purchases electricity.

If the wiring position is inconsistent with that shown in **Figure 2-35**, modify the CT wiring position.

Figure 2-35 Correct CT wiring position

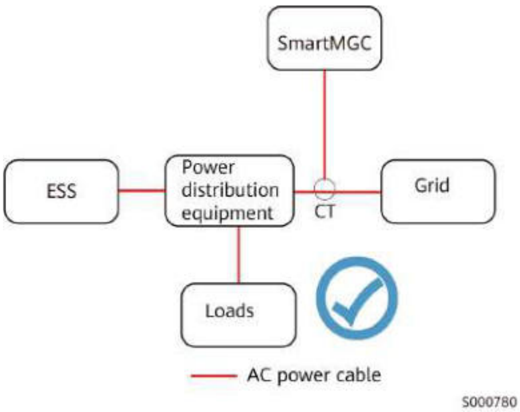
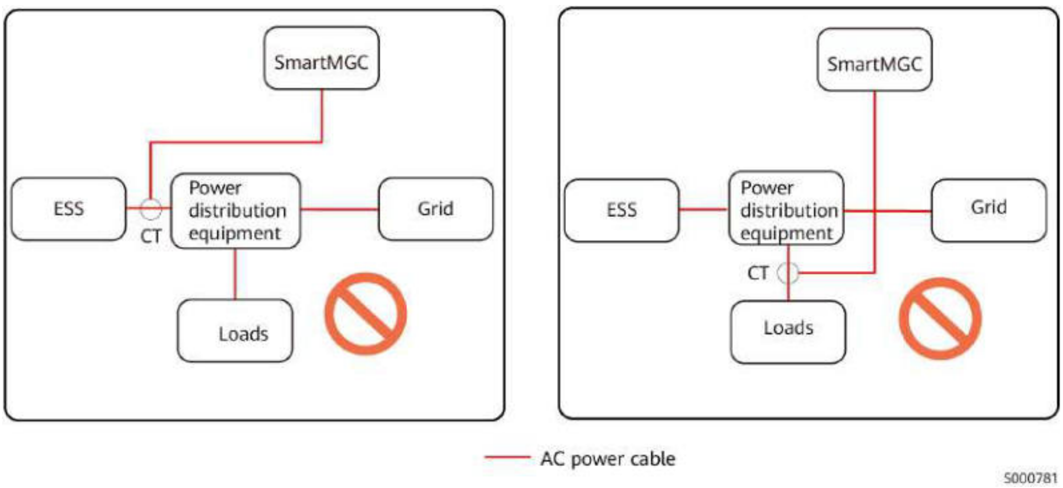


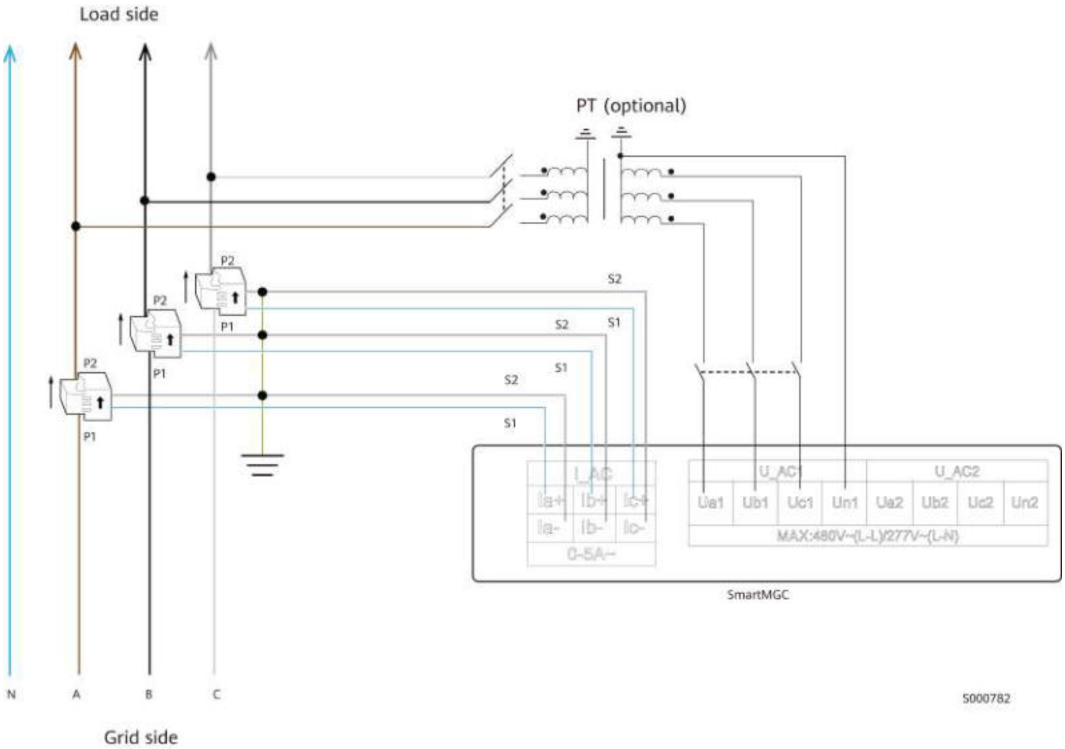
Figure 2-36 Incorrect CT wiring position



Step 2 Check whether the power sampling cable connection is correct. Check the cable connection by referring to **Figure 2-37**. If the cable connection is inconsistent with that shown in the figure, modify the power sampling cable connection.

- Current sampling: The I_AC port shall be connected to the CT. When the CT is connected in the positive direction, the power flows from the grid to loads. The wiring of each phase of the CT shall be consistent with that on the grid side.
- Voltage sampling: The U_AC1 port shall be connected to the PT or used for direct sampling. The wiring of each phase of the PT or direct sampling shall be consistent with that on the grid side.

Figure 2-37 Correct PT/CT wiring



Step 3 Check whether the sampling parameters of the grid connection point are correctly set. Log in to the SmartMGC WebUI, choose **Settings** > **Port Settings** > **PT/CT**, and check the parameter settings.

Table 2-25 CT parameter settings

Parameter	Description
PT/CT sampling	Enable the function of directly sampling the current and voltage at the grid connection point. When used with the CT and PT, it can function as a meter at the grid connection point.
PT/CT cable connection mode	This parameter is displayed when **PT/CT sampling** is set to **Enable**. Set this parameter to **Three-phase three-wire** or **Three-phase four-wire** based on the actual CT and PT wiring.

Parameter	Description
Primary current of CT	The I_AC port is connected to the CT to sample current. Set this parameter based on the actual specifications of the CT. If the current transformation ratio is 400:5: ● Set the primary current of the CT to 400 A. ● Set the secondary current of the CT to 5 A.
Secondary current of CT	
Primary voltage of grid PT	This parameter is displayed when **PT/CT sampling** is enabled. The voltage on the grid side is sampled through the U_AC1 port. ● If PT sampling is unavailable, set the primary and secondary voltages on the grid side based on the actual rated voltage on the grid side. ● If PT sampling is available, set the primary and secondary voltages on the grid side based on the actual specifications of the PT. If the voltage transformation ratio is 10000:100: – Set the primary voltage of the PT to 10000 V. – Set the secondary voltage of the PT to 100 V.
Secondary voltage of grid PT	
Primary voltage of microgrid PT	This parameter is displayed when **PT/CT sampling** is set to **Enable** and **MGCC mode** is set to **Enable**. Voltage is sampled through the U_AC2 port. ● If PT sampling is unavailable, set the primary and secondary voltages on the microgrid side based on the actual rated voltage on the microgrid side. ● If PT sampling is available, set the primary and secondary voltages on the microgrid side based on the actual specifications of the PT.
Secondary voltage of microgrid PT	
CT wiring direction	Set this parameter to **Positive**. The power flows from the grid to loads.

Step 4 Test the power value. Check whether the power value is normal in the scenarios where loads are disconnected and connected.

Disconnecting loads:

1. (Optional) Shut down the inverters. The PV power is 0. If there are inverters in the array, perform this step.

   Choose **Maintenance** > **Device Management** > **Startup/Shutdown** on the SmartMGC WebUI, click **All array inverters** under **Shut Down**, enter the login password, and confirm the shutdown.
2. Disconnect all loads from the system.
3. When the ESS is running in on-grid mode, it is charged at a fixed power.

   Choose **Monitoring** > **ESS** > **Running Parameters** on the SmartMGC WebUI, set **Active power (kW)** under **Power regulation** to 5 kW, and click **Settings**. If there are multiple ESSs in the array, click **Batch Sync**.
4. Check whether the power at the grid connection point is consistent with the ESS charge power.

Table 2-26 Power status diagnosis when loads are disconnected

Symptom		Status	Cause	Suggestion
The active power at the grid connection point is consistent with the ESS charge power.	CT installed on the grid side	Normal	-	-
	CT installed on the ESS side	Abnormal	CT installed on the ESS side	Adjust the CT wiring position to the grid side.
The active power at the grid connection point is inconsistent with the ESS charge power.	The active power at the grid connection point is not 0. The absolute values of the two are equal, but the polarity signs are opposite.	Abnormal	The CT wiring direction is reversed.	Choose **Settings** > **Port Settings** > **PT/CT**. Set **CT wiring direction** to the opposite direction.
	The active power at the grid connection point is not 0, and all single-phase power of phases A, B, and C is not 0.	Abnormal	• The phase sequence of the PT wiring is inconsistent. • The CT wiring sequence is inconsistent. • The primary/ secondary current/ voltage settings of the CT/PT are inconsistent with the actual situation.	• Check the phase sequence of the PT and CT wiring. Ensure that the phase sequence of the PT and CT wiring is the same. • Check and modify the CT wiring sequence. • Modify the settings based on the technical specifications of the CT/PT.
	The active power at the grid connection point is 0, and the all single-phase power of phases A, B, and C is 0.	Abnormal	CT installed on the load side	Adjust the CT wiring position to the grid side.
	The active power at the grid connection point is 0, and all or some of the single-phase currents of phases A, B, and C are 0.	Abnormal	Abnormal CT wiring	Check the CT wiring.

Symptom		Status	Cause	Suggestion
	The active power at the grid connection point is 0, and all or some of the voltages of phases A, B, and C are 0.	Abnormal	Abnormal PT wiring	Check the PT wiring.
To view the power at the grid connection point, single-phase currents and active power of phases A, B, and C, and three-phase voltage of phases A, B, and C, choose **Overview** > **Grid Connection Point Info**.				

Connecting loads:

1. (Optional) Shut down the inverters. The PV power is 0. If there are inverters in the array, perform this step.

   Choose **Maintenance** > **Device Management** > **Startup/Shutdown** on the SmartMGC WebUI, click **All array inverters** under **Shut Down**, enter the login password, and confirm the shutdown.
2. Shut down the ESS. The ESS power is 0.

   Choose **Maintenance** > **Device Management** > **Startup/Shutdown** on the SmartMGC WebUI, click **All array ESSs** under **Shut Down**, enter the login password, and confirm the shutdown.
3. Connect loads.
4. Check whether the power at the grid connection point is consistent with the load power.

Table 2-27 Power status diagnosis when loads are connected

Symptom	Status	Cause	Suggestion
The active power at the grid connection point is consistent with the load power.	Normal	-	-
The active power at the grid connection point is 0.	Abnormal	CT installed on the ESS side	Adjust the CT wiring position to the grid side.
To view the power at the grid connection point, choose **Overview** > **Grid Connection Point Info**.			

Step 5 Start the inverters and ESS. Choose **Maintenance** > **Device Management** > **Startup/Shutdown** on the SmartMGC WebUI.

- (Optional) To start the inverters, click **All array inverters** under **Start**, enter the login password, and confirm the startup. If there are inverters in the array, perform this step.

- To start the ESS, click **Start** under **All array ESSs**, enter the login password, and confirm the startup.

----End

2.3.4.2 Verifying the On/Off-Grid Switch

On/Off-grid switch verification is to manually turn on and off a switch to check whether the switch is correctly configured. This operation shall be performed on the WebUI.

DANGER

- Before operation, ensure that the equipment is intact. Otherwise, electric shocks or fires may occur.
- During operation, wear insulated gloves and use insulated tools to prevent electric shocks or short circuits.
- Non-standard and improper operations may result in fires or electric shocks.
- Prevent foreign matter from entering the equipment during operations. Otherwise, short circuits, equipment damage, load power derating, power failure, or personal injury may occur.

Procedure

Step 1 Log in to the SmartMGC WebUI, choose **Settings** > **Microgrid Control** > **General Basic Settings** > **Microgrid Settings** and set **Automatic on/off-grid switching mode** to **Not controlled**.

Step 2 Choose **Maintenance** > **Device Management** > **Startup/Shutdown**, click **Shut Down**, and click **All array devices** from the drop-down list to shut down the equipment.

Step 3 Check whether the DI4(HV) cable is properly connected for the switch-off status feedback port of the on/off-grid switch.

Manually turn on or off the on/off-grid switch onsite, and choose **Overview** > **Sampling Info** to check whether **DI4 status** changes.

- If the status changes, the DI4(HV) cable is properly connected.
- If the status does not change, check the DI4(HV) cable connection and rectify the fault.

Step 4 Check whether **DI port status if on/off-grid switch is off** is correctly set.

Choose **Settings** > **Microgrid Control** > **Scheduling Control** > **Manual control** and check whether the current **Status of switch at grid connection point** is consistent with the actual status of the on/off-grid switch. If not, modify **DI port status if on/off-grid switch is off** to ensure consistency.

Step 5 Check whether the cable connections are normal for the DO4(HV) switch-off control port and DO7(HV) switch-on control port of the on/off-grid switch.

Choose **Settings** > **Microgrid Control** > **Scheduling Control** > **Manual control**, and then click **Off** and **On** of **Status of switch at grid connection point**.

- Click **On**, and then check whether the actual status of the on/off-grid switch is on. If not, check the DO7(HV) cable connection and rectify the fault.
- Click **Off**, and then check whether the actual status of the on/off-grid switch is off. If not, check the DO4(HV) cable connection and rectify the fault.

Step 6 Choose **Settings** > **Microgrid Control** > **General Basic Settings** > **Microgrid Settings** and set **Automatic on/off-grid switching mode** to **Seamed switching**.

Step 7 Choose **Maintenance** > **Device Management** > **Startup/Shutdown**, click **Start**, and click **All array devices** from the drop-down list to start the equipment.

----End

2.3.4.3 Verifying the On/Off-Grid Switching Function

On/Off-grid switching function verification includes verifying planned and unplanned on/off-grid switching.

- To verify planned on/off-grid switching, click **Switch to on-grid** and **Switch to off-grid** to check whether the on/off-grid switching function is normal.
- To verify unplanned on/off-grid switching, manually turn off the switch on the U_AC1 voltage side of the SmartMGC to check whether the on/off-grid switching function is normal.

Planned On/Off-Grid Switching

Step 1 Log in to the SmartMGC WebUI and choose **Settings** > **Microgrid Control** > **On/Off-Grid Switching**.

Step 2 Verify that the on-grid switching function is normal when the PV+ESS system is started and running in off-grid mode.

1. Click **Switch to on-grid** and check whether **On/Off-grid status** is . If yes, go to 2. If no, check and rectify the fault based on the alarm information.
2. Choose **Monitoring** > **ESS** > **Running Parameters** and check whether **Working Mode** is **PQ**.
   - If yes, the switching to on-grid mode is successful.
   - If no, the switching to on-grid mode fails. Check and rectify the fault based on the alarm information.

Step 3 Verify that the off-grid switching function is normal when the PV+ESS system is started and running in on-grid mode.

1. Click **Switch to off-grid** and check whether **On/Off-grid status** is . If yes, go to 2. If no, check and rectify the fault based on the alarm information.
2. Choose **Monitoring** > **ESS** > **Running Parameters** and check whether **Working Mode** is **VSG**.
   - If yes, the switching to off-grid mode is successful.
   - If no, the switching to off-grid mode fails. Check and rectify the fault based on the alarm information.

----End

Unplanned On/Off-Grid Switching

NOTICE

Before verifying unplanned on/off-grid switching, choose **Settings** > **Microgrid Control** > **General Basic Settings** > **Microgrid Settings** and set **Seamed on/off-grid switching mode** to **Automatic**.

Step 1 Log in to the SmartMGC WebUI and choose **Settings** > **Microgrid Control** > **On/Off-Grid Switching**.

Step 2 Verify that the on-grid switching function is normal when the PV+ESS system is started and running in off-grid mode.

1. Manually turn on the switch on the U_AC1 voltage side of the SmartMGC and check whether **On/Off-grid status** is . If yes, go to **2**. If no, check and rectify the fault based on the alarm information.
2. Choose **Monitoring** > **ESS** > **Running Parameters** and check whether **Working Mode** is **PQ**.
   - If yes, the switching to on-grid mode is successful.
   - If no, the switching to on-grid mode fails. Check and rectify the fault based on the alarm information.

Step 3 Verify that the off-grid switching function is normal when the PV+ESS system is started and running in on-grid mode.

1. Manually turn off the switch on the U_AC1 voltage side of the SmartMGC and check whether **On/Off-grid status** is . If yes, go to **2**. If no, check and rectify the fault based on the alarm information.
2. Choose **Monitoring** > **ESS** > **Running Parameters** and check whether **Working Mode** is **VSG**.
   - If yes, the switching to off-grid mode is successful.
   - If no, the switching to off-grid mode fails. Check and rectify the fault based on the alarm information.

----End

2.3.4.4 Verifying Charging and Discharging Functions

NOTICE

Before verifying the charging and discharging functions, verify the cable connections for local power sampling.

Step 1 Log in to the SmartMGC WebUI, shut down the inverters. The PV power to 0. If there are inverters in the array, perform this step.

Choose **Maintenance** > **Device Management** > **Startup/Shutdown**, click **All array inverters** under **Shut Down**, enter the login password, and confirm the shutdown.

Step 2 Verify the discharge function when the ESS is running in on-grid mode.

1. Choose **Settings** > **Grid Connection Control** > **ESS Control**, select **Charge/Discharge based on grid dispatch**, set **Charge/Discharge time window control** to **Enable**, set all time segments to **Discharge**, and set the discharge power to 10 kW.
2. Choose **Overview** > **Sampling Info** and check whether the active power at the grid connection point is consistent with the discharge power.
   - If the values are consistent, the discharge function is normal.
   - If the values are inconsistent, check and rectify the fault based on the alarm information.

Step 3 Disconnect all loads.

Step 4 Verify the charge function when the ESS is running in on-grid mode.

1. Choose **Settings** > **Grid Connection Control** > **ESS Control**, select **Charge/Discharge based on grid dispatch**, set **Charge/Discharge time window control** to **Enable**, and set the charge power to 10 kW.
2. Choose **Overview** > **Sampling Info** and check whether the increase in the active power at the grid connection point is consistent with the charge power.
   - If the values are consistent, the charge function is normal.
   - If the values are inconsistent, check and rectify the fault based on the alarm information.

Step 5 Start the inverters. If there are inverters in the array, perform this step.

Choose **Maintenance** > **Device Management** > **Startup/Shutdown**, click **All array inverters** under **Start**, enter the login password, and confirm the startup.

Step 6 Connect loads.

----End

2.4 Connecting to a Plant

After devices are commissioned, you can create a plant and configure basic information on the app to implement unified device monitoring and O&M.

- If the owner does not have a plant in the management system or app, connect to a new plant by referring to **2.4.1 Adding a Plant**.
- If the owner has a plant in the management system or app, connect to the existing plant by referring to **2.4.2 Connecting to an Existing Plant**.
- When a device that supports the registration code is bound to a plant, the device registration code must be verified, ensuring access security.

2.4.1 Adding a Plant

1. If no plant has been created, tap **Add plant**.
2. Tap **Plant Info** and enter the basic plant information.
   - If a plant scheme has been designed on the Design Tool platform before plant deployment, you can tap the corresponding button on the screen to

import the basic information about the corresponding plant from the Design Tool.
   - If no plant scheme has ever been designed, enter the basic plant information as prompted.
   - Plant owner: Enter the mobile number or email address of the plant owner to bind the plant to the owner account. (If the owner has not registered an account, the system will automatically send an SMS message or a registration invitation email to the owner after the plant is created.)
3. Tap **Create and Continue**.
4. On the screen for adding devices, view the added devices.
   - If multiple devices need to be connected to the same plant, tap **+** to scan the QR codes of the devices and add the devices one by one.

     NOTE

     The devices to be added must have been commissioned.
   - After the devices are added, tap **Total string capacity** and enter the total string capacity of the plant.
5. Tap **Save and Continue**.
6. Set the feed-in tariff, purchase price, and revenue unit (currency) of the plant as electricity price inputs for revenue calculation.
7. **Complete**.

2.4.2 Connecting to an Existing Plant

1. If a plant has been created, tap **Connect to existing plant**.
2. Select the plant to be bound.
3. Tap **OK** to complete the binding.

2.5 Function Commissioning

2.5.1 Power Dispatch

Limited feed-in, demand limit, capacity limit, and multi-mode overlay take effect only when the system is operating in on-grid mode.

2.5.1.1 Limited Feed-in

Application Scenario

The limited feed-in mode applies to scenarios where the feed-in power at the grid connection point is limited. When the feed-in power is limited to zero, it is the zero export limitation function. Limited feed-in is classified into two control modes:

- Total power limit: The total power at the grid connection point only needs to meet the preset feed-in power limit. The power control of any phase at the grid connection point is not considered.

- Single-phase power limit: In some countries, the on-grid meter measures the power of each phase separately. Therefore, the power of each phase shall be controlled at the grid connection point.

CAUTION

- Single SmartLogger CT/PT direct sampling: When the power at the grid connection point exceeds the threshold, it takes 300 ms for the SmartMGC to control the power at the grid connection point within the threshold.
- Single SmartLogger with an external meter: When the power at the grid connection point exceeds the threshold, it takes 2s for the SmartMGC to control the power at the grid connection point within the threshold.

Prerequisites

The I_AC/U_AC1 sampling port of the SmartMGC has been correctly connected to the CT/PT (used for the meter at the grid connection point), or the SmartMGC has been correctly connected to the meter, and **Meter usage** has been set to **Feed-in meter**.

Procedure (Method 1: SmartMGC WebUI)

Step 1 Log in to the SmartMGC WebUI and enable the remote power scheduling function for the inverter and PCS.

- Choose **Monitoring** > **PCS** > **Running Parameters** and set **Remote Scheduling** to **Enable**.
- Choose **Monitoring** > **Inverter** > **Running Parameters** and set **Remote Scheduling** to **Enable**.

Step 2 Activate the active power control mode **Limited feed-in**.

1. Choose **Settings** > **Grid Connection Control** > **Active Power**. The **Active power control mode** page is displayed.
2. Select **Limited feed-in** and click **OK**.

   If this option cannot be selected, deselect **Unlimited** and try again.

Step 3 Set **Limited feed-in** parameters.

Table 2-28 Limited feed-in parameters

Category	Parameter	Description
Basic parameter	**Limitation mode**	Specifies the power limiting mode based on the power limiting criteria of the local power grid company. If the power of each phase at the grid connection point is limited, select **Single-phase power**. Otherwise, select **Total power**. ● **Total power**: The total power at the grid connection point is limited. ● **Single-phase power**: The power of each phase at the grid connection point is limited.
	Time-based limit	Specifies whether to set **Time-based limit** to **Enable**. After the parameter is set to **Enable**, you can set different values of **Maximum grid feed-in power** for different time segments. The control priority of **Maximum grid feed-in power** in a time segment configured is higher than that of **Maximum grid feed-in power** in basic parameters. If this parameter is not set to **Enable** or the current time segment is not configured, the system uses **Maximum grid feed-in power** in basic parameters for control.
	Maximum protection time	Specifies the maximum duration from the time when the SmartMGC detects power feed-in to the time when the device output power is adjusted to **Maximum grid feed-in power**. You are advised to set this parameter based on the maximum power feed-in duration allowed by the power grid company. If the maximum power feed-in duration allowed by the power grid company is 2s, set this parameter to 2s.
	Power raising threshold	This parameter is set to prevent the device output power from fluctuating repeatedly near the limit when the load power increases. The recommended value is 1%–2% Pn. Pn indicates the total rated power of the device.
	Three-phase imbalance control	This parameter is displayed when **Limitation mode** is set to **Single-phase power**. If the feed-in meter is a three-phase four-wire meter, you can control phase-level power dispatch separately to implement cost-effective dispatch. ● **Enable**: separate control for three phases ● **Disable**: joint control for three phases

Cate gory	Parameter	Description
	Maximum grid feed-in power	Specifies the maximum power that a device can feed into the power grid. You are advised to set this parameter to 1% of the rated array power. If the value is less than the setting, the power at the grid connection point may fluctuate frequently. The maximum value of this parameter cannot exceed the feed-in power threshold allowed by the power grid company. Value range: ● Maximum value: 60000 ● Minimum value: If **Demand limit** is set to **Active power limit** or **Apparent power limit**, the minimum value is determined by the value of **Maximum Peak Power** (you can view the value after choosing **Settings** > **Grid Connection Control** > **Capacity/Demand Control**).
Time wind ow	**Start and End Time**	This parameter is displayed when **Time-based limit** is set to **Enable**. It specifies the time window for the time-based limit. A maximum of 24 time segments can be set. Set **Maximum grid feed-in power** for different time segments and the time for repetition. The control priority of **Maximum grid feed-in power** in the time segments configured is higher than that of **Maximum grid feed-in power** in basic parameters.
	Maximum grid feed-in power	
	Repeat	

Step 4 (Optional) Set extended parameters for limited feed-in. Set extended parameters if the SmartMGC needs to drive the circuit breaker to prevent power feed-in. If not involved, skip this step.

In some regions, a circuit breaker must be installed at the grid connection point to prevent power feed-in. If power feed-in occurs, the SmartMGC switches off the circuit breaker through the DO port to ensure that the specifications are met.

Table 2-29 Extended parameters

Parameter	Description
Switch control for zero feed-in	Specifies whether to enable the function of switching off the circuit breaker through the DO port by the SmartMGC to prevent power feed-in.
Switch-off control port	Specifies the DO port for controlling switch-off. Click **Off** to verify the function of remotely switching off the circuit breaker by the SmartMGC.

Parameter	Description
Switch-on control port	Specifies the DO port for controlling switch-on. Click **On** to verify the function of remotely switching on the circuit breaker by the SmartMGC.
Switch-off state feedback port	Specifies the DI port that reports the switch-off state.
Switch-on state feedback port	Specifies the DI port that reports the switch-on state.

Step 5 Click **Inverter/PCS Parameters** in the upper right corner of the page, set inverter or PCS parameters, and synchronize the parameter settings in batches.

Table 2-30 Inverter or PCS parameters

Parameter	Description
Active power change gradient	To ensure that the power can be quickly adjusted to the target in the feed-in control scenario, you need to set this parameter. You are advised to set this parameter to 125%/s. If the upper limit is less than 125%/s, set this parameter to the maximum value.
Soft start time	Specifies the duration for the inverter or PCS output power to gradually increase when the device starts. The inverter or PCS output power increases slowly, reducing the feed-in risk. You are advised to set this parameter to 20s.
Soft start time after grid failure	Specifies the duration for the inverter or PCS output power to gradually increase when the inverter or PCS starts after the grid fault is rectified. The inverter or PCS output power increases slowly, reducing the feed-in risk. You are advised to set this parameter to 20s.
Protection upon Communication Failure	In the feed-in control scenario, the inverter or PCS automatically reduces the power to prevent feed-in when the inverter or PCS is disconnected from the SmartMGC. ● **Enable**: The inverter or PCS automatically reduces the power to prevent feed-in when it is disconnected from the SmartMGC. ● **Disable**: Protection upon communication failure is disabled.

Parameter	Description
Communication disconnection duration	This parameter is displayed when **Protection upon Communication Failure** is set to **Enable**. If communication between the inverter or PCS and the SmartMGC is interrupted beyond the duration specified by this parameter, it is considered as a failure. You are advised to set this parameter to 3s. (For the RD1699 grid code of Spain, you are advised to set this parameter to 2s.)
Active power mode when communication fails	Specifies the active power output mode after the inverter or PCS detects that the communication with the SmartMGC is interrupted. You are advised to set this parameter to **Fixed value**. ● **Fixed value**: The active power is limited by a fixed power value. ● **Percentage**: The active power is limited by a power percentage.
Active power limit when communication fails	Specifies the fixed value or percentage of active power. You are advised to set this parameter to 0.

Step 6 After the parameters are set, click **Submit**.

----End

Procedure (Method 2: SmartMGC Local App)

Step 1 Log in to the SmartMGC local app and enable the **Limited Feed-in** active power control.

1. Choose **Power adjustment** > **Active power** to access the **Active power** screen.
2. Enable **Limited Feed-in**.

Step 2 Set **Limited Feed-in** parameters. For details about how to set the parameters, see **Setting Limited Feed-in Parameters** and **Setting Extended Parameters for Limited Feed-in**.

----End

2.5.1.2 Demand Limit

Application Scenario

Demand limit applies to areas where peak demand charges are collected. It allows you to lower the peak power purchased from the grid during peak hours, thereby reducing electricity fees.

Prerequisites

The I_AC/U_AC1 sampling port of the SmartMGC has been correctly connected to the CT/PT (used for the meter at the grid connection point), or the SmartMGC has been correctly connected to the meter, and **Meter usage** has been set to **Feed-in meter**.

NOTICE

The demand limit function is invalid when the SmartMGC and ESS are being updated.

Procedure

Step 1 Enable the **Demand limit** function and access the **Capacity/Demand Control** page.

- SmartMGC WebUI: Choose **Settings** > **Grid Connection Control** > **Capacity/ Demand Control**.
- SmartMGC local app: Choose **Power adjustment** > **Capacity Control**.

Step 2 Set **Demand limit** to **Active power limit** or **Apparent power limit**.

- **Active power limit**: The active power purchased from the grid cannot exceed the limit.
- **Apparent power limit**: The apparent power purchased from the grid cannot exceed the limit.

Step 3 Set **Demand limit** parameters.

Table 2-31 Demand limit

Parameter	Description
Backup power SOC for capacity/ demand control	The reserved power, which is used for capacity/demand control, ensures that the ESS can meet capacity/demand control requirements. The value of this parameter affects the peak shaving capability. A larger value indicates a stronger peak shaving capability.
Allow ESS discharge to meet demand in TOU charge period	• **Enable**: When the ESS control mode is set to **TOU (Time-of-use Pricing)**, the ESS is allowed to discharge during the charging period to meet the system demand. • **Disable**: The function is disabled.
Dynamic demand calculation	This parameter is displayed when **Demand limit** is set to **Active power limit**. • **Enable**: The peak demand power is dynamically calculated based on **Demand calculation method**. • **Disable**: The function is disabled.

Parameter	Description
Demand calculation method	This parameter is displayed when **Demand limit** is set to **Active power limit**. ● **15-min sliding window/30-min sliding window**: The average power of each minute in the time segment (15 min or 30 min) is recorded, and the sum of the average values in the time segment is divided by 15 (when 15 min is set) or 30 (when 30 min is set) to determine the demand power in the time segment. The demand power in all time segments is calculated and recorded in this way, and the highest value in the current month is used as the demand power of the current month. ● **15-min average/30-min average**: A period (one month) is divided into multiple time segments (15 min or 30 min), and the average power in each time segment is calculated.
Start and End Time	Specifies the maximum peak power of the grid connection point in different time segments. A maximum of 14 time segments can be set for the maximum peak power. The time segments cannot overlap. 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.
Maximum Peak Power	
Repeat	Specifies the repeat execution time for configuration items.

Step 4 After the parameters are set, click **Submit**.

----End

2.5.1.3 Capacity Limit

Application Scenario

Capacity Limit applies to scenarios where the transformer or switch capacity at the grid connection point is limited. By limiting the maximum peak current at the grid connection point, this function prevents the current of electricity purchased from or sold to the grid from exceeding the device capacity, thereby preventing the transformer or switch from being damaged due to overload. This function ensures that the system runs stably within the safe capacity range.

CAUTION

- Single SmartLogger CT/PT direct sampling: When the capacity at the grid connection point exceeds the threshold, it takes 300 ms for the SmartMGC to control the capacity at the grid connection point within the threshold. Ensure that the settings match the onsite protection devices and switches at the grid connection point.
- Single SmartLogger with an external meter: When the capacity at the grid connection point exceeds the threshold, it takes 2s for the SmartMGC to control the capacity at the grid connection point within the threshold. Ensure that the settings match the onsite protection devices and switches at the grid connection point.
- The capacity limit function applies only to the active power. If the load generates a large amount of reactive power, you are advised to enable **Power factor closed-loop control** for the reactive power.

Prerequisites

The I_AC/U_AC1 sampling port of the SmartMGC has been correctly connected to the CT/PT (used for the meter at the grid connection point), or the SmartMGC has been correctly connected to the meter.

NOTICE

- The capacity limit function is invalid when the SmartMGC and ESS are being updated.
- The overload capability of transformers, power distribution switches, and cables must be greater than the sum of the maximum charge current and maximum load current of the ESS.
- If the capacity limit is met 24 hours a day, the ratio of the ESS capacity to the load power must be properly set to ensure that the ESS has sufficient capacity to meet the capacity limit.
- When the capacity limit function is enabled in **TOU (Time-of-use Pricing)** mode, the charge/discharge time set in **TOU (Time-of-use Pricing)** mode must cover 24 hours of a day. Capacity limit is not supported in non-charge/discharge time.

Procedure (Method 1: SmartMGC WebUI)

Step 1 Log in to the SmartMGC WebUI and enable the **Capacity limit** function.

1. Choose **Settings** > **Grid Connection Control** > **Capacity/Demand Control**. The **Capacity/Demand Control** page is displayed.
2. Set **Capacity limit** to **Current limit**.

Step 2 Set **Capacity limit** parameters.

Table 2-32 Capacity limit

Parameter	Description
Maximum feed-in current	Set this parameter based on the maximum peak current in the feed-in direction of the grid connection point.
Maximum current from grid	Set this parameter based on the maximum peak current in the power purchase direction of the grid connection point.
Shut down if feed-in current exceeds threshold	● **Enable**: The array will be forcibly shut down for 4 hours if the feed-in current exceeds the threshold. It is recommended that you use this function under the UK G100 regulations and configure relevant inverter/PCS parameters by referring to **Step 3**. If the array shuts down due to this function, you need to manually start it after waiting for at least 4 hours. ● **Disable**: The function is disabled.
Backup power SOC for capacity/demand control	The reserved power, which is used for capacity/demand control, ensures that the ESS can meet capacity/ demand control requirements. The value of this parameter affects the peak shaving capability. A larger value indicates a stronger peak shaving capability.
Allow ESS discharge to meet demand in TOU charge period	When **Capacity limit** is enabled, this parameter is automatically set to **Enable**. ● **Enable**: When the ESS control mode is set to **TOU (Time-of-use Pricing)**, the ESS is allowed to discharge during the charging period to meet the system demand. ● **Disable**: The function is disabled.

Step 3 (Optional) Set inverter or PCS parameters and synchronize the parameter settings in batches.

Inverter/PCS Parameters needs to be set only under the UK G100 regulations. If not involved, skip this step.

Table 2-33 Inverter or PCS parameters

Parameter	Description
Active power change gradient	To ensure that the power can be quickly adjusted to the target in the feed-in control scenario, you need to set this parameter. You are advised to set this parameter to 125%/s. If the upper limit is less than 125%/s, set this parameter to the maximum value.

Parameter	Description
Soft start time	Specifies the duration for the inverter or PCS output power to gradually increase when the device starts. The inverter or PCS output power increases slowly, reducing the feed-in risk. You are advised to set this parameter to 20s.
Soft start time after grid failure	Specifies the duration for the inverter or PCS output power to gradually increase when the inverter or PCS starts after the grid fault is rectified. The inverter or PCS output power increases slowly, reducing the feed-in risk. You are advised to set this parameter to 20s.
Protection upon Communication Failure	In the feed-in control scenario, the inverter or PCS automatically reduces the power to prevent feed-in when the inverter or PCS is disconnected from the SmartMGC. ● **Enable**: The inverter or PCS automatically reduces the power to prevent feed-in when it is disconnected from the SmartMGC. ● **Disable**: Protection upon communication failure is disabled.
Communication disconnection duration	This parameter is displayed when **Protection upon Communication Failure** is set to **Enable**. If communication between the inverter or PCS and the SmartMGC is interrupted beyond the duration specified by this parameter, it is considered as a failure. You are advised to set this parameter to 3s. (For the RD1699 grid code of Spain, you are advised to set this parameter to 2s.)
Active power mode when communication fails	Specifies the active power output mode after the inverter or PCS detects that the communication with the SmartMGC is interrupted. You are advised to set this parameter to **Fixed value**. ● **Fixed value**: The active power is limited by a fixed power value. ● **Percentage**: The active power is limited by a power percentage.
Active power limit when communication fails	Specifies the fixed value or percentage of active power. You are advised to set this parameter to 0.

Step 4 After the parameters are set, click **Submit**.

----End

Procedure (Method 2: SmartMGC Local App)

Step 1 Log in to the SmartMGC local app and enable the **Capacity Limit** function.

1. Choose **Power adjustment** > **Capacity Control** to access the **Capacity/ Demand Control** screen.
2. Set **Capacity Limit** to **Current limit**.

   Current limit: The current of electricity purchased from or sold to the grid cannot exceed the preset current limit.

Step 2 Set **Capacity Limit** parameters. For details about how to set the parameters, see **Setting Capacity Limit Parameters**.

Step 3 After the parameters are set, tap **Submit**.

----End

2.5.1.4 Multi-mode Overlay

In the multi-mode overlay scenario, the mode related to the grid connection point limit has the highest priority. If multiple grid connection point limit functions are applied at the same time, the minimum value is used as the upper limit and the maximum value is used as the lower limit.

Example:

Assume that the TOU (fixed power) and limited feed-in modes are applied at the same time:

- TOU (fixed power) discharge power: 50 kW
- Limited feed-in power at the grid connection point: 20 kW
- Load power: 25 kW

According to the principle of taking the smaller value as the upper limit, the upper limit of the system discharge power is min(50 kW, (20 kW + 25 kW)) = 45 kW. This ensures that the system operates optimally while meeting the power limit at the grid connection point.

Table 2-34 Multi-mode overlay

Mode	Limited Feed-in	Capacity Limit	Demand Limit	Max. Self-Consumption	TOU	TOU (Fixed Power)	Charge/Discharge Based on Grid Dispatch[a]
Limited feed-in	-	Supported	Supported	Supported	Supported	Supported	Partially supported
Capacity limit	Supported	-	Supported	Supported	Supported	Supported	Partially supported
Demand limit	Supported	Supported	-	Supported	Supported	Supported	Partially supported

Mode	Limited Feed-in	Capacity Limit	Demand Limit	Max. Self-Consumption	TOU	TOU (Fixed Power)	Charge/Discharge Based on Grid Dispatch[a]
Max. self-consumption	Supported	Supported	Supported	-	Supported	Supported	Supported
TOU	Supported	Supported	Supported	Supported	-	-	Supported
TOU (fixed power)	Supported	Supported	Supported	Supported	-	-	Supported
Charge/Discharge based on grid dispatch[a]	Partially supported	Partially supported	Partially supported	Supported	Supported	Supported	-
Note a: In this version, charge/discharge based on grid dispatch supports the combination with limited feed-in, capacity limit, and demand limit only in the PV+ESS collaboration scenario. In the PV+ESS independent scenario, charge/discharge based on grid dispatch cannot be combined with the preceding modes.							

Scenario 1: TOU + Maximum Self-Consumption

This combination applies to PV+ESS and ESS-only systems in scenarios with price differences between peak and off-peak hours and equipped with a feed-in meter. There is no restriction on the charge/discharge power of the ESS.

Step 1 Set the ESS working mode.

- SmartMGC WebUI: Choose **Settings** > **Grid Connection Control** > **ESS Control** and set **Working Mode** to **TOU (Time-of-use Pricing)**.
- SmartMGC local app: Choose **Power adjustment** > **BatterySetting** and set **Working mode settings** to **TOU (Time-of-Use)**.

Step 2 Enable **Max. self-consumption**.

Set **Max. self-consumption** to **Enable** and set related parameters.

Table 2-35 Related parameters

Parameter	Description
Max. self-consumption	Set this parameter to **Enable** if **Max. self-consumption** needs to be combined. ● **Enable**: The maximum self-consumption function is enabled. When the PV power is greater than the load power, the surplus PV power is charged to the ESS. After the charge power reaches the maximum value or the ESS is fully charged, the surplus PV power is fed to the grid. ● **Disable**: The maximum self-consumption function is disabled. When the PV power is greater than the load power, the surplus PV power is preferentially fed to the grid. After the feed-in power reaches the maximum value, the surplus PV power is charged to the ESS.
Maximum charge power from AC	Specifies the maximum power at which the grid charges the ESS. The value is determined by the local power grid company. If there is no requirement, the value is the maximum charge power of the ESS by default.
Maximum grid power during battery discharge	The default value 0 W is recommended. Adjust the ESS discharge power based on the preset threshold in the ESS discharge scenario. ● When the power purchased from the grid exceeds the preset threshold, the ESS starts discharging and adjusts the discharge power. ● When the power purchased from the grid is less than or equal to the preset threshold, the ESS continues to execute the previous dispatch command. For example, if this parameter is set to 0.05 kW and the adjustment deadband is 0 W: ● If the PV output power is 30 kW and the load power is 30 kW, no power is purchased from the grid and the ESS does not discharge energy. ● If the PV output power is 30 kW and the load power is 30.04 kW, 0.04 kW power is purchased from the grid and the ESS discharges 0 kW of energy. ● If the PV output power is 30 kW and the load power is 30.06 kW, 0.05 kW power is purchased from the grid and the ESS discharges 0.01 kW of energy.

Parameter	Description
Adjustment deadband	The default value 0 W is recommended. Set the precision of the ESS discharge power in the ESS discharge scenario. ● If the actual power purchase threshold of the grid connection point is within the range, the ESS executes the previous dispatch command. ● If the actual power purchase threshold of the grid connection point is not within the range, the ESS discharges energy.
Adaptive adjustment parameters	● **Enable**: The ESS performs adaptive adjustment. ● **Disable**: The ESS adjusts the power based on **ESS control adjustment interval** and **PV power adjustment step**.
ESS control adjustment interval	This parameter is displayed when **Adaptive adjustment parameters** is set to **Disable**. Specifies the ESS adjustment interval.
PV power adjustment step	This parameter is displayed when **Adaptive adjustment parameters** is set to **Disable**. Specifies the step for ESS adjustment.
Start and End Time	Specifies the start time and end time of charge/discharge. A maximum of 14 time segments can be set. The time segments cannot overlap. ● **Discharge**: The ESS is allowed to discharge energy to loads, but cannot feed energy to the grid. ● **Charge**: ESS charge is allowed.
Charge/Discharge	
Interval	

----End

Scenario 2: TOU (Fixed Power) + Max. Self-Consumption

This combination applies to ESS-only or PV+ESS systems in scenarios with a large price difference between peak and off-peak hours. The ESS needs to be charged and discharged at a fixed power, and there are restrictions on the charge/discharge power of the ESS.

Step 1 Set the ESS working mode.

- SmartMGC WebUI: Choose **Settings** > **Grid Connection Control** > **ESS Control** and set **Working Mode** to **TOU (fixed power)**.
- SmartMGC local app: Choose **Power adjustment** > **BatterySetting** and set **Working mode settings** to **TOU (Fixed power)**.

Step 2 Enable **Max. self-consumption**.

Set **Max. self-consumption** to **Enable** and set related parameters.

Table 2-36 Related parameters

Parameter	Description
Max. self-consumption	This parameter is displayed when **PT/CT sampling** is set to **Enable** or when a feed-in meter is connected. Set this parameter to **Enable** when both **TOU (fixed power)** and **Max. self-consumption** are chosen. ● **Enable**: The maximum self-consumption function is enabled. When the PV power is greater than the load power, the surplus PV power is charged to the ESS. After the charge power reaches the maximum value or the ESS is fully charged, the surplus PV power is fed to the grid. ● **Disable**: The maximum self-consumption function is disabled. When the PV power is greater than the load power, the surplus PV power is preferentially fed to the grid. Once the feed-in power reaches the maximum value, the surplus PV power is charged to the ESS (the charge power does not exceed the value set in **Charge/Discharge Power**.)
Maximum grid power during battery discharge	The default value 0 W is recommended. Adjust the ESS discharge power based on the preset threshold in the ESS discharge scenario. ● When the power purchased from the grid exceeds the preset threshold, the ESS starts discharging and adjusts the discharge power. ● When the power purchased from the grid is less than or equal to the preset threshold, the ESS continues to execute the previous dispatch command. For example, if this parameter is set to 0.05 kW and the adjustment deadband is 0 W: ● If the PV output power is 30 kW and the load power is 30 kW, no power is purchased from the grid and the ESS does not discharge energy. ● If the PV output power is 30 kW and the load power is 30.04 kW, 0.04 kW power is purchased from the grid and the ESS discharges 0 kW of energy. ● If the PV output power is 30 kW and the load power is 30.06 kW, 0.05 kW power is purchased from the grid and the ESS discharges 0.01 kW of energy.

Parameter	Description
Adjustment deadband	The default value 0 W is recommended. Set the precision of the ESS discharge power in the ESS discharge scenario. ● If the actual power purchase threshold of the grid connection point is within the range, the ESS executes the previous dispatch command. ● If the actual power purchase threshold of the grid connection point is not within the range, the ESS discharges energy.
Adaptive adjustment parameters	● **Enable**: The ESS performs adaptive adjustment. ● **Disable**: The ESS adjusts the power based on **ESS control adjustment interval** and **PV power adjustment step**.
ESS control adjustment interval	This parameter is displayed when **Adaptive adjustment parameters** is set to **Disable**. Specifies the ESS adjustment interval.
PV power adjustment step	This parameter is displayed when **Adaptive adjustment parameters** is set to **Disable**. Specifies the step for ESS adjustment.
Start and End Time	Specifies the start time and end time of charge/discharge. A maximum of 14 time segments can be set. The time segments cannot overlap. ● **Discharge**: The ESS is allowed to discharge energy to loads, but cannot feed energy to the grid. ● **Charge**: ESS charge is allowed.
Charge/Discharge	
Interval	

----End

Scenario 3: TOU + Max. Self-Consumption + Demand Limit

This combination applies to PV+ESS and ESS-only systems in scenarios with price differences between peak and off-peak hours, equipped with a feed-in meter, and with peak demand charges. It further enhances the system's cost-effectiveness and operational flexibility.

Step 1 Set the ESS working mode.

- SmartMGC WebUI: Choose **Settings** > **Grid Connection Control** > **ESS Control** and set **Working Mode** to **TOU (Time-of-use Pricing)**.
- SmartMGC local app: Choose **Power adjustment** > **BatterySetting** and set **Working mode settings** to **TOU (Time-of-Use)**.

Step 2 Enable **Max. self-consumption**.

Set **Max. self-consumption** to **Enable** and set related parameters.

Table 2-37 Related parameters

Parameter	Description
Max. self-consumption	Set this parameter to **Enable** if **Max. self-consumption** needs to be combined. ● **Enable**: The maximum self-consumption function is enabled. When the PV power is greater than the load power, the surplus PV power is charged to the ESS. After the charge power reaches the maximum value or the ESS is fully charged, the surplus PV power is fed to the grid. ● **Disable**: The maximum self-consumption function is disabled. When the PV power is greater than the load power, the surplus PV power is preferentially fed to the grid. After the feed-in power reaches the maximum value, the surplus PV power is charged to the ESS.
Maximum charge power from AC	Specifies the maximum power at which the grid charges the ESS. The value is determined by the local power grid company. If there is no requirement, the value is the maximum charge power of the ESS by default.
Maximum grid power during battery discharge	The default value 0 W is recommended. Adjust the ESS discharge power based on the preset threshold in the ESS discharge scenario. ● When the power purchased from the grid exceeds the preset threshold, the ESS starts discharging and adjusts the discharge power. ● When the power purchased from the grid is less than or equal to the preset threshold, the ESS continues to execute the previous dispatch command. For example, if this parameter is set to 0.05 kW and the adjustment deadband is 0 W: ● If the PV output power is 30 kW and the load power is 30 kW, no power is purchased from the grid and the ESS does not discharge energy. ● If the PV output power is 30 kW and the load power is 30.04 kW, 0.04 kW power is purchased from the grid and the ESS discharges 0 kW of energy. ● If the PV output power is 30 kW and the load power is 30.06 kW, 0.05 kW power is purchased from the grid and the ESS discharges 0.01 kW of energy.

Parameter	Description
Adjustment deadband	The default value 0 W is recommended. Set the precision of the ESS discharge power in the ESS discharge scenario. ● If the actual power purchase threshold of the grid connection point is within the range, the ESS executes the previous dispatch command. ● If the actual power purchase threshold of the grid connection point is not within the range, the ESS discharges energy.
Adaptive adjustment parameters	● **Enable**: The ESS performs adaptive adjustment. ● **Disable**: The ESS adjusts the power based on **ESS control adjustment interval** and **PV power adjustment step**.
ESS control adjustment interval	This parameter is displayed when **Adaptive adjustment parameters** is set to **Disable**. Specifies the ESS adjustment interval.
PV power adjustment step	This parameter is displayed when **Adaptive adjustment parameters** is set to **Disable**. Specifies the step for ESS adjustment.
Start and End Time	Specifies the start time and end time of charge/discharge. A maximum of 14 time segments can be set. The time segments cannot overlap. ● **Discharge**: The ESS is allowed to discharge energy to loads, but cannot feed energy to the grid. ● **Charge**: ESS charge is allowed.
Charge/Discharge	
Interval	

Step 3 Set demand limit parameters.

- SmartMGC Web: Choose **Settings** > **Grid Connection Control** > **Capacity/Demand Control**. For details about how to set other parameters, see **Demand Limit**.
- SmartMGC local app: Choose **Power Adjustment** > **Demand Limit**. For details about how to set other parameters, see **Demand Limit**.

----End

Scenario 4: TOU + Max. Self-Consumption + Capacity Limit + Limited Feed-in

This combination applies to PV+ESS and ESS-only systems in the capacity expansion scenario with price differences between peak and off-peak hours and equipped with a feed-in meter. The "energy storage+power distribution" mode flexibly provides energy and power support to meet new load requirements on the user side, resolve line and device bottlenecks, and indirectly improve the transformer capacity and line transmission capability.

Step 1 Set the ESS working mode.

- SmartMGC WebUI: Choose **Settings** > **Grid Connection Control** > **ESS Control** and set **Working Mode** to **TOU (Time-of-use Pricing)**.
- SmartMGC local app: Choose **Power Adjustment** > **Energy Storage Settings** and set **Working mode** to **TOU (time-of-use)**.

Step 2 Enable **Max. self-consumption**.

Set **Max. self-consumption** to **Enable** and set related parameters.

Table 2-38 Related parameters

Parameter	Description
Max. self-consumption	Set this parameter to **Enable** if **Max. self-consumption** needs to be combined. ● **Enable**: The maximum self-consumption function is enabled. When the PV power is greater than the load power, the surplus PV power is charged to the ESS. After the charge power reaches the maximum value or the ESS is fully charged, the surplus PV power is fed to the grid. ● **Disable**: The maximum self-consumption function is disabled. When the PV power is greater than the load power, the surplus PV power is preferentially fed to the grid. After the feed-in power reaches the maximum value, the surplus PV power is charged to the ESS.
Maximum charge power from AC	Specifies the maximum power at which the grid charges the ESS. The value is determined by the local power grid company. If there is no requirement, the value is the maximum charge power of the ESS by default.

Parameter	Description
Maximum grid power during battery discharge	The default value 0 W is recommended. Adjust the ESS discharge power based on the preset threshold in the ESS discharge scenario. ● When the power purchased from the grid exceeds the preset threshold, the ESS starts discharging and adjusts the discharge power. ● When the power purchased from the grid is less than or equal to the preset threshold, the ESS continues to execute the previous dispatch command. For example, if this parameter is set to 0.05 kW and the adjustment deadband is 0 W: ● If the PV output power is 30 kW and the load power is 30 kW, no power is purchased from the grid and the ESS does not discharge energy. ● If the PV output power is 30 kW and the load power is 30.04 kW, 0.04 kW power is purchased from the grid and the ESS discharges 0 kW of energy. ● If the PV output power is 30 kW and the load power is 30.06 kW, 0.05 kW power is purchased from the grid and the ESS discharges 0.01 kW of energy.
Adjustment deadband	The default value 0 W is recommended. Set the precision of the ESS discharge power in the ESS discharge scenario. ● If the actual power purchase threshold of the grid connection point is within the range, the ESS executes the previous dispatch command. ● If the actual power purchase threshold of the grid connection point is not within the range, the ESS discharges energy.
Adaptive adjustment parameters	● **Enable**: The ESS performs adaptive adjustment. ● **Disable**: The ESS adjusts the power based on **ESS control adjustment interval** and **PV power adjustment step**.
ESS control adjustment interval	This parameter is displayed when **Adaptive adjustment parameters** is set to **Disable**. Specifies the ESS adjustment interval.
PV power adjustment step	This parameter is displayed when **Adaptive adjustment parameters** is set to **Disable**. Specifies the step for ESS adjustment.

Parameter	Description
Start and End Time	Specifies the start time and end time of charge/discharge. A maximum of 14 time segments can be set. The time segments cannot overlap. • **Discharge**: The ESS is allowed to discharge energy to loads, but cannot feed energy to the grid. • **Charge**: ESS charge is allowed.
Charge/Discharge	
Interval	

Step 3 Enable **Capacity limit**.

- SmartMGC WebUI: Choose **Settings** > **Grid Connection Control** > **Capacity/Demand Control**. For details about how to set other parameters, see **Capacity Limit**.
- SmartMGC local app: Choose **Power adjustment** > **Capacity Control**. For details about how to set other parameters, see **Capacity Limit**.

Step 4 Enable limited feed-in.

- SmartMGC WebUI:
  a. Choose **Settings** > **Grid Connection Control** > **Active Power**. The **Active power control mode** page is displayed.
  b. Select **Limited feed-in** and click **OK**.
  c. If this option cannot be selected, deselect **Unlimited** and try again.
  d. For details about how to set other parameters, see **Limited Feed-in**.
- SmartMGC local app:
  a. Choose **Power adjustment** > **Active power** to access the **Active power** screen.
  b. Set **Limited Feed-in** to **Enable**.
  c. For details about how to set other parameters, see **Limited Feed-in**.

----End

2.5.1.5 Off-Grid Power Backup

Application Scenario

Off-grid power backup applies to the on/off-grid switching scenario. When the primary power supply is interrupted, the ESS shall immediately provide backup power to ensure the normal operation of lighting, air conditioners, and office equipment in key production lines or commercial places with automated equipment.

Prerequisites

The working mode of the ESS has been set to **Max. self-consumption**, **TOU (Time-of-use Pricing)**, or **TOU (fixed power)**. The off-grid power backup function has a higher priority than the ESS working mode.

Procedure

Step 1 Enable the off-grid power backup function.

- SmartMGC WebUI: Choose **Settings** > **Microgrid Control** > **Scheduling Control**, set **Off-grid power backup** to **Enable**, and set **Prioritize off-grid power backup** to **Enable**.
- SmartMGC local app: Choose **Set** > **Microgrid Parameters** > **Scheduling Control**, set **Off-grid power backup** to **Enable**, and set **Prioritize off-grid power backup** to **Enable**.

Step 2 Set other related parameters.

Table 2-39 Off-grid power backup

Parameter	Description	Remarks
Off-grid power backup	Set this parameter to **Enable**. When the SOC is less than or equal to **Min. SOC for off-grid power backup**, the ESS stops discharging to maintain sufficient power for off-grid operation.	-
Min. SOC for off-grid power backup	If the grid fails, the system switches from on-grid mode to off-grid mode. If you want to ensure sufficient backup power in off-grid scenarios, you need to set **Min. SOC for off-grid power backup**. **Min. SOC for off-grid power backup** ensures that the ESS always reserves energy when it works in on-grid mode. A large value of **Min. SOC for off-grid power backup** affects the economic benefits in on-grid scenarios.	This parameter is displayed when **Off-grid power backup** is set to **Enable**.
Prioritize off-grid power backup	Set this parameter to **Enable**. If the ESS SOC is less than or equal to the min. SOC for off-grid power backup minus 3%, the ESS is preferentially charged from the PV power or grid power.	
Draw power from grid for off-grid power backup	Specifies whether to obtain power from the grid for off-grid power backup.	This parameter is displayed when **Prioritize off-grid power backup** is set to **Enable**.

Parameter	Description	Remarks
Charge power for off-grid power backup	Specifies the power for charging the ESS by the grid for off-grid power backup. If the ESS working mode is set to **TOU (Time-of-use Pricing)** and **Draw power from grid for off-grid power backup** is triggered, this parameter instead of **Maximum charge power from AC** determines the grid power charged to the ESS. You are advised to set this parameter to the same value as **Maximum charge power from AC**.	This parameter is displayed when **Draw power from grid for off-grid power backup** is set to **Enable**.

----End

2.5.2 Third-Party EMS Connection

SmartMGC can connect to a third-party EMS over IEC 104, GOOSE, or Modbus. Select one based on the protocols supported by the third-party EMS.

2.5.2.1 IEC 104 Protocol

When the SmartMGC connects to a third-party management system over IEC 104, IEC 104 communication parameters must be set on the SmartMGC WebUI. The third-party management system receives array information through teleindication and telemetry.

Prerequisites

Download the latest software version document from the **FusionSolar Software Download Center**, decompress the document, and view the **IEC 104 Forwarding Protocol Interface Description** file. Search for the corresponding device model in the file, and check the telemetry, teleindication, telecontrol, and teleadjust signal quantity of the corresponding device model.

For example, to obtain the telemetry signal quantity of the SmartMGC, perform the following steps:

1. In **IEC 104 Forwarding Protocol Interface Description**, open the corresponding SmartMGC sheet based on the device model.
2. Collect statistics on and record the total number of signal names under **Telemetry**. The data is the telemetry signal quantity of the SmartMGC of this model.

Procedure

Step 1 Choose **Settings** > **Communications protocol** > **IEC104** and select **Custom Service** or **General Service** based on the mode of connecting to the third-party management system.

- **Custom Service**: Select **Custom Service** when the SmartMGC connects to the management system with a specified IP address (whitelist mode).

- **General Service**: Select **General Service** when the SmartMGC connects to the management system with a non-specified IP address (non-whitelist mode).

Step 2 Set basic IEC 104 parameters.

Figure 2-38 Setting IEC 104 parameters

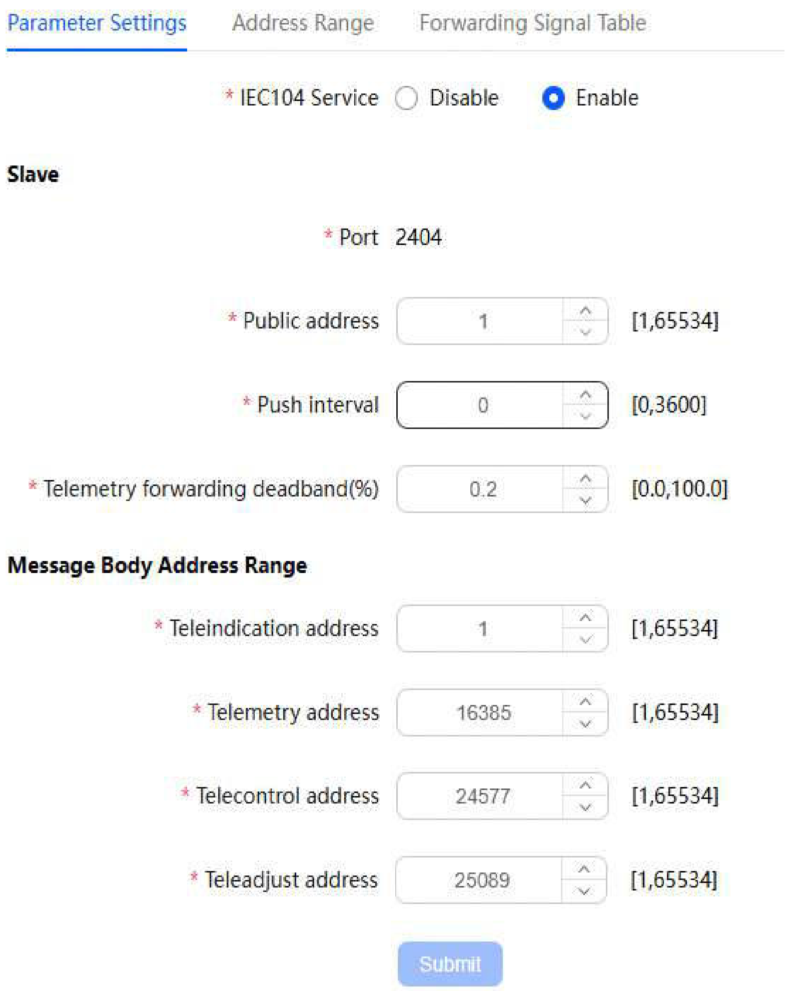


Table 2-40 Parameter settings

Parameter	Description
IEC104 Service	Specifies whether to set **IEC104** to **Enable**.
Port	Communications port.
Public address	Set this parameter as required. If the public addresses are inconsistent, the subsequent grid dispatch and inverter startup/shutdown control will be affected.

Parameter	Description
Push interval	Specifies the interval for the SmartMGC to push data to a third-party management system over IEC 104. If this parameter is set to 0s, there is no limit on the interval at which the SmartMGC sends data over IEC 104.
Telemetry forwarding deadband	When the telemetry data change exceeds this value, the change is reported.
Teleindication address	The start address of a signal must be less than or equal to the end address. The address ranges of different signals cannot overlap.
Telemetry address	
Telecontrol address	
Teleadjust address	

Step 3 Click **Address Range** and set the IEC 104 signal No. Three configuration modes are supported: manual configuration, importing configuration, and one-click configuration. You can select one based on site requirements.

Table 2-41 IEC 104 configuration modes

Configuration Mode	Description
Manual configuration	Manually enter the **Teleindication**, **Telemetry**, **Telecontrol**, and **Teleadjust** signal data of each device on the **Address Range** page.
Importing configuration	Export the template information in CSV format, configure the template data on the local PC using Excel, and then import the template to the system. This simplifies manual configuration on the WebUI.
One-click configuration	For the SmartMGC, the value is fixed at 150 for teleindication and telemetry ranges and 50 for telecontrol and teleadjust ranges. You only need to set the **Teleindication range**, **Telemetry range**, **Telecontrol range**, and **Teleadjust range** parameters for other devices. The system automatically matches the configuration information of other devices based on the SmartMGC.

The requirements for configuring the **Teleindication**, **Telemetry**, **Telecontrol**, and **Teleadjust** signal No. of each device are as follows:

- End value of signal No. ≥ Start value of signal No. + Signal No. quantity – 1
  The signal No. quantity is the quantity of signal No. obtained by the **Prerequisites** for each device.
- The signal No. range (end value – start value) configured in **Address Range** shall be greater than or equal to the actual quantity of signal No. of the

device. To facilitate calculation, you are advised to round up the end value of signal No. when setting the end value. For example, if the actual telemetry signal No. quantity of device ɑ is 15, you can configure 20 telemetry signal numbers for device ɑ.

The following describes the procedure for configuring the three protocols. Select a protocol based on the actual situation.

- **Method 1: manual configuration**
  a. Set the start and end values of **Teleindication**, **Telemetry**, **Telecontrol**, and **Teleadjust** for each device.
  b. Click **Submit**.
- **Method 2: configuration import**
  a. Click **Export** and select **Address Range** to export the information file.
  b. Edit the information file in Excel.
  c. Click **Import Address Range** to access the **Import** dialog box.
  d. Select the address range information file that has been edited and click **Import**.
  e. Click **Submit**.
- **Method 3: one-click configuration**
  a. Click **Configure** to access the **Configure** dialog box.
  b. Set the range values of **Teleindication**, **Telemetry**, **Telecontrol**, and **Teleadjust**, and click **OK**.
  c. Click **Submit**.

  NOTE

  - Check whether all of signal No. have been allocated to each device. If the addresses of multiple devices are the same, some of signal No. may not be allocated to these devices. You are advised to change the device addresses and click **Submit**.
  - Check whether some of signal No. allocated are changed greatly. If the device addresses change greatly, the signal No. will be changed greatly. You are advised to manually change the signal No. ranges.

----End

Example of Setting Signal No. for the IEC 104 Protocol

Assume that an array has one SmartMGC and one inverter.

NOTE

The quantity of device signal No. in **Table 2-42** is only an example. The actual quantity of device signal No. is subject to the actual quantity of **IEC 104 Forwarding Protocol Interface Description** in the software version documentation. For details about how to obtain the data, see **Prerequisites**.

Table 2-42 Signal No. quantity

Device Name	Teleindication Signal No. Quantity	Telemetry Signal No. Quantity	Telecontrol Signal No. Quantity	Teleadjust Signal No. Quantity
Logger	48	89	14	20
Inverter	83	32	3	0

Table 2-43 Signal No. setting

Device Name	No.	Teleindication		Telemetry		Telecontrol		Teleadjust	
		Start	End	Start	End	Start	End	Start	End
Logger	1	0	50	0	100	0	20	0	20
Inverter	2	51	150	101	150	21	30	0	0

Data Check

After setting the IEC 104 protocol parameters, check teleindication and telemetry data.

- **Teleindication** data check

  NOTE

  Path: **Maintenance** > **Field Test** > **Data Check** > **Teleindication**

  – **Manual check**
    i. Select the **Manual check** mode and click **Start**.
    ii. Change the **Analog Value** of a single signal to check the data of the signal.
    iii. Check the data of the remaining signals in sequence.
    iv. Click **Stop** to pause or complete the data check. All signals are reported based on the actual values.

  – **Automatic check**
    i. Select the **Auto check** mode.
    ii. Enter the **Interval** and **Start signal No.** for signal data check.
    iii. Click **Start**.
    iv. The system automatically completes the data check of the remaining signals from **Start signal No.**
    v. Click **Stop** to pause or complete the data check. All signals are reported based on the actual values.

NOTE

- During automatic check, you can switch pages, which does not affect the check process.
- If you click **Start**, the backend data of the system will no longer be updated. If you click **Stop**, the backend data of the system will be updated.
- After manual check, if you do not click **Stop** and do not perform any operation within 10 minutes, the system will automatically stop data check 10 minutes later. All signals are reported based on the actual values. After automatic check, the system will automatically stop data check in 10 minutes. All signals will be reported based on the actual values.

- **Telemetry** data check

  NOTE

  Path: **Maintenance** > **Field Test** > **Data Check** > **Telemetry**

  a. Click **Start**. Data check is automatically performed for all signals.
  b. (Optional) Click **Analog Value** of a signal to change the default **Analog Value**. The system automatically checks the signal with the new **Analog Value**.
  c. Click **Stop** to pause or complete the data check. All signals are reported based on the actual values.

  NOTE

  - If you click **Start**, the backend data of the system will no longer be updated. If you click **Stop**, the backend data of the system will be updated.
  - After telemetry signals are checked, click **Stop**. Otherwise, communication will be affected.

2.5.2.2 GOOSE Protocol

When the SmartMGC connects to a third-party EMS over GOOSE, GOOSE communication parameters shall be set on the SmartMGC WebUI to transmit real-time data and control commands quickly.

Prerequisites

- Download the latest software release document from the **FusionSolar Software Download Center**, decompress the package, and view the **GOOSE Interface Description** file to check the GOOSE interconnection description and interface description.
- Contact the third-party management system vendor to obtain the configuration file CID.

Procedure

Step 1 Set basic parameters. Choose **Settings** > **Communications protocol** > **GOOSE**.

Table 2-44 Basic parameters

Parameter	Description
GOOSE	Specifies whether to set **GOOSE** to **Enable**.
Data transmission	This parameter is displayed when **GOOSE** is set to **Enable**. It specifies whether to set **Data transmission** to **Enable**.
Data receiving	This parameter is displayed when **GOOSE** is set to **Enable**. It specifies whether to set **Data receiving** to **Enable**.
Network port	This parameter is displayed when **GOOSE** is set to **Enable**. You can set a network port for GOOSE communication based on the actual cable connection. Multiple network ports can be used for GOOSE communication, and if configured, they will be used to report and receive GOOSE packets.
Device status	This parameter is displayed when **GOOSE** is set to **Enable**. Specifies the status of the device. Only packets that match the device status are received and reported.
Device name	Displays the type and name of the device.
Device type	
Controller 1 type	Displays the type and name of the controller connected through GOOSE.
Controller 1 name	
Controller 2 type	
Controller 2 name	

Step 2 Import the configuration file CID.

Compress the configuration file CID into a .zip package and click **Import**.

Table 2-45 Configuration file status

Parameter	Description
Configuration status	Displays the current configuration status. ● **Unavailable**: No configuration file has been successfully imported ● **Normal**: A configuration file has been successfully imported. If a new configuration file is successfully imported again, the new configuration file replaces the old one, and **Last import time** is updated. If the new configuration file fails to be imported again, the old configuration file is retained, and **Last import time** is not updated.
Last import time	

----End

2.5.2.3 Modbus Protocol

When the SmartMGC connects to a third-party EMS over Modbus TCP, Modbus TCP communication parameters shall be set. Modbus TCP can connect to a third-party EMS in client or server mode.

Prerequisites

A third-party EMS can be connected only through a WAN port or mobile network.

Procedure

Client mode:

Step 1 Set basic parameters for the client mode.

Log in to the SmartMGC WebUI and choose **Settings** > **Communications protocol** > **Modbus** > **Client** > **Management System-1**.

Table 2-46 Management system-1

Parameter	Description
Management system-1 communication	Specifies whether to set **Management System-1** to **Enable**.
Management system 1 IP address	Specifies the IP address of the management system.
Port	Used for communication and data exchange between the management system and SmartMGC. The default value is **502**. The value can be set to **1502** based on site requirements.
TLS encryption	• **Enable**: Data exchanged between the SmartMGC and the management system is encrypted. • **Disable**: Data exchanged between the SmartMGC and the management system is not encrypted, which poses security risks.
TLS version	This parameter is displayed when **TLS encryption** is set to **Enable**. It specifies the TLS version. You are advised to select TLS1.2 or later.

Parameter	Description
Remote permission	• **Monitoring only**: The management system is only allowed to read information about the SmartMGC. • **Monitoring only**: The management system is allowed to read and write information about the SmartMGC. • **Management (temporary authorization)**: The management system is allowed to read and write information about the SmartMGC within the authorization period. If the authorization period expires, the management system is only allowed to read information about the SmartMGC but not allowed to write information.
Management system status	Displays the current status of the management system. If the SmartMGC cannot connect to the management system, rectify the fault based on the current status by referring to **Table 2-47**.

Table 2-47 Troubleshooting instructions for management system connection failure

Management System Status	Possible Cause	Troubleshooting
Closed by peer	• The management system is not running or the port is not enabled. • The management system receives a data timeout response and disable the connection. • The firewall blocks the connection.	1. Check whether the management system is started. 2. Check whether the IP address and port of the management system are correctly set. 3. Check the firewall settings of the client and server.
Disconnected abnormally	The SmartMGC does not receive service data from the management system within 30s.	The SmartMGC will attempt to reconnect. No action is required.

Management System Status	Possible Cause	Troubleshooting
Port unreachable	The SmartMGC cannot connect to the management system because the server or port is incorrectly set.	1. Check whether the management system is started successfully. 2. Check whether the IP address, domain name, or port of the management system is correctly set. 3. If the SmartMGC uses FE for communication, check whether the FE cable is properly connected to the network inside the plant. 4. If the SmartMGC uses 4G for communication, check whether the 4G card is properly installed, and whether the SIM card is in arrears or the traffic is used up.
Peer certificate verification failed	● The local certificate and peer certificate do not match the CA. ● Failed to verify the peer certificate validity period.	Check whether the SmartMGC certificate matches the management system certificate or whether the certificate has expired.
Local certificate abnormal	The SmartMGC fails to load the local certificate.	Check whether the certificate issued by the customer has been replaced onsite. ● If yes, import the certificate again. ● If no, restore the default settings.
Domain name resolution failed	● The IP address of the DNS server is incorrectly set. ● The address of the management system is incorrectly set.	Check whether the IP address of the DNS server and the address of the management system server are correctly set.

Management System Status	Possible Cause	Troubleshooting
Server unreachable	The SmartMGC cannot connect to the management system because the server or port is incorrectly set.	1. Check whether the management system is started successfully. 2. Check whether the IP address, domain name, or port of the management system is correctly set. 3. If the SmartMGC uses FE for communication, check whether the FE cable is properly connected to the network inside the plant. 4. If the SmartMGC uses 4G for communication, check whether the 4G card is properly installed, and whether the SIM card is in arrears or the traffic is used up.
Secondary challenge authentication failed	The account or password for second challenge authentication is incorrect.	1. If the SmartMGC or management system has been replaced, reset the password for second challenge authentication. 2. If the connection still fails, disable the second challenge authentication function.

----End

Server mode:

Step 1 Set basic parameters for the client mode.

Log in to the SmartMGC WebUI and choose **Settings** > **Communications protocol** > **Modbus** > **Communications protocol** > **Server**.

Table 2-48 Server

Parameter	Description
Modbus TCP service	Specifies whether to set **Modbus TCP service** to **Enable**. ● If this parameter is set to **Enable (restricted)**, the SmartMGC can communicate with a third-party management system whose IP address is whitelisted. ● If this parameter is set to **Enable (unrestricted)**, the SmartMGC can communicate with a third-party management system whose IP address is valid.
Modbus TCP/Client α[1]	This parameter is displayed when **Modbus TCP service** is set to **Enable (restricted)**. It specifies the IP address of the client.
Logger address	It specifies the slave address of the SmartMGC.
No response from disconnected device	Specifies whether to set **No response from disconnected device** to **Enable**.
[1]: α = 1–5	

----End

2.5.3 Black Start

The microgrid black start function allows the ESS with black start capability to energize first following a system blackout. It then sequentially restores power resources without self-start capability, enabling the microgrid to re-establish power supply independently. This solution uses the ESS as the core black start power source, enhancing the reliability of power supply for the microgrid when it operates in islanded mode.

In the microgrid scenario, a UPS is required to supply power to the SmartMGC and the ESS's CMU. If the UPS has power, log in to the local app to perform startup authorization and array deployment. If the UPS has no power, press the black start button on the ESS. After the ESS voltage is established, perform startup authorization and set the grid code before the first deployment.

The array can be black started only in the off-grid scenario or in the on/off-grid scenario when **On/Off-grid status** is set to .

Table 2-49 Black start description

Category	Scenario	Requirement
Array black start command (one-click black start)	The UPS has power.	● The SmartMGC and the ESS's CMU are powered by the UPS. ● Ensure that the array grid code is consistent with the local grid code. You are advised to perform deployment before enabling the array black start command. ● It is recommended that black start be performed only when the ESS SOC is greater than 2%. Otherwise, the black start may fail. If the ESS SOC is 0% or the **Battery Pack Undervoltage** alarm is generated, charge the ESS first.
Pressing the black start button	The UPS has no power.	● Disconnect all loads. ● Before the first deployment, turn off the AC switch of the ESS. This prevents device damage caused by voltage and frequency non-compliance due to the inconsistency between the default grid code and the local grid code. ● It is recommended that black start be performed only when the ESS SOC is greater than 2%. Otherwise, the black start may fail. If the ESS SOC is 0% or the **Battery Pack Undervoltage** alarm is generated, charge the ESS first. ● Requirements for using the black start button on the ESS: – Press and hold the black start button for more than 10 seconds, close the cabinet door, and wait for the black start. – The interval between two presses of the black start button shall be at least 1 minute.

2.5.3.1 Array Black Start Command

If the UPS has power, send a black start command on the SmartMGC WebUI or SmartMGC local app.

Method 1: SmartMGC WebUI

Step 1 Manually initiate a black start.

Choose **Maintenance** > **Device Management** > **Black Start** and then click **Black Start**.

----End

Method 2: SmartMGC local app

Step 1 Choose **Set** > **Microgrid Parameters** > **Black Start** and then tap **Start**.

----End

NOTE

On the black start screen, you can view the **Current Battery SOC** value, black start progress, and status.

2.5.3.2 Pressing the Black Start Button

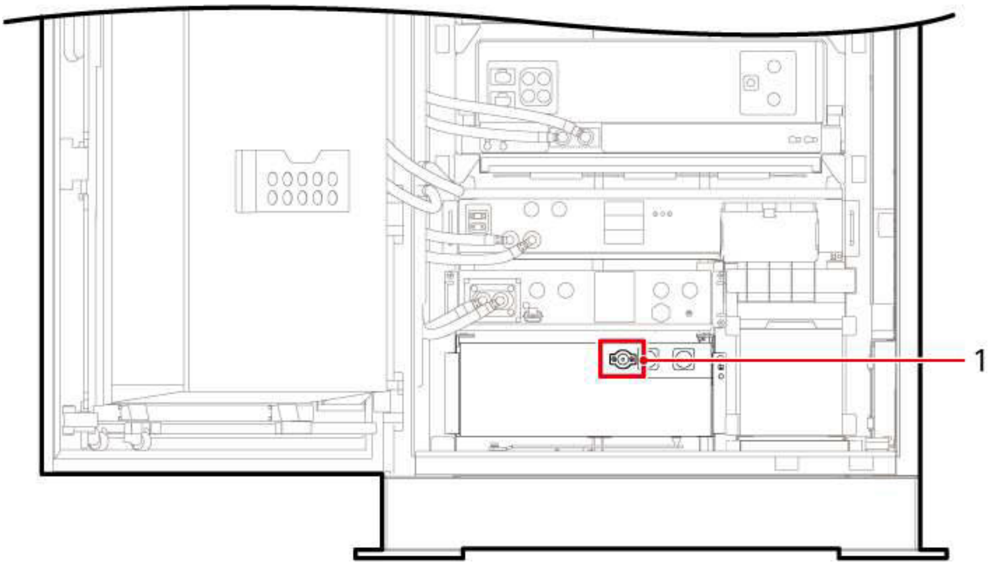
If the UPS has no power, press the black start button on the ESS. After the ESS voltage is established, perform startup authorization and set the grid code before the first deployment.

Scenario 1: Black Start Before the First Deployment

Step 1 Turn off the AC switch of the ESS to be black started.

Step 2 Open the ESS cabinet door. Press and hold the black start button on the RCM in the cabinet for more than 10 seconds.

Figure 2-39 Black start button



1	Black start button

Step 3 Close the cabinet door and wait until the black start is successful.

Step 4 Connect to the ESS locally on the app and set the startup authorization code and grid code of the ESS.

- Set the startup authorization code by referring to **2.3.1.4 Setting ESS Startup Authorization**.
- Set the grid code by referring to **2.3.2.3.1 Setting the Grid Code and Power Baseline**.

Step 5 Turn on the AC switch of the ESS.

Step 6 Perform black start locally again. Open the ESS cabinet door. Press and hold the black start button on the RCM in the cabinet for more than 10 seconds.

NOTICE

The interval between two presses of the black start button shall be at least 1 minute.

Step 7 Close the cabinet door. After the black start is successful, perform quick settings on the local app. For details, see **2.3.2 Quick Settings**.

NOTE

If the humidity in the cabinet is high, dehumidification will be triggered after the black start is successful.

----End

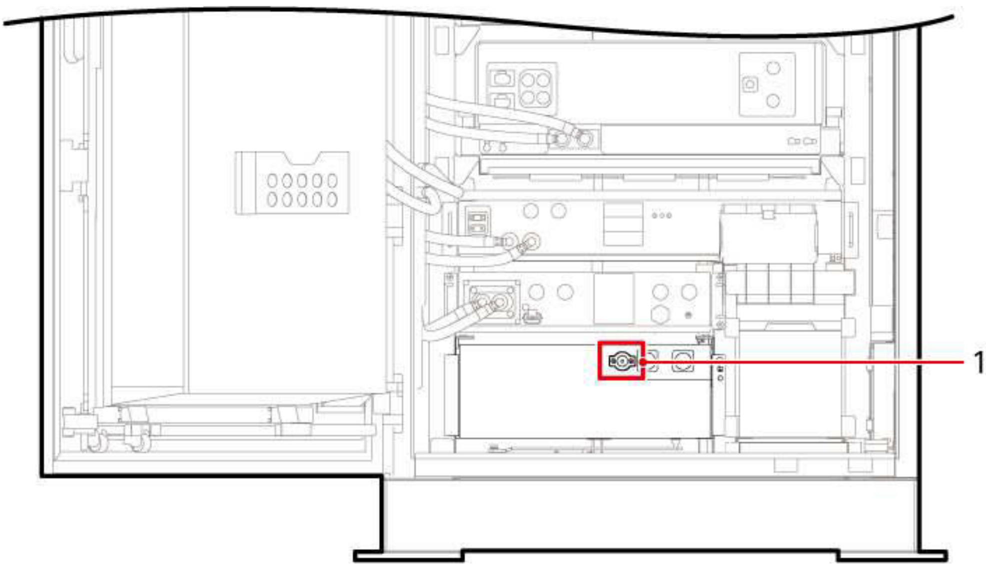
Scenario 2: Black Start After Deployment

Step 1 Open the ESS cabinet door. Press and hold the black start button on the RCM in the cabinet for more than 10 seconds.

NOTICE

The interval between two presses of the black start button shall be at least 1 minute.

Figure 2-40 Black start button



1	Black start button

Step 2 Close the cabinet door and wait until the black start is successful.

NOTE

If the humidity in the cabinet is high, dehumidification will be triggered after the black start is successful.

----End

2.5.4 ESS SOC Description

To ensure that the grid-forming ESS can reliably respond to power disturbances, the key is to always reserve charge and discharge margins. Properly set the SOC operating range to prevent the loss of regulation capability when the SOC reaches the limit. This ensures that the system can effectively maintain power balance when the load or PV power changes abruptly. It is crucial to prevent power outages or load shedding and ensure stable system operation.

WARNING

You are advised to retain the default values of the SOC parameters to ensure stable system operation. If you need to adjust the settings, contact the Company's engineers. When modifying SOC parameters, comply with the following principles to ensure the system's charge/discharge margin and power balance capability:

Array end-of-charge SOC > **Max. SOC for charging on/off-grid ESS** ≥ **Backup power SOC for capacity/demand control** ≥ **Min. SOC for off-grid power backup** > **Min. SOC for discharging on/off-grid ESS** > **Array end-of-discharge SOC**

Table 2-50 SOC description in the seamed on/off-grid scenario

Parameter	Description	Default Value (%)	Maximum Value (%)	Path
Array end-of-charge SOC	Array-level end-of-charge threshold. When the SOC of the ESS reaches this value, the charging stops and the ESS limits the charge capability to 0 for protection.	100	90–100	• SmartMGC WebUI: **Settings** > **Grid Connection Control** > **ESS Control** > **ESS SOC** • SmartMGC local app: **Set** > **Feature parameters**
Array end-of-discharge SOC	Array-level end-of-discharge threshold. When the SOC of the ESS reaches this value, the discharging stops and the ESS limits the discharge capability to 0 for protection.	1	0–15	

Parameter	Description	Default Value (%)	Maximum Value (%)	Path
Backup power SOC for capacity/ demand control	This parameter specifies the dedicated energy threshold reserved by the ESS to meet the capacity/ demand limit (a larger value indicates a stronger peak shaving capability). It shall be preferentially guaranteed during energy allocation to ensure that the ESS can continuously support load requirements during peak hours of the grid. This parameter is displayed when **Demand limit** is set to **Active power limit** or **Apparent power limit**, or **Capacity limit** is set to **Current limit**.	50	Dynamically obtained: **Array end-of-discharge SOC** to **Array end-of-charge SOC**, and greater than **Min. SOC for off-grid power backup**.	• SmartMGC WebUI: **Settings** > **Grid Connection Control** > **ESS Control** > **ESS SOC** • SmartMGC local app: **Power adjustment** > **Capacity Control**
Max. SOC for charging on/ off-grid ESS	Array-level end-of-charge threshold in the on/off-grid scenario. When the ESS SOC reaches this value, the MGCC limits the ESS charge power to 0. You are advised to set this parameter to ≤ (**Array end-of-charge SOC** – 2)%.	95	Dynamically obtained: MAX((**Min. SOC for discharging on/off-grid ESS** + 1), 5) to MIN((**Array end-of-charge SOC** – 1), 98)	• SmartMGC WebUI: **Settings** > **Grid Connection Control** > **ESS Control** > **ESS SOC** • SmartMGC local app: **Set** > **Microgrid Parameters** > **Scheduling Control**

Parameter	Description	Default Value (%)	Maximum Value (%)	Path
Min. SOC for discharging on/off-grid ESS	ESS end-of-discharge threshold in the on/off-grid scenario. When the ESS SOC decreases to this value, the MGCC limits the ESS discharge power to 0. You are advised to set this parameter to ≥ (**Array end-of-discharge SOC** + 2)%.	5	Dynamically obtained: MAX((**Array end-of-discharge SOC** + 1), 5) to MIN((**Max. SOC for charging on/off-grid ESS** – 1), 98)	
Min. SOC for off-grid power backup	Minimum threshold reserved for off-grid operation when the system is running in on-grid mode in the on/off-grid scenario. When the ESS SOC decreases to this value, the ESS stops discharging to ensure that the system can smoothly switch from on-grid mode to off-grid mode when the grid is abnormal. This parameter is displayed when **Off-grid power backup** is set to **Enable**.	40	20–90	

Parameter	Description	Default Value (%)	Maximum Value (%)	Path
SOC for turning on critical load switch	Threshold for the system to turn on the critical load switch. When the array SOC reaches this value, the switch is automatically turned on to ensure reliable power supply to critical loads. This parameter is displayed when the critical load switch is connected.	30	10–98	
SOC for turning off critical load switch	Threshold for the system to turn off the critical load switch. When the array SOC decreases to this value, the switch is automatically turned off to prevent the ESS from being overdischarged and ensure the operation of core devices. This parameter is displayed when the critical load switch is connected.	20	10–98	

2.5.5 Off-Grid Protection Parameter Description

To ensure stable off-grid operation, the ESS in off-grid VSG mode shall strictly comply with the protection parameters specified in **Table 2-51**.

CAUTION

Retain the default settings of the protection parameters to ensure stable system operation. If you need to adjust the settings, contact the Company's engineers.

Path for setting protection parameters:

Path on the SmartMGC WebUI:

- Protection parameters of the SmartMGC: **Settings** > **Microgrid Control** > **Advanced Control Configuration** > **Protective Relay Configuration**
- Off-grid protection parameters of the ESS: **Monitoring** > **ESS** > **Running Parameters**

Path on the SmartMGC local app:

Off-grid protection parameters of the ESS: Tap **Monitor**, select an ESS, and choose **Set** > **Power Parameters** > **Power Protection Parameters**.

Table 2-51 Protection parameter description

Working Condition	ESS	
Overvoltage protection	**Off-grid level-1 overvoltage protection threshold**	1.15 x Un[a]
	Duration threshold for off-grid level-1 overvoltage protection	15000
	Off-grid level-2 overvoltage protection threshold	1.2 x Un[a]
	Duration threshold for off-grid level-2 overvoltage protection	10500
	Off-grid level-3 overvoltage protection threshold	1.3 x Un[a]
	Duration threshold for off-grid level-3 overvoltage protection	300
	Off-grid level-4 overvoltage protection threshold	1.3 x Un[a]
	Duration threshold for off-grid level-4 overvoltage protection	300
Undervoltage protection	**Off-grid level-1 undervoltage protection threshold**	0.85 x Un[a]
	Duration threshold for off-grid level-1 undervoltage protection	10500
	Off-grid level-2 undervoltage protection threshold	0.75 x Un[a]
	Duration threshold for off-grid level-2 undervoltage protection	1000
	Off-grid level-3 undervoltage protection threshold	0.75 x Un[a]

Working Condition	ESS	
	Duration threshold for off-grid level-3 undervoltage protection	1000
	Off-grid level-4 undervoltage protection threshold	0.75 x Un[a]
	Duration threshold for off-grid level-4 undervoltage protection	1000
Overfrequency protection	**Off-grid level-1 overfrequency protection threshold**	1.08 x fn[b]
	Duration threshold for off-grid level-1 overfrequency protection	1000
	Off-grid level-2 overfrequency protection threshold	1.09 x fn[b]
	Duration threshold for off-grid level-2 overfrequency protection	800
	Off-grid level-3 overfrequency protection threshold	1.1 x fn[b]
	Duration threshold for off-grid level-3 overfrequency protection	700
	Off-grid level-4 overfrequency protection threshold	1.1 x fn[b]
	Duration threshold for off-grid level-4 overfrequency protection	700
Underfrequency protection	**Off-grid level-1 underfrequency protection threshold**	0.92 x fn[b]
	Duration threshold for off-grid level-1 underfrequency protection	1000
	Off-grid level-2 underfrequency protection threshold	0.91 x fn[b]
	Duration threshold for off-grid level-2 underfrequency protection	800
	Off-grid level-3 underfrequency protection threshold	0.9 x fn[b]
	Duration threshold for off-grid level-3 underfrequency protection	700
	Off-grid level-4 underfrequency protection threshold	0.9 x fn[b]
	Duration threshold for off-grid level-4 underfrequency protection	700

Working Condition	ESS	
Frequency change rate protection	/	/
	/	/
	/	/
	/	/
Rapid power loss detection	/	/
Note a: Rated voltage of the power grid. Note b: Rated frequency of the power grid.		

2.6 O&M

2.6.1 System Power-Off

After power-on and commissioning are complete, you can power off the system as required, and power it on and start devices when the system needs to be put into use.

Method 1: SmartMGC WebUI

Step 1 Send a shutdown command. Log in to the SmartMGC WebUI:

1. Choose **Maintenance** > **Device Management** > **Startup/Shutdown** and select the devices to be shut down.
2. Click **Shut Down** and click **Selected devices** from the drop-down list to shut down the devices.

Step 2 Power off the devices: Turn off the main power switches and then the auxiliary power switches of the devices by referring to the operations of **2.2 System Power-On** in the reverse order.

DANGER

Wear insulated gloves and use insulated tools to prevent electric shocks or short circuits.

NOTE

To prevent local operations on switches during subsequent power-on, you are advised not to turn off the auxiliary power switches.

----End

Method 2: SmartMGC local app

Step 1 Send a shutdown command. Connect the app to the SmartMGC:

1. On the home screen of the app, choose **Maintenance** > **Device management**.
2. On the **Device management** screen, tap the drop-down menu in the upper right corner.
3. Tap **Batch Control**.
4. Tap **Batch shutdown**, enter the app login password, and tap **OK**.

Step 2 Power off the devices: Turn off the main power switches and then the auxiliary power switches of the devices by referring to the operations of **2.2 System Power-On** in the reverse order.

DANGER

Wear insulated gloves and use insulated tools to prevent electric shocks or short circuits.

NOTE

To prevent local operations on switches during subsequent power-on, you are advised not to turn off the auxiliary power switches.

----End

2.6.2 Startup and Operation

The ESS startup modes are categorized into on-grid and off-grid modes.

- On-grid mode: Start the ESS on the SmartMGC WebUI or SmartMGC local app.
- Off-grid mode: Start the ESS through black start.

NOTICE

- On-grid mode: If the ESS SOC is 0%, charge the ESS and then start it after the ESS SOC is greater than **Array end-of-discharge SOC**. If the ESS SOC is greater than 0 and less than **Array end-of-discharge SOC**, set **Array end-of-discharge SOC** to a value within the range of [0, ESS SOC) and then start the ESS. After it is started, restore the value of **Array end-of-discharge SOC**.
- Off-grid mode: If the ESS SOC is 0%, charge the ESS and then start it through black start.

On-Grid Startup

Prerequisites:

- The mains supply is stable.
- The on/off-grid switch is turned on.

Procedure:

Method 1: SmartMGC WebUI

Step 1 Choose **Maintenance** > **Device Management** > **Startup/Shutdown** and select the devices to be started.

Step 2 Click **Start** and click **Selected devices** from the drop-down list to start the devices.

NOTE

Click **Start** and click **All array devices**, **All array inverters**, **All array ESSs**, or **All array PCSs** from the drop-down list to start all corresponding devices.

----End

Method 2: SmartMGC local app

Step 1 Connect the app to the **SmartMGC** and choose **Maintenance** > **Device management** on the home screen.

Step 2 On the **Device management** screen, tap the drop-down menu in the upper right corner.

Step 3 Tap **Batch Control**.

Step 4 Tap **Batch startup**, enter the app login password, and tap **OK**.

----End

Off-Grid Startup

In off-grid mode, the system is started through black start. For details, see **2.5.3 Black Start**.

2.6.3 Routine Maintenance

For details about the routine maintenance items of the devices involved in this solution, see the user manual or maintenance manual of the corresponding device. For details, see **F Reference Documents**.

3 Seamless On/Off-Grid Scenario (Single SmartLogger)

Seamless on/off-grid switching means that when the grid fails, the AC side of the PV+ESS system does not shut down, and the PCS remains online to switch between the PQ and VSG modes, quickly implementing on/off-grid switching of the PV+ESS system.

NOTICE

This microgrid solution does not provide the system-level redundancy backup function. If a device fails or the ESS reaches the end-of-charge/discharge SOC, the microgrid may collapse. As this solution does not provide professional UPSs, it is not applicable to scenarios that have high requirements on uninterruptible power supply.

3.1 Solution Introduction

The seamless on/off-grid switching system applies to C&I campuses where the grid capacity is limited, capacity expansion is difficult, and power is limited during peak hours or short-term power outages occur occasionally. In scenarios such as grid faults or policy-based power rationing, the system ensures continuous and reliable power supply for critical loads.

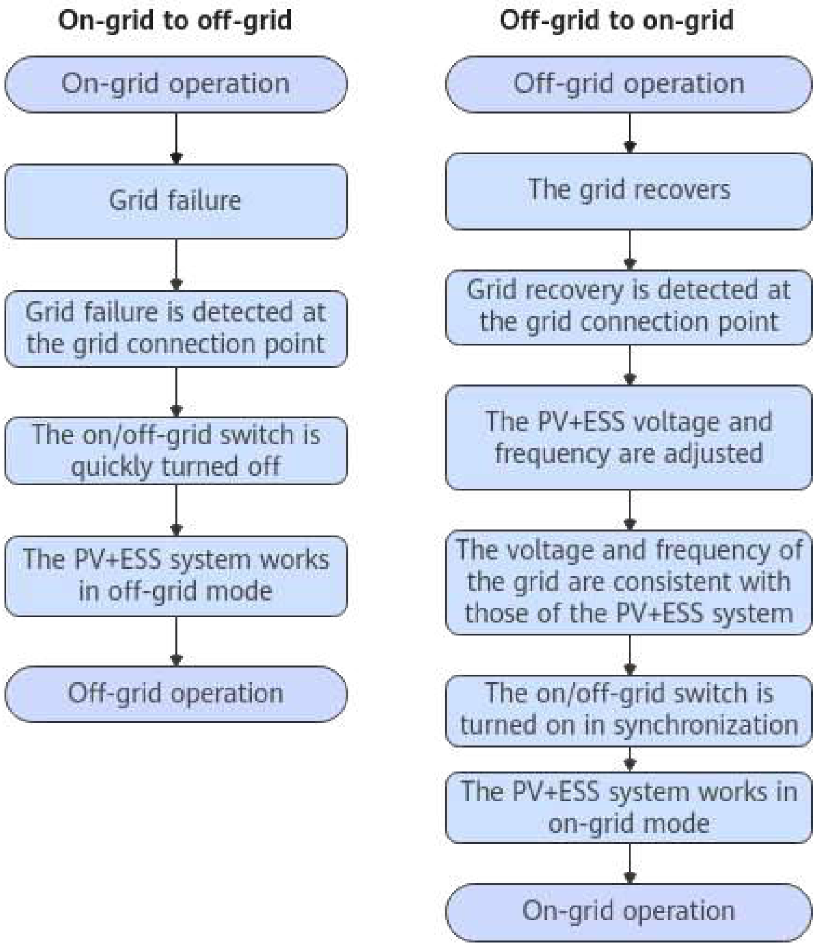
In this system, the SmartMGC functions as the core controller of the PV+ESS system and controls the on/off-grid switch to switch between the on-grid and off-grid modes, preventing power supply interruption.

- On-grid mode: When the grid supplies power properly, the system works in on-grid mode. In this mode, both the inverter and ESS work in PQ mode and multiple economical operation policies are supported, such as peak staggering and demand management, reducing electricity costs. In addition, the system has the disaster recovery capability. You can set the backup power SOC to reserve a certain amount of power to cope with unexpected power outages and ensure off-grid emergency power supply.
- Off-grid operation: When the grid is abnormal or the system disconnects from the grid, the SmartMGC automatically detects the fault and performs on/off-

grid switching. The system then enters the off-grid mode. In this mode, the ESS works in VSG mode and functions as the primary power source for grid forming to establish stable voltage and frequency support. The inverter works in PQ mode and collaborates with the ESS to provide continuous and reliable power supply for critical loads, ensuring uninterruptible power supply for key services.

Figure 3-1 shows the on/off-grid switching process in seamless on/off-grid mode.

Figure 3-1 Seamless on/off-grid switching process



3.1.1 Solution Architecture

The seamless on/off-grid switching system supports PV+ESS networking, PV+ESS +genset networking (genset grid forming), and PV+ESS+genset networking (genset grid following).

Table 3-1 Networking description

Scenario	Description
PV+ESS networking	The **SmartMGC** does not control the genset, but the genset can be used as the backup power supply and connected to the system through the ATS on the load side. The genset and the PV+ESS system do not run in parallel. The PV+ESS system supports low-voltage networking without transformers, low-voltage networking with isolation transformers, and medium-voltage networking with isolation transformers. ● **PV+ESS low-voltage networking without transformers**: If the grid voltage ranges from 380 V to 480 V, the ESS and inverter can directly connect to the grid. ● **PV+ESS low-voltage networking with isolation transformers**: If the grid voltage ranges from 200 V to 240 V, the ESS and inverter shall connect to isolation transformers to step down to low voltages (200 V to 240 V) before connecting to the grid. ● **PV+ESS medium-voltage networking with transformers**: If the grid voltage is greater than 480 V, the ESS and inverter shall connect to transformers to step up to medium voltages (greater than 480 V) before connecting to the grid.
PV+ESS+genset networking (genset grid forming)	The **SmartMGC** controls the startup and shutdown of the genset, and the genset runs in parallel with the PV+ESS system. When the ESS SOC is insufficient, the genset is started to run in grid-forming mode with loads, and the ESS runs in grid-following mode.
PV+ESS+genset networking (genset grid-following)	The **SmartMGC** controls the startup and shutdown of the genset, and the genset runs in parallel with the PV+ESS system. When the ESS SOC is insufficient, the genset is started to generate power in grid-following mode, and the ESS runs in grid-forming mode with loads.

In this system, the meter at the grid connection point is optional and can be deployed based on customer requirements. If the loads exceed the ESS load-carrying capacity, non-critical loads can be installed outside the on/off-grid switch. During on-grid operation, the meter monitors the power at the grid connection point.

If a genset is configured for critical loads, the genset shall be connected to the ATS on the critical load side to ensure uninterruptible power supply to critical loads.

During on-grid operation, a third-party EMS can be connected to implement power dispatch and SOC reservation for backup power. During on/off-grid switching and off-grid operation, the SmartMGC is used for control.

NOTICE

The third-party EMS performs power dispatch only during on-grid operation. Do not send other control instructions. Otherwise, on/off-grid switching failure or microgrid collapse may occur.

Scenario 1: PV+ESS Networking

Figure 3-2 PV+ESS low-voltage networking without transformers

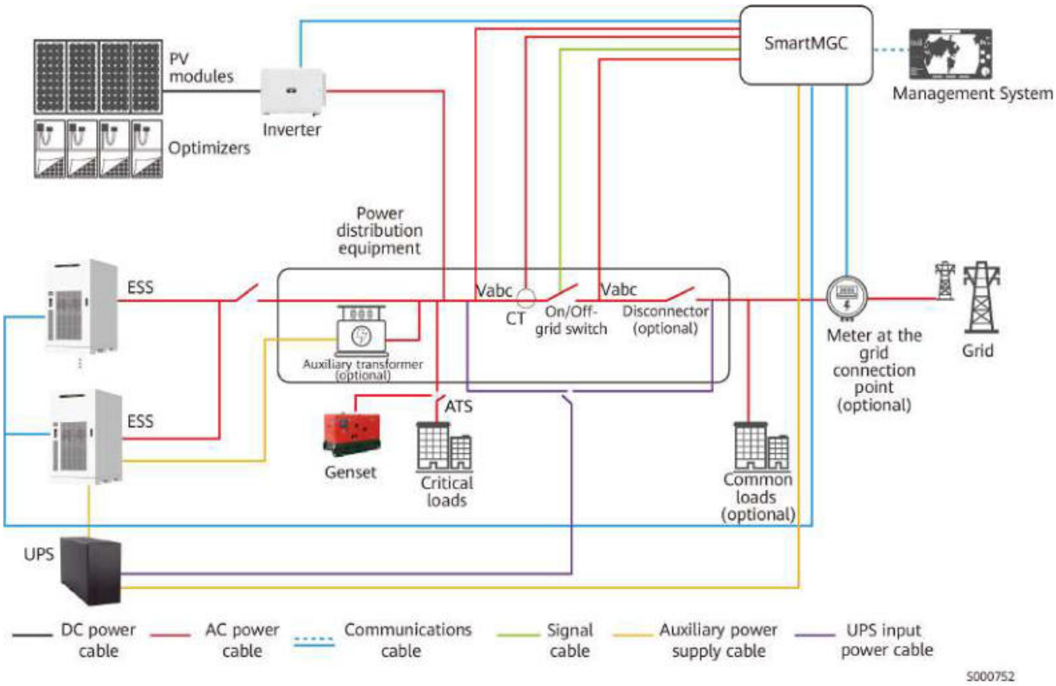


Figure 3-3 PV+ESS low-voltage networking with isolation transformers

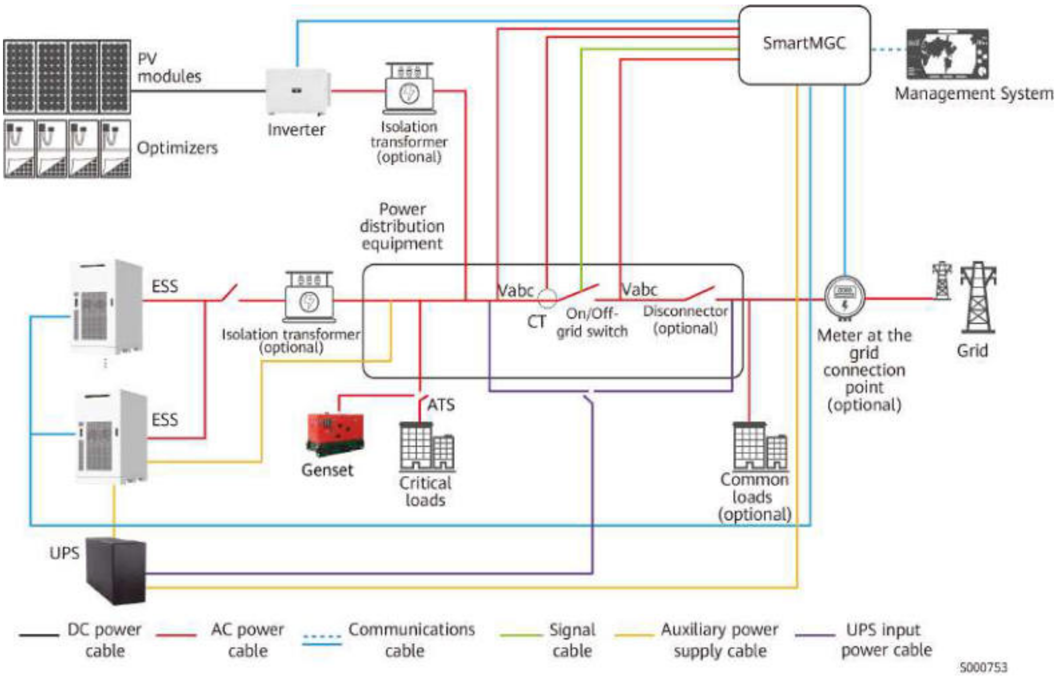
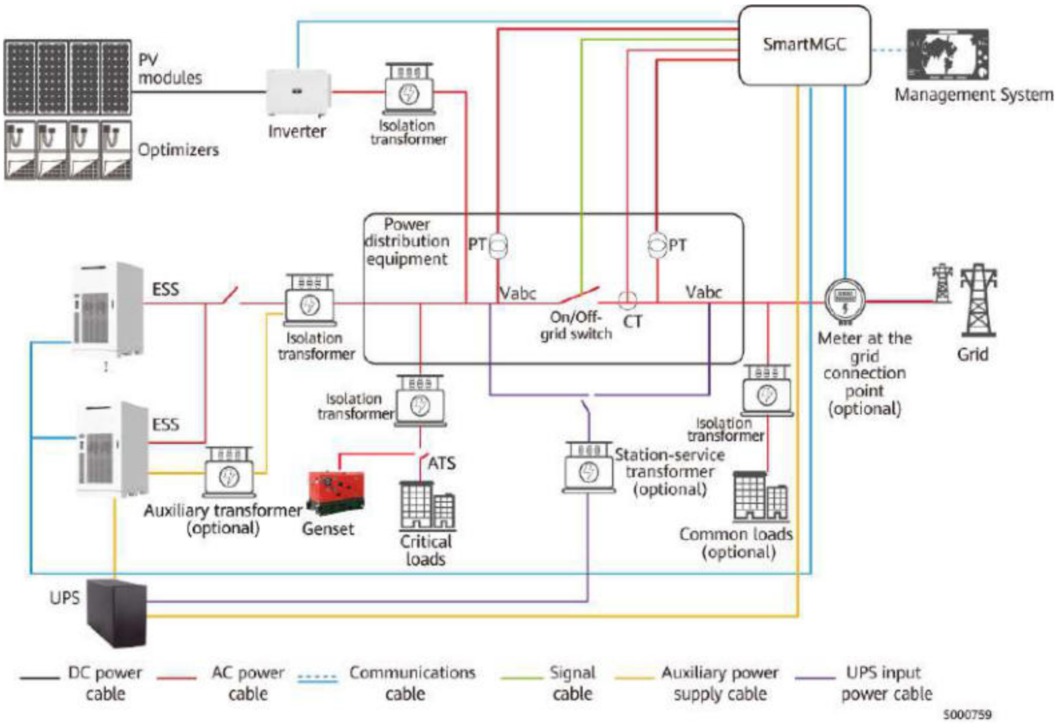


Figure 3-4 PV+ESS medium-voltage networking with transformers



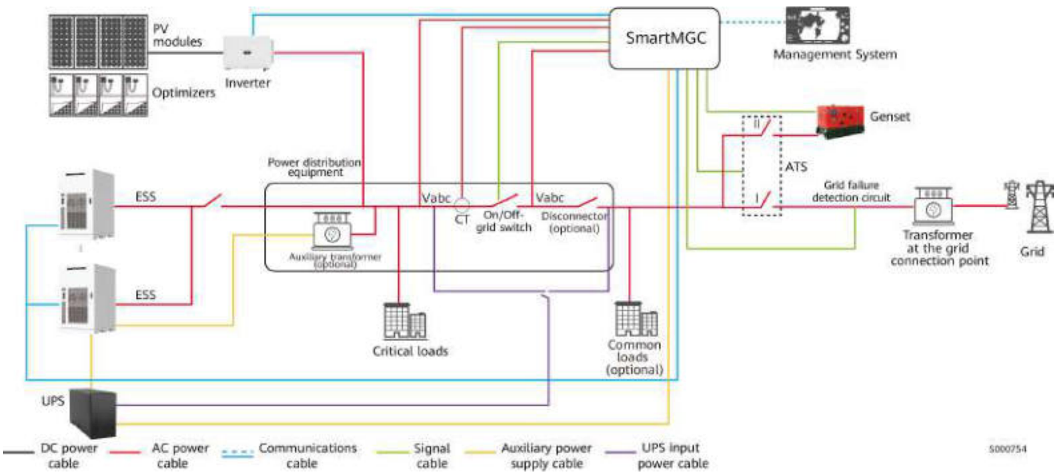
Scenario 2: PV+ESS+Genset Networking (Genset Grid Forming)

- During on-grid operation, the PV+ESS seamless on/off-grid switching is supported. After the system is disconnected from the grid, the ESS works in VSG grid forming mode and the PV system works in PQ grid following mode.
- During off-grid operation:

- When the ESS SOC is sufficient, the ESS runs in VSG grid-forming mode, the PV system runs in PQ grid-following mode, and the genset is shut down.
- When the ESS SOC is insufficient, the **SmartMGC** controls the connection and startup of the genset via DO through the ATS on the grid side. The genset runs in grid-forming mode, and the ESS and PV system run in PQ grid-following mode. When the ESS is being charged, you can determine whether to charge it from the genset based on the actual situation.
- After the mains supply recovers:
  - If the genset is shut down and the ESS is running in VSG mode, the ESS switches from VSG to PQ mode after the on/off-grid switch is turned on in synchronization to restore the grid connection.
  - If the genset starts running, the ESS switches from PQ to VSG mode, and the on/off-grid switch is automatically turned off. Then, the genset automatically shuts down, the ATS switches to the mains supply, and the on/off-grid switch is turned on in synchronization to restore the grid connection. After that, the ESS switches to PQ mode.

- The system shall meet the functional requirements of the genset and ATS. The genset capacity shall be greater than the load capacity to meet the requirements for independent load carrying. Reserve sufficient spinning reserve margin to ensure load stability.

Figure 3-5 PV+ESS+genset networking (genset grid forming)

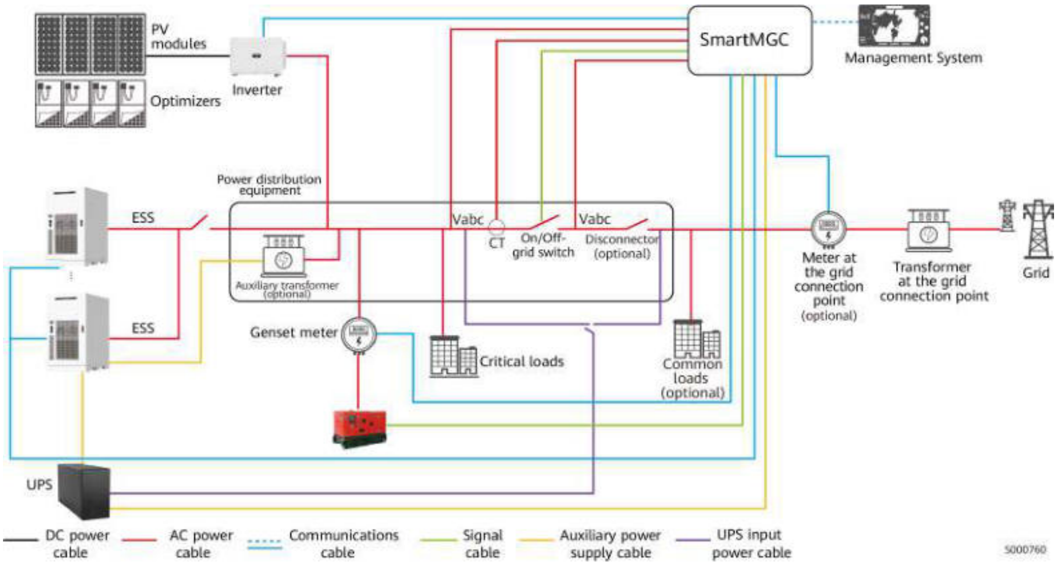


Scenario 3: PV+ESS+Genset Networking (Genset Grid Following)

- During on-grid operation, the PV+ESS seamless on/off-grid switching is supported. After the system is disconnected from the grid, the ESS works in VSG grid forming mode and the PV system works in PQ grid following mode.
- During off-grid operation:
  - When the ESS SOC is sufficient, the ESS runs in VSG grid-forming mode, the PV system runs in PQ grid-following mode, and the genset is shut down.
  - When the ESS SOC is insufficient, the **SmartMGC** starts the genset via DO. The genset runs in grid-following mode, and the ESS runs in grid-forming mode with loads.

- After the mains supply recovers:
  - If the genset is shut down and the ESS is running in VSG mode, the ESS switches from VSG to PQ mode after the on/off-grid switch is turned on in synchronization to restore the grid connection.
  - If the genset is started, the **SmartMGC** shuts down the genset via DO. After the on/off-grid switch is turned on in synchronization to restore the grid connection, the ESS switches to PQ mode.
- The system shall meet the functional requirements of the genset. The genset capacity shall be greater than the load capacity.

Figure 3-6 PV+ESS+genset networking (genset grid following)



Components

Table 3-2 lists the key components in the seamless on/off-grid scenario.

Table 3-2 Components in the seamless on/off-grid scenario

Name	Model/Specifications	Quantity	Remarks
Smart String Grid Forming Energy Storage System (ESS)	• LUNA2000-241-2S1-DS • LUNA2000-241-2S1 • LUNA2000-215-2S10 • LUNA2000-215-2S11 • LUNA2000-161-2S11 • LUNA2000-107-1S11	≤ 40	Purchased from the Company.
SmartMGC	SmartMGC5000B	1	Purchased from the Company.

Name	Model/Specifications	Quantity	Remarks
Expansion module	SmartModule	1	Purchased from the Company (optional) The SmartModule is required when 20 to 40 ESSs are deployed.
Meter at the grid connection point	• DTSU666-HW • YDS60-80 • DHSU1079-ZT • DTSU71C	1	Purchased from the Company (optional).

Name	Model/Specifications	Quantity	Remarks
Power distribution equipment (including the on/off-grid switch)	CT	3	Prepared by the customer (optional). Current transformer (CT) specifications requirements: ● The rated current on the secondary side of the CT is 5 A, and the accuracy class is ≥ 0.5. If higher accuracy is required, the recommended accuracy class is ≥ 0.5S. ● The recommended rated load capacity of the CT is ≥ 5 VA, and the cable length between the CT and the SmartMGC is ≤ 5 m. ● The minimum rated load capacity of the CT is 2.5 VA, and the cable length between the CT and the SmartMGC is ≤ 2 m. ● The secondary side cable is a copper cable, and the cross-sectional area of the CT secondary side cable is ≥ 1.5 mm^2. If a terminal block is available, it is recommended that the cross-sectional area of the cable between the secondary side of the CT and the terminal block be ≥ 2.5 mm^2. Potential transformer (PT) specifications requirements: The rated voltage on the secondary side of the PT is 100–480 V, the accuracy class is ≥ 0.2, and only the PT in YY wiring mode is supported. It is recommended that a disconnector be used together with the PT. ● In a common three-phase measurement scenario, two groups of PTs are required to measure the bus voltage
	PT	Depending on the actual networking	

Name	Model/Specifications	Quantity	Remarks
			inside the plant and the grid voltage, respectively. ● In a medium-voltage scenario, the medium-voltage PT is required to measure the three-phase medium-voltage AC grid voltage. ● If the measured DC voltage ranges from 57.7 V to 277 V or the AC voltage ranges from 100 V to 480 V, PT connection is not required. **DANGER** ● **Installation position requirements**: The SmartMGC shall be installed inside the power distribution cabinet or box. Do not install it in an exposed position to prevent electrical safety risks caused by accidental contact. ● **Maintenance operation requirements**: Before replacing the SmartMGC or maintaining the CT/PT loop, ensure that the CT/PT loop is powered off and the CT terminal bridge is securely connected.

Name	Model/Specifications	Quantity	Remarks
	On/Off-grid switch: ● Supports DI/DO signal feedback and remote control. ● Works with a low-voltage common switch (switch-off time < 80 ms, including arc extinguishing) to implement 150 ms switching. ● Works with a low-voltage common switch (switch-off time < 35 ms, including arc extinguishing) to implement 60 ms switching. ● Works with a low-voltage fast switch (supporting DC DO control, switch-off time without loads < 15 ms) to implement 20 ms switching.	1	Prepared by the customer. The on/off-grid switch shall meet the local power distribution requirements.
	Power distribution cabinet: ● For details about the dimensions, IP rating, and color, see the description of the vendor or customer requirements. ● The length of the cables from the inverter and ESS to the power distribution cabinet shall be ≥ 5 m.	1	Prepared by the customer. **NOTICE** The power distribution cabinet shall have sufficient space for installing the meter, CT, **SmartMGC**, auxiliary transformer, and UPS.

<table>
<tr><th>Name</th><th>Model/Specifications</th><th>Quantity</th><th>Remarks</th></tr>
<tr><td></td><td>UPS:
Power ≥ 1 kVA, 500 W x Number of ESSs (peak power), online UPS, 220 V AC
Backup time ≥ 1 hour. If the system is off-grid for a long time, the backup time is ≥ 48 hours.
To ensure reliable power supply to the UPS, it is recommended that the UPS power supply be provided from either side of the on/off-grid switch, whichever side is available, and automatically controlled by a relay.</td><td>1</td><td>Prepared by the customer. For details about the capacity configuration, see D Off-Grid UPS Capacity Configuration.
NOTICE
The specifications of the UPS must meet the power consumption requirements of the ESS auxiliary power supply.
Dynamic performance: Transient peak power ≥ 500 W/cabinet (to cope with inrush current during device startup).
Shutdown power consumption: ≤ 30 W/cabinet in standby mode (to reduce continuous power consumption).
Steady-state power consumption: 30–100 W/cabinet in operating mode (to ensure basic monitoring functions).</td></tr>
</table>

Name	Model/Specifications	Quantity	Remarks
	Auxiliary transformer: ● Auxiliary transformer that converts the grid voltage to 220 V. ● Transformer capacity: 5 kVA x N (quantity of ESSs).	1	Prepared by the customer (optional). Depending on the actual networking architecture. ● When the rated AC grid voltage is > 415 V (420/440/480 V), the ESS auxiliary power supply must be a power supply connected from outside the ESS. An auxiliary transformer is added to convert the grid voltage into 220 V single-phase power and supply the power to the **MAINS** port of the ESS. ● When the rated AC grid voltage is ≤ 415 V, the **MAINS** port of the ESS can obtain power from the PCS terminal inside the ESS or from a power supply outside the ESS. The auxiliary transformer is not required (except for the 220 V single-phase grid in Japan).
	Isolation transformer/ Transformer: ● Supports the grid frequency of 50/60 Hz. ● Matches the ESS capacity in an array. ● Supports long-term stable operation carrying loads of 1.1 times its rated capacity.	1	Prepared by the customer (optional). Depending on the actual networking architecture. Applies to low-voltage isolation transformer or medium-voltage transformer scenarios. The ESS is connected to the transformer in three-phase four-wire mode to ensure a safe and stable connection between the ESS and the grid.

Name	Model/Specifications	Quantity	Remarks
Management system	-	1	The management system displays the real-time and historical running status of the plant comprehensively and provides customers with intelligent alarm reporting, analysis, diagnosis, and O&M functions to improve power generation efficiency, reduce O&M costs, implement refined management, optimize operation, and increase potential benefits.
Disconnector	Configured based on the capacity of the grid connection point.	1	Prepared by the customer (optional). Depending on the actual networking architecture. When repairing the on/off-grid switch, disconnect the microgrid from the grid to implement physical isolation for safety.

Name	Model/Specifications	Quantity	Remarks
Genset	Three-phase	1	Prepared by the customer (optional). Depending on the actual networking architecture. • **Scenario 1: PV+ESS Networking**: The **SmartMGC** does not control the genset. The genset is connected to the load side through the ATS, and the ATS controls the genset. To prevent ATS misoperations or genset startup or shutdown during PV+ESS switching, you are advised to set the ATS switching delay to more than 15 seconds (for example, 20 seconds) to avoid the time window of seamed PV+ESS switching. • **Scenario 2: PV+ESS +Genset Networking (Genset Grid Forming)**: The **SmartMGC** controls the genset. The genset is connected to the grid side through the ATS. The ATS controls the switching between the main and auxiliary power supplies. The following requirements shall be met: – PC-level ATSs are recommended to ensure reliability. The ATS shall ensure that when one power supply is connected, the other power supply must be disconnected to prevent danger caused by simultaneous connection of the two power supplies. It is recommended that the ATS switching dead time be greater than 200 ms. (Dead time or Off state
ATS	Dual power supply switching device	1	

Name	Model/Specifications	Quantity	Remarks
			refers to a brief "zero state" when the ATS is switching between power supplies. During this period, both power supplies are disconnected.) Ensure that the contact of the next power supply can be closed only after the arc of the previous power supply is completely extinguished, further protecting the contacts from being burnt by the arc. – The **SmartMGC** controls the startup and shutdown of the genset through DO, and the frequency deviation is less than 0.1 Hz and the voltage deviation is less than 2% when the genset is running stably. – The genset capacity shall be greater than the load capacity to meet the requirements for independent load carrying. – Grid detection is required: The mains status is reported to the DI(HV) port of the **SmartMGC** through the ATS, or an external grid failure detection relay is connected (supporting dry contact signal feedback) to determine whether the grid recovers. ● **Scenario 3: PV+ESS +Genset Networking (Genset Grid Following)**: The **SmartMGC** controls the genset. The genset shall be connected to the

Name	Model/Specifications	Quantity	Remarks
			off-grid power distribution bus and the following requirements shall be met: – The **SmartMGC** controls the startup and shutdown of the genset through DO, and the frequency deviation is less than 0.1 Hz and the voltage deviation is less than 2% when the genset is running stably. – The genset capacity shall be greater than the load capacity.

NOTE

If inverters and optimizers are involved in the networking, see **A Inverter and Optimizer Models** for the specific model list.

3.1.2 Communication Networking

One SmartMGC manages multiple ESSs, multiple inverters, and one meter at the grid connection point to form an array. In the array:

- The SmartMGC communicates with the ESSs over FE or optical fibers in star or ring topology.
- The inverters communicate with the SmartMGC over RS485 or MBUS.
- The meter communicates with the SmartMGC over RS485.

The maximum communication distances of the SmartMGC are as follows:

- RS485: 1000 m
- FE: 100 m
- Optical fiber: 12000 m (100M optical module)

Communication networking selection criteria: In actual networking, select a proper networking mode from the following typical scenarios based on the quantity of ESSs in the array and whether optical fiber deployment is supported.

Typical Scenario 1: FE Ring Topology (0–20 ESSs)

This topology is recommended when 0 to 20 ESSs are deployed and no optical fiber is used. In this scenario, the SmartMGC5000B is required.

- One FE ring network in the PV+ESS system supports a maximum of 20 ESSs.
- The ESSs are connected through FE communications ports (WAN1/LAN1 and WAN2/LAN2).

- The FE network cable shall meet the following technical specifications: CAT 5E outdoor shielded network cable, internal resistance ≤ 1.5 ohms/10 m, cable cross-sectional area (outer diameter) ≤ 9 mm, and shielded RJ45 connector.

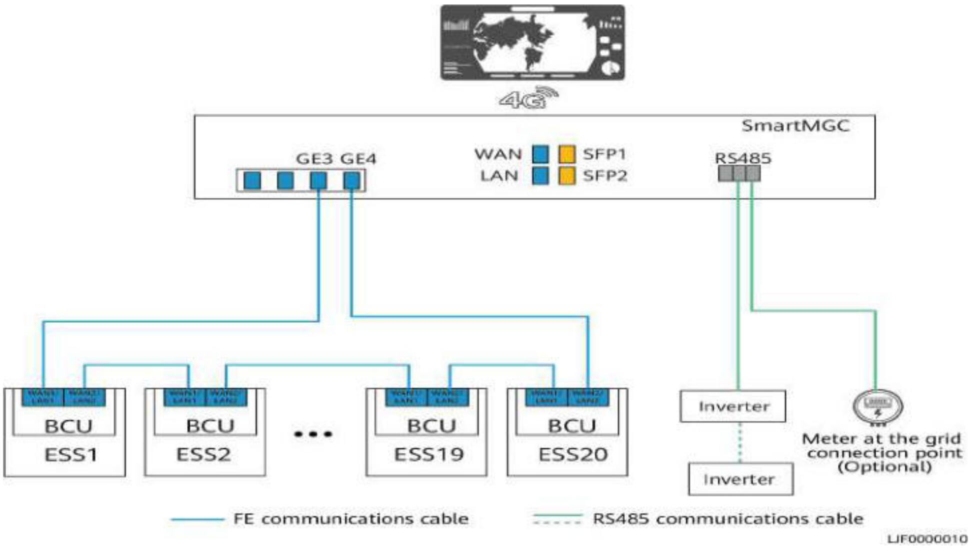
NOTICE

If the ESS FE ring topology is implemented, the ESSs must be connected to the GE3 and GE4 ports of the SmartMGC and **ESS ring network** shall be set to **GE3+GE4**. Otherwise, the SmartMGC cannot communicate with the ESSs properly.

Path for setting **ESS ring network**:

- App: **Set** > **Comm. parameters** > **Wired Network** > **Network Configuration**
- WebUI: **Settings** > **Port Settings** > **Ethernet** > **Network Configuration**

Figure 3-7 FE ring topology



Typical Scenario 2: Fiber Ring Topology (0–20 ESSs)

This topology is recommended when 0 to 20 ESSs are deployed and optical fibers are used. In this scenario, the SmartMGC5000B is required.

- One fiber ring network supports a maximum of 20 ESSs.
- One SmartMGC in the PV+ESS system supports a maximum of 20 ESSs.
- The ESSs are connected through optical fiber ports (TX1-SFP1-RX1 and RX2-SFP2-TX2).
- The optical fiber cables are provided by the customer and shall meet the following technical specifications: four-core or eight-core single-mode armored optical fiber cable with a transmission wavelength of 1310 nm and an outer diameter of ≤ 18 mm.

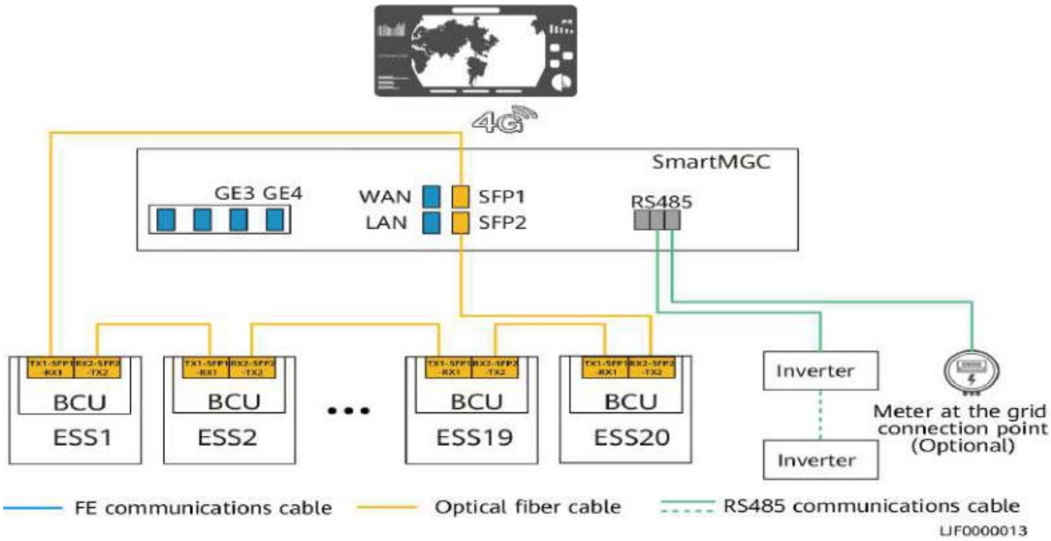
NOTICE

If the ESS fiber ring topology is implemented through the SmartMGC, set **ESS ring network** to **SFP1+SFP2**. Otherwise, the SmartMGC cannot communicate with the ESSs properly.

Path for setting **ESS ring network**:

- App: **Set** > **Comm. parameters** > **Wired Network** > **Network Configuration**
- WebUI: **Settings** > **Port Settings** > **Ethernet** > **Network Configuration**

Figure 3-8 Fiber ring topology



Typical Scenario 3: FE Ring Topology (20–40 ESSs)

This topology is recommended when 20 to 40 ESSs are deployed and no optical fiber is used. In this scenario, the SmartMGC5000B is required.

- In this scenario, the SmartModule is required to extend ports of the SmartMGC, supporting the connection of multiple devices.
- One FE ring network supports a maximum of 20 ESSs.
- The ESSs are connected through FE communications ports (WAN1/LAN1 and WAN2/LAN2).
- The FE network cable shall meet the following technical specifications: CAT 5E outdoor shielded network cable, internal resistance ≤ 1.5 ohms/10 m, cable cross-sectional area (outer diameter) ≤ 9 mm, and shielded RJ45 connector.

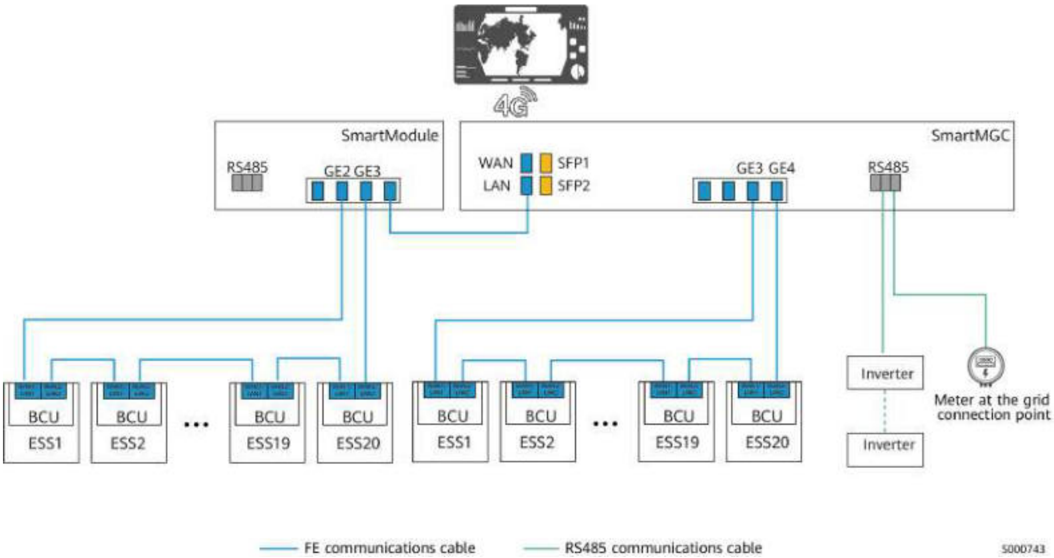
NOTICE

If the ESS fiber ring topology is implemented through the SmartMGC, set **ESS ring network** to **SFP1+SFP2**. Otherwise, the SmartMGC cannot communicate with the ESSs properly.

Path for setting **ESS ring network**:

- App: **Set** > **Comm. parameters** > **Wired Network** > **Network Configuration**
- WebUI: **Settings** > **Port Settings** > **Ethernet** > **Network Configuration**

Figure 3-9 FE ring topology (20–40 ESSs)



3.1.3 Electrical Connections

NOTICE

The power distribution and electrical connections of the PV+ESS system must comply with the installation regulations of the devices and the country or region where the devices are located. The following wiring diagrams show the connections between devices and are for reference only. In actual applications, design the wiring diagrams based on the local power distribution regulations.

The seamless on/off-grid scenario supports multiple types of earthing systems, each with different earthing requirements. For details, see **Table 3-3**.

Table 3-3 System earthing requirements and switch pole selection

Earthing System	PE Wire (Protective Earthing) Requirement	Neutral Wire (Functional Earthing) Requirement	On/Off-grid Switch Pole Selection
TN-C	The PE wire on the load or device side (such as the ESS and inverter) is connected to the PEN wire of the power distribution system.	• The PEN wire of the power distribution system must be grounded and does not require residual current protection. • The neutral wire on the device side (such as the ESS and inverter) must be connected to the PEN wire of the power distribution system. • The specifications of the PEN wire and neutral wire shall be the same as those of the general power cables.	3-pole switch.

Earthing System	PE Wire (Protective Earthing) Requirement	Neutral Wire (Functional Earthing) Requirement	On/Off-grid Switch Pole Selection
TN-S	The PE wire on the load or device side (such as the ESS and inverter) is connected to the PE wire of the power distribution system.	• The neutral wire of the power distribution system must be grounded. • The neutral wire on the device side (such as the ESS and inverter) must be connected to the neutral wire of the power distribution system. • The specifications of the neutral wire shall be the same as those of the general power cables.	During off-grid operation, the method of handling the neutral wire (depending on the local grid requirements) determines the quantity of poles of the on/off-grid switch. • Keep the neutral wire connected: Use a 3-pole switch or a 4-pole switch without connecting the neutral wire. • Disconnect the neutral wire: A 4-pole switch must be used.
TN-C-S	The upstream power supply side (from the PV +ESS+genset to the AC bus section of the power distribution system) uses the TN-C system. After the power supply is routed into the customer's system, the PE wire is separated from the PEN wire to form the TN-S system. The PE wire and neutral wire on the load side are connected to the PE wire and neutral wire after the power supply is routed into the customer's system, respectively.		
TT	The PE wire on the load or device side (such as the ESS and inverter) is grounded locally and is not connected to the neutral wire of the power distribution system.		

Earthing System	PE Wire (Protective Earthing) Requirement	Neutral Wire (Functional Earthing) Requirement	On/Off-grid Switch Pole Selection

			NOTICE
			● If a 4-pole switch is used, the neutral wire and PE wire of the power distribution system shall be connected to the earthing grid outside the cabinet, respectively. Do not short-circuit the two wires inside the cabinet.
			● To prevent the **PCS Grounding Abnormal** alarm from being triggered and the ESS from shutting down due to system earthing failure caused by the disconnection of the neutral wire after the 4-pole switch is turned off, a dedicated earthing switch shall be installed on the microgrid side and electrically linked with the 4-pole switch:
			  ● When the 4-pole switch is turned off (the system enters off-grid mode), the earthing switch will be turned on to ground the neutral wire on the microgrid side.
			  ● When the 4-pole switch is turned on (the system enters on-grid mode), the earthing switch will be turned off to ensure that the microgrid system is grounded through the neutral wire on the grid side.

IT	-	The ESS is connected to the isolation transformer in three-phase four-wire mode. The neutral wire of the ESS is connected to the neutral point of the isolation transformer, and the neutral point on the ESS side of the isolation transformer shall be grounded.	3-pole switch.

Scenario 1: PV+ESS Networking

Table 3-4 Characteristics of the control loop for the on/off-grid switch

Switch Type	Characteristics of the Switch Control Loop	Reference
Low-voltage fast switch	The switch DI is integrated with a power supply (wet contact) to implement on/off-grid switching in 20 ms.	Figure 3-11
Common low-voltage switch	The switch DI is integrated with a power supply (wet contact) to implement on/off-grid switching in 60–150 ms.	Figure 3-12
	The switch DI is not integrated with a power supply (dry contact) and shall be powered externally to implement on/off-grid switching in 60–150 ms.	Figure 3-13 Figure 3-14 Figure 3-10 Figure 3-15 Figure 3-16
Common medium-voltage switch	The switch DI is not integrated with a power supply (dry contact) and shall be powered externally to implement on/off-grid switching in < 200 ms.	Figure 3-17

Figure 3-10 PV+ESS low-voltage networking without transformers (TN-C, with 3-pole ACB)

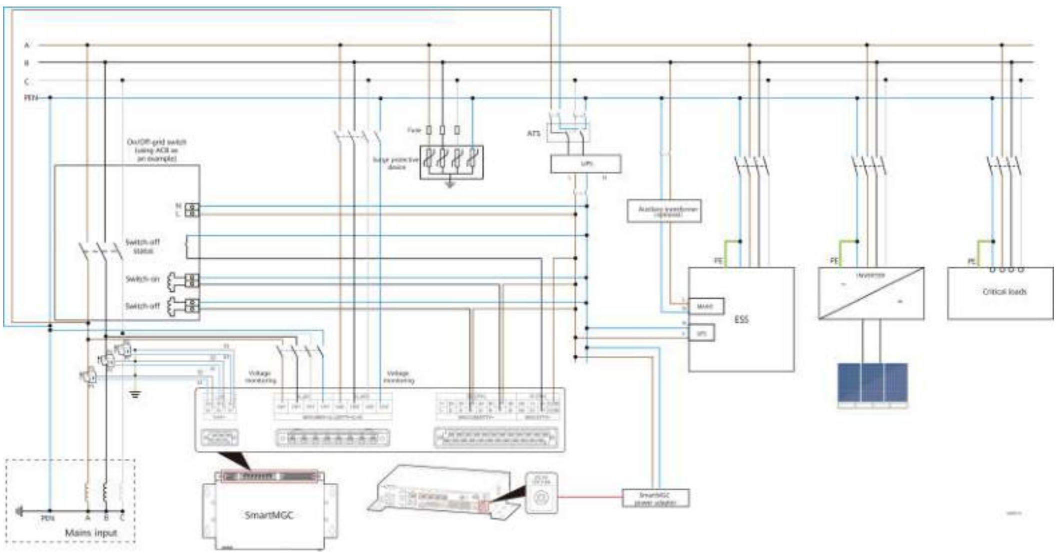


Figure 3-11 PV+ESS low-voltage networking without transformers (TN-S, with 4-pole fast switch)

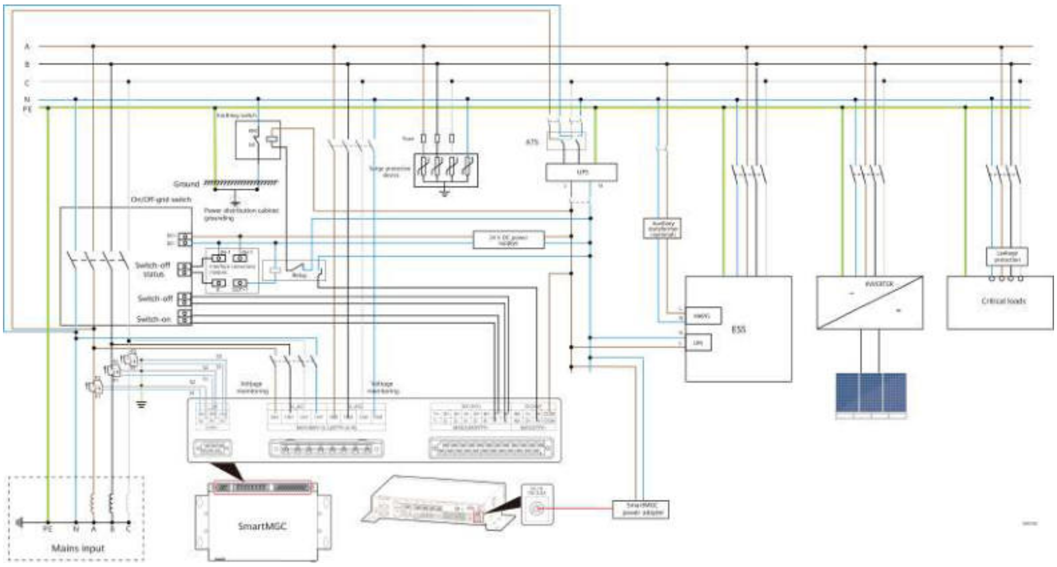


Figure 3-12 PV+ESS low-voltage networking without transformers (TN-S, with 4-pole MCCB)

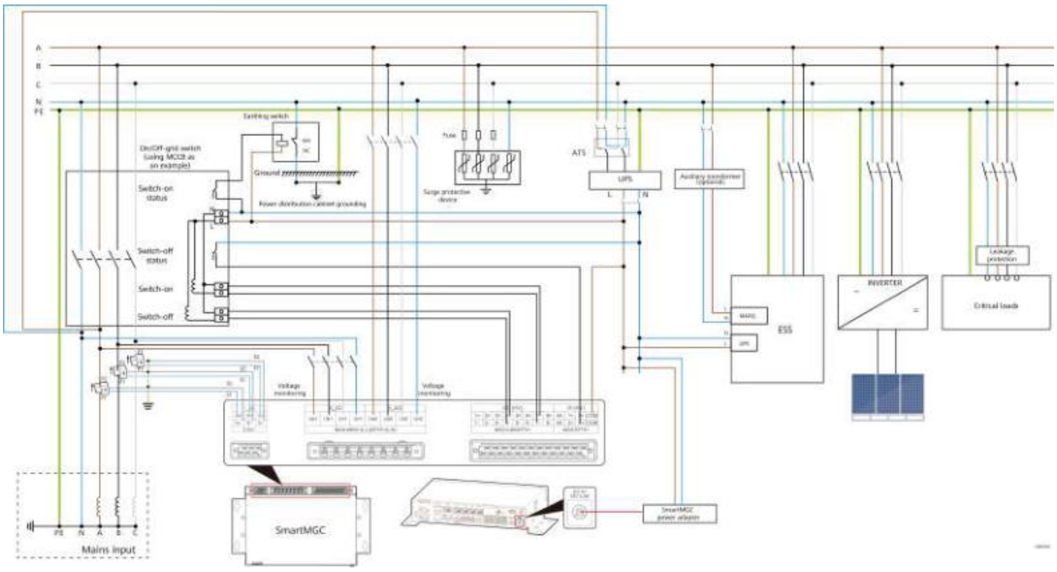


Figure 3-13 PV+ESS low-voltage networking without transformers (TN-S, with 4-pole ACB)

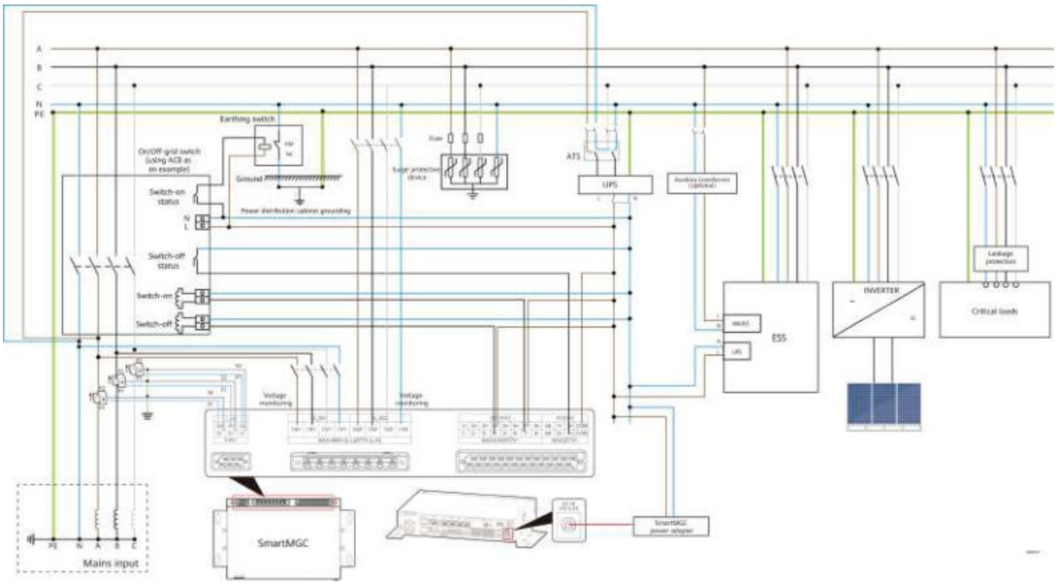


Figure 3-14 PV+ESS low-voltage networking without transformers (TN-C-S, with 4-pole ACB)

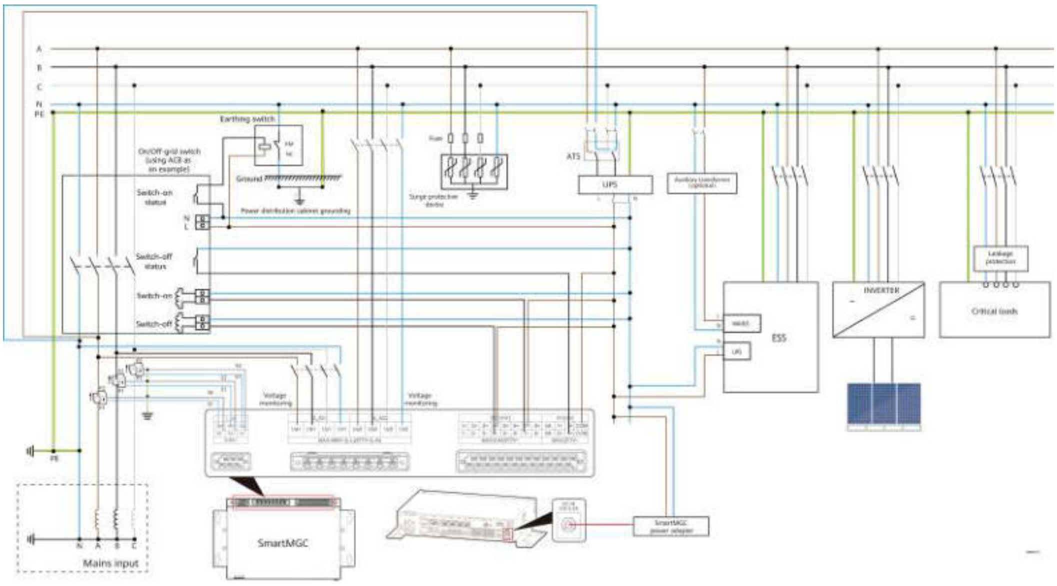


Figure 3-15 PV+ESS low-voltage networking without transformers (TT, with 3-pole ACB)

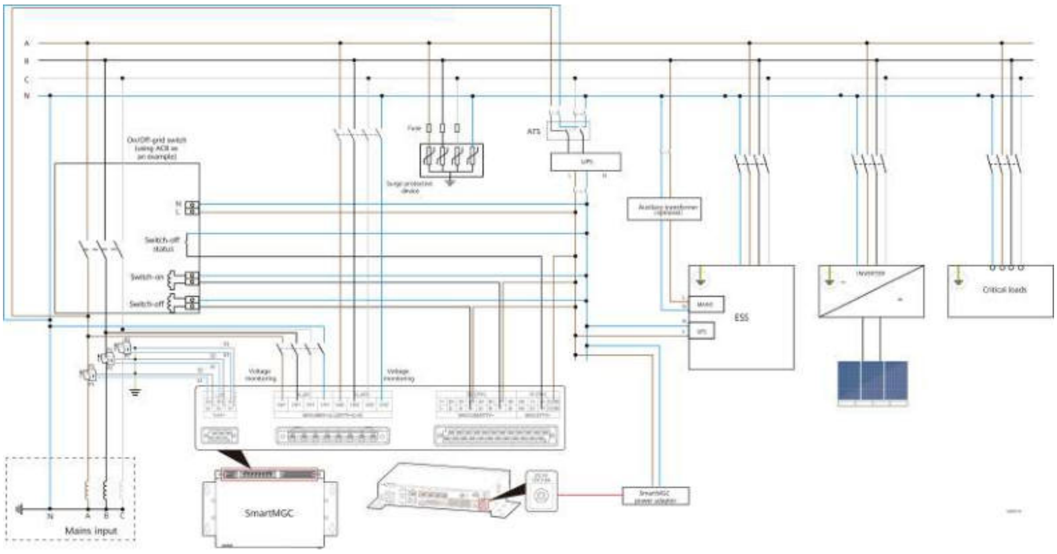


Figure 3-16 PV+ESS low-voltage networking with isolation transformers (TN-S, with 3-pole ACB)

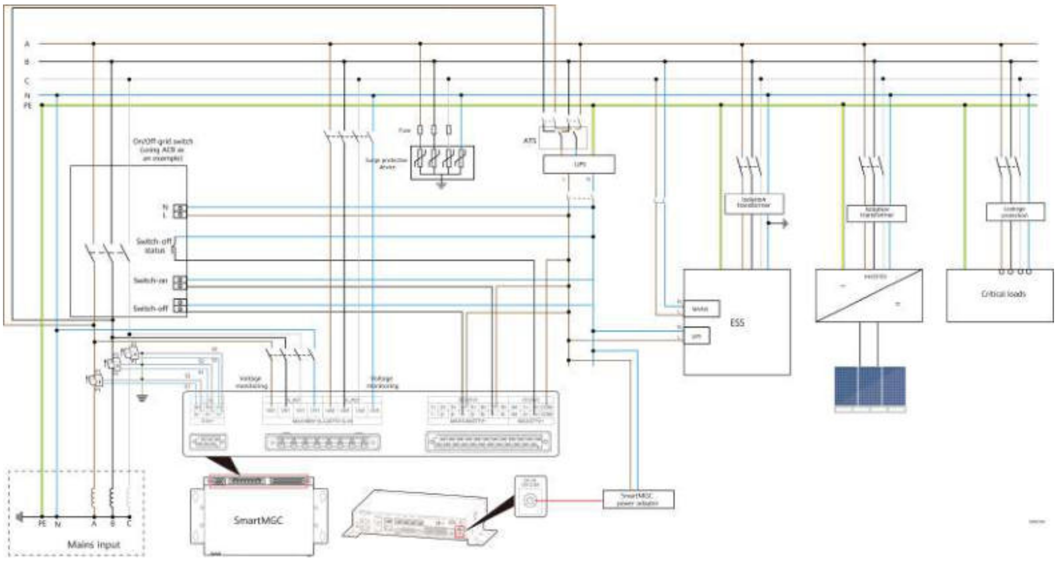
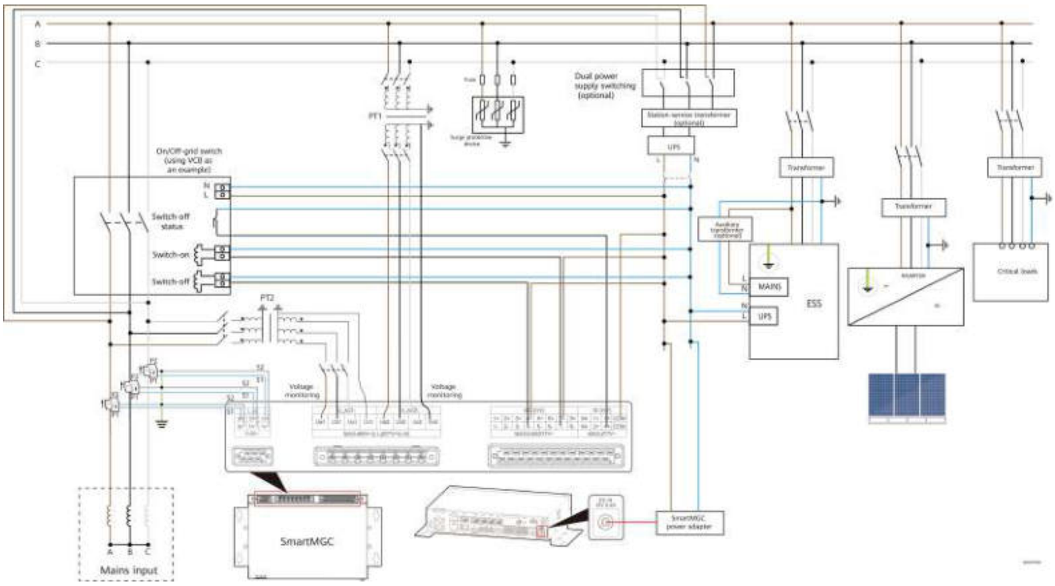


Figure 3-17 PV+ESS medium-voltage networking with transformers



The electrical connections are described as follows:

- The DO7(HV) port of the SmartMGC controls the on/off-grid switch to switch on.
- The DO4(HV) (common) or DO8(HV) (fast) port of the **SmartMGC** is used to control the on/off-grid switch to turn off.
- The DI4(HV) port (recommended) of the SmartMGC receives the actual working status of the on/off-grid switch to monitor the on-grid or off-grid status of the grid connection point.
- (Optional) The DO1(HV) and DO2(HV) ports of the SmartMGC control the critical load switch to switch on and off.
- (Optional) The DI1(HV) (recommended) port of the SmartMGC receives the actual working status of the critical load switch to monitor whether the critical loads have power supply.
- The two power supplies for UPS are automatically switched to ensure the power supply of the UPS in on-grid and off-grid operations.

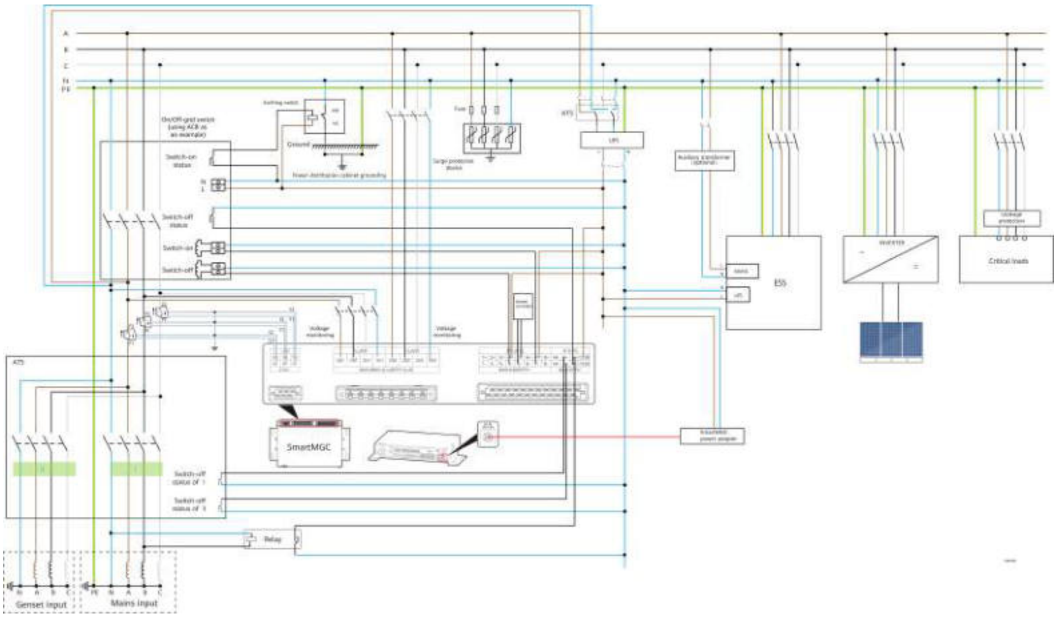
NOTE

If the default DI ports are not available for onsite cable connection, configure the required DI ports in **Settings** > **Microgrid Control** > **General Basic Settings** on the SmartMGC WebUI.

Scenario 2: PV+ESS+Genset Networking (Genset Grid Forming)

In this scenario, an ATS is required. The critical load switch, minor load switch, and common load switch are not supported.

Figure 3-18 PV+ESS+genset networking - genset grid forming (TN-S, with a 4-pole switch)



The wiring diagram is described as follows:

- The DO7(HV) port of the SmartMGC controls the on/off-grid switch to switch on.
- The DO4(HV) port of the SmartMGC controls the on/off-grid switch to switch off.
- The DI4(HV) port (recommended) of the SmartMGC receives the actual working status of the on/off-grid switch to monitor the on-grid or off-grid status of the grid connection point.
- The DO5(HV) port of the **SmartMGC** controls the genset startup and shutdown at high level. (This scenario uses high level for genset control as an example.) If pulse control is required, use DO5(HV) for startup control and DO6(HV) for shutdown control. The DO port of the **SmartMGC** is a dry contact and supports the loop working voltage of 24 V DC or 220 V AC. You need to configure the voltage based on the specifications of the genset controller.
- The DI1(HV) (recommended) port of the **SmartMGC** receives the actual working status of the ATS I on the grid side to report the switch-off status of the mains switch (primary power supply).
- The DI2(HV) (recommended) port of the **SmartMGC** receives the actual working status of the ATS II on the genset side to report the switch-off status of the genset switch (auxiliary power supply).
- The DI3(HV) (recommended) port of the **SmartMGC** receives the valid state of grid power recovery to monitor the switch-off status of the switch on the grid side.
- The two power supplies for UPS are automatically switched to ensure the power supply of the UPS in on-grid and off-grid operations.

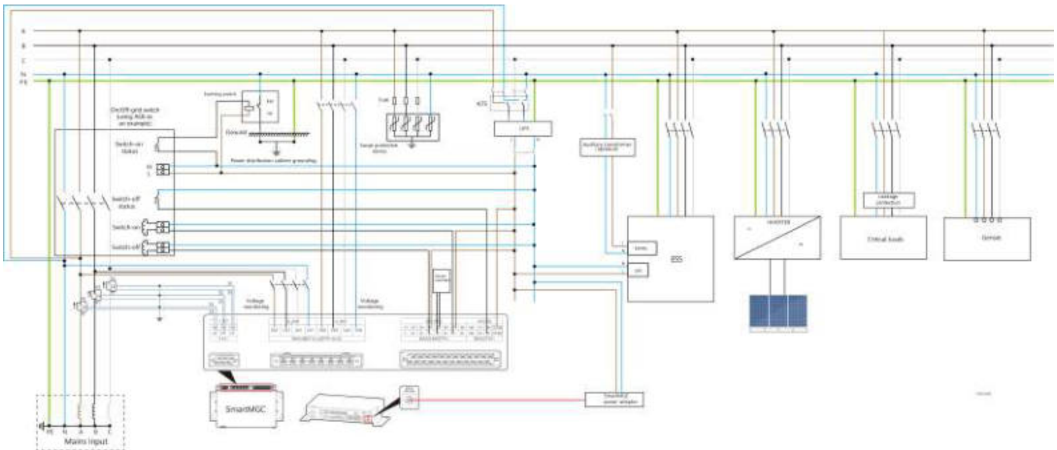
NOTE

If the default DI ports are not available for onsite cable connection, configure the required DI ports in **Settings** > **Microgrid Control** > **General Basic Settings** on the SmartMGC WebUI.

Scenario 3: PV+ESS+Genset Networking (Genset Grid Following)

In this scenario, the critical load switch, minor load switch, and common load switch are not supported.

Figure 3-19 PV+ESS+genset networking - genset grid following (TN-S, with a 4-pole switch)



The wiring diagram is described as follows:

- The DO7(HV) port of the SmartMGC controls the on/off-grid switch to switch on.
- The DO4(HV) port of the SmartMGC controls the on/off-grid switch to switch off.
- The DI4(HV) port (recommended) of the SmartMGC receives the actual working status of the on/off-grid switch to monitor the on-grid or off-grid status of the grid connection point.
- The DO5(HV) port of the **SmartMGC** controls the genset startup and shutdown at high level. (This scenario uses high level for genset control as an example.) If pulse control is required, use DO5(HV) for startup control and DO6(HV) for shutdown control. The DO port of the **SmartMGC** is a dry contact and supports the loop working voltage of 24 V DC or 220 V AC. You need to configure the voltage based on the specifications of the genset controller.
- The two power supplies for UPS are automatically switched to ensure the power supply of the UPS in on-grid and off-grid operations.
- A meter is required for the genset branch to monitor the power of the genset branch.

NOTE

If the default DI ports are not available for onsite cable connection, configure the required DI ports in **Settings** > **Microgrid Control** > **General Basic Settings** on the SmartMGC WebUI.

3.1.4 Application Constraints

For details about the application constraints in the seamless on/off-grid scenario, see **DI/DO Specifications of the SmartMGC**, **Loading Capability Constraints**, and **PV-to-ESS Ratio Constraints**.

DI/DO Specifications of the SmartMGC

NOTICE

High-voltage DI/DO specifications:

- The pulse current capability of DO1(HV) to DO8(HV) is ≤ 5 A @ 200 ms.
- The switch-off control loop of DO8(HV) can operate at DC voltage (12–220 V).
- The control loop of DO1(HV) to DO7(HV) can operate at AC voltage (100–277 V) or DC voltage (12–30 V).
- The DO(HV) and DI(HV) ports are dry contacts. The DO(HV) ports control the switch-on and switch-off of the on/off-grid switch and load switch through pulse signals.
- The switch status feedback loop of DI4(HV) can operate only at 100 V/220 V/230 V/277 V AC voltage or 110 V/220 V DC voltage.

Low-voltage DI/DO specifications:

- DI port: supports passive dry contact signals.
- DO port: supports 12 V DC operating voltage for the control loop.

This section uses the high-voltage DI port as an example. If a low-voltage DI port is required, note that the low-voltage DI port is designed as a wet contact (with an internal power supply) and shall be connected to passive dry contact signals. Do not connect other power supplies to the external loop.

In the seamless on/off-grid system, the DI/DO ports of the **SmartMGC** vary depending on the networking mode. The details are as follows:

- For details about the seamless PV+ESS networking, see **Table 3-5**.
- For details about the seamless PV+ESS+genset networking (genset grid forming), see **Table 3-6**.
- For details about the seamless PV+ESS+genset networking (genset grid following), see **Table 3-7**.

Table 3-5 DI/DO specifications of the **SmartMGC** (seamless PV+ESS networking)

Port	Port Description	AC Control Loop	DC Control Loop (12–30 V)	High-Voltage DC Control Loop (110 V, 220 V)
DO1(HV)	Turns on the critical load switch.	√	√	Signal conversion using an intermediate relay: The DO output signal of the SmartMGC is converted into a high-voltage DC control signal through an intermediate relay.
DO2(HV)	Turns off the critical load switch.	√	√	
DO4(HV)	Turns off the switch at the grid connection point (common port).	√	√	
DO7(HV)	Turns on the switch at the grid connection point (fast port).	√	√	
DO8(HV)[a]	Turns off the switch at the grid connection point (fast port).	×	√ (Preferred)	√
DI1(HV)[b] (recommended)	Reports the Off state of the critical load switch.	√	Signal conversion using an intermediate relay: The status signal sent from the external device is converted into a high-voltage DC feedback signal or AC feedback signal through an intermediate relay.	√
DI4(HV)[b] (recommended)	Reports the Off state of the switch at the grid connection point.			
Note a: You can select either the common port or the fast port for turning off the switch at the grid connection point. Note b: If the default DI ports are not available for onsite cable connection, configure the required DI ports in **Settings** > **Microgrid Control** > **General Basic Settings** on the SmartMGC WebUI.				

Table 3-6 DI/DO specifications of the **SmartMGC** (seamless PV+ESS+genset networking - genset grid forming)

Port	Port Description	AC Control Loop	DC Control Loop (12–30 V)	High-Voltage DC Control Loop (110 V, 220 V)
DO4(HV)	Turns off the switch at the grid connection point (common port).	√	√	Signal conversion using an intermediate relay: The DO output signal of the SmartMGC is converted into a high-voltage DC control signal through an intermediate relay.
DO5(HV)	Used based on the startup and shutdown control mode of the connected genset. ● Pulse: starts the genset. ● Level: starts the genset when closed.	√	√	
DO6(HV)	Used based on the startup and shutdown control mode of the connected genset. ● Pulse: shuts down the genset. ● Level: starts the genset when open.	√	√	
DO7(HV)	Turns on the switch at the grid connection point (fast port).	√	√	
DO8(HV)[a]	Turns off the switch at the grid connection point (fast port).	×	√ (Preferred)	√
DI1(HV)[b] (recommended)	Reports the Off state of ATS I on the grid side.	√	Signal conversion using an intermediate relay: The status signal sent from the external device is converted into a high-voltage DC feedback signal or AC feedback signal through an intermediate relay.	√
DI2(HV)[b] (recommended)	Reports the Off state of ATS II on the genset side.			
DI3(HV)[b] (recommended)	Reports the state of grid power recovery.			

Port	Port Description	AC Control Loop	DC Control Loop (12–30 V)	High-Voltage DC Control Loop (110 V, 220 V)
DI4(HV)[b] (recommended)	Reports the Off state of the switch at the grid connection point.			
Note a: You can select either the common port or the fast port for turning off the switch at the grid connection point. Note b: If the default DI ports are not available for onsite cable connection, configure the required DI ports in **Settings** > **Microgrid Control** > **General Basic Settings** on the SmartMGC WebUI.				

Table 3-7 DI/DO specifications of the **SmartMGC** (seamless PV+ESS+genset networking - genset grid following)

Port	Port Description	AC Control Loop	DC Control Loop (12–30 V)	High-Voltage DC Control Loop (110 V, 220 V)
DO4(HV)	Turns off the switch at the grid connection point (common port).	√	√	Signal conversion using an intermediate relay: The DO output signal of the SmartMGC is converted into a high-voltage DC control signal through an intermediate relay.
DO5(HV)	Used based on the startup and shutdown control mode of the connected genset. ● Pulse: starts the genset. ● Level: starts the genset when closed.	√	√	
DO6(HV)	Used based on the startup and shutdown control mode of the connected genset. ● Pulse: shuts down the genset. ● Level: starts the genset when open.	√	√	
DO7(HV)	Turns on the switch at the grid connection point (fast port).	√	√	
DO8(HV)[a]	Turns off the switch at the grid connection point (fast port).	×	√ (Preferred)	√

Port	Port Description	AC Control Loop	DC Control Loop (12–30 V)	High-Voltage DC Control Loop (110 V, 220 V)
DI4(HV)[b] (recommended)	Reports the Off state of the switch at the grid connection point.	√	Signal conversion using an intermediate relay: The status signal sent from the external device is converted into a high-voltage DC feedback signal or AC feedback signal through an intermediate relay.	√
Note a: You can select either the common port or the fast port for turning off the switch at the grid connection point. Note b: If the default DI ports are not available for onsite cable connection, configure the required DI ports in **Settings** > **Microgrid Control** > **General Basic Settings** on the SmartMGC WebUI.				

Loading Capability Constraints

The loading capability of the ESS varies depending on the load type. For details, see **Table 3-8**.

CAUTION

The load specifications shall meet the loading capability constraints. If the loading capability constraints are exceeded, the device may shut down due to overload protection when the grid or load fluctuates.

Table 3-8 Loading capability constraints

Type	Specifications	Remarks
Total load	≤ (2/3) x Pn[a].	• Single-phase rated capacity = (1/3) x Pn. • Load of each phase ≤ (2/3) x Single-phase rated capacity, that is, Load of each phase ≤ (2/3) x (1/3) x Pn. • Total load of LUNA2000-107-1S11 ≤ (3/5) x Pn.
Non-linear load	• Half-wave rectification load ≤ (1/20) x Pn. • The total current harmonics of loads comply with specifications or standards..	-
Unbalanced load	• No load to two phases: ≤ (2/3) x (2/3) x Pn. • No load to one phase: ≤ (2/3) x (1/3) x Pn.	• Single-phase rated capacity = (1/3) x Pn. • Load of each phase ≤ (2/3) x Single-phase rated capacity, that is, Load of each phase ≤ (2/3) x (1/3) x Pn.
Motor load	• Load of motors that use direct on line (DOL) starters, star-delta starters, or soft starters ≤ (1/10) x Pn. • Load of motors that use star-delta starters ≤ (1/5) x Pn. • Load of motors that use variable frequency drives ≤ (2/3) x Pn.	• If there are other basic loads, the load of motors to be connected and disconnected shall be decreased accordingly in the same proportion. (The inrush current of the asynchronous motor startup shall be ≤ 8 x Rated current. Otherwise, you are advised to add a frequency converter.) • If there are asynchronous motor loads and common non-impact loads in the system, the load capacity is calculated as follows: [A x 10 + (3/2) x B] ≤ Pn. – A: load capacity of the asynchronous motor – B: other common load capacity

Type	Specifications	Remarks
Capacity of transformer switch-on/off	≤ 1.2 x Pn.	-
Dynamic load of the medium-voltage cascaded system	After the medium-voltage cascaded transformer establishes a stable voltage (excluding the power on the medium-voltage line), the dynamic load shall meet the following requirements: ● **Balanced resistive load (R load) step** – Supported condition: ≤ 50% balanced R load step. – Performance requirements: – Within 20 ms after the step: The root-mean-square (RMS) value deviation of the PCS output voltage is ≤ ±30% x Un[b]. – After 20 ms: The RMS value of the output voltage recovers to a steady-state voltage deviation of ≤ ±10% x Un. ● **Balanced inductive/capacitive load (L/C load) step** – Supported conditions: – ≤ 40% balanced inductive load (L load) step. – ≤ 20% balanced capacitive load (C load) step. – Performance requirement: The system shall remain connected to the grid during the step. ● **Unbalanced RLC load step** – Supported conditions: The total load step of a single phase or two phases is ≤ 20%. – Performance requirement: The system shall remain connected to the grid during the step.	-
Note a: Pn is the rated capacity of the ESS. Note b: Un is the steady-state voltage of the system after the step.		

PV-to-ESS Ratio Constraints

The maximum PV-to-ESS ratio varies depending on the ESS model and configuration. For details, see **Table 3-9**.

Table 3-9 Maximum PV-to-ESS ratio for different ESS models

Model	Maximum PV-to-ESS Ratio
LUNA2000-241-2S1-DS	2:1
LUNA2000-241-2S1	2:1
LUNA2000-215-2S10	2:1
LUNA2000-215-2S11	2:1
LUNA2000-161-2S11	1.8:1
LUNA2000-107-1S11	1.2:1

NOTE

The following conditions must be met for mixed use of ESS models with different C-rates:

- A maximum of two models can be used together.
- Preferentially configure the model with more battery packs. If the capacity needs to be supplemented, use a model with fewer battery packs (161 kWh or 107 kWh).
- The PV-to-ESS ratio and loading capability are configured based on the rated power of the model with more battery packs.
- In on-grid (PQ) mode, the system operates at the minimum C-rate. (Choose **Settings** > **Grid Connection Control** > **ESS Control** > **Control Mode** > **ESS Parameters** and set **Scheduling mode** to **Energy first**)

Examples:

Assume that x units of the 215 kWh model and y units of the 107 kWh model are configured. The following conditions shall be met:

- $x \geq y$
- The loading capability is (x * 108 kW * 2/3).
- The maximum PV capacity is (x * 108 kW * 2).
- In on-grid mode, the system operates at 0.5CP. (Choose **Settings** > **Grid Connection Control** > **ESS Control** > **Control Mode** > **ESS Parameters** and set **Scheduling mode** to **Energy first**.)

Grid Code Application Constraints

Table 3-10 Grid code application constraints

Constraint	Affected Function	Description
Grid code compliance[a]	ESS (PCS) high/low voltage ride-through function	During on-grid operation, if the grid experiences a high/low frequency or voltage ride-through, the PV +ESS system will quickly disconnect from the grid, which may not meet the time requirements for reactive or active power support specified by the grid code, leading to compliance risks. Therefore, to use the seamless on/off-grid switching mode, you need to obtain the permission from the local power grid company.
	Inverter high/low voltage ride-through function	During on-grid operation, if the grid experiences a high/low frequency or voltage ride-through, the PV +ESS system will quickly disconnect from the grid, which may not meet the time requirements for reactive or active power support specified by the grid code. Therefore, you need to enable the microgrid compatibility function of the inverter. This function quickly reduces the inverter output current to nearly zero when the grid frequency or voltage fluctuates beyond the limit.
	Anti-islanding function	When the grid fails, the anti-islanding function shuts down the PV+ESS devices and switches the PV+ESS system to off-grid mode. In this mode, the switch at the grid connection point is turned off to isolate the system from the external power grid (anti-islanding is performed only for the external power grid at the grid connection point).
	Frequency adaptability function	Some grid codes allow the PCS to enable frequency regulation control, frequency adaptability, or automatic frequency regulation when it is operating in on-grid mode. These functions are disabled by default. After these functions are enabled, the PCS will implement automatic charge and discharge in response to the grid frequency changes. This may cause the ESS SOC to reach the upper or lower limit, resulting in a seamless switching failure. Therefore, in seamless switching scenarios, you need to disable the preceding functions. Choose **Monitoring** > **ESS** > **Running Parameters** and ensure that **Frequency regulation control**, **Frequency adaptability**, **Overfrequency-caused power derating**, and **Underfrequency-caused power raising** are set to **Disable**.

Constraint	Affected Function	Description
Anti-disturbance capability	Lifespan of the on/off-grid switch	During on-grid operation, if the AC power grid experiences a voltage or frequency disturbance (not power outage) that reaches the detection threshold, the system mistakenly switches to off-grid mode. After the voltage or frequency recovers, the system resumes on-grid operation. This process will cause the on/off-grid switch to turn on and off, thereby consuming the lifespan of the switch.
Note a: The seamed on/off-grid switching mode is recommended if the power grid requirements need to be strictly followed.		

3.2 System Power-On

DANGER

Wear personal protective equipment (PPE) strictly as required and use insulated tools to prevent electric shocks or short circuits.

CAUTION

During the power-on procedure, monitor the system for faults. If you detect any faults, power off the ESS, rectify the faults, and then continue with the procedure.

In the seamless on/off-grid scenario, power on the system when an external power supply is available. Before power-on, perform the check by referring to the "Check Before Power-On" section in the user manual of each device.

Figure 3-20 Power-on process

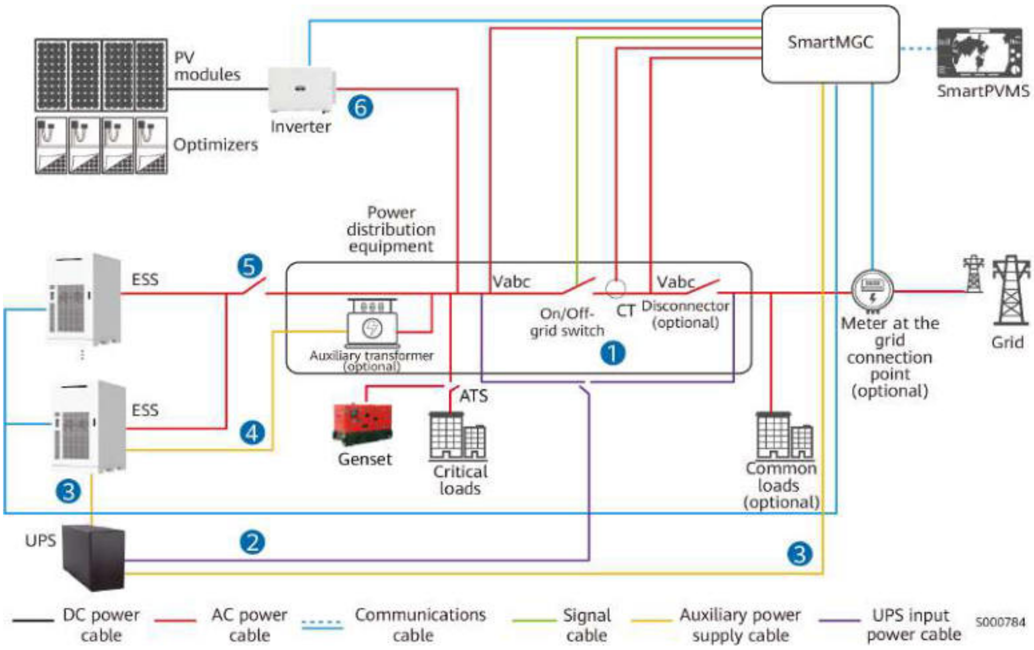


Table 3-11 Power-on process description

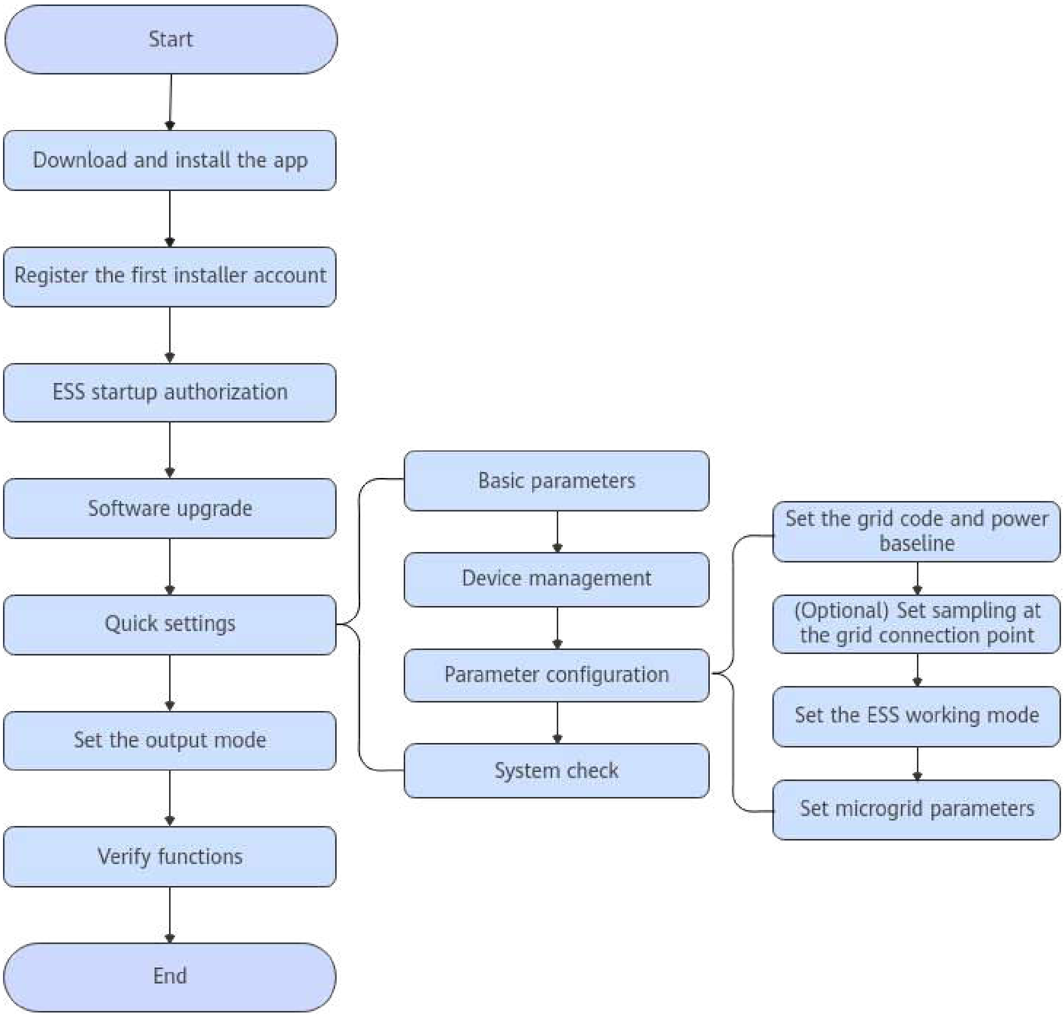
Step	Task	Power-On Operation
1	Powering on the power distribution equipment	Turn on the on/off-grid switch in the power distribution equipment.
2	Powering on the UPS	1. Turn on the UPS power switch on the power distribution equipment side. 2. Start the UPS.
3	Powering on the UPS-SmartMGC auxiliary power supply	1. Turn on the SmartMGC power switch on the UPS side. 2. Turn on the power switch (if any) between the SmartMGC and the UPS.
	Powering on the UPS-ESS auxiliary power supply	For details, see **Power-On Operations**. **CAUTION** Before powering on the ESS auxiliary power supply (for LTMS and other devices), remove the jumper bar from 1–2 and insert it into 2–3 on the XT terminal block, and remove the jumper bar from 4–5 and insert it into 5–6 on the XT terminal block. Otherwise, the auxiliary power supply will fail.
4	Powering on the ESS auxiliary power supply (for LTMS and other devices)	
5	Powering on the ESS AC side	

Step	Task	Power-On Operation
6	Powering on the inverter	**If an inverter is involved in the networking, select a power-on method based on the inverter model:** **Method 1:** 1. Set the DC SWITCH to ON. When you hear a click, the switch is completely turned on. 2. Check that the indicators are not steady red. **Method 2:** 1. Set the DC SWITCH 1 (MAIN SWITCH) to ON. When you hear a click, the switch is completely turned on. 2. Check the status of the PV connection indicator. If it is steady green, set DC SWITCH 2 and DC SWITCH 3 to ON. 3. Check that other indicators are not steady red.
Note: For details about the switch layout and operations of the devices prepared by the customer, see the documents provided by the vendors.		

3.3 Deployment and Commissioning

This section describes how to connect to the **SmartMGC** locally using the app to complete the deployment and commissioning process. For details, see **Figure 3-21**.

Figure 3-21 Commissioning process in the seamless on/off-grid scenario



3.3.1 Preparations and App Login

3.3.1.1 Downloading and Installing the App

NOTICE

The mobile phone operating system must be Android 8.0, iOS 13.0, or later. (iPhone 6 or later is supported for the iOS version.)

Scan the following QR code to download and install the app.

NOTE

If you select **Download via the Browser** and a security warning message is displayed indicating that the app is from an external source, tap **ALLOW**.

3.3.1.2 Registering the Company's First Installer Account

Context

When you register the first installer account, a company is registered at the same time.

Procedure

1. On the app login screen, tap **No account?**.
2. On the **Role** screen, tap **I'm an installer** and complete the registration as prompted.

3.3.1.3 Logging In to the App

After the app is correctly installed on a mobile phone, you can access the management system through the app.

Logging In to the App

1. On the mobile device, tap the app icon to access the login screen.
2. On the app login screen, enter the account information and tap **Log In**.

NOTE

- If a new user logs in to the app for the first time or a user logs in to the app for the first time after the password is reset, change the login password as prompted.
- If a user enters incorrect passwords for five consecutive times within 5 minutes, the account will be locked for 30 minutes. The user can log in again after the lockout period expires or contact the installer or administrator to unlock the account.
- 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. In these cases, the Company shall not be liable for any loss.

3.3.1.4 Setting ESS Startup Authorization

Prerequisites

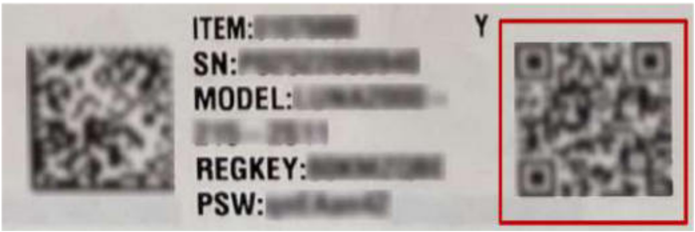
- Install the ESS and connect cables by referring to the sections of **Site Selection Requirements** and **Installing Cables** of the ESS. Failure to meet these requirements may result in the startup password not being issued. As a result, the ESS cannot be started.
- The WLAN function has been enabled on the mobile phone.
- Before connecting your mobile phone to the WLAN (or WiFi) of the ESS, ensure that the ESS is powered on and the ESS initialization is complete (the WLAN indicator is steady on).
- The mobile phone is within 5 m of the device. Otherwise, the communication quality between the app and the device may be poor.

Procedure

Figure 3-22 ESS startup authorization procedure

1. Obtain the **Verification code**.
   a. Log in to the app, scan the WLAN QR code on the ESS (the QR code on the right of the SN on the device), and connect to the WLAN of the ESS.

      Figure 3-23 QR code example (for reference only; the actual QR code on the device prevails)

      NOTE

      - For the first connection to the device WLAN, log in with the initial password. You can obtain the initial WLAN password from the device label, that is, the characters following "PSW".
      - 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 device WLAN. The WLAN name of the device consists of "device name-SN".
      - If **This WLAN network has no Internet access. Connect anyway?** message is displayed when you connect to the device WLAN, tap **CONNECT**. Otherwise, you cannot log in to the system. The actual UI and messages may vary with mobile phones.

   b. Log in to the local screen of the ESS as the **installer** user, and obtain **Verification code**.

      NOTE

      Set the password as prompted at the first login.
2. Apply for the **Startup password**.

   Contact the device vendor or its authorized supervision service provider to apply for the **Startup password** using the **Verification code** on the Power-Partner app.
3. Enter the **Startup password** to complete the ESS startup authorization.

a. (Optional) If the app is disconnected from the ESS, use the app to scan the WLAN QR code on the ESS to log in to the local screen of the ESS as the **installer** user.
b. Enter the **Startup password** and tap **Authorized**.

NOTE

Ensure account security by changing the password periodically. 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.

3.3.1.5 Updating the Software Version

NOTICE

Only the currently connected SmartMGC and its subordinate devices can be updated.

Prerequisites

- Ensure that you have completed the ESS startup authorization before updating the software version to prevent update failures or system alarms.

Downloading the Update Package (from the FusionSolar Software Download Website)

1. Log in to the **FusionSolar Software Download** website using the product customer account on a PC and download the latest software packages of the SmartLogger and ESS.

   NOTE

   To protect software integrity, mitigate the risk of software package implantation or tampering, and enhance software supply chain safety, you are advised to install **ICS Lite** on your PC, which can automatically verify the digital signature of the software package.

   Table 3-12 Software download paths

Device	Path
SmartLogger	**SmartLogger5000B**
ESS	**LUNA2000B**

2. After downloading the software update packages from the website, import them from the PC to the mobile phone where the update is to be performed.

Updating the Device Version (App)

1. Scan the WLAN QR code on the SmartMGC to connect to its WLAN.
2. Log in to the local commissioning screen and choose **Maintenance** > **Upgrade device**.

3. On the **Select device** screen, select the devices to be updated.
4. Tap **Select Update Package** under each device and select the update package as prompted.

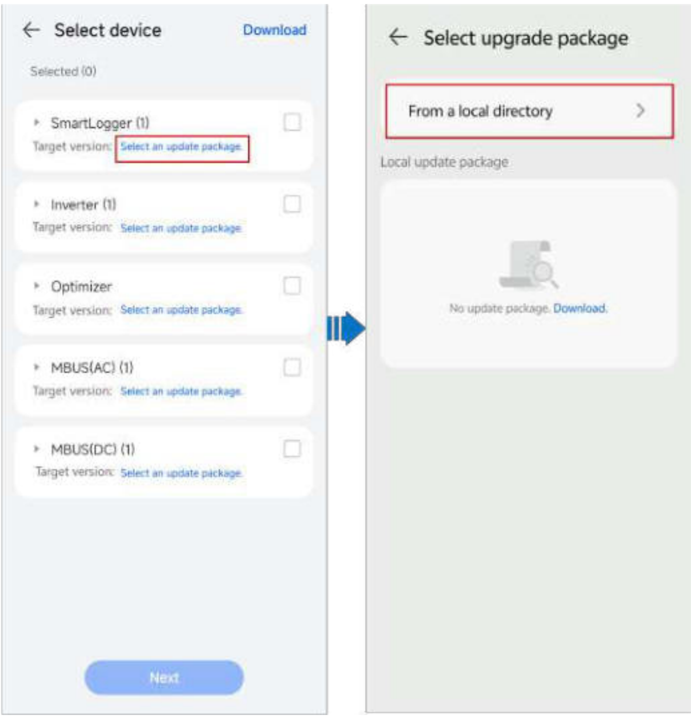
   NOTE

   - iOS mobile phone: After downloading the update package from the website and storing it on the mobile phone, hold down the file to share it to the app. Then the update package is directly displayed on the screen for selecting the update package.
   - Android mobile phone: Choose **Select Update Package** > **From a local directory** to access the phone folder and manually select the update package.
5. Tap **Next** and complete the update as prompted.

   NOTE

   After the update is successful, the target version of the device will be refreshed. If the update fails, check whether the selected update package is correct and rectify the fault as prompted.

Figure 3-24 Device update



3.3.2 Quick Settings

Log in to the SmartMGC local commissioning screen as the **installer** user using the app and enter the **Quick Settings** screen.

For details about how to log in to the SmartMGC local commissioning screen, see **E Connecting the App to the SmartMGC**.

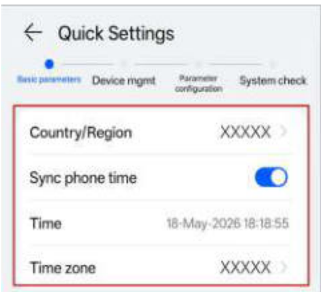
3.3.2.1 Basic Parameters

Set basic parameters such as the country/region, time zone, running configuration, and communication networking to ensure data accuracy and facilitate O&M management and fault locating.

Step 1 Set the basic parameters.

Set **Country/Region**, **Time**, and **Time zone** based on the location and local time of the plant.

Figure 3-25 Basic information



Step 2 Set the running configuration parameters.

Figure 3-26 Running configuration

Table 3-13 Running configuration parameters

Parameter	Description
Scenario	Set this parameter to **On/Off-grid**. The PV+ESS system can run in on-grid or off-grid mode. The system supports bidirectional switching between the two modes. The grid supply is required in this scenario. The running scenario configuration is used to configure the array scenario as required to ensure that the system control function is correctly executed.

Step 3 Set **Networking** parameters.

1. Set network connection parameters for connecting to the management system.

   The SmartMGC can be connected through a mobile network or wired network. Tap **>** on the right of **Network Connection**, set **Mobile network** or **Wired Network** parameters as required, and tap **Submit**.

Figure 3-27 Network connection

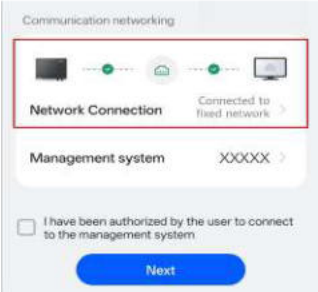


Table 3-14 Network connection parameters

Parameter	Description
Mobile network	
Network mode	Set this parameter based on the SIM card network mode.
APN mode	The default value is **Automatic**. Set this parameter to **Manual** if the dial-up connection cannot be set up in **Automatic** mode.
Identification type	This parameter is displayed when APN mode is set to **Manual**. It specifies the type of user identity authentication. – **PAP**: Password Authentication Protocol – **CHAP**: Challenge Handshake Authentication Protocol
APN	This parameter is displayed when **APN mode** is set to **Manual**. If this parameter is incorrectly set, the mobile network services will be affected. The parameter information comes from the SIM card carrier. If you have any questions about the parameter settings, contact the Company's engineers.
SIM access point number	
APN user name	
APN user password	
Wired network	
DHCP	This parameter is enabled by default. After it is enabled, IP addresses are automatically allocated. If the router does not support DHCP, disable **DHCP** and manually assign an IP address.
IP Address	Set this parameter when **DHCP** is disabled. Retain the default values or change them as required. The network ports are independent of each other and their configurations cannot conflict with each other.
Subnet mask	
Default Gateway	

Parameter	Description
Primary DNS Server	Set this parameter when **DHCP** is disabled. DNS server address, which is obtained from the router or carrier. You can ignore this parameter if the device connects to the LAN. If the device connects to the public network, for example, the management system, set this parameter to the IP address of the LAN router.
Secondary DNS Server	Set this parameter when **DHCP** is disabled. DNS server address, which is obtained from the router or carrier. This parameter does not need to be set in normal cases. If the primary DNS server cannot resolve the domain name, use the secondary DNS server.

2. Set parameters for connecting to the management system

   Connecting to the management system enables centralized monitoring and remote O&M of the plant. Tap **>** on the right of **Management system**, set parameters such as the domain name as required, and tap **Submit**.

Figure 3-28 Management system

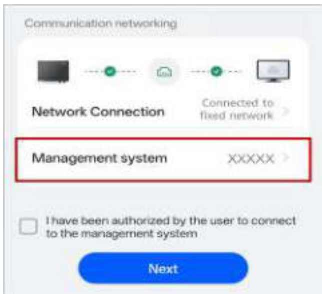


Table 3-15 Management system parameters

Parameter	Description	Remarks
Domain Name	Specifies the domain name of the management system.	The system has preset **Port** and **TLS encryption** for the default domain name. You do not need to set them. If you need to change the domain name, configure the corresponding **Port** and **TLS encryption**.
Port	Set the port number based on the domain name. The default port number is 27250.	
TLS encryption	You are advised to enable **TLS encryption** to ensure data security. – **Enable**: Data exchanged between the SmartMGC and the management system is encrypted. – **Disable**: Data exchanged between the SmartMGC and the management system is not encrypted, which poses security risks.	

If a third-party energy management system (EMS) is connected, set related parameters based on the corresponding communications protocol.

Figure 3-29 Management system connection

Table 3-16 Modbus TCP

Parameter	Description
Connection	Specifies whether to allow a third-party EMS to connect to the SmartMGC. – **Enable (restricted)**: The SmartMGC communicates with a third-party management system for which the client IP address (whitelist) has been configured. – **Enable (unrestricted)**: The SmartMGC communicates with a third-party management system with a valid IP address. – **Disable**: No IP address is allowed to connect to the SmartMGC.
Client 1 IP address	This parameter is displayed when **Connection** is set to **Enable (restricted)**. It specifies the IP address of the client.
Client 2 IP address	
Client 3 IP address	
Client 4 IP address	

Parameter	Description
Client 5 IP address	
Address mode	This parameter is displayed when **Connection** is set to **Enable (restricted)** or **Enable (unrestricted)**. If the communication address of the connected device is unique, you are advised to select **Physical address**. Otherwise, you must select **Logical address**.
SmartLogger address	This parameter is displayed when **Connection** is set to **Enable (restricted)** or **Enable (unrestricted)**. It specifies the slave address of the SmartLogger.

Table 3-17 Modbus RTU

Category	Parameter	Description
COM 1/2/3, M1.COM1/2/3	**Baud rate**	Specifies the communication rate of the RS485 port. Set this parameter to be consistent with the baud rate of the connected device.
	Parity	Specifies the error detection mechanism for data transmission over RS485. Set this parameter to be consistent with the parity mode of the connected device.
	Stop Bit	Specifies the interval after the transmission of each data byte is complete, which is equivalent to the terminator of a data frame. Set this parameter to be consistent with the stop bit of the connected device.

NOTE

If the SmartLogger communicates with a third-party EMS over IEC 104, set communication parameters by referring to **3.5.2.1 IEC 104 Protocol**.

3. Connect to the management system authorized by the customer.

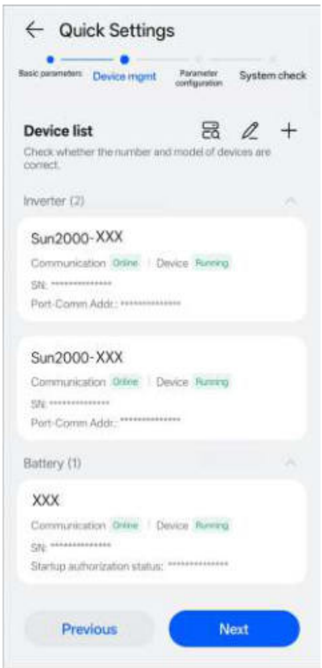
   Select **I have obtained the owner's authorization to access the management system.**.

----End

3.3.2.2 Device Management

Check whether the quantity and models of devices displayed on the current screen are consistent with those of the connected devices. If they are inconsistent, tap the search icon or check whether the device cables are properly connected.

Figure 3-30 Device management



Step 1 (Optional) If the device is not displayed, tap the search icon to connect to a device or tap **+** to add a device. Auto discovery does not apply to third-party devices, such as the meter and environmental monitoring instrument (EMI). You need to tap **+** to add them manually.

NOTE

- The device list displays only the devices directly connected to the SmartMGC.
- If a device cannot be found, check whether the cable to the device is properly connected. After confirming that the cable connection is correct, tap **Search** or **+**.
- Meter: For details about the supported meter models, see **B Meter Model List**.
- EMI: For details about the supported EMI models, see **C EMI Model List**.

Table 3-18 Parameters for adding a meter

Parameter	Description
Device type	Set this parameter to **Power meter**.
Intelligent Power Meter Type	Select a value based on the model of the connected meter. • If the power meter model is DTSU666-HW, select **DTSU666-HW**. • If the power meter model is YDS60-80, select **YADA-YDS60-80**. • If the power meter model is DHSU1079-ZT, select **DHSU1079-ZT**. • If the power meter model is DTSU71C, select **DTSU71C**.
port	Select a port based on the SmartMGC COM port connected to the meter.

Parameter	Description
Address	Set the communications address of the meter as required, which must not conflict with the addresses of other devices on the same bus. The value ranges from 1 to 247. For details, see the user manual of the meter.
Baud rate	Set the RS485 communications rate of the meter as required. For details, see the user manual of the meter.
Parity	Set the RS485 communications parity mode of the meter as required. The options are **No parity**, **Odd parity** and **Even parity**. For details, see the user manual of the meter.
Stop Bit	Specifies the interval after the transmission of each data byte is complete, which is equivalent to the terminator of a data frame. Set this parameter of the meter as required. For details, see the user manual of the meter.
Meter purpose	Set the usage of the meter based on the actual connection position of the meter. ● **Feed-in meter**[1]: used for grid-connection point control. Each array allows only one feed-in meter to be connected. ● **Production meter**: PV output meter. Multiple production meters can be connected. ● **Consumption meter**: load consumption meter. Multiple consumption meters can be connected. ● **Charger meter**: charger consumption meter. Multiple charger meters can be connected. ● **Third-party production meter**: third-party PV output meter. Multiple third-party production meters can be connected. ● **Genset meter**: genset output meter. Only one genset meter can be connected to each array.

<table>
<tr><th>Parameter</th><th>Description</th></tr>
<tr><td>Voltage change ratio</td><td rowspan="2">
Set this parameter to 1 if the meter uploads the primary value.
Set this parameter based on the actual transformer ratio if the meter uploads the secondary value.
If both the meter and the SmartMGC support the settings of the voltage ratio and current ratio, you can only set them either on the meter or the SmartMGC. You are advised to set these parameters on the meter.
If the meter connects to a transformer, set SPEC of the meter to 0, indicating that the meter connects to the system through a transformer.
Examples:

Scenario 1: When the voltage of the grid connection point is 400 V, the power meter must be connected to a CT, and the CT ratio is 400:5.
Set the voltage transformation ratio of the meter to 1.
Set the current transformation ratio of the meter to 80.
Scenario 2: When the voltage of the grid connection point is 10 kV, the meter must be connected to both the CT and PT. The CT ratio is 400:5, and the PT ratio is 10000:100.
Set the voltage transformation ratio of the meter to 100.
Set the current transformation ratio of the meter to 80.

</td></tr>
<tr><td>Current change ratio</td></tr>
<tr><td colspan="2">[1]: The Feed-in meter must be connected to a COM port of the SmartMGC separately to avoid affecting the dispatch performance of the system.</td></tr>
</table>

Step 2 (Optional) Perform ESS startup authorization. If the ESS is not authorized to start, tap the related prompt on the current screen to access the **Startup Authorization** screen, and enter **Startup password** to complete the ESS startup authorization.

NOTE

- How to obtain **Startup password**: Provide **Verification code** for the device supplier or its authorized supervision service provider. They will apply for **Startup password** for you using the Power-Partner app.
- If battery packs are added to the ESS in the network, the ESS automatically restart after you enter **Startup password** and submit the authorization.

Step 3 (Optional) Change the device name. To facilitate subsequent log export and fault locating, you can change the device name based on the device location. For example, if multiple ESSs are connected, you can add numbers for the ESSs, such as ESS_1 and ESS_2.

Tap to go to the **Edit Device** screen. Tap next to the target device and change the device name.

----End

3.3.2.3 Parameter Configuration

Set operation rules such as grid standards and ESS policies to ensure that the plant runs safely and efficiently in the expected mode.

3.3.2.3.1 Setting the Grid Code and Power Baseline

Step 1 Set the grid code.

Figure 3-31 Grid code

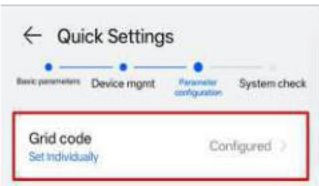
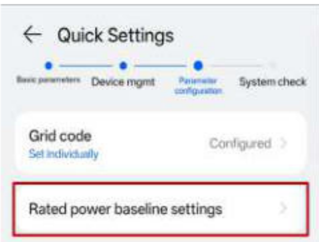


Table 3-19 Grid code parameter

Parameter	Description
Grid Code	Select the local grid code.

Step 2 Set the rated power baseline.

Figure 3-32 Rated power baseline



1. Tap **Rated power baseline settings**, select the target ESS device, and tap **Set**.
2. Tap **>** on the right of **Rated power baseline**, select the target power, and tap **Submit**.
3. Return to the **Select Device** screen and view the setting result.
4. Select the corresponding rated power on the device nameplate.

NOTICE

- To ensure safe operation of the device, after setting the power in the software, immediately draw a check mark on the device nameplate in the rated power option that is the same as the value set in the software to confirm the final configuration.
- To support this function, the following version mapping shall be met:
  - SmartMGC: SmartLogger5000B V100R026C10 or later
  - ESS: LUNA2000B V200R026C10 or later
  - App: 26.3.1 or later

Table 3-20 Rated power baseline parameter

Parameter	Description
Rated power baseline	The rated power baseline is the reference for calculating the system power. After **Rated power baseline** is set, the active power baseline and apparent power baseline will be adjusted accordingly.

Step 3 Set plant information.

Figure 3-33 Plant information

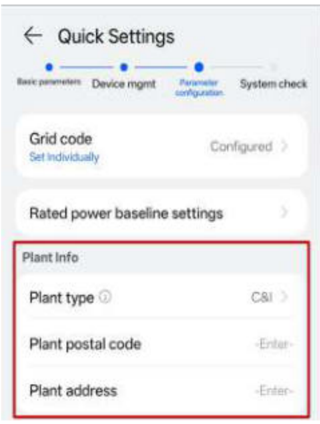


Table 3-21 Plant information parameters

Parameter	Description
Plant type	Select **C&I**.
Plant postal code	**Plant postal code** is displayed when the mobile phone is not connected to the Internet or it is connected to the Internet but the location function of the app is not enabled. Set this parameter to the actual postal code of the plant.

Parameter	Description
Plant address	Set this parameter to the address of the plant.

----End

3.3.2.3.2 Grid Connection Point Sampling Configuration

The SmartMGC can directly sample the current and voltage at the grid connection point. When used with the CT and PT, it can function as a meter at the grid connection point. In this case, you need to set the grid connection point sampling parameters. In addition, the SmartMGC can collect voltage signals through the U_AC2 port to implement secondary frequency and voltage regulation.

Step 1 Set the grid connection point sampling parameters.

Figure 3-34 Grid connection point sampling parameters (on/off-grid)

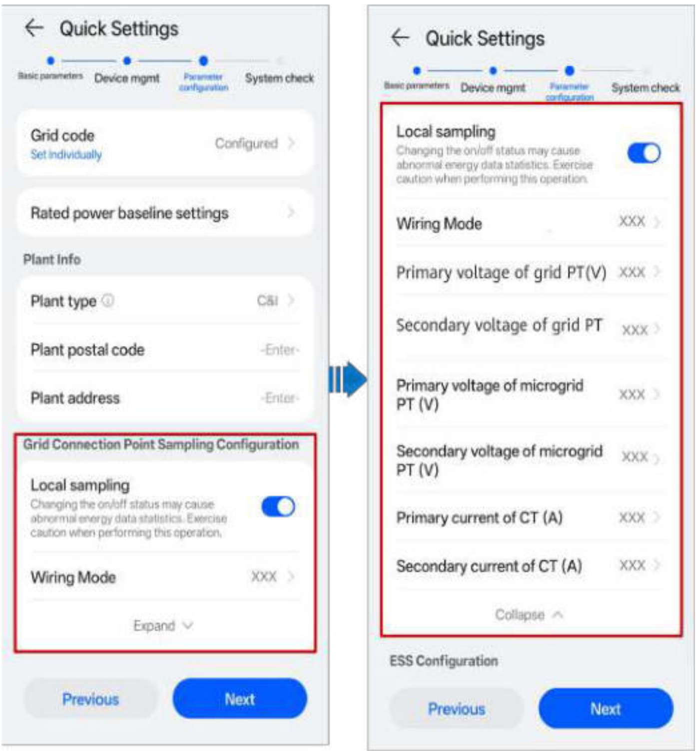


Table 3-22 Grid connection point sampling parameters

Parameter	Description
Local sampling	Enable this parameter.
Wiring mode	Set the output mode based on the actual cable connections of the CT and PT.

Parameter	Description
Primary voltage of grid PT (V)	Voltage is sampled through the U_AC1 port. ● If PT voltage sampling is unavailable, set the primary and secondary voltages on the grid side based on the actual rated voltage on the grid side. ● If PT voltage sampling is available, set the primary and secondary voltages on the grid side based on the actual specifications of the PT. **NOTICE** To ensure safety, a PT must be used for voltage sampling in the medium- and high-voltage system.
Secondary voltage of grid PT (V)	
Primary voltage of microgrid PT (V)	Voltage is sampled through the U_AC2 port. ● If PT voltage sampling is unavailable, set the primary and secondary voltages on the microgrid side based on the actual rated voltage on the microgrid side. ● If PT voltage sampling is available, set the primary and secondary voltages on the microgrid side based on the actual specifications of the PT. **NOTICE** ● To ensure safety, a PT must be used for voltage sampling in the medium- and high-voltage system. ● Connect the secondary voltage output cable of the microgrid PT to the U_AC2 port. The SmartMGC depends on this port to collect voltage signals to implement secondary frequency regulation. If the cable is not correctly connected, the system control will fail and the system stability cannot be maintained.
Secondary voltage of microgrid PT (V)	
Primary current of CT (A)	The I_AC port is connected to the CT to sample current. Set this parameter based on the actual specifications of the CT.
Secondary current of CT (A)	

----End

3.3.2.3.3 Setting the ESS Working Mode

The ESS working mode allows the SmartMGC to control the power output of devices in an array according to different control modes, ensuring that the grid and loads work properly and maximizing the economic benefits of the plant.

Set the working mode of the ESS based on the actual scenario.

- On-grid: Set **Working mode settings** to **Maximum self-consumption**, **TOU (Time-of-Use)**, **No control**, or **No control** based on the actual application scenario. **No control** is used only for commissioning.
- Off-grid operation: Set **Working mode settings** to **No control**.

Figure 3-35 Setting the ESS working mode

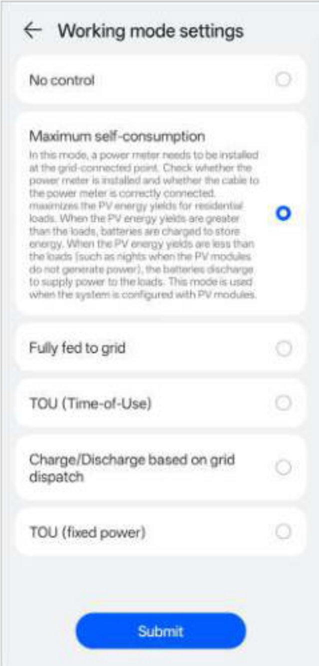


Table 3-23 describes the ESS control policies supported by the SmartLogger.

Table 3-23 ESS settings

Working Mode	Description
No Control	This mode is used only for commissioning. In this mode, the SmartMGC does not control the power dispatch of the ESS.
Maximum Self-Consumption	This mode applies to PV+ESS systems in areas where the electricity price is high and the feed-in-tariff (FIT) subsidy is low or unavailable. PV power is preferentially supplied to loads, and the surplus PV power is used to charge the ESS. When the ESS is fully charged or reaches the maximum charge power, the surplus power is fed to the grid. The grid can supply power to loads but cannot charge the ESS.
Time-of-Use (TOU)	This mode applies to PV+ESS or ESS-only systems in scenarios where the price difference is large between peak and off-peak hours and power meters are used. During off-peak hours, the grid supplies power to charge the ESS. During peak hours, the ESS discharges energy to loads.

Working Mode	Description
Charge/ Discharge Based on Grid Dispatch	This mode applies to the scenario where the northbound controller delivers active power dispatch commands. The purpose of discharge based on grid dispatch is to meet the active power dispatch target value at the grid connection point. PV energy is preferred. If the generated PV energy is insufficient, the ESS discharges energy and the energy is fed to the grid based on the active power dispatch target value. If the generated PV energy is sufficient, the energy is fed to the grid based on the active power dispatch target value, and the surplus PV energy is used to charge the ESS. The purpose of charge based on grid dispatch is to meet the active power dispatch target value at the grid connection point. If the ESS charge power is insufficient, the grid charges the ESS with the maximum capability. If the ESS is not fully charged when the dispatch target value is met, the PV energy is used to charge the ESS.
TOU (Fixed Power)	This mode applies to ESS-only or PV+ESS systems in scenarios where the price difference is large between peak and off-peak hours and the charge and discharge power needs to be set. During off-peak hours, the grid supplies power to charge the ESS. During peak hours, the ESS discharges energy to loads.

No Control

Function

This mode is used only for commissioning. In this mode, the SmartMGC does not control the power dispatch of the ESS.

Procedure

Step 1 Set **Working mode settings** to **No control** for the ESS.

Step 2 Tap **Submit**.

----End

Maximum Self-Consumption

Function

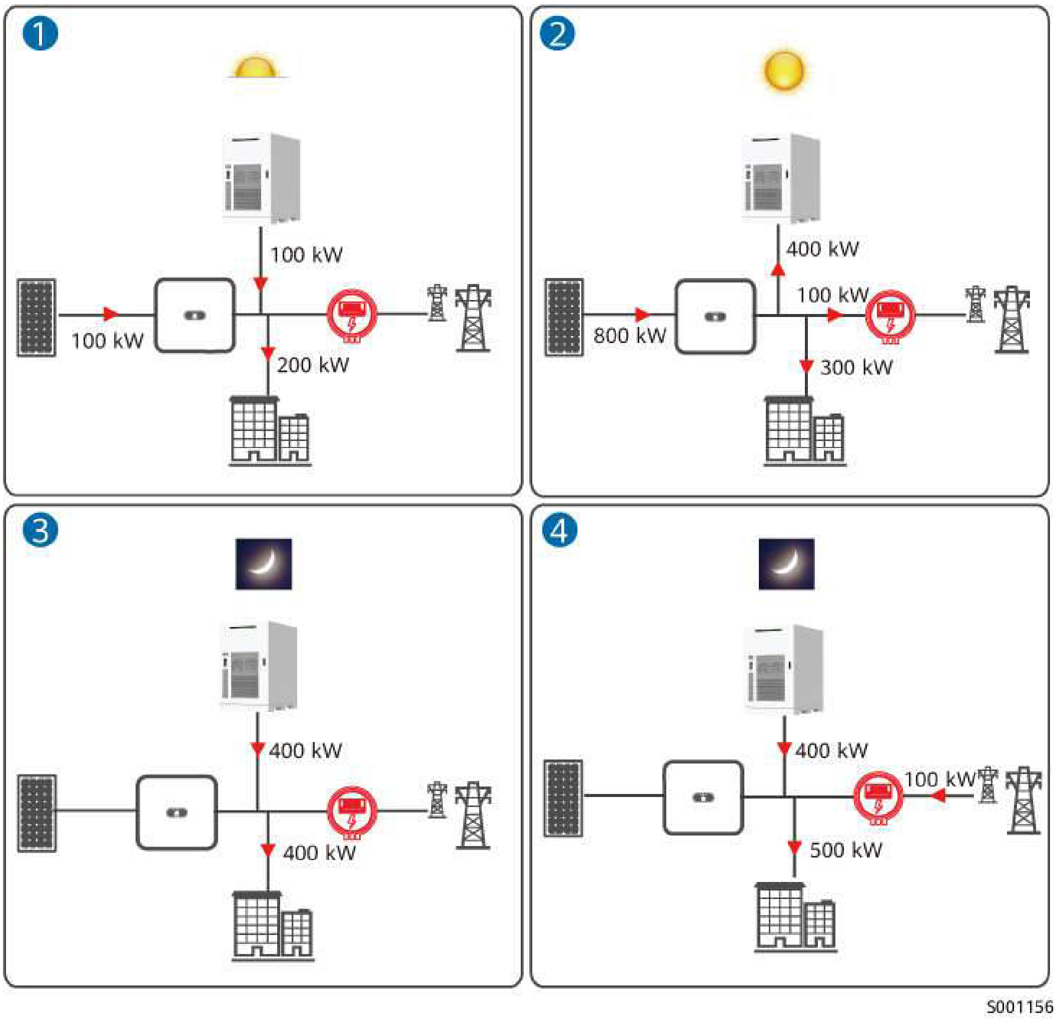
This mode applies to PV+ESS systems in areas where the electricity price is high and the feed-in-tariff (FIT) subsidy is low or unavailable. PV power is preferentially supplied to loads, and the surplus PV power is used to charge the ESS. When the ESS is fully charged or reaches the maximum charge power, the surplus power is fed to the grid. The grid can supply power to loads but cannot charge the ESS.

Energy priority:

- PV energy supply priority: load > ESS > power grid
- Load power consumption priority: PV > ESS > power grid

The following uses **Figure 3-36** (ESS capacity: 800 kWh/400 kW) as an example.

Figure 3-36 Maximum self-consumption description



(1) 06:00–08:00: Insufficient irradiance

(2) 10:00–14:00: Sufficient irradiance

(3) 19:00–20:00: No irradiance

(4) 21:00–22:00: No irradiance

Procedure

Step 1 Set **Working mode settings** to **Maximum self-consumption** for the ESS.

Step 2 Tap **Submit**.

----End

Time-of-Use (TOU)

Function

This mode applies to PV+ESS or ESS-only systems in scenarios where the price difference is large between peak and off-peak hours and power meters are used.

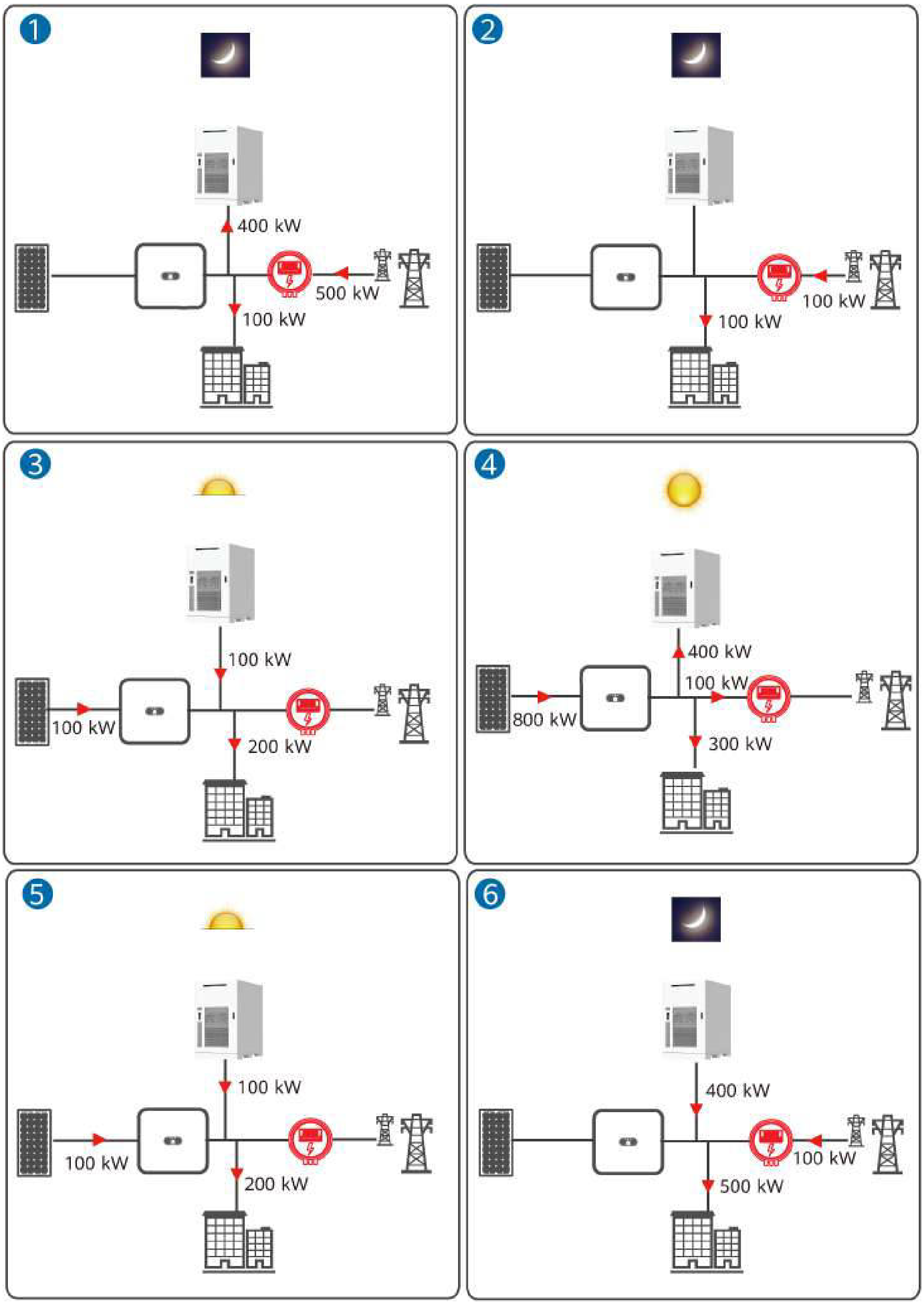
During off-peak hours, the grid supplies power to charge the ESS. During peak hours, the ESS discharges energy to loads.

In this mode, at least one charge or discharge period for the ESS needs to be set. For example, if you set the low electricity price period at night as the charge period, the system charges the ESS at the maximum power during this period. If you set the high electricity price period as the discharge period, the ESS discharges only according to the actual demand of load power. The ESS can discharge only during the discharge period, reducing electricity costs.

In some countries, the grid is not allowed to charge the ESS. In this case, this mode cannot be used.

The following uses **Figure 3-37** as an example (ESS capacity: 800 kWh/400 kW, **Maximum self-consumption** enabled).

Figure 3-37 TOU



(1) 00:00–06:00: Charge period

(2) 00:00–06:00: Charge period

(3) 06:00–08:30: Insufficient irradiance during the discharge period

(4) 10:00–14:00: Sufficient irradiance during the discharge period

(5) 17:00–18:00: Insufficient irradiance during the discharge period

(6) 21:00–22:00: Discharge period

Procedure

Step 1 Set **Working mode settings** to **TOU (Time-of-Use)** for the ESS.

Step 2 Set **TOU (Time-of-Use)** parameters.

Table 3-24 TOU

<table>
<tr><th>Parameter</th><th>Description</th></tr>
<tr><td>Start time</td><td rowspan="4">Specifies the start time and end time of charge/discharge. A maximum of 14 time segments can be set. The time segments cannot overlap.
● Discharge: The ESS is allowed to discharge energy to loads, but cannot feed energy to the grid.
● Charge: ESS charge is allowed.</td></tr>
<tr><td>End date</td></tr>
<tr><td>Day</td></tr>
<tr><td>Charge/Discharge</td></tr>
<tr><td>Maximum self-consumption</td><td>When both TOU (Time-of-Use) and Maximum self-consumption are used, set this parameter to Enable.
● Enable: The maximum self-consumption function is enabled. When the PV power is greater than the load power, the surplus PV power is charged to the ESS. After the charge power reaches the maximum value or the ESS is fully charged, the surplus PV power is fed to the grid.
● Disable: The maximum self-consumption function is disabled. When the PV power is greater than the load power, the surplus PV power is preferentially fed to the grid. After the feed-in power reaches the maximum value, the surplus PV power is charged to the ESS.</td></tr>
<tr><td>Maximum charge power of grid</td><td>Specifies the maximum power at which the grid charges the ESS. The value is determined by the local power grid company. If there is no requirement, the value is the maximum charge power of the ESS by default.
If Draw power from grid for off-grid power backup (choose Set > Microgrid Parameters > Scheduling Control) is triggered, Charge power for off-grid power backup determines the grid power charged to the ESS. You are advised to set this parameter to the same value as Charge power for off-grid power backup.</td></tr>
</table>

Step 3 After the parameters are set, tap **Submit**.

----End

Charge/Discharge Based on Grid Dispatch

Function

This mode applies to the scenario where the northbound controller delivers active power dispatch commands.

The purpose of discharge based on grid dispatch is to meet the active power dispatch target value at the grid connection point. PV energy is preferred. If the generated PV energy is insufficient, the ESS discharges energy and the energy is fed to the grid based on the active power dispatch target value. If the generated PV energy is sufficient, the energy is fed to the grid based on the active power dispatch target value, and the surplus PV energy is used to charge the ESS.

The purpose of charge based on grid dispatch is to meet the active power dispatch target value at the grid connection point. If the battery charge power is insufficient or the PCS limits the power, the grid charges the batteries with the maximum capability. If the batteries are not fully charged when the scheduling target value is met, the PV power is used to charge the batteries.

In some countries, the grid is not allowed to charge the ESS. In this case, this mode cannot be used.

Procedure

Step 1 Set **Working mode settings** to **Charge/Discharge based on grid dispatch** for the ESS.

Step 2 Tap **Submit**.

----End

TOU (Fixed Power)

Function

This mode applies to ESS-only systems in scenarios where the price difference is large between peak and off-peak hours and no power meters are used.

During off-peak hours, the grid supplies power to charge the ESS. During peak hours, the ESS discharges energy to loads.

In this mode, at least one charge or discharge period for the ESS needs to be set. For example, if you set the low electricity price period at night as the charge period, the system charges the ESS at the fixed power during this period. If you set the high electricity price period as the discharge period, the ESS can discharge energy only during the discharge period at the fixed power, reducing electricity costs.

In some countries, the grid is not allowed to charge the ESS. In this case, this mode cannot be used.

Procedure

Step 1 Set **Working mode settings** to **TOU (Fixed power)** for the ESS.

Step 2 Set **TOU (Fixed power)** parameters.

Table 3-25 TOU (fixed power)

Parameter	Description
Start time	Specifies the start time and end time of charge/discharge. A maximum of 14 time segments can be set. The time segments cannot overlap.
End date	
Day	Specifies the charge/discharge interval.
Charge/Discharge	● **Discharge**: – In the scenario with a power meter, the ESS is allowed to discharge energy to loads, but cannot feed energy to the grid. – In the scenario without a power meter, the ESS is allowed to discharge energy to loads or feed energy to the grid. ● **Charge**: Charging the ESS with grid power is allowed.
Charge Power	Specifies the ESS charge/discharge power.
Discharge power	
Maximum self-consumption	When both **TOU (Fixed power)** and **Maximum self-consumption** are used, set this parameter to **Enable**. ● **Enable**: The maximum self-consumption function is enabled. When the PV power is greater than the load power, the surplus PV power is charged to the ESS. After the charge power reaches the maximum value or the ESS is fully charged, the surplus PV power is fed to the grid. ● **Disable**: The maximum self-consumption function is disabled. When the PV power is greater than the load power, the surplus PV power is preferentially fed to the grid. After the feed-in power reaches the maximum value, the surplus power is charged to the ESS. (During charging, the charge power does not exceed the values of **Charge Power** and **Discharge power**.)

Step 3 After the parameters are set, tap **Submit**.

----End

3.3.2.3.4 Microgrid Configuration

The SmartMGC integrates the microgrid control function to implement seamless on/off-grid switching. When the grid is abnormal or recovers, the system can switch within milliseconds to ensure uninterrupted power supply to loads. The switching process is imperceptible to loads, providing uninterrupted high-quality power supply.

In the seamless on/off-grid system, parameter settings vary depending on the networking mode. Set the parameters by referring to the corresponding table based on the specific networking scenario.

- For details about the seamless PV+ESS networking, see **Table 3-26**.
- For details about the seamless PV+ESS+genset networking (genset grid forming), see **Table 3-27**.
- For details about the seamless PV+ESS+genset networking (genset grid following), see **Table 3-28**.

NOTICE

- Connect cables strictly according to the following table. Otherwise, the related functions cannot be enabled.
- To support the **Synchronous voltage**, **Allow ESS to charge from genset** and **Main power supply in off-grid mode** functions, the following version mapping shall be met:
  - SmartMGC: SmartLogger5000B V100R026C10 or later
  - ESS: LUNA2000B V200R026C10 or later
  - App: 26.3.1 or later
  - Management system: 26.2.0 or later

Figure 3-38 Microgrid configuration parameters (seamless PV+ESS networking)

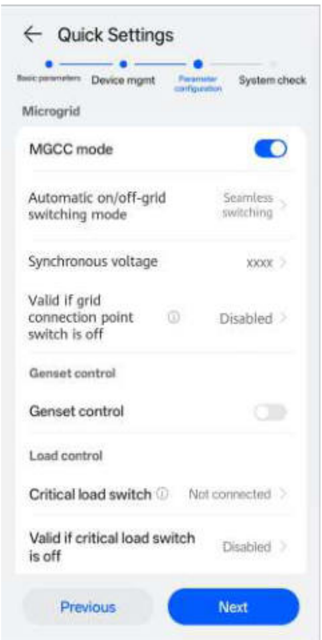


Table 3-26 Microgrid configuration parameters (seamless PV+ESS networking)

<table>
<tr><th>Category</th><th>Parameter</th><th>Description</th></tr>
<tr><td rowspan="4">Microgrid basic settings</td><td>MGCC mode</td><td>Enable this parameter. The microgrid control function is enabled. When the microgrid is off-grid, the SmartEMO function and functions involved in power adjustment and ESS control will be invalid.</td></tr>
<tr><td>Automatic on/off-grid switching mode</td><td>Set the on/off-grid switching mode as required.
Set this parameter to Seamless switchover.</td></tr>
<tr><td>Synchronous voltage</td><td>Specifies the voltage signal source used as the baseline for synchronization determination.
When Wiring mode is set to Three-phase four-wire, you can select Ua, Ub, Uc, Uab, Ubc, Uca, or Uabc. When Wiring mode is set to Three-phase three-wire, you can select only Uab, Ubc, or Uca.
Select an option based on the actual cable connections of the PTs on the power grid side of the grid connection point. If three PTs are configured on the power grid side of the grid connection point, Uabc is recommended.</td></tr>
<tr><td>Valid if grid connection point switch is off</td><td>
Set this parameter based on the actual status of the switch at the grid connection point and the status received by DI4(HV) (recommended)[b] (see in SetComm. parameters > AI/DI/DO). For details about the configuration criteria, see the following table.
<table>
<tr><th>Status of Switch at Grid Connection Point</th><th>Status Received from DI4(HV) (Recommended)[b]</th><th>Parameter Setting</th></tr>
<tr><td rowspan="2">Off</td><td>Off</td><td>Off</td></tr>
<tr><td>On</td><td>On</td></tr>
<tr><td rowspan="2">On</td><td>Off</td><td>On</td></tr>
<tr><td>On</td><td>Off</td></tr>
</table>
System cable connections:
DO4(HV)[a]: turns off the switch at the grid connection point (common port); supports the DC or AC power supply.
DO7(HV): turns on the switch at the grid connection point.
DO8 (HV)[a]: turns off the switch at the grid connection point (fast port); needs to connect to the DC power supply.
DI4(HV) (recommended)[b]: reports the Off state of the switch at the grid connection point and monitors whether the status of the grid connection point is on-grid or off-grid.
</td></tr>
</table>

<table>
<tr><th>Category</th><th>Parameter</th><th>Description</th></tr>
<tr><td>Genset control</td><td>Genset control</td><td>Set this parameter to Disable. When Critical load switch is set to Connected, Genset control is disabled and does not need to be set.</td></tr>
<tr><td rowspan="2">Load control</td><td>Critical load switch</td><td>

Specify whether the critical load switch is connected.
System cable connections:

DI1(HV) (recommended)[b]: reports the Off state of the critical load switch.
DO1(HV): turns on the critical load switch.
DO2(HV): turns off the critical load switch.

</td></tr>
<tr><td>Valid if critical load switch is off</td><td>Set this parameter based on the actual status of the critical load switch and the status received by DI1(HV) (recommended)[b] (see in Set > Comm. parameters > AI/DI/DO). For details about the configuration criteria, see the following table.
<table>
<tr><th>Load Switch Status</th><th>Status Received from DI1(HV) (Recommended)[b]</th><th>Parameter Setting</th></tr>
<tr><td rowspan="2">Off</td><td>Off</td><td>Off</td></tr>
<tr><td>On</td><td>On</td></tr>
<tr><td rowspan="2">On</td><td>Off</td><td>On</td></tr>
<tr><td>On</td><td>Off</td></tr>
</table></td></tr>
<tr><td colspan="3">Note a: You can select either the common port or the fast port for turning off the switch at the grid connection point. The switching time of the fast port is 20 ms, and that of the common port is 60 ms or 150 ms.
Note b: If the default DI port is not available for onsite cable connection, configure the required DI port through Settings > Microgrid Control > General Basic Settings on the SmartMGC WebUI and check the status received by the corresponding DI port.</td></tr>
</table>

Figure 3-39 Microgrid configuration parameters (seamless PV+ESS+genset networking - genset grid forming)

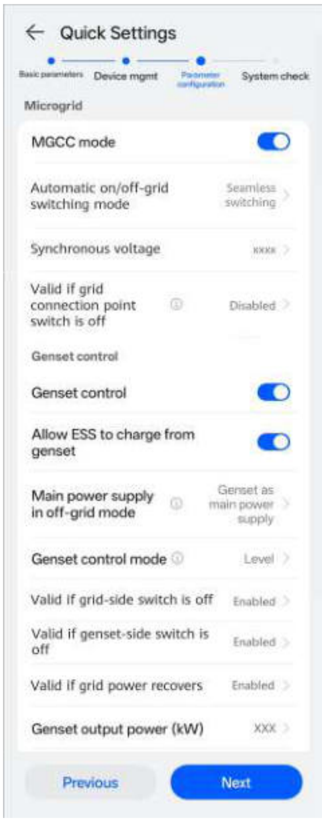


Table 3-27 Microgrid configuration parameters (seamless PV+ESS+genset networking - genset grid forming)

Category	Parameter	Description
Microgrid basic settings	**MGCC mode**	Enable this parameter. The microgrid control function is enabled. When the microgrid is off-grid, the SmartEMO function and functions involved in power adjustment and ESS control will be invalid.
	Automatic on/off-grid switching mode	Set the on/off-grid switching mode as required. Set this parameter to **Seamless switchover**.
	Synchronous voltage	Specifies the voltage signal source used as the baseline for synchronization determination. When **Wiring mode** is set to **Three-phase four-wire**, you can select **Ua**, **Ub**, **Uc**, **Uab**, **Ubc**, **Uca**, or **Uabc**. When **Wiring mode** is set to **Three-phase three-wire**, you can select only **Uab**, **Ubc**, or **Uca**. Select an option based on the actual cable connections of the PTs on the power grid side of the grid connection point. If three PTs are configured on the power grid side of the grid connection point, **Uabc** is recommended.

<table>
<tr><th>Category</th><th>Parameter</th><th>Description</th></tr>
<tr><td></td><td>Valid if grid connection point switch is off</td><td>
Set this parameter based on the actual status of the switch at the grid connection point and the status received by DI4(HV) (recommended)[b] (see in Set > Comm. parameters > AI/DI/DO). For details about the configuration criteria, see the following table.
<table>
<tr><th>Status of Switch at Grid Connection Point</th><th>Status Received from DI4(HV) (Recommended)[b]</th><th>Parameter Setting</th></tr>
<tr><td rowspan="2">Off</td><td>Off</td><td>Off</td></tr>
<tr><td>On</td><td>On</td></tr>
<tr><td rowspan="2">On</td><td>Off</td><td>On</td></tr>
<tr><td>On</td><td>Off</td></tr>
</table>
System cable connections:
DO4(HV)[a]: turns off the switch at the grid connection point (common port); supports the DC or AC power supply.
DO7(HV): turns on the switch at the grid connection point.
DO8 (HV)[a]: turns off the switch at the grid connection point (fast port); needs to connect to the DC power supply.
DI4(HV) (recommended)[b]: reports the Off state of the switch at the grid connection point and monitors whether the grid connection point is on-grid or off-grid.
</td></tr>
<tr><td rowspan="3">Genset control</td><td>Genset control</td><td>Set this parameter to Enable.</td></tr>
<tr><td>Allow ESS to charge from genset</td><td>Specifies whether the ESS can be charged by the genset.
Enable: This mode applies to scenarios where the ESS SOC is low and the estimated off-grid duration is long. The ESS can be charged by the genset.
Disable: This mode applies to scenarios where the ESS has sufficient power or the genset needs to directly supply power to loads preferentially. The ESS cannot be charged by the genset.</td></tr>
<tr><td>Main power supply in off-grid mode</td><td>Set this parameter to Genset main power supply.
Set the grid-forming source of the genset+ESS system in off-grid scenarios. That is, set the primary power supply of the system in off-grid mode. The setting must be consistent with the actual situation. Otherwise, the system will malfunction.
Genset main power supply: The genset is used as the primary power supply.
ESS as main power supply: The ESS is used as the primary power supply. In on/off-grid scenarios, if this parameter is set to ESS as main power supply, a genset meter must be connected.</td></tr>
</table>

<table>
<tr><th>Category</th><th>Parameter</th><th>Description</th></tr>
<tr><td></td><td>Genset control mode</td><td>Set this parameter based on the genset startup/shutdown control mode of the DO5(HV) and DO6(HV) terminals.

Pulse control mode:
DO5(HV): starts the genset.
DO6(HV): shuts down the genset.
Level control mode:
For genset startup control: DO5(HV) is closed (output high level), and DO6(HV) is open (output low level).
For genset shutdown control: DO5(HV) is open (output low level), and DO6(HV) is closed (output high level).
</td></tr>
<tr><td></td><td>Valid if grid-side switch is off</td><td>Set this parameter based on the actual status of the switch on the grid side and the status received by DI1(HV) (recommended)[b] (see in Set > Comm. parameters > AI/DI/DO). For details about the configuration criteria, see the following table.
<table>
<tr><th>Switch Status on the Grid Side</th><th>Status Received from DI1(HV) (Recommended)[b]</th><th>Parameter Setting</th></tr>
<tr><td rowspan="2">Off</td><td>Off</td><td>Off</td></tr>
<tr><td>On</td><td>On</td></tr>
<tr><td rowspan="2">On</td><td>Off</td><td>On</td></tr>
<tr><td>On</td><td>Off</td></tr>
</table>
System cable connection (grid switch Off state feedback): DI1 (HV) (recommended)[b]</td></tr>
<tr><td></td><td>Valid if genset switch is off</td><td>Set this parameter based on the actual status of the genset switch and the status received by DI2(HV) (recommended)[b] (see in Set > Comm. parameters > AI/DI/DO). For details about the configuration criteria, see the following table.
<table>
<tr><th>Genset Switch Status</th><th>Status Received from DI2(HV) (Recommended)[b]</th><th>Parameter Setting</th></tr>
<tr><td rowspan="2">Off</td><td>Off</td><td>Off</td></tr>
<tr><td>On</td><td>On</td></tr>
<tr><td rowspan="2">On</td><td>Off</td><td>On</td></tr>
<tr><td>On</td><td>Off</td></tr>
</table>
System cable connection (genset switch Off state feedback): DI2(HV) (recommended)[b]</td></tr>
</table>

<table>
<tr><th>Category</th><th>Parameter</th><th>Description</th></tr>
<tr><td rowspan="2"></td><td>Valid if grid power recovers</td><td>

Set this parameter based on the actual grid power status and the status received by DI3(HV) (recommended)[b] (see in Set > Comm. parameters > AI/DI/DO). For details about the configuration criteria, see the following table.
<table>
<tr><th>Grid Power Status</th><th>Status Received from DI3(HV) (Recommended)[b]</th><th>Parameter Setting</th></tr>
<tr><td rowspan="2">Grid recovered (mains available)</td><td>Off</td><td>Off</td></tr>
<tr><td>On</td><td>On</td></tr>
<tr><td rowspan="2">Grid not recovered (mains unavailable)</td><td>Off</td><td>On</td></tr>
<tr><td>On</td><td>Off</td></tr>
</table>

System cable connection (grid power recovery state feedback): DI3 (HV) (recommended) [b]

</td></tr>
<tr><td>Genset output power</td><td>Set the output power of the genset.
NOTE
Ensure that the value is the same as the output power on the genset nameplate.</td></tr>
<tr><td colspan="3">Note a: You can select either the common port or the fast port for turning off the switch at the grid connection point. The switching time of the fast port is 20 ms, and that of the common port is 60 ms or 150 ms.
Note b: If the default DI port is not available for onsite cable connection, configure the required DI port through Settings > Microgrid Control > General Basic Settings on the SmartMGC WebUI and check the status received by the corresponding DI port.</td></tr>
</table>

Figure 3-40 Microgrid configuration parameters (seamless PV+ESS+genset networking - genset grid following)

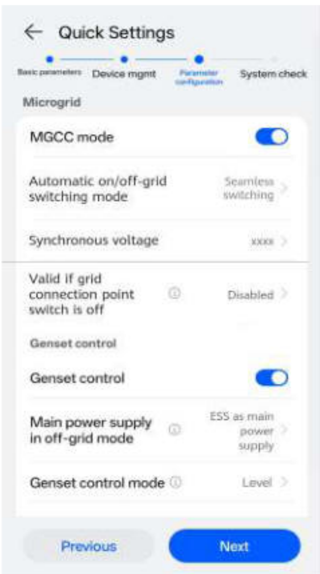


Table 3-28 Microgrid configuration parameters (seamless PV+ESS+genset networking - genset grid following)

<table>
<tr><th>Category</th><th>Parameter</th><th>Description</th></tr>
<tr><td rowspan="4">Microgrid configuration parameters</td><td>MGCC mode</td><td>Enable this parameter. The microgrid control function is enabled. When the microgrid is off-grid, the SmartEMO function and functions involved in power adjustment and ESS control will be invalid.</td></tr>
<tr><td>Automatic on/off-grid switching mode</td><td>Set the on/off-grid switching mode as required.
Set this parameter to Seamless switchover.</td></tr>
<tr><td>Synchronous voltage</td><td>Specifies the voltage signal source used as the baseline for synchronization determination.
When Wiring mode is set to Three-phase four-wire, you can select Ua, Ub, Uc, Uab, Ubc, Uca, or Uabc. When Wiring mode is set to Three-phase three-wire, you can select only Uab, Ubc, or Uca.
Select an option based on the actual cable connections of the PTs on the power grid side of the grid connection point. If three PTs are configured on the power grid side of the grid connection point, Uabc is recommended.</td></tr>
<tr><td>Valid if grid connection point switch is off</td><td>Set this parameter based on the actual status of the switch at the grid connection point and the status received by DI4(HV) (recommended)[b] (see in Set > Comm. parameters > AI/DI/DO). For details about the configuration criteria, see the following table.
<table>
<tr><th>Status of Switch at Grid Connection Point</th><th>Status Received from DI4(HV) (Recommended)[b]</th><th>Parameter Setting</th></tr>
<tr><td rowspan="2">Off</td><td>Off</td><td>Off</td></tr>
<tr><td>On</td><td>On</td></tr>
<tr><td rowspan="2">On</td><td>Off</td><td>On</td></tr>
<tr><td>On</td><td>Off</td></tr>
</table>
System cable connections:

DO4(HV)[a]: turns off the switch at the grid connection point (common port); supports the DC or AC power supply.
DO7(HV): turns on the switch at the grid connection point.
DO8 (HV)[a]: turns off the switch at the grid connection point (fast port); needs to connect to the DC power supply.
DI4(HV) (recommended)[b]: reports the Off state of the switch at the grid connection point and monitors whether the grid connection point is on-grid or off-grid.
</td></tr>
</table>

Category	Parameter	Description
Genset parameters	**Genset control**	Set this parameter to **Enable**.
	Main power supply in off-grid mode	Set this parameter to **ESS as main power supply**. Set the grid-forming source of the genset+ESS system in off-grid scenarios. That is, set the primary power supply of the system in off-grid mode. The setting must be consistent with the actual situation. Otherwise, the system will malfunction. ● **Genset main power supply**: The genset is used as the primary power supply. ● **ESS as main power supply**: The ESS is used as the primary power supply. In on/off-grid scenarios, if this parameter is set to **ESS as main power supply**, a genset meter must be connected.
	Genset control mode	Set this parameter based on the genset startup/shutdown control mode of the DO5(HV) and DO6(HV) terminals. ● **Pulse** control mode: – DO5(HV): starts the genset. – DO6(HV): shuts down the genset. ● **Level** control mode: – For genset startup control: DO5(HV) is closed (output high level), and DO6(HV) is open (output low level). – For genset shutdown control: DO5(HV) is open (output low level), and DO6(HV) is closed (output high level).
	Genset output power	Set the output power of the genset. **NOTE** Ensure that the value is the same as the output power on the genset nameplate.
Note a: You can select either the common port or the fast port for turning off the switch at the grid connection point. The switching time of the fast port is 20 ms, and that of the common port is 60 ms or 150 ms. Note b: If the default DI port is not available for onsite cable connection, configure the required DI port through **Settings** > **Microgrid Control** > **General Basic Settings** on the SmartMGC WebUI and check the status received by the corresponding DI port.		

3.3.2.4 System Check

This function comprehensively diagnoses the system health status, covering network communication, device status, alarm information, software version, and device cable connections. If any exception is detected, rectify the fault as prompted and tap **Check Again** to confirm that the issue has been resolved. You are advised to complete the system check to ensure stable device operation.

Figure 3-41 System check

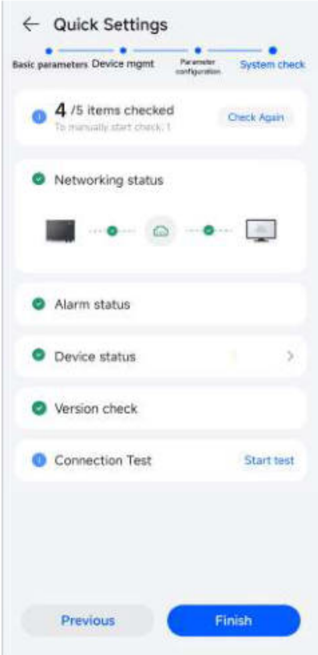


Table 3-29 System check

Check Type	Description	Triggering Method
Networking status	Check whether the management system is successfully connected and whether the mobile network signal is weak	The check is automatically started. You can tap **Check Again** to start the check again.
Alarm status	Check whether an alarm is generated. **NOTE** If an alarm is generated, rectify the fault by referring to **Possible Cause and Suggestion**.	
Device status	Check whether **Running status** is **Faulty**, or **communication status** is **Offline**. **NOTE** If **Offline** or **Offline** is displayed, check the networking connection status and hardware status of the device for exceptions and rectify the fault by referring to **Offline** of the corresponding alarm.	
Version check	Check whether all devices in the device list need to be updated. **NOTE** After the update is complete, you can return to the **System check** screen to continue the deployment. However, if the SmartMGC is restarted during the update, the app will be disconnected from the WLAN of the SmartMGC. As a result, the deployment cannot continue.	

<table>
<tr><th>Check Type</th><th>Description</th><th>Triggering Method</th></tr>
<tr><td>Connection Test</td><td>Check whether the communication between devices is normal, whether the PT/CT cable connection and the A/B/C wire sequences of the PCS AC cables are normal, and identify possible faults. You can identify and rectify faults by viewing rectification suggestions to ensure that the system runs properly.
NOTE
● This function applies only to the C&I Hybrid Cooling Grid Forming ESS and is displayed in the scenario with multiple cabinets.
● For the on-grid operation, connection check is required in the zero feed-in scenario with three-phase imbalance phase-level power control.In the off-grid scenario, ensure that the load has been disconnected and then perform Connection Test.</td><td>Tap Start test to manually start the check. Tap Check Again to start the check again.</td></tr>
</table>

3.3.3 Setting the Output Mode

To ensure the normal operation of the devices, set the output mode of the inverter and ESS correctly based on the actual cable connections. If the settings are inconsistent with the actual cable connections, system alarms may be generated or the dispatch logic may be incorrect.

Procedure

Step 1 Set **Output mode** for the inverter.

Tap **Monitor**, select an inverter, choose **Set** > **Grid parameters**, and set **Output mode** to **Three-phase, four-wire** for the inverter.

Step 2 Set **Output mode** for the ESS.

Tap **Monitor**, select an ESS, choose **Set** > **Power Parameters** > **Grid parameters**, and set **Output mode** to **Three-phase, four-wire** for the ESS.

----End

3.3.4 Function Verification

3.3.4.1 Verifying the Cable Connections for Local Power Sampling

Verifying the cable connections for local power sampling ensures that the SmartMGC correctly samples the power at the grid connection point for stable system operation.

DANGER

- Before operation, ensure that the equipment is intact. Otherwise, electric shocks or fires may occur.
- During operation, wear insulated gloves and use insulated tools to prevent electric shocks or short circuits.
- Non-standard and improper operations may result in fires or electric shocks.
- Prevent foreign matter from entering the equipment during operations. Otherwise, short circuits, equipment damage, load power derating, power failure, or personal injury may occur.

Step 1 Check whether the CT wiring position is correct. The CT must be connected to the metering point where the customer purchases electricity.

If the wiring position is inconsistent with that shown in **Figure 3-42**, modify the CT wiring position.

Figure 3-42 Correct CT wiring position

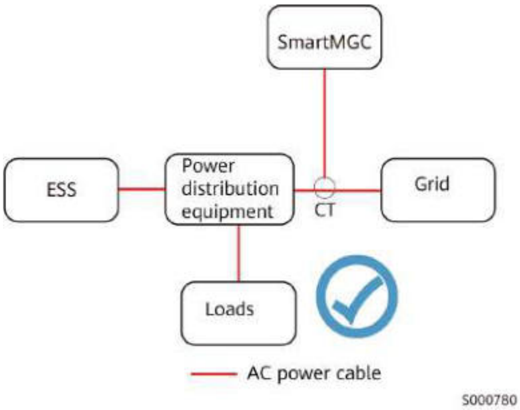
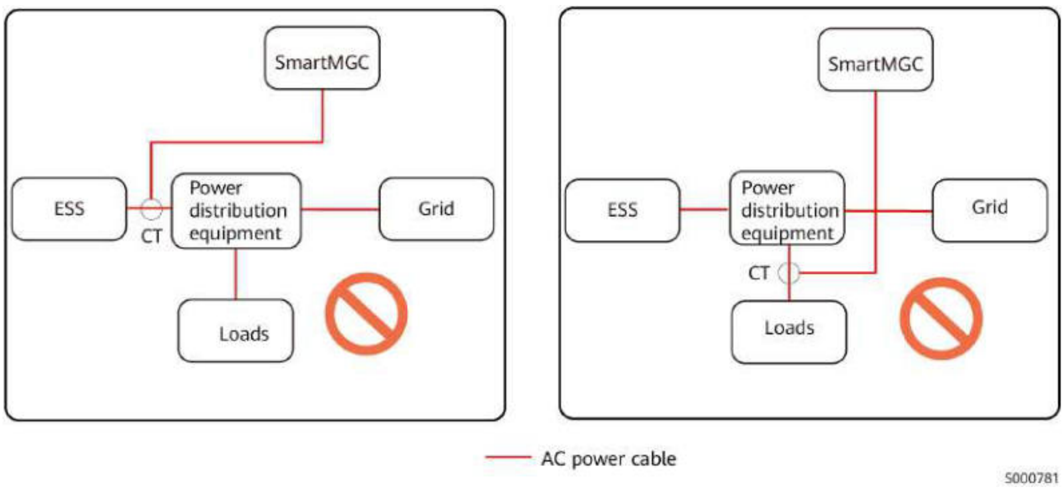


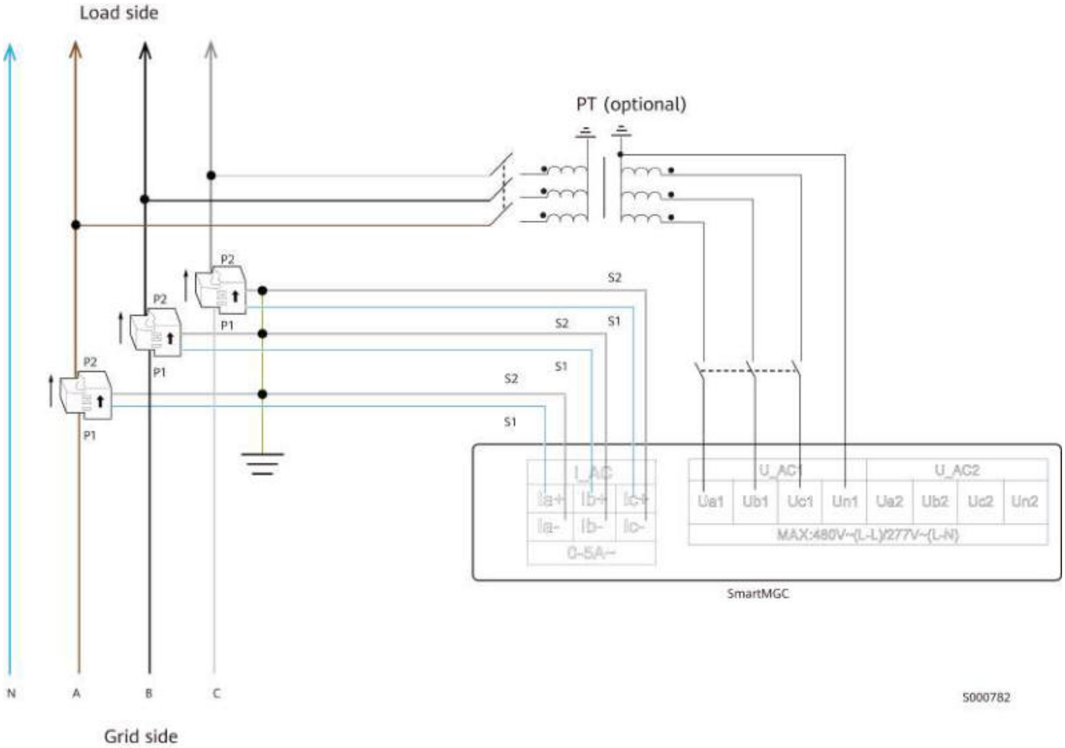
Figure 3-43 Incorrect CT wiring position



Step 2 Check whether the power sampling cable connection is correct. Check the cable connection by referring to **Figure 3-44**. If the cable connection is inconsistent with that shown in the figure, modify the power sampling cable connection.

- Current sampling: The I_AC port shall be connected to the CT. When the CT is connected in the positive direction, the power flows from the grid to loads. The wiring of each phase of the CT shall be consistent with that on the grid side.
- Voltage sampling: The U_AC1 port shall be connected to the PT or used for direct sampling. The wiring of each phase of the PT or direct sampling shall be consistent with that on the grid side.

Figure 3-44 Correct PT/CT wiring



Step 3 Check whether the sampling parameters of the grid connection point are correctly set. Log in to the SmartMGC WebUI, choose **Settings** > **Port Settings** > **PT/CT**, and check the parameter settings.

Table 3-30 CT parameter settings

Parameter	Description
PT/CT sampling	Enable the function of directly sampling the current and voltage at the grid connection point. When used with the CT and PT, it can function as a meter at the grid connection point.
PT/CT cable connection mode	This parameter is displayed when **PT/CT sampling** is set to **Enable**. Set this parameter to **Three-phase three-wire** or **Three-phase four-wire** based on the actual CT and PT wiring.

Parameter	Description
Primary current of CT	The I_AC port is connected to the CT to sample current. Set this parameter based on the actual specifications of the CT. If the current transformation ratio is 400:5: ● Set the primary current of the CT to 400 A. ● Set the secondary current of the CT to 5 A.
Secondary current of CT	
Primary voltage of grid PT	This parameter is displayed when **PT/CT sampling** is enabled. The voltage on the grid side is sampled through the U_AC1 port. ● If PT sampling is unavailable, set the primary and secondary voltages on the grid side based on the actual rated voltage on the grid side. ● If PT sampling is available, set the primary and secondary voltages on the grid side based on the actual specifications of the PT. If the voltage transformation ratio is 10000:100: – Set the primary voltage of the PT to 10000 V. – Set the secondary voltage of the PT to 100 V.
Secondary voltage of grid PT	
Primary voltage of microgrid PT	This parameter is displayed when **PT/CT sampling** is set to **Enable** and **MGCC mode** is set to **Enable**. Voltage is sampled through the U_AC2 port. ● If PT sampling is unavailable, set the primary and secondary voltages on the microgrid side based on the actual rated voltage on the microgrid side. ● If PT sampling is available, set the primary and secondary voltages on the microgrid side based on the actual specifications of the PT.
Secondary voltage of microgrid PT	
CT wiring direction	Set this parameter to **Positive**. The power flows from the grid to loads.

Step 4 Test the power value. Check whether the power value is normal in the scenarios where loads are disconnected and connected.

Disconnecting loads:

1. (Optional) Shut down the inverters. The PV power is 0. If there are inverters in the array, perform this step.

   Choose **Maintenance** > **Device Management** > **Startup/Shutdown** on the SmartMGC WebUI, click **All array inverters** under **Shut Down**, enter the login password, and confirm the shutdown.
2. Disconnect all loads from the system.
3. When the ESS is running in on-grid mode, it is charged at a fixed power.

   Choose **Monitoring** > **ESS** > **Running Parameters** on the SmartMGC WebUI, set **Active power (kW)** under **Power regulation** to 5 kW, and click **Settings**. If there are multiple ESSs in the array, click **Batch Sync**.
4. Check whether the power at the grid connection point is consistent with the ESS charge power.

Table 3-31 Power status diagnosis when loads are disconnected

<table>
<tr><th colspan="2">Symptom</th><th>Status</th><th>Cause</th><th>Suggestion</th></tr>
<tr><td rowspan="2">The active power at the grid connection point is consistent with the ESS charge power.</td><td>CT installed on the grid side</td><td>Normal</td><td>-</td><td>-</td></tr>
<tr><td>CT installed on the ESS side</td><td>Abnormal</td><td>CT installed on the ESS side</td><td>Adjust the CT wiring position to the grid side.</td></tr>
<tr><td rowspan="4">The active power at the grid connection point is inconsistent with the ESS charge power.</td><td>The active power at the grid connection point is not 0. The absolute values of the two are equal, but the polarity signs are opposite.</td><td>Abnormal</td><td>The CT wiring direction is reversed.</td><td>Choose Settings > Port Settings > PT/CT.
Set CT wiring direction to the opposite direction.</td></tr>
<tr><td>The active power at the grid connection point is not 0, and all single-phase power of phases A, B, and C is not 0.</td><td>Abnormal</td><td>● The phase sequence of the PT wiring is inconsistent.
● The CT wiring sequence is inconsistent.
● The primary/ secondary current/ voltage settings of the CT/PT are inconsistent with the actual situation.</td><td>● Check the phase sequence of the PT and CT wiring. Ensure that the phase sequence of the PT and CT wiring is the same.
● Check and modify the CT wiring sequence.
● Modify the settings based on the technical specifications of the CT/PT.</td></tr>
<tr><td>The active power at the grid connection point is 0, and the all single-phase power of phases A, B, and C is 0.</td><td>Abnormal</td><td>CT installed on the load side</td><td>Adjust the CT wiring position to the grid side.</td></tr>
<tr><td>The active power at the grid connection point is 0, and all or some of the single-phase currents of phases A, B, and C are 0.</td><td>Abnormal</td><td>Abnormal CT wiring</td><td>Check the CT wiring.</td></tr>
</table>

Symptom		Status	Cause	Suggestion
	The active power at the grid connection point is 0, and all or some of the voltages of phases A, B, and C are 0.	Abnormal	Abnormal PT wiring	Check the PT wiring.
To view the power at the grid connection point, single-phase currents and active power of phases A, B, and C, and three-phase voltage of phases A, B, and C, choose **Overview** > **Grid Connection Point Info**.				

Connecting loads:

1. (Optional) Shut down the inverters. The PV power is 0. If there are inverters in the array, perform this step.

   Choose **Maintenance** > **Device Management** > **Startup/Shutdown** on the SmartMGC WebUI, click **All array inverters** under **Shut Down**, enter the login password, and confirm the shutdown.
2. Shut down the ESS. The ESS power is 0.

   Choose **Maintenance** > **Device Management** > **Startup/Shutdown** on the SmartMGC WebUI, click **All array ESSs** under **Shut Down**, enter the login password, and confirm the shutdown.
3. Connect loads.
4. Check whether the power at the grid connection point is consistent with the load power.

Table 3-32 Power status diagnosis when loads are connected

Symptom	Status	Cause	Suggestion
The active power at the grid connection point is consistent with the load power.	Normal	-	-
The active power at the grid connection point is 0.	Abnormal	CT installed on the ESS side	Adjust the CT wiring position to the grid side.
To view the power at the grid connection point, choose **Overview** > **Grid Connection Point Info**.			

Step 5 Start the inverters and ESS. Choose **Maintenance** > **Device Management** > **Startup/Shutdown** on the SmartMGC WebUI.

- (Optional) To start the inverters, click **All array inverters** under **Start**, enter the login password, and confirm the startup. If there are inverters in the array, perform this step.

- To start the ESS, click **Start** under **All array ESSs**, enter the login password, and confirm the startup.

----End

3.3.4.2 Verifying the On/Off-Grid Switch

On/Off-grid switch verification is to manually turn on and off a switch to check whether the switch is correctly configured. This operation shall be performed on the WebUI.

DANGER

- Before operation, ensure that the equipment is intact. Otherwise, electric shocks or fires may occur.
- During operation, wear insulated gloves and use insulated tools to prevent electric shocks or short circuits.
- Non-standard and improper operations may result in fires or electric shocks.
- Prevent foreign matter from entering the equipment during operations. Otherwise, short circuits, equipment damage, load power derating, power failure, or personal injury may occur.

Step 1 Log in to the SmartMGC WebUI, choose **Settings** > **Microgrid Control** > **General Basic Settings** > **Microgrid Settings** and set **Automatic on/off-grid switching mode** to **Not controlled**.

Step 2 Choose **Maintenance** > **Device Management** > **Startup/Shutdown**, click **Shut Down**, and click **All array devices** from the drop-down list to shut down the equipment.

Step 3 Check whether the DI4(HV) cable is properly connected for the switch-off status feedback port of the on/off-grid switch.

Manually turn on or off the on/off-grid switch onsite, and choose **Overview** > **Sampling Info** to check whether **DI4 status** changes.

- If the status changes, the DI4(HV) cable is properly connected.
- If the status does not change, check the DI4(HV) cable connection and rectify the fault.

Step 4 Check whether **DI port status if on/off-grid switch is off** is correctly set.

Choose **Settings** > **Microgrid Control** > **Scheduling Control** > **Manual control** and check whether the current **Status of switch at grid connection point** is consistent with the actual status of the on/off-grid switch. If not, modify **DI port status if on/off-grid switch is off** to ensure consistency.

Step 5 Check whether the cable connections are normal for the DO4(HV)/DO8(HV) switch-off control port and DO7(HV) switch-on control port of the on/off-grid switch.

Choose **Settings** > **Microgrid Control** > **Scheduling Control** > **Manual control**, and then click **Off** and **On** of **Status of switch at grid connection point**.

- Click **On**, and then check whether the actual status of the on/off-grid switch is on. If not, check the DO7(HV) cable connection and rectify the fault.
- Click **Off**, and then check whether the actual status of the on/off-grid switch is off. If not, check the DO4(HV)/DO8(HV) cable connection and rectify the fault.

Step 6 Choose **Settings** > **Microgrid Control** > **General Basic Settings** > **Microgrid Settings** and set **Automatic on/off-grid switching mode** to **Seamless switching**.

Step 7 Choose **Maintenance** > **Device Management** > **Startup/Shutdown**, click **Start**, and click **All array devices** from the drop-down list to start the equipment.

----End

3.3.4.3 Genset ATS Function Verification

Check the following parameters only when the genset is connected through the ATS on the mains side. On/Off-grid switch verification is to manually turn on and off a switch to check whether the switch is correctly configured. This operation shall be performed on the WebUI.

DANGER

- Before switch operation, ensure that the equipment is intact. Otherwise, electric shocks or fires may occur.
- During switch operation, wear insulated gloves and use insulated tools to prevent electric shocks or short circuits.
- Non-standard and improper operations may result in fires or electric shocks.
- Prevent foreign matter from entering the equipment during operations. Otherwise, short circuits, equipment damage, load power derating, power failure, or personal injury may occur.

Step 1 Log in to the **SmartMGC** WebUI, choose **Settings** > **Microgrid Control** > **General Basic Settings** > **Microgrid Settings** and set **Automatic on/off-grid switching mode** to **Not controlled**.

Step 2 Choose **Maintenance** > **Device Management** > **Startup/Shutdown**, click **Shut Down**, and click **All array devices** from the drop-down list to shut down the equipment.

Step 3 Check whether the cable connection is normal for the DI1(HV) switch-off feedback port of ATS I on the grid side.

Manually turn on or off ATS I on the grid side onsite, and choose **Overview** > **Sampling Info** to check whether **DI1 status** changes.

- If the status changes, the DI1(HV) cable is properly connected.
- If the status does not change, check the DI1(HV) cable connection and rectify the fault.

Step 4 Check whether **Valid if grid-side switch is off** is correctly set.

Check whether this parameter is correctly set based on the actual status of ATS I on the grid side and the status received by DI1(HV) (see in **Overview** > **Sampling Info**). For details, see **Table 3-33**.

Table 3-33 Parameter description for **Valid if grid-side switch is off**

Switch Status of ATS I on the Grid Side	Status Received by DI1(HV)	Parameter Setting
Off	Open	Open
	Closed	Closed
On	Open	Closed
	Closed	Open

Step 5 Check whether the cable connection is normal for the DI2(HV) switch-off feedback port of ATS II on the genset side.

Manually turn on or off ATS II on the genset side onsite, and choose **Overview** > **Sampling Info** to check whether **DI2 status** changes.

- If the status changes, the DI2(HV) cable is properly connected.
- If the status does not change, check the DI2(HV) cable connection and rectify the fault.

Step 6 Check whether **Valid if genset-side switch is off** is correctly set.

Check whether this parameter is correctly set based on the actual status of ATS II on the genset side and the status received by DI1(HV) (see in **Overview** > **Sampling Info**). For details, see the following table.

Table 3-34 Parameter description for **Valid if genset-side switch is off**

Switch Status of ATS II on the Genset Side	Status Received by DI2(HV)	Parameter Setting
Off	Open	Open
	Closed	Closed
On	Open	Closed
	Closed	Open

Step 7 Check whether the cable connections are normal for the genset startup and shutdown control ports DO5(HV) and DO6(HV).

Choose **Settings** > **Microgrid Control** > **Scheduling Control** > **Manual control**, and then verify the **Start** and **Shut Down** of the genset based on the genset control mode.

When the genset is controlled in pulse mode:

- Click **Start**, and then check whether the actual genset status is started. If not, check the DO5(HV) cable connection and rectify the fault.
- Click **Shut Down**, and then check whether the actual genset status is shutdown. If not, check the DO6(HV) cable connection and rectify the fault.

When the genset is controlled in level mode, with high level for startup, and low level for shutdown:

Click **Start** or **Shut Down**, and then check whether the actual genset status is started or shutdown. If not, check the DO5(HV) cable connection and rectify the fault.

When the genset is controlled in level mode, with low level for startup, and high level for shutdown:

Click **Start** or **Shut Down**, and then check whether the actual genset status is started or shutdown. If not, check the DO6(HV) cable connection and rectify the fault.

Step 8 Choose **Settings** > **Microgrid Control** > **General Basic Settings** > **Microgrid Settings** and set **Automatic on/off-grid switching mode** to **Seamless switching**.

Step 9 Choose **Maintenance** > **Device Management** > **Startup/Shutdown**, click **Start**, and click **All array devices** from the drop-down list to start the equipment.

----End

3.3.4.4 Verifying the On/Off-Grid Switching Function

On/Off-grid switching function verification includes verifying planned and unplanned on/off-grid switching.

- To verify planned on/off-grid switching, click **Switch to on-grid** and **Switch to off-grid** to check whether the on/off-grid switching function is normal.
- To verify unplanned on/off-grid switching, manually turn off the switch on the U_AC1 voltage side of the SmartMGC to check whether the on/off-grid switching function is normal.

Planned On/Off-Grid Switching

Step 1 Log in to the SmartMGC WebUI and choose **Settings** > **Microgrid Control** > **On/Off-Grid Switching**.

Step 2 Verify that the on-grid switching function is normal when the PV+ESS system is started and running in off-grid mode.

1. Click **Switch to on-grid** and check whether **On/Off-grid status** is . If yes, go to **2**. If no, check and rectify the fault based on the alarm information.
2. Choose **Monitoring** > **ESS** > **Running Parameters** and check whether **Working Mode** is **PQ**.
   - If yes, the switching to on-grid mode is successful.
   - If no, the switching to on-grid mode fails. Check and rectify the fault based on the alarm information.

Step 3 Verify that the off-grid switching function is normal when the PV+ESS system is started and running in on-grid mode.

1. Click **Switch to off-grid** and check whether **On/Off-grid status** is . If yes, go to 2. If no, check and rectify the fault based on the alarm information.
2. Choose **Monitoring** > **ESS** > **Running Parameters** and check whether **Working Mode** is **VSG**.
   - If yes, the switching to off-grid mode is successful.
   - If no, the switching to off-grid mode fails. Check and rectify the fault based on the alarm information.

----End

Unplanned On/Off-Grid Switching

NOTICE

Before verifying unplanned on/off-grid switching, choose **Settings** > **Microgrid Control** > **General Basic Settings** > **Microgrid Settings** and set **Seamed on/off-grid switching mode** to **Automatic**.

Step 1 Log in to the SmartMGC WebUI and choose **Settings** > **Microgrid Control** > **On/Off-Grid Switching**.

Step 2 Verify that the on-grid switching function is normal when the PV+ESS system is started and running in off-grid mode.

1. Manually turn on the switch on the U_AC1 voltage side of the SmartMGC and check whether **On/Off-grid status** is . If yes, go to 2. If no, check and rectify the fault based on the alarm information.
2. Choose **Monitoring** > **ESS** > **Running Parameters** and check whether **Working Mode** is **PQ**.
   - If yes, the switching to on-grid mode is successful.
   - If no, the switching to on-grid mode fails. Check and rectify the fault based on the alarm information.

Step 3 Verify that the off-grid switching function is normal when the PV+ESS system is started and running in on-grid mode.

1. Manually turn off the switch on the U_AC1 voltage side of the SmartMGC and check whether **On/Off-grid status** is . If yes, go to 2. If no, check and rectify the fault based on the alarm information.
2. Choose **Monitoring** > **ESS** > **Running Parameters** and check whether **Working Mode** is **VSG**.
   - If yes, the switching to off-grid mode is successful.
   - If no, the switching to off-grid mode fails. Check and rectify the fault based on the alarm information.

----End

3.3.4.5 Verifying Charging and Discharging Functions

NOTICE

Before verifying the charging and discharging functions, verify the cable connections for local power sampling.

Step 1 Log in to the SmartMGC WebUI, shut down the inverters. The PV power to 0. If there are inverters in the array, perform this step.

Choose **Maintenance** > **Device Management** > **Startup/Shutdown**, click **All array inverters** under **Shut Down**, enter the login password, and confirm the shutdown.

Step 2 Verify the discharge function when the ESS is running in on-grid mode.

1. Choose **Settings** > **Grid Connection Control** > **ESS Control**, select **Charge/ Discharge based on grid dispatch**, set **Charge/Discharge time window control** to **Enable**, set all time segments to **Discharge**, and set the discharge power to 10 kW.
2. Choose **Overview** > **Sampling Info** and check whether the active power at the grid connection point is consistent with the discharge power.
   - If the values are consistent, the discharge function is normal.
   - If the values are inconsistent, check and rectify the fault based on the alarm information.

Step 3 Disconnect all loads.

Step 4 Verify the charge function when the ESS is running in on-grid mode.

1. Choose **Settings** > **Grid Connection Control** > **ESS Control**, select **Charge/ Discharge based on grid dispatch**, set **Charge/Discharge time window control** to **Enable**, and set the charge power to 10 kW.
2. Choose **Overview** > **Sampling Info** and check whether the increase in the active power at the grid connection point is consistent with the charge power.
   - If the values are consistent, the charge function is normal.
   - If the values are inconsistent, check and rectify the fault based on the alarm information.

Step 5 Start the inverters. If there are inverters in the array, perform this step.

Choose **Maintenance** > **Device Management** > **Startup/Shutdown**, click **All array inverters** under **Start**, enter the login password, and confirm the startup.

Step 6 Connect loads.

----End

3.4 Connecting to a Plant

After devices are commissioned, you can create a plant and configure basic information on the app to implement unified device monitoring and O&M.

- If the owner does not have a plant in the management system or app, connect to a new plant by referring to **3.4.1 Adding a Plant**.
- If the owner has a plant in the management system or app, connect to the existing plant by referring to **3.4.2 Connecting to an Existing Plant**.
- When a device that supports the registration code is bound to a plant, the device registration code must be verified, ensuring access security.

3.4.1 Adding a Plant

1. If no plant has been created, tap **Add plant**.
2. Tap **Plant Info** and enter the basic plant information.
   - If a plant scheme has been designed on the Design Tool platform before plant deployment, you can tap the corresponding button on the screen to import the basic information about the corresponding plant from the Design Tool.
   - If no plant scheme has ever been designed, enter the basic plant information as prompted.
   - Plant owner: Enter the mobile number or email address of the plant owner to bind the plant to the owner account. (If the owner has not registered an account, the system will automatically send an SMS message or a registration invitation email to the owner after the plant is created.)
3. Tap **Create and Continue**.
4. On the screen for adding devices, view the added devices.
   - If multiple devices need to be connected to the same plant, tap **+** to scan the QR codes of the devices and add the devices one by one.

     NOTE

     The devices to be added must have been commissioned.
   - After the devices are added, tap **Total string capacity** and enter the total string capacity of the plant.
5. Tap **Save and Continue**.
6. Set the feed-in tariff, purchase price, and revenue unit (currency) of the plant as electricity price inputs for revenue calculation.
7. **Complete**.

3.4.2 Connecting to an Existing Plant

1. If a plant has been created, tap **Connect to existing plant**.
2. Select the plant to be bound.
3. Tap **OK** to complete the binding.

3.5 Function Commissioning

3.5.1 Power Dispatch

Limited feed-in, demand limit, capacity limit, and multi-mode overlay take effect only when the system is operating in on-grid mode.

3.5.1.1 Limited Feed-in

Application Scenario

The limited feed-in mode applies to scenarios where the feed-in power at the grid connection point is limited. When the feed-in power is limited to zero, it is the zero export limitation function. Limited feed-in is classified into two control modes:

- Total power limit: The total power at the grid connection point only needs to meet the preset feed-in power limit. The power control of any phase at the grid connection point is not considered.
- Single-phase power limit: In some countries, the on-grid meter measures the power of each phase separately. Therefore, the power of each phase shall be controlled at the grid connection point.

⚠ CAUTION

- Single SmartLogger CT/PT direct sampling: When the power at the grid connection point exceeds the threshold, it takes 300 ms for the SmartMGC to control the power at the grid connection point within the threshold.
- Single SmartLogger with an external meter: When the power at the grid connection point exceeds the threshold, it takes 2s for the SmartMGC to control the power at the grid connection point within the threshold.

Prerequisites

The I_AC/U_AC1 sampling port of the SmartMGC has been correctly connected to the CT/PT (used for the meter at the grid connection point), or the SmartMGC has been correctly connected to the meter, and **Meter usage** has been set to **Feed-in meter**.

Procedure (Method 1: SmartMGC WebUI)

Step 1 Log in to the SmartMGC WebUI and enable the remote power scheduling function for the inverter and PCS.

- Choose **Monitoring** > **PCS** > **Running Parameters** and set **Remote Scheduling** to **Enable**.
- Choose **Monitoring** > **Inverter** > **Running Parameters** and set **Remote Scheduling** to **Enable**.

Step 2 Activate the active power control mode **Limited feed-in**.

1. Choose **Settings** > **Grid Connection Control** > **Active Power**. The **Active power control mode** page is displayed.

2. Select **Limited feed-in** and click **OK**.

   If this option cannot be selected, deselect **Unlimited** and try again.

Step 3 Set **Limited feed-in** parameters.

Table 3-35 Limited feed-in parameters

Category	Parameter	Description
Basic parameter	**Limitation mode**	Specifies the power limiting mode based on the power limiting criteria of the local power grid company. If the power of each phase at the grid connection point is limited, select **Single-phase power**. Otherwise, select **Total power**. ● **Total power**: The total power at the grid connection point is limited. ● **Single-phase power**: The power of each phase at the grid connection point is limited.
	Time-based limit	Specifies whether to set **Time-based limit** to **Enable**. After the parameter is set to **Enable**, you can set different values of **Maximum grid feed-in power** for different time segments. The control priority of **Maximum grid feed-in power** in a time segment configured is higher than that of **Maximum grid feed-in power** in basic parameters. If this parameter is not set to **Enable** or the current time segment is not configured, the system uses **Maximum grid feed-in power** in basic parameters for control.
	Maximum protection time	Specifies the maximum duration from the time when the SmartMGC detects power feed-in to the time when the device output power is adjusted to **Maximum grid feed-in power**. You are advised to set this parameter based on the maximum power feed-in duration allowed by the power grid company. If the maximum power feed-in duration allowed by the power grid company is 2s, set this parameter to 2s.
	Power raising threshold	This parameter is set to prevent the device output power from fluctuating repeatedly near the limit when the load power increases. The recommended value is 1%–2% Pn. Pn indicates the total rated power of the device.

Category	Parameter	Description
	Three-phase imbalance control	This parameter is displayed when **Limitation mode** is set to **Single-phase power**. If the feed-in meter is a three-phase four-wire meter, you can control phase-level power dispatch separately to implement cost-effective dispatch. ● **Enable**: separate control for three phases ● **Disable**: joint control for three phases
	Maximum grid feed-in power	Specifies the maximum power that a device can feed into the power grid. You are advised to set this parameter to 1% of the rated array power. If the value is less than the setting, the power at the grid connection point may fluctuate frequently. The maximum value of this parameter cannot exceed the feed-in power threshold allowed by the power grid company. Value range: ● Maximum value: 60000 ● Minimum value: If **Demand limit** is set to **Active power limit** or **Apparent power limit**, the minimum value is determined by the value of **Maximum Peak Power** (you can view the value after choosing **Settings** > **Grid Connection Control** > **Capacity/Demand Control**).
Time window	**Start and End Time**	This parameter is displayed when **Time-based limit** is set to **Enable**. It specifies the time window for the time-based limit. A maximum of 24 time segments can be set. Set **Maximum grid feed-in power** for different time segments and the time for repetition. The control priority of **Maximum grid feed-in power** in the time segments configured is higher than that of **Maximum grid feed-in power** in basic parameters.
	Maximum grid feed-in power	
	Repeat	

Step 4 (Optional) Set extended parameters for limited feed-in. Set extended parameters if the SmartMGC needs to drive the circuit breaker to prevent power feed-in. If not involved, skip this step.

In some regions, a circuit breaker must be installed at the grid connection point to prevent power feed-in. If power feed-in occurs, the SmartMGC switches off the circuit breaker through the DO port to ensure that the specifications are met.

Table 3-36 Extended parameters

Parameter	Description
Switch control for zero feed-in	Specifies whether to enable the function of switching off the circuit breaker through the DO port by the SmartMGC to prevent power feed-in.
Switch-off control port	Specifies the DO port for controlling switch-off. Click **Off** to verify the function of remotely switching off the circuit breaker by the SmartMGC.
Switch-on control port	Specifies the DO port for controlling switch-on. Click **On** to verify the function of remotely switching on the circuit breaker by the SmartMGC.
Switch-off state feedback port	Specifies the DI port that reports the switch-off state.
Switch-on state feedback port	Specifies the DI port that reports the switch-on state.

Step 5 Click **Inverter/PCS Parameters** in the upper right corner of the page, set inverter or PCS parameters, and synchronize the parameter settings in batches.

Table 3-37 Inverter or PCS parameters

Parameter	Description
Active power change gradient	To ensure that the power can be quickly adjusted to the target in the feed-in control scenario, you need to set this parameter. You are advised to set this parameter to 125%/s. If the upper limit is less than 125%/s, set this parameter to the maximum value.
Soft start time	Specifies the duration for the inverter or PCS output power to gradually increase when the device starts. The inverter or PCS output power increases slowly, reducing the feed-in risk. You are advised to set this parameter to 20s.
Soft start time after grid failure	Specifies the duration for the inverter or PCS output power to gradually increase when the inverter or PCS starts after the grid fault is rectified. The inverter or PCS output power increases slowly, reducing the feed-in risk. You are advised to set this parameter to 20s.

Parameter	Description
Protection upon Communication Failure	In the feed-in control scenario, the inverter or PCS automatically reduces the power to prevent feed-in when the inverter or PCS is disconnected from the SmartMGC. ● **Enable**: The inverter or PCS automatically reduces the power to prevent feed-in when it is disconnected from the SmartMGC. ● **Disable**: Protection upon communication failure is disabled.
Communication disconnection duration	This parameter is displayed when **Protection upon Communication Failure** is set to **Enable**. If communication between the inverter or PCS and the SmartMGC is interrupted beyond the duration specified by this parameter, it is considered as a failure. You are advised to set this parameter to 3s. (For the RD1699 grid code of Spain, you are advised to set this parameter to 2s.)
Active power mode when communication fails	Specifies the active power output mode after the inverter or PCS detects that the communication with the SmartMGC is interrupted. You are advised to set this parameter to **Fixed value**. ● **Fixed value**: The active power is limited by a fixed power value. ● **Percentage**: The active power is limited by a power percentage.
Active power limit when communication fails	Specifies the fixed value or percentage of active power. You are advised to set this parameter to 0.

Step 6 After the parameters are set, click **Submit**.

----End

Procedure (Method 2: SmartMGC Local App)

Step 1 Log in to the SmartMGC local app and enable the **Limited Feed-in** active power control.

1. Choose **Power adjustment** > **Active power** to access the **Active power** screen.
2. Enable **Limited Feed-in**.

Step 2 Set **Limited Feed-in** parameters. For details about how to set the parameters, see **Setting Limited Feed-in Parameters** and **Setting Extended Parameters for Limited Feed-in**.

----End

3.5.1.2 Demand Limit

Application Scenario

Demand limit applies to areas where peak demand charges are collected. It allows you to lower the peak power purchased from the grid during peak hours, thereby reducing electricity fees.

Prerequisites

The I_AC/U_AC1 sampling port of the SmartMGC has been correctly connected to the CT/PT (used for the meter at the grid connection point), or the SmartMGC has been correctly connected to the meter, and **Meter usage** has been set to **Feed-in meter**.

NOTICE

The demand limit function is invalid when the SmartMGC and ESS are being updated.

Procedure

Step 1 Enable the **Demand limit** function and access the **Capacity/Demand Control** page.

- SmartMGC WebUI: Choose **Settings** > **Grid Connection Control** > **Capacity/ Demand Control**.
- SmartMGC local app: Choose **Power adjustment** > **Capacity Control**.

Step 2 Set **Demand limit** to **Active power limit** or **Apparent power limit**.

- **Active power limit**: The active power purchased from the grid cannot exceed the limit.
- **Apparent power limit**: The apparent power purchased from the grid cannot exceed the limit.

Step 3 Set **Demand limit** parameters.

Table 3-38 Demand limit

Parameter	Description
Backup power SOC for capacity/ demand control	The reserved power, which is used for capacity/demand control, ensures that the ESS can meet capacity/demand control requirements. The value of this parameter affects the peak shaving capability. A larger value indicates a stronger peak shaving capability.

Parameter	Description
Allow ESS discharge to meet demand in TOU charge period	● **Enable**: When the ESS control mode is set to **TOU (Time-of-use Pricing)**, the ESS is allowed to discharge during the charging period to meet the system demand. ● **Disable**: The function is disabled.
Dynamic demand calculation	This parameter is displayed when **Demand limit** is set to **Active power limit**. ● **Enable**: The peak demand power is dynamically calculated based on **Demand calculation method**. ● **Disable**: The function is disabled.
Demand calculation method	This parameter is displayed when **Demand limit** is set to **Active power limit**. ● **15-min sliding window/30-min sliding window**: The average power of each minute in the time segment (15 min or 30 min) is recorded, and the sum of the average values in the time segment is divided by 15 (when 15 min is set) or 30 (when 30 min is set) to determine the demand power in the time segment. The demand power in all time segments is calculated and recorded in this way, and the highest value in the current month is used as the demand power of the current month. ● **15-min average/30-min average**: A period (one month) is divided into multiple time segments (15 min or 30 min), and the average power in each time segment is calculated.
Start and End Time	Specifies the maximum peak power of the grid connection point in different time segments. A maximum of 14 time segments can be set for the maximum peak power. The time segments cannot overlap. 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.
Maximum Peak Power	
Repeat	Specifies the repeat execution time for configuration items.

Step 4 After the parameters are set, click **Submit**.

----End

3.5.1.3 Capacity Limit

Application Scenario

Capacity Limit applies to scenarios where the transformer or switch capacity at the grid connection point is limited. By limiting the maximum peak current at the grid connection point, this function prevents the current of electricity purchased from or sold to the grid from exceeding the device capacity, thereby preventing the transformer or switch from being damaged due to overload. This function ensures that the system runs stably within the safe capacity range.

CAUTION

- Single SmartLogger CT/PT direct sampling: When the capacity at the grid connection point exceeds the threshold, it takes 300 ms for the SmartMGC to control the capacity at the grid connection point within the threshold. Ensure that the settings match the onsite protection devices and switches at the grid connection point.
- Single SmartLogger with an external meter: When the capacity at the grid connection point exceeds the threshold, it takes 2s for the SmartMGC to control the capacity at the grid connection point within the threshold. Ensure that the settings match the onsite protection devices and switches at the grid connection point.
- The capacity limit function applies only to the active power. If the load generates a large amount of reactive power, you are advised to enable **Power factor closed-loop control** for the reactive power.

Prerequisites

The I_AC/U_AC1 sampling port of the SmartMGC has been correctly connected to the CT/PT (used for the meter at the grid connection point), or the SmartMGC has been correctly connected to the meter.

NOTICE

- The capacity limit function is invalid when the SmartMGC and ESS are being updated.
- The overload capability of transformers, power distribution switches, and cables must be greater than the sum of the maximum charge current and maximum load current of the ESS.
- If the capacity limit is met 24 hours a day, the ratio of the ESS capacity to the load power must be properly set to ensure that the ESS has sufficient capacity to meet the capacity limit.
- When the capacity limit function is enabled in **TOU (Time-of-use Pricing)** mode, the charge/discharge time set in **TOU (Time-of-use Pricing)** mode must cover 24 hours of a day. Capacity limit is not supported in non-charge/discharge time.

Procedure (Method 1: SmartMGC WebUI)

Step 1 Log in to the SmartMGC WebUI and enable the **Capacity limit** function.

1. Choose **Settings** > **Grid Connection Control** > **Capacity/Demand Control**. The **Capacity/Demand Control** page is displayed.

2. Set **Capacity limit** to **Current limit**.

Step 2 Set **Capacity limit** parameters.

Table 3-39 Capacity limit

Parameter	Description
Maximum feed-in current	Set this parameter based on the maximum peak current in the feed-in direction of the grid connection point.
Maximum current from grid	Set this parameter based on the maximum peak current in the power purchase direction of the grid connection point.
Shut down if feed-in current exceeds threshold	• **Enable**: The array will be forcibly shut down for 4 hours if the feed-in current exceeds the threshold. It is recommended that you use this function under the UK G100 regulations and configure relevant inverter/PCS parameters by referring to **Step 3**. If the array shuts down due to this function, you need to manually start it after waiting for at least 4 hours. • **Disable**: The function is disabled.
Backup power SOC for capacity/demand control	The reserved power, which is used for capacity/demand control, ensures that the ESS can meet capacity/ demand control requirements. The value of this parameter affects the peak shaving capability. A larger value indicates a stronger peak shaving capability.
Allow ESS discharge to meet demand in TOU charge period	When **Capacity limit** is enabled, this parameter is automatically set to **Enable**. • **Enable**: When the ESS control mode is set to **TOU (Time-of-use Pricing)**, the ESS is allowed to discharge during the charging period to meet the system demand. • **Disable**: The function is disabled.

Step 3 (Optional) Set inverter or PCS parameters and synchronize the parameter settings in batches.

Inverter/PCS Parameters needs to be set only under the UK G100 regulations. If not involved, skip this step.

Table 3-40 Inverter or PCS parameters

Parameter	Description
Active power change gradient	To ensure that the power can be quickly adjusted to the target in the feed-in control scenario, you need to set this parameter. You are advised to set this parameter to 125%/s. If the upper limit is less than 125%/s, set this parameter to the maximum value.
Soft start time	Specifies the duration for the inverter or PCS output power to gradually increase when the device starts. The inverter or PCS output power increases slowly, reducing the feed-in risk. You are advised to set this parameter to 20s.
Soft start time after grid failure	Specifies the duration for the inverter or PCS output power to gradually increase when the inverter or PCS starts after the grid fault is rectified. The inverter or PCS output power increases slowly, reducing the feed-in risk. You are advised to set this parameter to 20s.
Protection upon Communication Failure	In the feed-in control scenario, the inverter or PCS automatically reduces the power to prevent feed-in when the inverter or PCS is disconnected from the SmartMGC. ● **Enable**: The inverter or PCS automatically reduces the power to prevent feed-in when it is disconnected from the SmartMGC. ● **Disable**: Protection upon communication failure is disabled.
Communication disconnection duration	This parameter is displayed when **Protection upon Communication Failure** is set to **Enable**. If communication between the inverter or PCS and the SmartMGC is interrupted beyond the duration specified by this parameter, it is considered as a failure. You are advised to set this parameter to 3s. (For the RD1699 grid code of Spain, you are advised to set this parameter to 2s.)
Active power mode when communication fails	Specifies the active power output mode after the inverter or PCS detects that the communication with the SmartMGC is interrupted. You are advised to set this parameter to **Fixed value**. ● **Fixed value**: The active power is limited by a fixed power value. ● **Percentage**: The active power is limited by a power percentage.
Active power limit when communication fails	Specifies the fixed value or percentage of active power. You are advised to set this parameter to 0.

Step 4 After the parameters are set, click **Submit**.

----End

Procedure (Method 2: SmartMGC Local App)

Step 1 Log in to the SmartMGC local app and enable the **Capacity Limit** function.

1. Choose **Power adjustment** > **Capacity Control** to access the **Capacity/ Demand Control** screen.
2. Set **Capacity Limit** to **Current limit**.

   Current limit: The current of electricity purchased from or sold to the grid cannot exceed the preset current limit.

Step 2 Set **Capacity Limit** parameters. For details about how to set the parameters, see **Setting Capacity Limit Parameters**.

Step 3 After the parameters are set, tap **Submit**.

----End

3.5.1.4 Multi-mode Overlay

In the multi-mode overlay scenario, the mode related to the grid connection point limit has the highest priority. If multiple grid connection point limit functions are applied at the same time, the minimum value is used as the upper limit and the maximum value is used as the lower limit.

Example:

Assume that the TOU (fixed power) and limited feed-in modes are applied at the same time:

- TOU (fixed power) discharge power: 50 kW
- Limited feed-in power at the grid connection point: 20 kW
- Load power: 25 kW

According to the principle of taking the smaller value as the upper limit, the upper limit of the system discharge power is min(50 kW, (20 kW + 25 kW)) = 45 kW. This ensures that the system operates optimally while meeting the power limit at the grid connection point.

Table 3-41 Multi-mode overlay

Mode	Limited Feed-in	Capacity Limit	Demand Limit	Max. Self-Consumption	TOU	TOU (Fixed Power)	Charge/Discharge Based on Grid Dispatch[a]
Limited feed-in	-	Supported	Supported	Supported	Supported	Supported	Partially supported

Mode	Limited Feed-in	Capacity Limit	Demand Limit	Max. Self-Consumption	TOU	TOU (Fixed Power)	Charge/Discharge Based on Grid Dispatch[a]
Capacity limit	Supported	-	Supported	Supported	Supported	Supported	Partially supported
Demand limit	Supported	Supported	-	Supported	Supported	Supported	Partially supported
Max. self-consumption	Supported	Supported	Supported	-	Supported	Supported	Supported
TOU	Supported	Supported	Supported	Supported	-	-	Supported
TOU (fixed power)	Supported	Supported	Supported	Supported	-	-	Supported
Charge/Discharge based on grid dispatch[a]	Partially supported	Partially supported	Partially supported	Supported	Supported	Supported	-
Note a: In this version, charge/discharge based on grid dispatch supports the combination with limited feed-in, capacity limit, and demand limit only in the PV+ESS collaboration scenario. In the PV+ESS independent scenario, charge/discharge based on grid dispatch cannot be combined with the preceding modes.							

Scenario 1: TOU + Maximum Self-Consumption

This combination applies to PV+ESS and ESS-only systems in scenarios with price differences between peak and off-peak hours and equipped with a feed-in meter. There is no restriction on the charge/discharge power of the ESS.

Step 1 Set the ESS working mode.

- SmartMGC WebUI: Choose **Settings** > **Grid Connection Control** > **ESS Control** and set **Working Mode** to **TOU (Time-of-use Pricing)**.
- SmartMGC local app: Choose **Power adjustment** > **BatterySetting** and set **Working mode settings** to **TOU (Time-of-Use)**.

Step 2 Enable **Max. self-consumption**.

Set **Max. self-consumption** to **Enable** and set related parameters.

Table 3-42 Related parameters

Parameter	Description
Max. self-consumption	Set this parameter to **Enable** if **Max. self-consumption** needs to be combined. ● **Enable**: The maximum self-consumption function is enabled. When the PV power is greater than the load power, the surplus PV power is charged to the ESS. After the charge power reaches the maximum value or the ESS is fully charged, the surplus PV power is fed to the grid. ● **Disable**: The maximum self-consumption function is disabled. When the PV power is greater than the load power, the surplus PV power is preferentially fed to the grid. After the feed-in power reaches the maximum value, the surplus PV power is charged to the ESS.
Maximum charge power from AC	Specifies the maximum power at which the grid charges the ESS. The value is determined by the local power grid company. If there is no requirement, the value is the maximum charge power of the ESS by default.
Maximum grid power during battery discharge	The default value 0 W is recommended. Adjust the ESS discharge power based on the preset threshold in the ESS discharge scenario. ● When the power purchased from the grid exceeds the preset threshold, the ESS starts discharging and adjusts the discharge power. ● When the power purchased from the grid is less than or equal to the preset threshold, the ESS continues to execute the previous dispatch command. For example, if this parameter is set to 0.05 kW and the adjustment deadband is 0 W: ● If the PV output power is 30 kW and the load power is 30 kW, no power is purchased from the grid and the ESS does not discharge energy. ● If the PV output power is 30 kW and the load power is 30.04 kW, 0.04 kW power is purchased from the grid and the ESS discharges 0 kW of energy. ● If the PV output power is 30 kW and the load power is 30.06 kW, 0.05 kW power is purchased from the grid and the ESS discharges 0.01 kW of energy.

Parameter	Description
Adjustment deadband	The default value 0 W is recommended. Set the precision of the ESS discharge power in the ESS discharge scenario. ● If the actual power purchase threshold of the grid connection point is within the range, the ESS executes the previous dispatch command. ● If the actual power purchase threshold of the grid connection point is not within the range, the ESS discharges energy.
Adaptive adjustment parameters	● **Enable**: The ESS performs adaptive adjustment. ● **Disable**: The ESS adjusts the power based on **ESS control adjustment interval** and **PV power adjustment step**.
ESS control adjustment interval	This parameter is displayed when **Adaptive adjustment parameters** is set to **Disable**. Specifies the ESS adjustment interval.
PV power adjustment step	This parameter is displayed when **Adaptive adjustment parameters** is set to **Disable**. Specifies the step for ESS adjustment.
Start and End Time	Specifies the start time and end time of charge/discharge. A maximum of 14 time segments can be set. The time segments cannot overlap. ● **Discharge**: The ESS is allowed to discharge energy to loads, but cannot feed energy to the grid. ● **Charge**: ESS charge is allowed.
Charge/Discharge	
Interval	

----End

Scenario 2: TOU (Fixed Power) + Max. Self-Consumption

This combination applies to ESS-only or PV+ESS systems in scenarios with a large price difference between peak and off-peak hours. The ESS needs to be charged and discharged at a fixed power, and there are restrictions on the charge/discharge power of the ESS.

Step 1 Set the ESS working mode.

- SmartMGC WebUI: Choose **Settings** > **Grid Connection Control** > **ESS Control** and set **Working Mode** to **TOU (fixed power)**.
- SmartMGC local app: Choose **Power adjustment** > **BatterySetting** and set **Working mode settings** to **TOU (Fixed power)**.

Step 2 Enable **Max. self-consumption**.

Set **Max. self-consumption** to **Enable** and set related parameters.

Table 3-43 Related parameters

Parameter	Description
Max. self-consumption	This parameter is displayed when **PT/CT sampling** is set to **Enable** or when a feed-in meter is connected. Set this parameter to **Enable** when both **TOU (fixed power)** and **Max. self-consumption** are chosen. ● **Enable**: The maximum self-consumption function is enabled. When the PV power is greater than the load power, the surplus PV power is charged to the ESS. After the charge power reaches the maximum value or the ESS is fully charged, the surplus PV power is fed to the grid. ● **Disable**: The maximum self-consumption function is disabled. When the PV power is greater than the load power, the surplus PV power is preferentially fed to the grid. Once the feed-in power reaches the maximum value, the surplus PV power is charged to the ESS (the charge power does not exceed the value set in **Charge/Discharge Power**.)
Maximum grid power during battery discharge	The default value 0 W is recommended. Adjust the ESS discharge power based on the preset threshold in the ESS discharge scenario. ● When the power purchased from the grid exceeds the preset threshold, the ESS starts discharging and adjusts the discharge power. ● When the power purchased from the grid is less than or equal to the preset threshold, the ESS continues to execute the previous dispatch command. For example, if this parameter is set to 0.05 kW and the adjustment deadband is 0 W: ● If the PV output power is 30 kW and the load power is 30 kW, no power is purchased from the grid and the ESS does not discharge energy. ● If the PV output power is 30 kW and the load power is 30.04 kW, 0.04 kW power is purchased from the grid and the ESS discharges 0 kW of energy. ● If the PV output power is 30 kW and the load power is 30.06 kW, 0.05 kW power is purchased from the grid and the ESS discharges 0.01 kW of energy.

Parameter	Description
Adjustment deadband	The default value 0 W is recommended. Set the precision of the ESS discharge power in the ESS discharge scenario. ● If the actual power purchase threshold of the grid connection point is within the range, the ESS executes the previous dispatch command. ● If the actual power purchase threshold of the grid connection point is not within the range, the ESS discharges energy.
Adaptive adjustment parameters	● **Enable**: The ESS performs adaptive adjustment. ● **Disable**: The ESS adjusts the power based on **ESS control adjustment interval** and **PV power adjustment step**.
ESS control adjustment interval	This parameter is displayed when **Adaptive adjustment parameters** is set to **Disable**. Specifies the ESS adjustment interval.
PV power adjustment step	This parameter is displayed when **Adaptive adjustment parameters** is set to **Disable**. Specifies the step for ESS adjustment.
Start and End Time	Specifies the start time and end time of charge/discharge. A maximum of 14 time segments can be set. The time segments cannot overlap. ● **Discharge**: The ESS is allowed to discharge energy to loads, but cannot feed energy to the grid. ● **Charge**: ESS charge is allowed.
Charge/Discharge	
Interval	

----End

Scenario 3: TOU + Max. Self-Consumption + Demand Limit

This combination applies to PV+ESS and ESS-only systems in scenarios with price differences between peak and off-peak hours, equipped with a feed-in meter, and with peak demand charges. It further enhances the system's cost-effectiveness and operational flexibility.

Step 1 Set the ESS working mode.

- SmartMGC WebUI: Choose **Settings** > **Grid Connection Control** > **ESS Control** and set **Working Mode** to **TOU (Time-of-use Pricing)**.
- SmartMGC local app: Choose **Power adjustment** > **BatterySetting** and set **Working mode settings** to **TOU (Time-of-Use)**.

Step 2 Enable **Max. self-consumption**.

Set **Max. self-consumption** to **Enable** and set related parameters.

Table 3-44 Related parameters

Parameter	Description
Max. self-consumption	Set this parameter to **Enable** if **Max. self-consumption** needs to be combined. • **Enable**: The maximum self-consumption function is enabled. When the PV power is greater than the load power, the surplus PV power is charged to the ESS. After the charge power reaches the maximum value or the ESS is fully charged, the surplus PV power is fed to the grid. • **Disable**: The maximum self-consumption function is disabled. When the PV power is greater than the load power, the surplus PV power is preferentially fed to the grid. After the feed-in power reaches the maximum value, the surplus PV power is charged to the ESS.
Maximum charge power from AC	Specifies the maximum power at which the grid charges the ESS. The value is determined by the local power grid company. If there is no requirement, the value is the maximum charge power of the ESS by default.
Maximum grid power during battery discharge	The default value 0 W is recommended. Adjust the ESS discharge power based on the preset threshold in the ESS discharge scenario. • When the power purchased from the grid exceeds the preset threshold, the ESS starts discharging and adjusts the discharge power. • When the power purchased from the grid is less than or equal to the preset threshold, the ESS continues to execute the previous dispatch command. For example, if this parameter is set to 0.05 kW and the adjustment deadband is 0 W: • If the PV output power is 30 kW and the load power is 30 kW, no power is purchased from the grid and the ESS does not discharge energy. • If the PV output power is 30 kW and the load power is 30.04 kW, 0.04 kW power is purchased from the grid and the ESS discharges 0 kW of energy. • If the PV output power is 30 kW and the load power is 30.06 kW, 0.05 kW power is purchased from the grid and the ESS discharges 0.01 kW of energy.

Parameter	Description
Adjustment deadband	The default value 0 W is recommended. Set the precision of the ESS discharge power in the ESS discharge scenario. ● If the actual power purchase threshold of the grid connection point is within the range, the ESS executes the previous dispatch command. ● If the actual power purchase threshold of the grid connection point is not within the range, the ESS discharges energy.
Adaptive adjustment parameters	● **Enable**: The ESS performs adaptive adjustment. ● **Disable**: The ESS adjusts the power based on **ESS control adjustment interval** and **PV power adjustment step**.
ESS control adjustment interval	This parameter is displayed when **Adaptive adjustment parameters** is set to **Disable**. Specifies the ESS adjustment interval.
PV power adjustment step	This parameter is displayed when **Adaptive adjustment parameters** is set to **Disable**. Specifies the step for ESS adjustment.
Start and End Time	Specifies the start time and end time of charge/discharge. A maximum of 14 time segments can be set. The time segments cannot overlap. ● **Discharge**: The ESS is allowed to discharge energy to loads, but cannot feed energy to the grid. ● **Charge**: ESS charge is allowed.
Charge/Discharge	
Interval	

Step 3 Set demand limit parameters.

- SmartMGC Web: Choose **Settings** > **Grid Connection Control** > **Capacity/Demand Control**. For details about how to set other parameters, see **Demand Limit**.
- SmartMGC local app: Choose **Power Adjustment** > **Demand Limit**. For details about how to set other parameters, see **Demand Limit**.

----End

Scenario 4: TOU + Max. Self-Consumption + Capacity Limit + Limited Feed-in

This combination applies to PV+ESS and ESS-only systems in the capacity expansion scenario with price differences between peak and off-peak hours and equipped with a feed-in meter. The "energy storage+power distribution" mode flexibly provides energy and power support to meet new load requirements on the user side, resolve line and device bottlenecks, and indirectly improve the transformer capacity and line transmission capability.

Step 1 Set the ESS working mode.

- SmartMGC WebUI: Choose **Settings** > **Grid Connection Control** > **ESS Control** and set **Working Mode** to **TOU (Time-of-use Pricing)**.
- SmartMGC local app: Choose **Power Adjustment** > **Energy Storage Settings** and set **Working mode** to **TOU (time-of-use)**.

Step 2 Enable **Max. self-consumption**.

Set **Max. self-consumption** to **Enable** and set related parameters.

Table 3-45 Related parameters

Parameter	Description
Max. self-consumption	Set this parameter to **Enable** if **Max. self-consumption** needs to be combined. ● **Enable**: The maximum self-consumption function is enabled. When the PV power is greater than the load power, the surplus PV power is charged to the ESS. After the charge power reaches the maximum value or the ESS is fully charged, the surplus PV power is fed to the grid. ● **Disable**: The maximum self-consumption function is disabled. When the PV power is greater than the load power, the surplus PV power is preferentially fed to the grid. After the feed-in power reaches the maximum value, the surplus PV power is charged to the ESS.
Maximum charge power from AC	Specifies the maximum power at which the grid charges the ESS. The value is determined by the local power grid company. If there is no requirement, the value is the maximum charge power of the ESS by default.

Parameter	Description
Maximum grid power during battery discharge	The default value 0 W is recommended. Adjust the ESS discharge power based on the preset threshold in the ESS discharge scenario. ● When the power purchased from the grid exceeds the preset threshold, the ESS starts discharging and adjusts the discharge power. ● When the power purchased from the grid is less than or equal to the preset threshold, the ESS continues to execute the previous dispatch command. For example, if this parameter is set to 0.05 kW and the adjustment deadband is 0 W: ● If the PV output power is 30 kW and the load power is 30 kW, no power is purchased from the grid and the ESS does not discharge energy. ● If the PV output power is 30 kW and the load power is 30.04 kW, 0.04 kW power is purchased from the grid and the ESS discharges 0 kW of energy. ● If the PV output power is 30 kW and the load power is 30.06 kW, 0.05 kW power is purchased from the grid and the ESS discharges 0.01 kW of energy.
Adjustment deadband	The default value 0 W is recommended. Set the precision of the ESS discharge power in the ESS discharge scenario. ● If the actual power purchase threshold of the grid connection point is within the range, the ESS executes the previous dispatch command. ● If the actual power purchase threshold of the grid connection point is not within the range, the ESS discharges energy.
Adaptive adjustment parameters	● **Enable**: The ESS performs adaptive adjustment. ● **Disable**: The ESS adjusts the power based on **ESS control adjustment interval** and **PV power adjustment step**.
ESS control adjustment interval	This parameter is displayed when **Adaptive adjustment parameters** is set to **Disable**. Specifies the ESS adjustment interval.
PV power adjustment step	This parameter is displayed when **Adaptive adjustment parameters** is set to **Disable**. Specifies the step for ESS adjustment.

Parameter	Description
Start and End Time	Specifies the start time and end time of charge/ discharge. A maximum of 14 time segments can be set. The time segments cannot overlap. ● **Discharge**: The ESS is allowed to discharge energy to loads, but cannot feed energy to the grid. ● **Charge**: ESS charge is allowed.
Charge/Discharge	
Interval	

Step 3 Enable **Capacity limit**.

- SmartMGC WebUI: Choose **Settings** > **Grid Connection Control** > **Capacity/ Demand Control**. For details about how to set other parameters, see **Capacity Limit**.
- SmartMGC local app: Choose **Power adjustment** > **Capacity Control**. For details about how to set other parameters, see **Capacity Limit**.

Step 4 Enable limited feed-in.

- SmartMGC WebUI:
  a. Choose **Settings** > **Grid Connection Control** > **Active Power**. The **Active power control mode** page is displayed.
  b. Select **Limited feed-in** and click **OK**.
  c. If this option cannot be selected, deselect **Unlimited** and try again.
  d. For details about how to set other parameters, see **Limited Feed-in**.
- SmartMGC local app:
  a. Choose **Power adjustment** > **Active power** to access the **Active power** screen.
  b. Set **Limited Feed-in** to **Enable**.
  c. For details about how to set other parameters, see **Limited Feed-in**.

----End

3.5.1.5 Off-Grid Power Backup

Application Scenario

Off-grid power backup applies to the on/off-grid switching scenario. When the primary power supply is interrupted, the ESS shall immediately provide backup power to ensure the normal operation of lighting, air conditioners, and office equipment in key production lines or commercial places with automated equipment.

Prerequisites

The working mode of the ESS has been set to **Max. self-consumption**, **TOU (Time-of-use Pricing)**, or **TOU (fixed power)**. The off-grid power backup function has a higher priority than the ESS working mode.

Procedure

Step 1 Enable the off-grid power backup function.

- SmartMGC WebUI: Choose **Settings** > **Microgrid Control** > **Scheduling Control**, set **Off-grid power backup** to **Enable**, and set **Prioritize off-grid power backup** to **Enable**.
- SmartMGC local app: Choose **Set** > **Microgrid Parameters** > **Scheduling Control**, set **Off-grid power backup** to **Enable**, and set **Prioritize off-grid power backup** to **Enable**.

Step 2 Set other related parameters.

Table 3-46 Off-grid power backup

Parameter	Description	Remarks
Off-grid power backup	Set this parameter to **Enable**. When the SOC is less than or equal to **Min. SOC for off-grid power backup**, the ESS stops discharging to maintain sufficient power for off-grid operation.	-
Min. SOC for off-grid power backup	If the grid fails, the system switches from on-grid mode to off-grid mode. If you want to ensure sufficient backup power in off-grid scenarios, you need to set **Min. SOC for off-grid power backup**. **Min. SOC for off-grid power backup** ensures that the ESS always reserves energy when it works in on-grid mode. A large value of **Min. SOC for off-grid power backup** affects the economic benefits in on-grid scenarios.	This parameter is displayed when **Off-grid power backup** is set to **Enable**.
Prioritize off-grid power backup	Set this parameter to **Enable**. If the ESS SOC is less than or equal to the min. SOC for off-grid power backup minus 3%, the ESS is preferentially charged from the PV power or grid power.	
Draw power from grid for off-grid power backup	Specifies whether to obtain power from the grid for off-grid power backup.	This parameter is displayed when **Prioritize off-grid power backup** is set to **Enable**.

Parameter	Description	Remarks
Charge power for off-grid power backup	Specifies the power for charging the ESS by the grid for off-grid power backup. If the ESS working mode is set to **TOU (Time-of-use Pricing)** and **Draw power from grid for off-grid power backup** is triggered, this parameter instead of **Maximum charge power from AC** determines the grid power charged to the ESS. You are advised to set this parameter to the same value as **Maximum charge power from AC**.	This parameter is displayed when **Draw power from grid for off-grid power backup** is set to **Enable**.

----End

3.5.2 Third-Party EMS Connection

SmartMGC can connect to a third-party EMS over IEC 104, GOOSE, or Modbus. Select one based on the protocols supported by the third-party EMS.

3.5.2.1 IEC 104 Protocol

When the SmartMGC connects to a third-party management system over IEC 104, IEC 104 communication parameters must be set on the SmartMGC WebUI. The third-party management system receives array information through teleindication and telemetry.

Prerequisites

Download the latest software version document from the **FusionSolar Software Download Center**, decompress the document, and view the **IEC 104 Forwarding Protocol Interface Description** file. Search for the corresponding device model in the file, and check the telemetry, teleindication, telecontrol, and teleadjust signal quantity of the corresponding device model.

For example, to obtain the telemetry signal quantity of the SmartMGC, perform the following steps:

1. In **IEC 104 Forwarding Protocol Interface Description**, open the corresponding SmartMGC sheet based on the device model.
2. Collect statistics on and record the total number of signal names under **Telemetry**. The data is the telemetry signal quantity of the SmartMGC of this model.

Procedure

Step 1 Choose **Settings** > **Communications protocol** > **IEC104** and select **Custom Service** or **General Service** based on the mode of connecting to the third-party management system.

- **Custom Service**: Select **Custom Service** when the SmartMGC connects to the management system with a specified IP address (whitelist mode).

- **General Service**: Select **General Service** when the SmartMGC connects to the management system with a non-specified IP address (non-whitelist mode).

Step 2 Set basic IEC 104 parameters.

Figure 3-45 Setting IEC 104 parameters

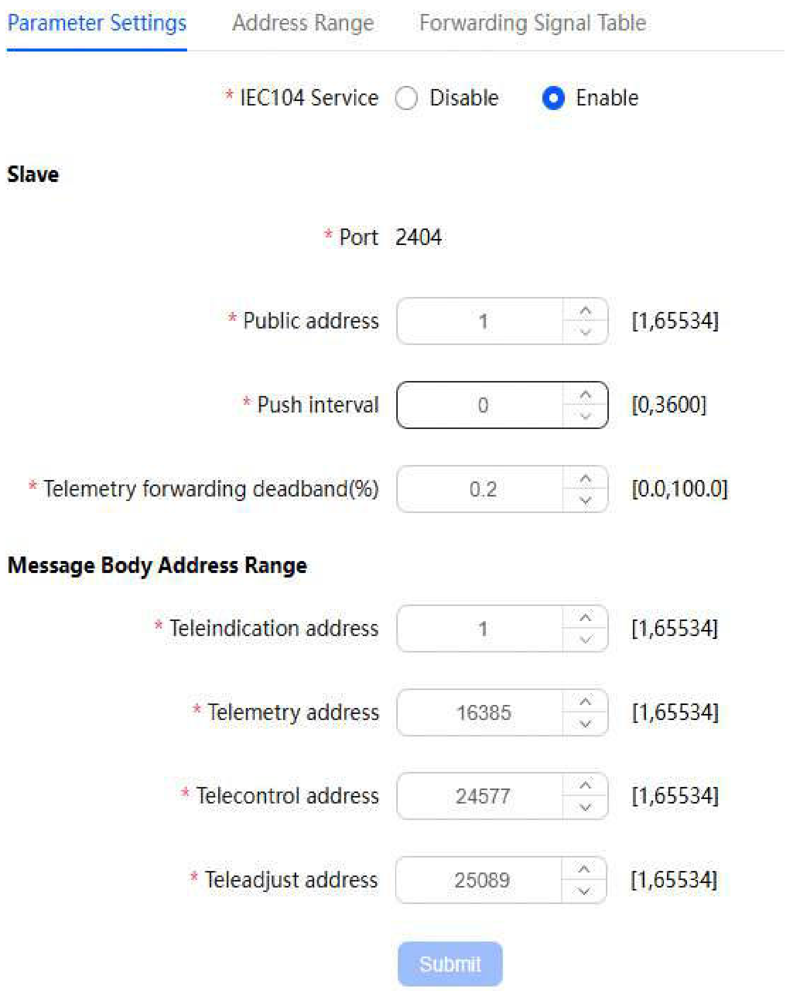


Table 3-47 Parameter settings

Parameter	Description
IEC104 Service	Specifies whether to set **IEC104** to **Enable**.
Port	Communications port.
Public address	Set this parameter as required. If the public addresses are inconsistent, the subsequent grid dispatch and inverter startup/shutdown control will be affected.

Parameter	Description
Push interval	Specifies the interval for the SmartMGC to push data to a third-party management system over IEC 104. If this parameter is set to 0s, there is no limit on the interval at which the SmartMGC sends data over IEC 104.
Telemetry forwarding deadband	When the telemetry data change exceeds this value, the change is reported.
Teleindication address	The start address of a signal must be less than or equal to the end address. The address ranges of different signals cannot overlap.
Telemetry address	
Telecontrol address	
Teleadjust address	

Step 3 Click **Address Range** and set the IEC 104 signal No. Three configuration modes are supported: manual configuration, importing configuration, and one-click configuration. You can select one based on site requirements.

Table 3-48 IEC 104 configuration modes

Configuration Mode	Description
Manual configuration	Manually enter the **Teleindication**, **Telemetry**, **Telecontrol**, and **Teleadjust** signal data of each device on the **Address Range** page.
Importing configuration	Export the template information in CSV format, configure the template data on the local PC using Excel, and then import the template to the system. This simplifies manual configuration on the WebUI.
One-click configuration	For the SmartMGC, the value is fixed at 150 for teleindication and telemetry ranges and 50 for telecontrol and teleadjust ranges. You only need to set the **Teleindication range**, **Telemetry range**, **Telecontrol range**, and **Teleadjust range** parameters for other devices. The system automatically matches the configuration information of other devices based on the SmartMGC.

The requirements for configuring the **Teleindication**, **Telemetry**, **Telecontrol**, and **Teleadjust** signal No. of each device are as follows:

- End value of signal No. ≥ Start value of signal No. + Signal No. quantity – 1
  The signal No. quantity is the quantity of signal No. obtained by the **Prerequisites** for each device.
- The signal No. range (end value – start value) configured in **Address Range** shall be greater than or equal to the actual quantity of signal No. of the

device. To facilitate calculation, you are advised to round up the end value of signal No. when setting the end value. For example, if the actual telemetry signal No. quantity of device α is 15, you can configure 20 telemetry signal numbers for device α.

The following describes the procedure for configuring the three protocols. Select a protocol based on the actual situation.

- **Method 1: manual configuration**
  a. Set the start and end values of **Teleindication**, **Telemetry**, **Telecontrol**, and **Teleadjust** for each device.
  b. Click **Submit**.
- **Method 2: configuration import**
  a. Click **Export** and select **Address Range** to export the information file.
  b. Edit the information file in Excel.
  c. Click **Import Address Range** to access the **Import** dialog box.
  d. Select the address range information file that has been edited and click **Import**.
  e. Click **Submit**.
- **Method 3: one-click configuration**
  a. Click **Configure** to access the **Configure** dialog box.
  b. Set the range values of **Teleindication**, **Telemetry**, **Telecontrol**, and **Teleadjust**, and click **OK**.
  c. Click **Submit**.

  NOTE

  - Check whether all of signal No. have been allocated to each device. If the addresses of multiple devices are the same, some of signal No. may not be allocated to these devices. You are advised to change the device addresses and click **Submit**.
  - Check whether some of signal No. allocated are changed greatly. If the device addresses change greatly, the signal No. will be changed greatly. You are advised to manually change the signal No. ranges.

----End

Example of Setting Signal No. for the IEC 104 Protocol

Assume that an array has one SmartMGC and one inverter.

NOTE

The quantity of device signal No. in **Table 3-49** is only an example. The actual quantity of device signal No. is subject to the actual quantity of **IEC 104 Forwarding Protocol Interface Description** in the software version documentation. For details about how to obtain the data, see **Prerequisites**.

Table 3-49 Signal No. quantity

Device Name	Teleindication Signal No. Quantity	Telemetry Signal No. Quantity	Telecontrol Signal No. Quantity	Teleadjust Signal No. Quantity
Logger	48	89	14	20
Inverter	83	32	3	0

Table 3-50 Signal No. setting

Device Name	No.	Teleindication		Telemetry		Telecontrol		Teleadjust	
		Start	End	Start	End	Start	End	Start	End
Logger	1	0	50	0	100	0	20	0	20
Inverter	2	51	150	101	150	21	30	0	0

Data Check

After setting the IEC 104 protocol parameters, check teleindication and telemetry data.

- **Teleindication** data check

  NOTE

  Path: **Maintenance** > **Field Test** > **Data Check** > **Teleindication**

  - **Manual check**
    1. Select the **Manual check** mode and click **Start**.
    2. Change the **Analog Value** of a single signal to check the data of the signal.
    3. Check the data of the remaining signals in sequence.
    4. Click **Stop** to pause or complete the data check. All signals are reported based on the actual values.
  - **Automatic check**
    1. Select the **Auto check** mode.
    2. Enter the **Interval** and **Start signal No.** for signal data check.
    3. Click **Start**.
    4. The system automatically completes the data check of the remaining signals from **Start signal No.**
    5. Click **Stop** to pause or complete the data check. All signals are reported based on the actual values.

NOTE

- During automatic check, you can switch pages, which does not affect the check process.
- If you click **Start**, the backend data of the system will no longer be updated. If you click **Stop**, the backend data of the system will be updated.
- After manual check, if you do not click **Stop** and do not perform any operation within 10 minutes, the system will automatically stop data check 10 minutes later. All signals are reported based on the actual values. After automatic check, the system will automatically stop data check in 10 minutes. All signals will be reported based on the actual values.

- **Telemetry** data check

  NOTE

  Path: **Maintenance** > **Field Test** > **Data Check** > **Telemetry**

  a. Click **Start**. Data check is automatically performed for all signals.
  b. (Optional) Click **Analog Value** of a signal to change the default **Analog Value**. The system automatically checks the signal with the new **Analog Value**.
  c. Click **Stop** to pause or complete the data check. All signals are reported based on the actual values.

  NOTE

  - If you click **Start**, the backend data of the system will no longer be updated. If you click **Stop**, the backend data of the system will be updated.
  - After telemetry signals are checked, click **Stop**. Otherwise, communication will be affected.

3.5.2.2 GOOSE Protocol

When the SmartMGC connects to a third-party EMS over GOOSE, GOOSE communication parameters shall be set on the SmartMGC WebUI to transmit real-time data and control commands quickly.

Prerequisites

- Download the latest software release document from the **FusionSolar Software Download Center**, decompress the package, and view the **GOOSE Interface Description** file to check the GOOSE interconnection description and interface description.
- Contact the third-party management system vendor to obtain the configuration file CID.

Procedure

Step 1 Set basic parameters. Choose **Settings** > **Communications protocol** > **GOOSE**.

Table 3-51 Basic parameters

Parameter	Description
GOOSE	Specifies whether to set **GOOSE** to **Enable**.
Data transmission	This parameter is displayed when **GOOSE** is set to **Enable**. It specifies whether to set **Data transmission** to **Enable**.
Data receiving	This parameter is displayed when **GOOSE** is set to **Enable**. It specifies whether to set **Data receiving** to **Enable**.
Network port	This parameter is displayed when **GOOSE** is set to **Enable**. You can set a network port for GOOSE communication based on the actual cable connection. Multiple network ports can be used for GOOSE communication, and if configured, they will be used to report and receive GOOSE packets.
Device status	This parameter is displayed when **GOOSE** is set to **Enable**. Specifies the status of the device. Only packets that match the device status are received and reported.
Device name	Displays the type and name of the device.
Device type	
Controller 1 type	Displays the type and name of the controller connected through GOOSE.
Controller 1 name	
Controller 2 type	
Controller 2 name	

Step 2 Import the configuration file CID.

Compress the configuration file CID into a .zip package and click **Import**.

Table 3-52 Configuration file status

Parameter	Description
Configuration status	Displays the current configuration status. ● **Unavailable**: No configuration file has been successfully imported ● **Normal**: A configuration file has been successfully imported. If a new configuration file is successfully imported again, the new configuration file replaces the old one, and **Last import time** is updated. If the new configuration file fails to be imported again, the old configuration file is retained, and **Last import time** is not updated.
Last import time	

----End

3.5.2.3 Modbus Protocol

When the SmartMGC connects to a third-party EMS over Modbus TCP, Modbus TCP communication parameters shall be set. Modbus TCP can connect to a third-party EMS in client or server mode.

Prerequisites

A third-party EMS can be connected only through a WAN port or mobile network.

Procedure

Client mode:

Step 1 Set basic parameters for the client mode.

Log in to the SmartMGC WebUI and choose **Settings** > **Communications protocol** > **Modbus** > **Client** > **Management System-1**.

Table 3-53 Management system-1

Parameter	Description
Management system-1 communication	Specifies whether to set **Management System-1** to **Enable**.
Management system 1 IP address	Specifies the IP address of the management system.
Port	Used for communication and data exchange between the management system and SmartMGC. The default value is **502**. The value can be set to **1502** based on site requirements.
TLS encryption	• **Enable**: Data exchanged between the SmartMGC and the management system is encrypted. • **Disable**: Data exchanged between the SmartMGC and the management system is not encrypted, which poses security risks.
TLS version	This parameter is displayed when **TLS encryption** is set to **Enable**. It specifies the TLS version. You are advised to select TLS1.2 or later.

Parameter	Description
Remote permission	• **Monitoring only**: The management system is only allowed to read information about the SmartMGC. • **Monitoring only**: The management system is allowed to read and write information about the SmartMGC. • **Management (temporary authorization)**: The management system is allowed to read and write information about the SmartMGC within the authorization period. If the authorization period expires, the management system is only allowed to read information about the SmartMGC but not allowed to write information.
Management system status	Displays the current status of the management system. If the SmartMGC cannot connect to the management system, rectify the fault based on the current status by referring to **Table 3-54**.

Table 3-54 Troubleshooting instructions for management system connection failure

Management System Status	Possible Cause	Troubleshooting
Closed by peer	• The management system is not running or the port is not enabled. • The management system receives a data timeout response and disable the connection. • The firewall blocks the connection.	1. Check whether the management system is started. 2. Check whether the IP address and port of the management system are correctly set. 3. Check the firewall settings of the client and server.
Disconnected abnormally	The SmartMGC does not receive service data from the management system within 30s.	The SmartMGC will attempt to reconnect. No action is required.

Management System Status	Possible Cause	Troubleshooting
Port unreachable	The SmartMGC cannot connect to the management system because the server or port is incorrectly set.	1. Check whether the management system is started successfully. 2. Check whether the IP address, domain name, or port of the management system is correctly set. 3. If the SmartMGC uses FE for communication, check whether the FE cable is properly connected to the network inside the plant. 4. If the SmartMGC uses 4G for communication, check whether the 4G card is properly installed, and whether the SIM card is in arrears or the traffic is used up.
Peer certificate verification failed	● The local certificate and peer certificate do not match the CA. ● Failed to verify the peer certificate validity period.	Check whether the SmartMGC certificate matches the management system certificate or whether the certificate has expired.
Local certificate abnormal	The SmartMGC fails to load the local certificate.	Check whether the certificate issued by the customer has been replaced onsite. ● If yes, import the certificate again. ● If no, restore the default settings.
Domain name resolution failed	● The IP address of the DNS server is incorrectly set. ● The address of the management system is incorrectly set.	Check whether the IP address of the DNS server and the address of the management system server are correctly set.

Management System Status	Possible Cause	Troubleshooting
Server unreachable	The SmartMGC cannot connect to the management system because the server or port is incorrectly set.	1. Check whether the management system is started successfully. 2. Check whether the IP address, domain name, or port of the management system is correctly set. 3. If the SmartMGC uses FE for communication, check whether the FE cable is properly connected to the network inside the plant. 4. If the SmartMGC uses 4G for communication, check whether the 4G card is properly installed, and whether the SIM card is in arrears or the traffic is used up.
Secondary challenge authentication failed	The account or password for second challenge authentication is incorrect.	1. If the SmartMGC or management system has been replaced, reset the password for second challenge authentication. 2. If the connection still fails, disable the second challenge authentication function.

----End

Server mode:

Step 1 Set basic parameters for the client mode.

Log in to the SmartMGC WebUI and choose **Settings** > **Communications protocol** > **Modbus** > **Communications protocol** > **Server**.

Table 3-55 Server

Parameter	Description
Modbus TCP service	Specifies whether to set **Modbus TCP service** to **Enable**. ● If this parameter is set to **Enable (restricted)**, the SmartMGC can communicate with a third-party management system whose IP address is whitelisted. ● If this parameter is set to **Enable (unrestricted)**, the SmartMGC can communicate with a third-party management system whose IP address is valid.
Modbus TCP/Client α[1]	This parameter is displayed when **Modbus TCP service** is set to **Enable (restricted)**. It specifies the IP address of the client.
Logger address	It specifies the slave address of the SmartMGC.
No response from disconnected device	Specifies whether to set **No response from disconnected device** to **Enable**.
[1]: α = 1–5	

----End

3.5.3 Black Start

The microgrid black start function allows the ESS with black start capability to energize first following a system blackout. It then sequentially restores power resources without self-start capability, enabling the microgrid to re-establish power supply independently. This solution uses the ESS as the core black start power source, enhancing the reliability of power supply for the microgrid when it operates in islanded mode.

In the microgrid scenario, a UPS is required to supply power to the SmartMGC and the ESS's CMU. If the UPS has power, log in to the local app to perform startup authorization and array deployment. If the UPS has no power, press the black start button on the ESS. After the ESS voltage is established, perform startup authorization and set the grid code before the first deployment.

The array can be black started only in the off-grid scenario or in the on/off-grid scenario when **On/Off-grid status** is set to .

Table 3-56 Black start description

Category	Scenario	Requirement
Array black start command (one-click black start)	The UPS has power.	• The SmartMGC and the ESS's CMU are powered by the UPS. • Ensure that the array grid code is consistent with the local grid code. You are advised to perform deployment before enabling the array black start command. • It is recommended that black start be performed only when the ESS SOC is greater than 2%. Otherwise, the black start may fail. If the ESS SOC is 0% or the **Battery Pack Undervoltage** alarm is generated, charge the ESS first.
Pressing the black start button	The UPS has no power.	• Disconnect all loads. • Before the first deployment, turn off the AC switch of the ESS. This prevents device damage caused by voltage and frequency non-compliance due to the inconsistency between the default grid code and the local grid code. • It is recommended that black start be performed only when the ESS SOC is greater than 2%. Otherwise, the black start may fail. If the ESS SOC is 0% or the **Battery Pack Undervoltage** alarm is generated, charge the ESS first. • Requirements for using the black start button on the ESS: – Press and hold the black start button for more than 10 seconds, close the cabinet door, and wait for the black start. – The interval between two presses of the black start button shall be at least 1 minute.

3.5.3.1 Array Black Start Command

If the UPS has power, send a black start command on the SmartMGC WebUI or SmartMGC local app.

Method 1: SmartMGC WebUI

Step 1 Manually initiate a black start.

Choose **Maintenance** > **Device Management** > **Black Start** and then click **Black Start**.

----End

Method 2: SmartMGC local app

Step 1 Choose **Set** > **Microgrid Parameters** > **Black Start** and then tap **Start**.

----End

NOTE

On the black start screen, you can view the **Current Battery SOC** value, black start progress, and status.

3.5.3.2 Pressing the Black Start Button

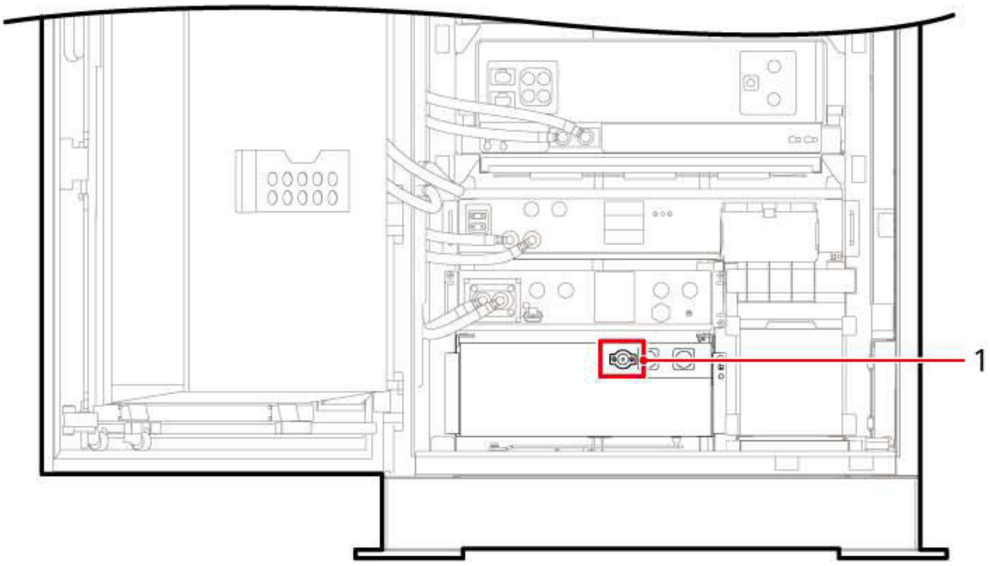
If the UPS has no power, press the black start button on the ESS. After the ESS voltage is established, perform startup authorization and set the grid code before the first deployment.

Scenario 1: Black Start Before the First Deployment

Step 1 Turn off the AC switch of the ESS to be black started.

Step 2 Open the ESS cabinet door. Press and hold the black start button on the RCM in the cabinet for more than 10 seconds.

Figure 3-46 Black start button



1	Black start button

Step 3 Close the cabinet door and wait until the black start is successful.

Step 4 Connect to the ESS locally on the app and set the startup authorization code and grid code of the ESS.

- Set the startup authorization code by referring to **3.3.1.4 Setting ESS Startup Authorization**.
- Set the grid code by referring to **3.3.2.3.1 Setting the Grid Code and Power Baseline**.

Step 5 Turn on the AC switch of the ESS.

Step 6 Perform black start locally again. Open the ESS cabinet door. Press and hold the black start button on the RCM in the cabinet for more than 10 seconds.

NOTICE

The interval between two presses of the black start button shall be at least 1 minute.

Step 7 Close the cabinet door. After the black start is successful, perform quick settings on the local app. For details, see **3.3.2 Quick Settings**.

NOTE

If the humidity in the cabinet is high, dehumidification will be triggered after the black start is successful.

----End

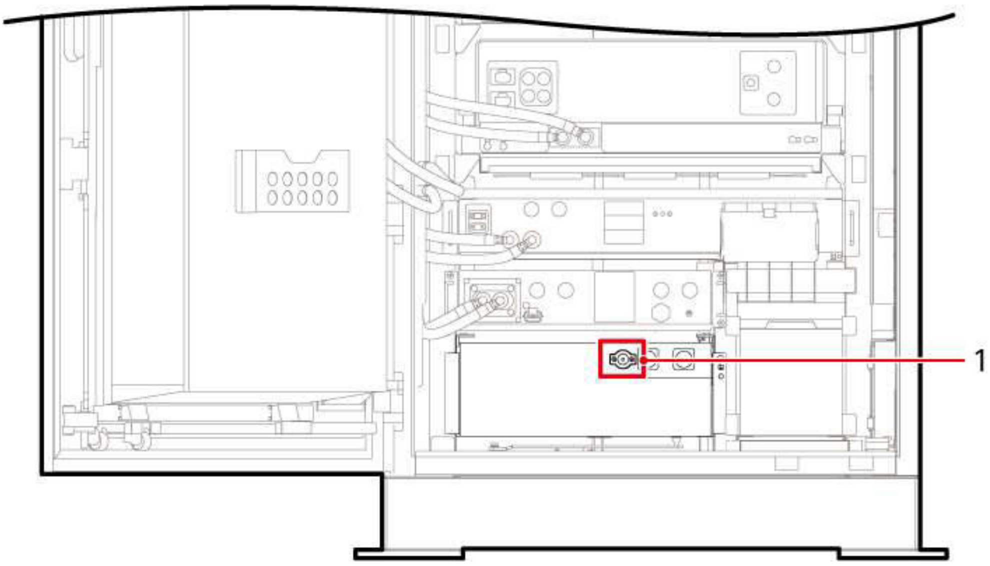
Scenario 2: Black Start After Deployment

Step 1 Open the ESS cabinet door. Press and hold the black start button on the RCM in the cabinet for more than 10 seconds.

NOTICE

The interval between two presses of the black start button shall be at least 1 minute.

Figure 3-47 Black start button



1	Black start button

Step 2 Close the cabinet door and wait until the black start is successful.

NOTE

If the humidity in the cabinet is high, dehumidification will be triggered after the black start is successful.

----End

3.5.4 ESS SOC Description

To ensure that the grid-forming ESS can reliably respond to power disturbances, the key is to always reserve charge and discharge margins. Properly set the SOC operating range to prevent the loss of regulation capability when the SOC reaches the limit. This ensures that the system can effectively maintain power balance when the load or PV power changes abruptly. It is crucial to prevent power outages or load shedding and ensure stable system operation.

⚠ WARNING

You are advised to retain the default values of the SOC parameters to ensure stable system operation. If you need to adjust the settings, contact the Company's engineers. When modifying SOC parameters, comply with the following principles to ensure the system's charge/discharge margin and power balance capability:

Array end-of-charge SOC > **Max. SOC for charging on/off-grid ESS** ≥ **Backup power SOC for capacity/demand control** ≥ **Min. SOC for off-grid power backup** > **Min. SOC for discharging on/off-grid ESS** > **Array end-of-discharge SOC**

Table 3-57 SOC description in the seamless on/off-grid scenario

Parameter	Description	Default Value (%)	Maximum Value (%)	Path
Array end-of-charge SOC	Array-level end-of-charge threshold. When the SOC of the ESS reaches this value, the charging stops, which means that the ESS limits the charge capability to 0 for protection.	100	90–100	• SmartMGC WebUI: **Settings** > **Grid Connection Control** > **ESS Control** > **ESS SOC** • SmartMGC local app: **Set** > **Feature parameters**
Array end-of-discharge SOC	Array-level end-of-discharge threshold. When the SOC of the ESS reaches this value, the discharging stops, which means that the ESS limits the discharge capability to 0 for protection.	1	0–15	

Parameter	Description	Default Value (%)	Maximum Value (%)	Path
Backup power SOC for capacity/ demand control	This parameter specifies the dedicated energy threshold reserved by the ESS to meet the capacity/ demand limit (a larger value indicates a stronger peak shaving capability). It shall be preferentially guaranteed during energy allocation to ensure that the ESS can continuously support load requirements during peak hours of the grid.	50	Dynamically obtained: **Array end-of-discharge SOC** to **Array end-of-charge SOC**, and greater than **Min. SOC for off-grid power backup**.	• SmartMGC WebUI: **Settings** > **Grid Connection Control** > **ESS Control** > **ESS SOC** • SmartMGC local app: **Power adjustment** > **Capacity Control**
Max. SOC for charging on/ off-grid ESS	ESS end-of-charge threshold in the on/off-grid scenario. When the SOC of the ESS reaches this value, the MGCC limits the ESS charge power to 0. To prevent switchover by mistake when the SOC of the ESS reaches **Array end-of-charge SOC** in off-grid VSG mode, you are advised to set this parameter to ≤ (**Array end-of-charge SOC –** 2)%.	95	Dynamically obtained: MAX((**Min. SOC for discharging on/off-grid ESS** + 1), 5) to MIN((**Array end-of-charge SOC** – 1), 98)	• SmartMGC WebUI: **Settings** > **Grid Connection Control** > **ESS Control** > **ESS SOC** • SmartMGC local app: **Set** > **Microgrid Parameters** > **Scheduling Control**
Min. SOC for discharging on/off-grid ESS	ESS end-of-discharge threshold in the on/off-grid scenario. When the SOC of the ESS decreases to this value, the MGCC limits the ESS discharge power to 0. To prevent switchover by mistake when the SOC of the ESS decreases to **Array end-of-discharge SOC** in off-grid VSG mode, you are advised to set this parameter to ≥ (**Array end-of-discharge SOC** + 2)%.	5	Dynamically obtained: MAX((**Array end-of-discharge SOC** + 1), 5) to MIN((**Max. SOC for charging on/off-grid ESS** – 1), 98)	

Parameter	Description	Default Value (%)	Maximum Value (%)	Path
Min. SOC for off-grid power backup	Minimum threshold reserved for off-grid operation when the system is running in on-grid mode in the on/off-grid scenario. When the ESS SOC decreases to this value, the ESS stops discharging to ensure that the system can smoothly switch from on-grid mode to off-grid mode when the grid is abnormal. This parameter is displayed when **Off-grid power backup** is set to **Enable**.	40	20–90	
SOC for turning on critical load switch	Threshold for the system to turn on the critical load switch. When the array SOC reaches this value, the switch is automatically turned on to ensure reliable power supply to critical loads. This parameter is displayed when the critical load switch is connected.	30	10–98	
SOC for turning off critical load switch	Threshold for the system to turn off the critical load switch. When the array SOC decreases to this value, the switch is automatically turned off to prevent the ESS from being overdischarged and ensure the operation of core devices. This parameter is displayed when the critical load switch is connected.	20	10–98	

Parameter	Description	Default Value (%)	Maximum Value (%)	Path
Generator Set Start-up Energy Storage SOC	Specifies the threshold for starting the genset. When the SOC of the ESS is lower than this value, the genset is automatically started to ensure power balance and power supply continuity. This parameter is displayed when **Generator set control** is set to **Enable**. It is supported only in the PV +ESS+genset (genset grid forming or genset grid following) networking.	20	Dynamically obtained: MAX((**Min. SOC for discharging on/off-grid ESS** + 5), 10) to 90	• SmartMGC WebUI: **Settings** > **Grid Connection Control** > **ESS Control** > **ESS SOC** • SmartMGC local app: **Set** > **Microgrid Parameters** > **Microgrid**
Generator set stops energy storage SOC	Specifies the threshold for stopping the genset. When the SOC of the ESS is higher than this value, the genset is automatically stopped to ensure economical operation and maintain the optimal operating status of the ESS. This parameter is displayed when **Generator set control** is set to **Enable**. It is supported only in the PV +ESS+genset (genset grid forming or genset grid following) networking.	40	Dynamically obtained: 15 to MIN((**Max. SOC for charging on/off-grid ESS** – 5), 95)	

3.5.5 Off-Grid Protection Parameter Description

For seamless switching and stable off-grid operation, ensure that the protection parameters of the ESS and the **SmartMGC** strictly comply with the protection parameters specified in **Table 3-58**.

CAUTION

Retain the default settings of the protection parameters to ensure stable system operation. If you need to adjust the settings, contact the Company's engineers.

Path for setting protection parameters:

Path on the SmartMGC WebUI:

- Protection parameters of the SmartMGC: **Settings** > **Microgrid Control** > **Advanced Control Configuration** > **Protective Relay Configuration**
- Off-grid protection parameters of the ESS: **Monitoring** > **ESS** > **Running Parameters**

Path on the SmartMGC local app:

Off-grid protection parameters of the ESS: Tap **Monitor**, select an ESS, and choose **Set** > **Power Parameters** > **Power Protection Parameters**.

Table 3-58 Protection parameter description

Working Condition	SmartMGC		ESS	
Overvoltage protection	**Threshold for triggering section I overvoltage protection**	1.1 x Un[a]	**Off-grid level-1 overvoltage protection threshold**	1.15*Un[a]
	Delay of section I overvoltage protection	10000 ms	**Duration threshold for off-grid level-1 overvoltage protection**	15000 ms
	Threshold for triggering section II overvoltage protection	1.2 x Un[a]	**Off-grid level-2 overvoltage protection threshold**	1.2 x Un[a]
	Delay of section II overvoltage protection	200 ms	**Duration threshold for off-grid level-2 overvoltage protection**	10500 ms
	/	/	**Off-grid level-3 overvoltage protection threshold**	1.3 x Un[a]
	/	/	**Duration threshold for off-grid level-3 overvoltage protection**	300 ms
	/	/	**Off-grid level-4 overvoltage protection threshold**	1.3 x Un[a]
	/	/	**Duration threshold for off-grid level-4 overvoltage protection**	300 ms

Working Condition	SmartMGC		ESS	
Undervoltage protection	**Threshold for triggering section I undervoltage protection**	0.9 x Un[a]	**Off-grid level-1 undervoltage protection threshold**	0.85 x Un[a]
	Delay of section I undervoltage protection	10000 ms	**Duration threshold for off-grid level-1 undervoltage protection**	10500 ms
	Threshold for triggering section II undervoltage protection	0.8 x Un[a]	**Off-grid level-2 undervoltage protection threshold**	0.75 x Un[a]
	Delay of section II undervoltage protection	0 ms	**Duration threshold for off-grid level-2 undervoltage protection**	1000 ms
	/	/	**Off-grid level-3 undervoltage protection threshold**	0.75 x Un[a]
	/	/	**Duration threshold for off-grid level-3 undervoltage protection**	1000 ms
	/	/	**Off-grid level-4 undervoltage protection threshold**	0.75 x Un[a]
	/	/	**Duration threshold for off-grid level-4 undervoltage protection**	1000 ms
Overfrequency protection	**Threshold for triggering section I overfrequency protection**	fn[b] + 2	**Off-grid level-1 overfrequency protection threshold**	1.08 x fn[b]
	Delay of section I overfrequency protection	500 ms	**Duration threshold for off-grid level-1 overfrequency protection**	1000 ms
	/	/	**Off-grid level-2 overfrequency protection threshold**	1.09 x fn[b]

Working Condition	SmartMGC		ESS	
	/	/	**Duration threshold for off-grid level-2 overfrequency protection**	800 ms
	/	/	**Off-grid level-3 overfrequency protection threshold**	1.1 x fn[b]
	/	/	**Duration threshold for off-grid level-3 overfrequency protection**	700 ms
	/	/	**Off-grid level-4 overfrequency protection threshold**	1.1 x fn[b]
	/	/	**Duration threshold for off-grid level-4 overfrequency protection**	700 ms
Underfrequency protection	**Threshold for triggering section I underfrequency protection**	fn[b] – 2	**Off-grid level-1 underfrequency protection threshold**	0.92 x fn[b]
	Delay of section I underfrequency protection	500 ms	**Duration threshold for off-grid level-1 underfrequency protection**	1000 ms
	/	/	**Off-grid level-2 underfrequency protection threshold**	0.91 x fn[b]
	/	/	**Duration threshold for off-grid level-2 underfrequency protection**	800 ms
	/	/	**Off-grid level-3 underfrequency protection threshold**	0.9 x fn[b]
	/	/	**Duration threshold for off-grid level-3 underfrequency protection**	700 ms
	/	/	**Off-grid level-4 underfrequency protection threshold**	0.9 x fn[b]

Working Condition	SmartMGC		ESS	
	/	/	**Duration threshold for off-grid level-4 underfrequency protection**	700 ms
Frequency change rate protection	**Threshold for triggering section I protection if ROCOF increases**	5 Hz/s	/	/
	Threshold for triggering section I protection if ROCOF decreases	5 Hz/s	/	/
	Delay of section I protection if ROCOF increases	140 ms	/	/
	Delay of section I protection if ROCOF decreases	140 ms	/	/
Rapid power loss detection	**Threshold for triggering rapid power loss detection**	80 x Un	/	/
Note a: Rated voltage of the power grid. Note b: Rated frequency of the power grid.				

3.6 O&M

3.6.1 System Power-Off

After power-on and commissioning are complete, you can power off the system as required, and power it on and start devices when the system needs to be put into use.

Method 1: SmartMGC WebUI

Step 1 Send a shutdown command. Log in to the SmartMGC WebUI:

1. Choose **Maintenance** > **Device Management** > **Startup/Shutdown** and select the devices to be shut down.
2. Click **Shut Down** and click **Selected devices** from the drop-down list to shut down the devices.

Step 2 Power off the devices: Turn off the main power switches and then the auxiliary power switches of the devices by referring to the operations of **3.2 System Power-On** in the reverse order.

DANGER

Wear insulated gloves and use insulated tools to prevent electric shocks or short circuits.

NOTE

To prevent local operations on switches during subsequent power-on, you are advised not to turn off the auxiliary power switches.

----End

Method 2: SmartMGC local app

Step 1 Send a shutdown command. Connect the app to the SmartMGC:

1. On the home screen of the app, choose **Maintenance** > **Device management**.
2. On the **Device management** screen, tap the drop-down menu in the upper right corner.
3. Tap **Batch Control**.
4. Tap **Batch shutdown**, enter the app login password, and tap **OK**.

Step 2 Power off the devices: Turn off the main power switches and then the auxiliary power switches of the devices by referring to the operations of **3.2 System Power-On** in the reverse order.

DANGER

Wear insulated gloves and use insulated tools to prevent electric shocks or short circuits.

NOTE

To prevent local operations on switches during subsequent power-on, you are advised not to turn off the auxiliary power switches.

----End

3.6.2 Startup and Operation

After power-on and commissioning are complete, you can power off the system as required, and power it on and start devices when the system needs to be put into use.

- On-grid mode: Start the ESS on the SmartMGC WebUI or SmartMGC local app.
- Off-grid mode: Start the ESS through black start.

NOTICE

- On-grid mode: If the ESS SOC is 0%, charge the ESS and then start it after the ESS SOC is greater than **Array end-of-discharge SOC**. If the ESS SOC is greater than 0 and less than **Array end-of-discharge SOC**, set **Array end-of-discharge SOC** to a value within the range of [0, ESS SOC) and then start the ESS. After it is started, restore the value of **Array end-of-discharge SOC**.
- Off-grid mode: If the ESS SOC is 0%, charge the ESS and then start it through black start.

On-Grid Startup

Prerequisites:

- The mains supply is stable.
- The on/off-grid switch is turned on.

Procedure:

Method 1: SmartMGC WebUI

Step 1 Choose **Maintenance** > **Device Management** > **Startup/Shutdown** and select the devices to be started.

Step 2 Click **Start** and click **Selected devices** from the drop-down list to start the devices.

NOTE

Click **Start** and click **All array devices**, **All array inverters**, **All array ESSs**, or **All array PCSs** from the drop-down list to start all corresponding devices.

----End

Method 2: SmartMGC local app

Step 1 Connect the app to the **SmartMGC** and choose **Maintenance** > **Device management** on the home screen.

Step 2 On the **Device management** screen, tap the drop-down menu in the upper right corner.

Step 3 Tap **Batch Control**.

Step 4 Tap **Batch startup**, enter the app login password, and tap **OK**.

----End

Off-Grid Startup

In off-grid mode, the system is started through black start. For details, see **3.5.3 Black Start**.

3.6.3 Routine Maintenance

For details about the routine maintenance items of the devices involved in this solution, see the user manual or maintenance manual of the corresponding device. For details, see **F Reference Documents**.

A Inverter and Optimizer Models

Table A-1 Inverter models

<table>
<tr><th>Product Series</th><th>Product Model</th><th>Remarks</th></tr>
<tr><td>V3</td><td>SUN2000-50KTL-M0
SUN2000-50KTL-JPM0
SUN2000-60KTL-M0
SUN2000-60KTL-JPM0</td><td rowspan="2">Purchased from the Company.
The maximum PV-to-ESS ratio is 1:1 when the V3 series inverter is used with the ESS. The maximum PV-to-ESS ratio is 2:1 when the ESS is used with inverters of other series.
In the same PV system, the quantity of inverters shall not exceed 40, and a maximum of two inverter series can be used. The inverter with a larger power shall be preferentially deployed.
Inverters from the Company shall not be used together with those from other vendors.</td></tr>
<tr><td>M3</td><td>SUN2000-30K-MC0
SUN2000-40K-MC0
SUN2000-50K-MC0
SUN2000-29.9KTL-M3
SUN2000-30KTL-M3
SUN2000-33KTL-NH
SUN2000-36KTL-M3
SUN2000-40KTL-M3
SUN2000-40KTL-NH
SUN2000-50KTL-M3
SUN2000-50KTL-ZHM3
SUN2000-50KTL-NHM3</td></tr>
</table>

Product Series	Product Model	Remarks
V5/V5+	• SUN2000-75KTL-M1 • SUN2000-100KTL-M1 • SUN2000-100KTL-M2 • SUN2000-110KTL-M2 • SUN2000-110KTL-INM0 • SUN2000-111KTL-NHM0 • SUN2000-115KTL-M2	
V6 (SUN2000MG)	• SUN2000-50K-MGL0-BR • SUN2000-50K-MGL0 • SUN2000-75K-MGL0-BR • SUN2000-80K-MGL0 • SUN2000-150K-MG0-ZH • SUN2000-150K-MG0	
V6 (SUN5000MG)	• SUN5000-150K-MG0-ZH • SUN5000-150K-MG0	

Table A-2 Optimizer models

Product Series	Product Model	Remarks
1-to-1 optimizer	• SUN2000-450W-P2 • SUN2000-600W-P	Purchased from the Company. The quantity of optimizers depends on the actual quantity of PV modules. • SUN2000-29.9KTL-M3, SUN2000-30KTL-M3, SUN2000-33KTL-NH, SUN2000-36KTL-M3, SUN2000-40KTL-M3, and SUN2000-40KTL-NH support optimizers. • SUN2000-50KTL-ZHM3/M3/NHM3 supports only MERC-1300W-P or MERC-1100W-P. • MERC-1300W-P or MERC-1100W-P is mandatory for SUN5000-150K-MG0/MG0-ZH.
1-to-2 optimizer	• MERC-1300W-P • MERC-1100W-P	

B Meter Model List

Table B-1 Supported power meters

Vendor	Model	Limited Feed-in
ABB	A44	-
Acrel	PZ96L	-
Algodue	UPM209	-
CHINT	DDSU666-H	-
CHINT	DTSU666	-
CHINT	DTSU666-H	Supported[1]
CHINT	DTSU666-HW	Supported[1]
Elster	A1800ALPHA	-
GAVAZZI	EM210	-
Janitza	UMG103-CBM	-
Janitza	UMG104	-
Janitza	UMG604	-
Janitza	UMG96-S2	-
Lead	LD-C83	-
Linyang	DDSU71	-
Linyang	DTSU71	Supported[1]
Linyang	DTSU71C	Supported[1]
MingHua	CRDM-830	-
Mitsubishi	EMU4-BD1-MB	-
Mitsubishi	M8FM-N3LTR	-

Vendor	Model	Limited Feed-in
Mitsubishi	ME110SR-MB	-
Mitsubishi	ME110SSR-MB	-
Mitsubishi	ME110NSR-MB	-
Mitsubishi	ME110SSR-4APH	-
NARUN	PD510	-
NetBiter	CEWE	-
People	RM858E	-
REAL ENERGY SYSTEM	PRISMA-310A	-
Rishabh	LM1360	-
Schneider	PM1200	-
Schneider	PM2xxx	-
Schneider	PM5100	-
Schneider	PM5300	-
SFERE	PD194Z	-
Socomec	COUNTIS-E43	-
Toshiba	S2MS	-
Wave Energy	PWM-72	-
WEG	MMW03-M22CH	-
YADA	YDS60-80	-
YADA	YDS60-C24	Supported[1]
YADA	YDS70-C16	-
Wisdom	DDSU1079-CT	-
Wisdom	DHSU1079-CT	Supported[1]
Wisdom	DHSU1079-ZT	Supported[1]
[1]: Applicable to three-phase power scenarios.		

C EMI Model List

Table C-1 Supported EMIs

Vendor	Model	EMI Signal
ABB	VSN800-12	Total irradiance, ambient temperature, and PV module temperature
	VSN800-14	Total irradiance, ambient temperature, PV module temperature, wind direction, and wind speed
Gill MetPak Pro	Gill MetPak Pro	Total irradiance, ambient temperature, PV module temperature, wind direction, and wind speed
Hukseflux SRx	Hukseflux SRx	Total irradiance and ambient temperature
Ingenieurbüro Si-RS485TC	Ingenieurbüro Si-RS485TC	Total irradiance, ambient temperature, PV module temperature, and wind speed
Kipp&Zonen	SMPx series	Total irradiance and ambient temperature
Lufft	WSx-UMB	Total irradiance, ambient temperature, wind direction, and wind speed

Vendor	Model	EMI Signal
	WSx-UMB (external sensors)	Total irradiance, ambient temperature, PV module temperature, wind direction, and wind speed
Meier-NT ADL-SR	Meier-NT ADL-SR	Total irradiance, ambient temperature, PV module temperature, and wind speed
MeteoControl	SR20-D2	Total irradiance and ambient temperature
RainWise	PVmet-150	Total irradiance, ambient temperature, and PV module temperature
	PVmet-200	Total irradiance, ambient temperature, PV module temperature, wind direction, and wind speed
Soluzione Solare	SunMeter	Total irradiance and ambient temperature
Handan	RYQ-3	Total irradiance, ambient temperature, PV module temperature, wind direction, and wind speed
Jinzhou Licheng	JinZhouLiCheng	Total irradiance, ambient temperature, PV module temperature, wind direction, and wind speed
Jinzhou Solargiga	PC-4 (V2.11)	Total irradiance, ambient temperature, PV module temperature, wind direction, and wind speed

D Off-Grid UPS Capacity Configuration

ESS Quantity	UPS Battery Capacity[a] (kWh)	12 V Battery Ampere-Hour[b] (Ah)	24 V Battery Ampere-Hour[c] (Ah)	48 V Battery Ampere-Hour[d] (Ah)
1	2.88	240	120	60
2	4.32	360	180	90
3	5.76	480	240	120
4	7.2	600	300	150
5	8.64	720	360	180
6	10.08	840	420	210
7	11.52	960	480	240
8	12.96	1080	540	270
9	14.4	1200	600	300
10	15.84	1320	660	330
11	17.28	1440	720	360
12	18.72	1560	780	390
13	20.16	1680	840	420
14	21.6	1800	900	450
15	23.04	1920	960	480
16	24.48	2040	1020	510
17	25.92	2160	1080	540
18	27.36	2280	1140	570
19	28.8	2400	1200	600

ESS Quantity	UPS Battery Capacity[a] (kWh)	12 V Battery Ampere-Hour[b] (Ah)	24 V Battery Ampere-Hour[c] (Ah)	48 V Battery Ampere-Hour[d] (Ah)
20	30.24	2520	1260	630
Note a: Battery capacity = [Power consumption of the SmartMGC + Total power of ESS auxiliary power supplies (Single ESS auxiliary power x Quantity of ESSs)] x Backup time/1000 Note b: 12 V battery ampere-hour = Battery capacity x 1000/12 Note c: 24 V battery ampere-hour = Battery capacity x 1000/24 Note d: 48 V battery ampere-hour = Battery capacity x 1000/48				

E Connecting the App to the SmartMGC

Prerequisites

- The device has been powered on, and the WLAN function is enabled.
- The WLAN function has been enabled on the mobile phone.
- Keep the mobile phone within 5 m away from the device. Otherwise, the communication signal quality between the app and the device may be affected.

Procedure

Step 1 Start device commissioning.

- Method 1: If the mobile phone is connected to the Internet, log in to the app and choose **Services** > **Device Commissioning**.
- Method 2: If the mobile phone is not connected to the Internet, choose **: :** > **Device Commissioning** in the upper right corner of the app login screen.

NOTE

Method 2 can be used only when no Internet access is available. You are advised to log in to the app to commission devices using method 1.

Step 2 Connect to the WLAN of the SmartMGC.

Tap **Scan**. On the QR code scanning screen, align the QR code with the scanning box to automatically scan and connect to the WLAN of the SmartMGC.

NOTE

- The WLAN name of the device consists of "device name-device SN".
- For the first connection, log in with the initial password. You can obtain the initial WLAN password from the device label, that is, the characters following "PSW".
- 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.
- If the WLAN of the SmartMGC cannot be found or the connection fails, press the RST button for 1s to 3s to start the WLAN module. After the COM indicator keeps steady on for 2 minutes, you can connect the app to the device WLAN.

Step 3 Log in to the local commissioning screen of the SmartMGC.

Select the **installer** user, enter the login password, and tap **Log in**.

NOTE

- Set the login password as prompted at the first login.
- After logging out, wait for 60 seconds before logging in to the app as another user. Otherwise, the login will fail.
- 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.

----End

F Reference Documents

Device	Document
ESS	• **HUAWEI LUNA2000-(107-241) Series Commercial and Industrial Hybrid Cooling Grid Forming ESS User Manual** • **HUAWEI LUNA2000-(107-241) Series Commercial and Industrial Hybrid Cooling Grid Forming ESS Quick Guide** • **HUAWEI LUNA2000-(107-241) Series Commercial and Industrial Hybrid Cooling Grid Forming ESS Maintenance Manual**

Device	Document
Inverter	• **SUN2000-(20KTL, 29.9KTL, 30KTL, 36KTL, 40KTL)-M3 Series User Manual** • **SUN2000-(20KTL, 29.9KTL, 30KTL, 36KTL, 40KTL)-M3 Series Quick Guide** • **SUN2000-(20KTL-M3, 33KTL-NH, 40KTL-NH) User Manual** • **SUN2000-(20KTL-M3, 33KTL-NH, 40KTL-NH) Quick Guide** • **SUN2000-(50KTL-ZHM3, 50KTL-M3, 50KTL-BRM3) User Manual** • **SUN2000-(50KTL-ZHM3, 50KTL-M3, 50KTL-BRM3) Quick Guide** • **SUN2000-50KTL-NHM3 User Manual** • **SUN2000-50KTL-NHM3 Quick Guide** • **SUN2000-(50KTL, 60KTL, 65KTL)-M0 User Manual** • **SUN2000-(50KTL, 60KTL, 65KTL)-M0 Quick Guide** • **SUN2000-(50KTL-JPM0, 50KTL-JPM1, 63KTL-JPM0) User Manual** • **SUN2000-(50KTL-JPM0, 50KTL-JPM1, 63KTL-JPM0) Quick Guide** • **SUN2000-(75KTL, 100KTL, 110KTL, 125KTL) Series User Manual** • **SUN2000-(75KTL, 100KTL, 110KTL, 125KTL) Series Quick Guide** • **SUN2000-(75KTL-M1, 100KTL-M2, 110KTL-M2, 115KTL-M2) User Manual** • **SUN2000-(100KTL, 110KTL)-M2 Quick Guide (STAUBLI)** • **SUN2000-(75KTL-M1, 100KTL-M2, 110KTL-M2, 115KTL-M2) Quick Guide (Amphenol)** • **SUN2000-111KTL-NHM0 User Manual (large current)** • **SUN2000-111KTL-NHM0 Quick Guide (large current)** • **SUN2000-(50K, 75K, 80K, 150K)-MG Series User Manual** • **SUN2000-(50K, 75K, 80K, 150K)-MG Series Quick Guide** • **SUN5000-(150K-MG0-ZH,150K-MG0) User Manual** • **SUN5000-(150K-MG0-ZH, 150K-MG0) Quick Guide** • **SUN2000-50K-MC0 User Manual** • **SUN2000-50K-MC0 Quick Guide** • **SUN2000-(30K, 40K)-MC0 Series User Manual** • **SUN2000-(30K, 40K)-MC0 Series Quick Guide**

Device	Document
SUN2000P	• **HUAWEI MERC-(1300W, 1100W)-P Smart PV Optimizer User Manual** • **HUAWEI MERC-(1300W, 1100W)-P Smart PV Optimizer Quick Guide** • **SUN2000 Smart PV Optimizer User Manual** • **SUN2000-(600W-P, 450W-P2) Smart PV Optimizer Quick Guide** • **SUN2000-450W-P Smart PV Optimizer Quick Guide**
SmartMGC	• **SmartMGC5000 User Manual** • **SmartMGC5000 Quick Guide**
Power meter	• **DTSU666-HW Smart Power Sensor Quick Guide** • **YDS60-80 Smart Power Sensor Quick Guide** • **DTSU71C Smart Power Sensor Quick Guide** • **DHSU1079-ZT Smart Power Sensor Quick Guide**

G Digital Power Customer Service

https://digitalpower.huawei.com/robotchat/

H Contact Information

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

https://digitalpower.huawei.com

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

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

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

NOTE

EU Representative Information: Huawei Technologies Hungary Kft.

Add.: HU-1133 Budapest, Váci út 116-118., 1. Building, 6. floor.

Email: hungary.reception@huawei.com

I Acronyms and Abbreviations

A

ACB	air circuit breaker
ATS	automatic transfer switch

C

CT	current transformer

D

DHCP	Dynamic Host Configuration Protocol

E

EMS	energy management system
ESS	energy storage system

F

FE	fast Ethernet

M

MCCB	molded case circuit breaker

P

PCS	power control system
PT	potential transformer

S

SFP	small form-factor pluggable
SOC	state of charge
SOH	state of health

T

TOU	time-of-use pricing

U

UPS	uninterruptible power supply

V

VCB	vacuum circuit breaker

