Commercial and Industrial Microgrid Energy Storage Solution

Quick Guide (With SmartLogger-based Microgrid Control)

Issue 02

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About This Document

Purpose

This document describes the networking architecture, communication logic, operation and maintenance (O&M) methods, installation, cable connection, check and preparation before power-on, and system commissioning, power-off, and power-on operations of the commercial and industrial (C&I) microgrid energy storage solution with the microgrid control function implemented by the SmartLogger.

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 **A Reference Documents**.

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.

Symbol	Description
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 in earlier issues.

Issue 02 (2024-04-12)

Added **1.1.2 On/Off-Grid PV+ESS (VSG) System**.

Updated **1.2 Communication Logic**.

Updated **2 Installation and Cable Connection**.

Updated **3 Check and Preparation Before Power-On**.

Added **4.1.2 On/Off-Grid PV+ESS (VSG) System**.

Added **4.2.2 Software Upgrade**.

Updated **4.2.3 Preparations Before Deployment**.

Updated **4.2.4 Commissioning Using the Deployment Wizard**.

Updated **5 Microgrid Control**.

Issue 01 (2023-12-18)

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

Contents

1 Solution Introduction

NOTICE

- When the microgrid control function implemented by the SmartLogger is enabled, it is not recommended that northbound dispatch be delivered during off-grid operation.
- When the microgrid control function implemented by the SmartLogger is enabled, the SOC during charge/discharge operations shall range from 10% to 90% in VSG mode.
- When the microgrid control function implemented by the SmartLogger is enabled in the on/off-grid (VSG) scenario, the synchronous switching from off-grid to on-grid may fail if the steady-state frequency fluctuation of the grid exceeds ±0.2 Hz.
- When the microgrid control function implemented by the SmartLogger is enabled, only one grid connection point and one SmartLogger are supported.
- An insulation monitoring device (IMD) must be configured in microgrid scenarios (on/off-grid and off-grid). If no IMD is configured, safety risks exist in the ESS and the ESS restarts every 24 hours to perform the offline insulation resistance detection to ensure the ESS safety. During the restart, the microgrid cannot supply power to loads, resulting in microgrid collapses.
- During off-grid operation, the load requirements are as follows:
  1. The instantaneous peak current (basic current + inrush current) upon load connection and disconnection shall not exceed 1.1 times of the PCS rated current.
  2. The total rated capacity of all loads shall not exceed 2/3 of the PCS rated capacity.
  3. Motor load constraints: The load of motors that use direct on line (DOL) starters or star-delta starters shall not exceed 1/10 of the PCS rated power. The load of motors that use variable frequency drives or soft starters shall not exceed 2/3 of the PCS rated power. If the PCS carries load, the load of motors to be connected and disconnected shall be decreased accordingly in the same proportion.
  4. Isolation transformer: The isolation transformer equipped for the PCS must be started together with the PCS. Do not start the PCS before switching on the isolation transformer.

5. Transformers on the load side (excluding isolation transformers): The load-side transformers less than or equal to 1/2 of the PCS rated power can be connected and disconnected independently, and those greater than 1/2 of the PCS rated power shall be started together with the PCS.
6. Even harmonic load constraints: When the excitation reactive power of the PCS transformer reaches 2.5 kvar (1/40 of the PCS rated power), 1/40 even harmonics (calculated based on the typical 200 kVA transformer parameters) are allowed. When the excitation reactive power of the PCS transformer reaches 5 kvar or above (1/20 of the PCS rated power), 1/20 even harmonics (calculated based on the typical 200 kVA transformer parameters) are allowed. When the PCS has no output fundamental wave current, loads with even harmonics cannot be connected.

1.1 Networking Architecture

The C&I microgrid energy storage solution has the following networking architectures: on/off-grid PV+ESS (PQ/VSG) system, on/off-grid PV+ESS (VSG) system, and off-grid PV+ESS system.

1.1.1 On/Off-Grid PV+ESS (PQ/VSG) System

The on/off-grid PV+ESS (PQ/VSG) system applies to C&I campuses where the power grid capacity is insufficient, capacity expansion is difficult, or power is limited during peak hours.

In this system, the ESS is AC-coupled with the PV system through an isolation transformer. The microgrid system is connected to or disconnected from the power grid through an on/off-grid switch. When the system is off-grid, the ESS functions as the main power supply to support the power grid, and also supplies power together with the PV system to critical loads.

Figure 1-1 shows the networking architecture of the on/off-grid PV+ESS (PQ/VSG) system. **Table 1-1** lists the components.

Figure 1-1 Networking architecture of the on/off-grid PV+ESS (PQ/VSG) system

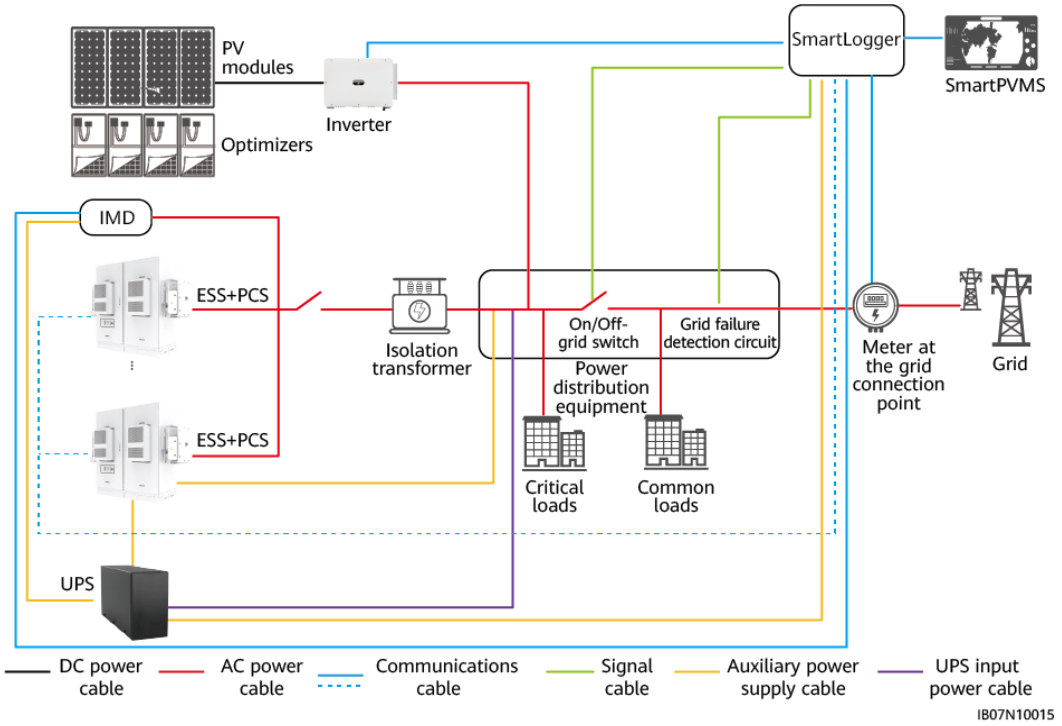


Table 1-1 Components of the on/off-grid PV+ESS (PQ/VSG) system

Name	Model/Specifications	Quantity	Remarks
Smart String Energy Storage System (ESS)	• LUNA2000-200KWH-2H1 • LUNA2000-161KWH-2H1 • LUNA2000-129KWH-2H1 • LUNA2000-97KWH-1H1	≤ 20	Purchased from the Company
Smart Power Control System (PCS)	LUNA2000-100KTL-M1	≤ 20	Purchased from the Company. The quantity ratio of PCS to ESS is 1:1.

Name	Model/Specifications	Quantity	Remarks
Smart PV inverter (inverter)	• SUN2000-29.9KTL-M3 • SUN2000-30KTL-M3 • SUN2000-36KTL-M3 • SUN2000-40KTL-M3 • SUN2000-33KTL-NH • SUN2000-40KTL-NH • SUN2000-50KTL-M3 • SUN2000-50KTL-ZHM3 • SUN2000-50KTL-NHM3 • SUN2000-50KTL-M0 • SUN2000-60KTL-M0 • SUN2000-50KTL-JPM0 • SUN2000-63KTL-JPM0 • SUN2000-75KTL-M1 • SUN2000-100KTL-M1 • SUN2000-110KTL-INM0 • SUN2000-111KTL-NHM0 • SUN2000-100KTL-M2 • SUN2000-110KTL-M2 • SUN2000-115KTL-M2	≤ 30	Purchased from the Company. Inverters of different models shall not be used together. Inverters from the Company shall not be used together with those from other vendors. In the on/off-grid (PQ/VSG) scenario, the maximum capacity ratio of inverter to PCS is 2:1.

Name	Model/Specifications	Quantity	Remarks
Smart PV Optimizer (SUN2000P)	• SUN2000-450W-P2 • SUN2000-600W-P • MERC-1300W-P • MERC-1100W-P	Depending on the actual quantity of PV modules	Purchased from the Company (optional). Only SUN2000-29.9KTL-M3, SUN2000-30KTL-M3, SUN2000-36KTL-M3, SUN2000-40KTL-M3, SUN2000-33KTL-NH, and SUN2000-40KTL-NH support the SUN2000P. SUN2000-50KTL-M3, SUN2000-50KTL-ZHM3, and SUN2000-50KTL-NHM3 support MERC-1300W-P or MERC-1100W-P.
SmartLogger 3000C01 (SmartLogger)	SmartLogger3000C01	1	Purchased from the Company. There is no model restriction in China Region and Japan.
SmartModule	SmartModule1000A01	Depending on the actual networking architecture	Purchased from the Company (optional). The SmartModule is used with the SmartLogger.

Name	Model/Specifications	Quantity	Remarks
Network switch	• Unmanaged switch • 10M/100M auto-sensing RJ45 ports • Industrial-grade operating temperature range: –40°C to +75°C, or otherwise determined based on local conditions • Dual power ports with a wide voltage input range: 9–60 V DC • Guide rail mounting and wall mounting; IP30 above	Depending on the actual networking architecture	Prepared by the customer (optional)
Meter at the grid connection point	DTSU666-HW or YDS60-80	1	Purchased from the Company
FusionSolar Smart PV Management System (SmartPVMS)	iMaster NetEco V600R023C00CP2101 and later versions	1	Purchased from the Company (optional)
Power distribution equipment (including the on/off-grid switch and grid failure detection circuit)	• The on/off-grid switch supports remote signal feedback and remote control. • The grid failure detection circuit supports remote signal feedback.	1	Prepared by the customer. If **On/Off-grid switching mode** is set to **Manual** or **No control**, the on/off-grid switch does not need to be remotely controlled and the grid failure detection circuit does not need to be configured.
Isolation transformer	400/400 V, Dyn11, 1.1 times long-term operation, 50 Hz/60 Hz	1	Prepared by the customer

Name	Model/Specifications	Quantity	Remarks
UPS	• 1–3 kVA, online UPS, 220 V • Power backup duration ≥ 1 hour • 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.	1	Prepared by the customer
IMD	DOLD RN5897.12/011, used with the coupler DOLD RP5898/61	1	Prepared by the customer. Do not connect the measurement cable of the IMD to circuit breakers or switches to prevent the measurement loop from being disconnected.

1.1.2 On/Off-Grid PV+ESS (VSG) System

The on/off-grid PV+ESS (VSG) system applies to C&I campuses where the power grid capacity is insufficient, capacity expansion is difficult, or power is limited during peak hours.

In this system, the ESS is AC-coupled with the PV system through an isolation transformer. The microgrid system is connected to or disconnected from the power grid through an on/off-grid switch controlled by a relay protection device. When the system is off-grid, the ESS functions as the main power supply to support the power grid, and also supplies power together with the PV system to critical loads.

Figure 1-2 and **Figure 1-3** show the networking architecture of the on/off-grid PV +ESS (VSG) system. **Table 1-2** lists the components.

Figure 1-2 Networking architecture of the on/off-grid PV+ESS (VSG) system (with genset controlled by ATS)

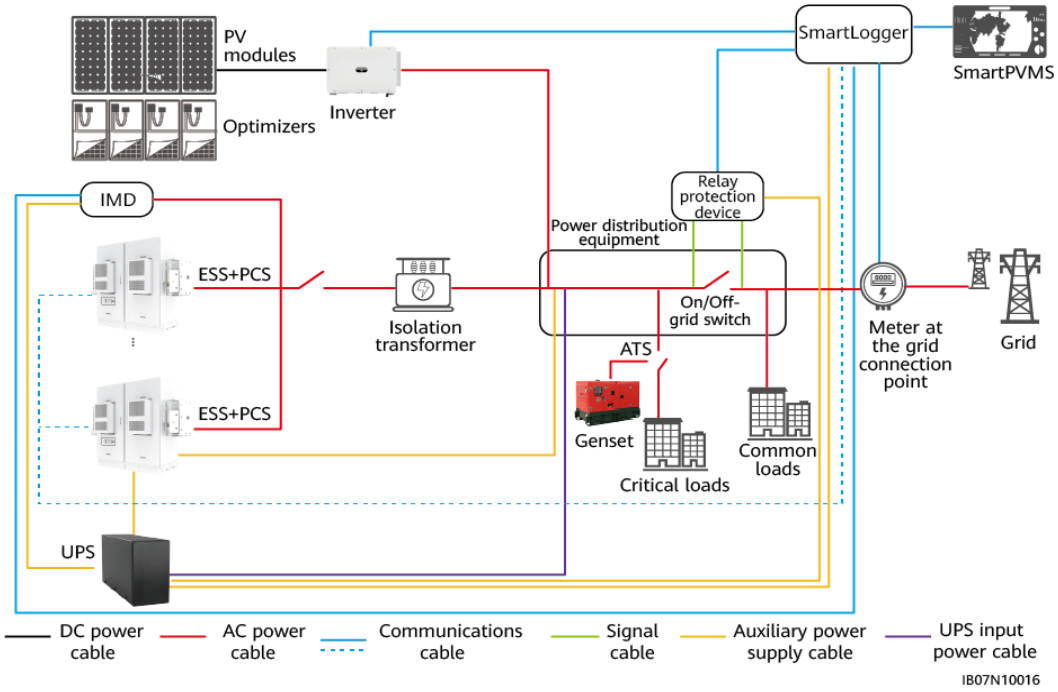


Figure 1-3 Networking architecture of the on/off-grid PV+ESS (VSG) system (with genset controlled by SmartLogger)

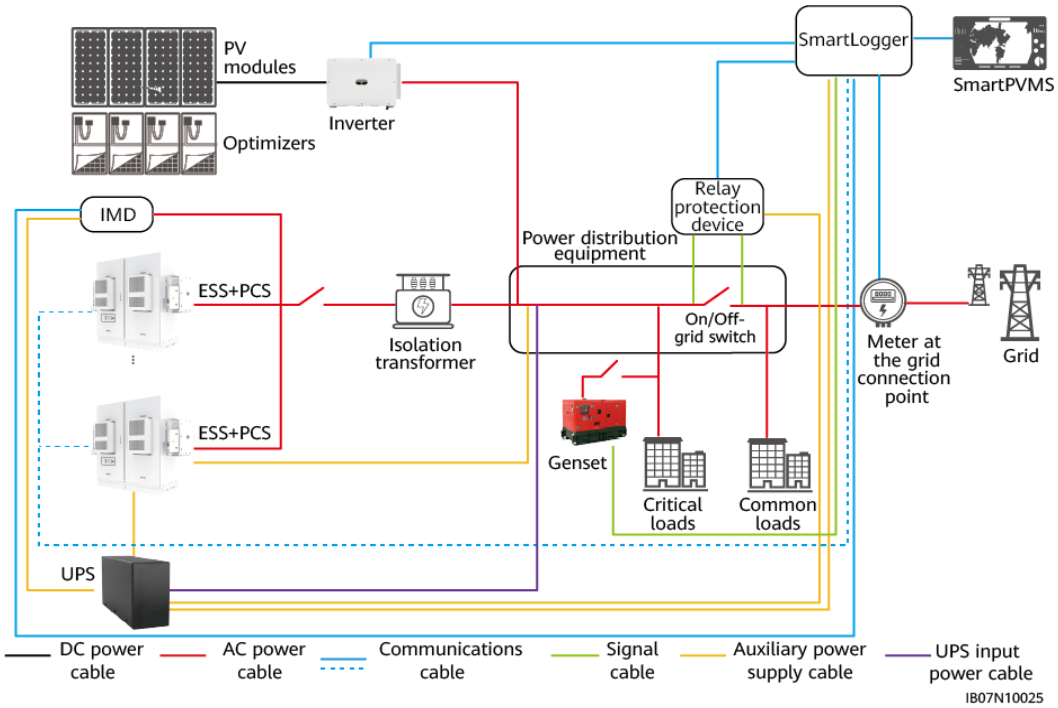


Table 1-2 Components of the on/off-grid PV+ESS (VSG) system

Name	Model/ Specifications	Quantity	Remarks
Smart String Energy Storage System (ESS)	• LUNA2000-200KWH-2H1 • LUNA2000-161KWH-2H1 • LUNA2000-129KWH-2H1 • LUNA2000-97KWH-1H1	≤ 20	Purchased from the Company
Smart Power Control System (PCS)	LUNA2000-100KTL-M1	≤ 20	Purchased from the Company. The quantity ratio of PCS to ESS is 1:1.

Name	Model/ Specifications	Quantity	Remarks
Smart PV inverter (inverter)	• SUN2000-29.9KTL-M3 • SUN2000-30KTL-M3 • SUN2000-36KTL-M3 • SUN2000-40KTL-M3 • SUN2000-33KTL-NH • SUN2000-40KTL-NH • SUN2000-50KTL-M3 • SUN2000-50KTL-ZHM3 • SUN2000-50KTL-NHM3 • SUN2000-50KTL-M0 • SUN2000-60KTL-M0 • SUN2000-50KTL-JPM0 • SUN2000-63KTL-JPM0 • SUN2000-75KTL-M1 • SUN2000-100KTL-M1 • SUN2000-110KTL-INM0 • SUN2000-111KTL-NHM0 • SUN2000-100KTL-M2 • SUN2000-110KTL-M2 • SUN2000-115KTL-M2	≤ 30	Purchased from the Company. Inverters of different models shall not be used together. Inverters from the Company shall not be used together with those from other vendors. In the on/off-grid (VSG) scenario, the maximum capacity ratio of inverter to PCS is 1:1.

Name	Model/ Specifications	Quantity	Remarks
Smart PV Optimizer (SUN2000P)	• SUN2000-450W-P2 • SUN2000-600W-P • MERC-1300W-P • MERC-1100W-P	Depending on the actual quantity of PV modules	Purchased from the Company (optional). Only SUN2000-29.9KTL-M3, SUN2000-30KTL-M3, SUN2000-36KTL-M3, SUN2000-40KTL-M3, SUN2000-33KTL-NH, and SUN2000-40KTL-NH support the SUN2000P. SUN2000-50KTL-M3, SUN2000-50KTL-ZHM3, and SUN2000-50KTL-NHM3 support MERC-1300W-P or MERC-1100W-P.
SmartLogger	SmartLogger3000C01	1	Purchased from the Company. There is no model restriction in China Region and Japan.
SmartModule	SmartModule1000A01	1	Purchased from the Company (mandatory). The SmartModule is used with the SmartLogger.
Network switch	• Unmanaged switch • 10M/100M auto-sensing RJ45 ports • Industrial-grade operating temperature range: –40°C to +75°C, or otherwise determined based on local conditions • Dual power ports with a wide voltage input range: 9–60 V DC • Guide rail mounting and wall mounting; IP30 above	Depending on the actual networking architecture	Prepared by the customer (optional)

Name	Model/ Specifications	Quantity	Remarks
Meter at the grid connection point	DTSU666-HW or YDS60-80	1	Purchased from the Company
FusionSolar Smart PV Management System (SmartPVMS)	iMaster NetEco V600R023C00CP2101 and later versions	1	Purchased from the Company (optional)
Relay protection device	• Schneider: Easergy P3U30-5AAA2BBA • Two groups of potential transformers and one group of current transformers are required.	1	Prepared by the customer
Power distribution equipment (including the on/off-grid switch)	-	1	Prepared by the customer
Isolation transformer	400/400 V, Dyn11, 1.1 times long-term operation, 50 Hz/60 Hz	1	Prepared by the customer
UPS	• 1–3 kVA, online UPS, 220 V • Power backup duration ≥ 1 hour • 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.	1	Prepared by the customer

Name	Model/ Specifications	Quantity	Remarks
IMD	DOLD RN5897.12/011, used with the coupler DOLD RP5898/61	1	Prepared by the customer. Do not connect the measurement cable of the IMD to circuit breakers or switches to prevent the measurement loop from being disconnected.
Genset	Three-phase	1	Prepared by the customer (optional). In the scenario where the genset is controlled by the SmartLogger, the genset must be a grid-connected model and equipped with a grid-connection switch that supports automatic switch-on/off.
Automatic transfer switch (ATS)	Dual power supply switching device	1	Prepared by the customer (optional)

1.1.3 Off-Grid PV+ESS System

The off-grid PV+ESS system applies to remote areas and islands without electricity. The ESS and the PV system are controlled and coordinated to supply power.

In this system, the ESS is AC-coupled with the PV system through an isolation transformer. The ESS functions as the main power supply for grid forming, and also supplies power together with the PV system to loads.

Figure 1-4 shows the networking architecture of the off-grid PV+ESS system. **Table 1-3** lists the components.

Figure 1-4 Networking architecture of the off-grid PV+ESS system

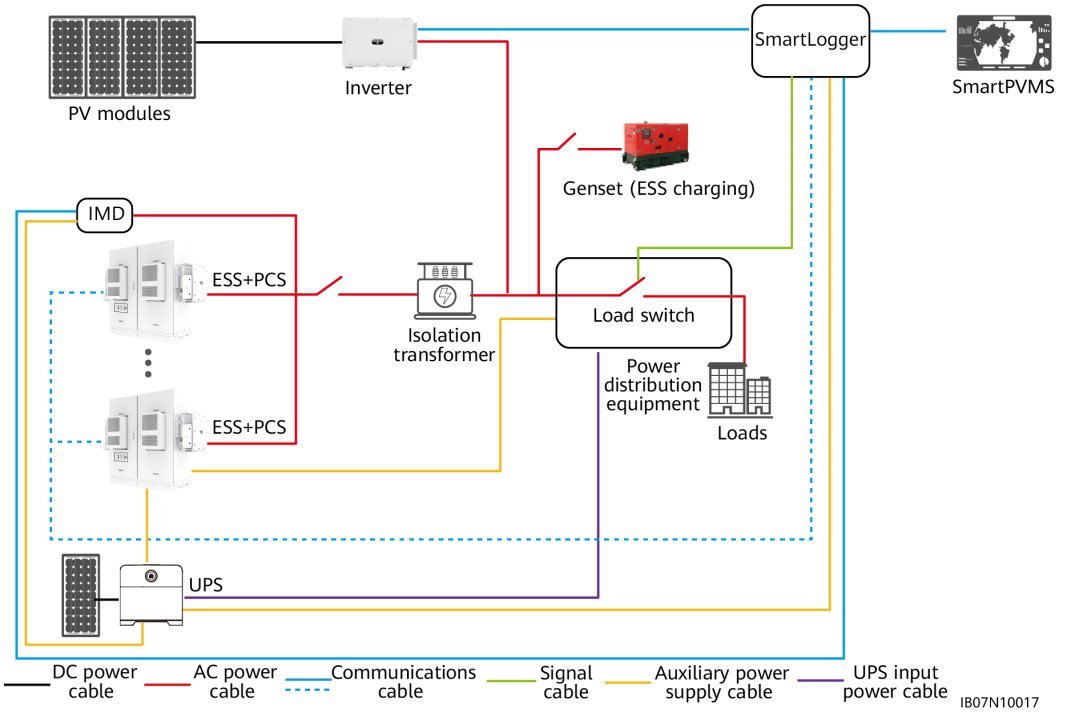


Table 1-3 Components of the off-grid PV+ESS system

Name	Model/Specifications	Quantity	Remarks
Smart String Energy Storage System (ESS)	• LUNA2000-200KWH-2H1 • LUNA2000-161KWH-2H1 • LUNA2000-129KWH-2H1 • LUNA2000-97KWH-1H1	≤ 20	Purchased from the Company
Smart Power Control System (PCS)	LUNA2000-100KTL-M1	≤ 20	Purchased from the Company. The quantity ratio of PCS to ESS is 1:1.

Name	Model/Specifications	Quantity	Remarks
Smart PV inverter (inverter)	• SUN2000-29.9KTL-M3 • SUN2000-30KTL-M3 • SUN2000-36KTL-M3 • SUN2000-40KTL-M3 • SUN2000-33KTL-NH • SUN2000-40KTL-NH • SUN2000-50KTL-M3 • SUN2000-50KTL-ZHM3 • SUN2000-50KTL-NHM3 • SUN2000-50KTL-M0 • SUN2000-60KTL-M0 • SUN2000-50KTL-JPM0 • SUN2000-63KTL-JPM0 • SUN2000-75KTL-M1 • SUN2000-100KTL-M1 • SUN2000-110KTL-INM0 • SUN2000-111KTL-NHM0 • SUN2000-100KTL-M2 • SUN2000-110KTL-M2 • SUN2000-115KTL-M2	≤ 30	Purchased from the Company. Inverters of different models shall not be used together. Inverters from the Company shall not be used together with those from other vendors. Optimizers are not supported. In the off-grid scenario, the maximum capacity ratio of inverter to PCS is 2:1.
SmartLogger	SmartLogger3000C01	1	Purchased from the Company. There is no model restriction in China Region and Japan.
SmartModule	SmartModule1000A01	Depending on the actual networking architecture	Purchased from the Company (optional). The SmartModule is used with the SmartLogger.

Name	Model/Specifications	Quantity	Remarks
Network switch	• Unmanaged switch • 10M/100M auto-sensing RJ45 ports • Industrial-grade operating temperature range: –40°C to +75°C, or otherwise determined based on local conditions • Dual power ports with a wide voltage input range: 9–60 V DC • Guide rail mounting and wall mounting; IP30 above	Depending on the actual networking architecture	Prepared by the customer (optional)
FusionSolar Smart PV Management System (SmartPVMS)	iMaster NetEco V600R023C00CP2101 and later versions	1	Purchased from the Company (optional)
Power distribution equipment (including the load switch)	The load switch supports remote signal feedback and remote control.	1	Prepared by the customer
Isolation transformer	400/400 V, Dyn11, 1.1 times long-term operation, 50 Hz/60 Hz	1	Prepared by the customer
UPS	• iSitePower-M-(MAP05A1, MAB05B1) or devices with the same functions • Power: ≥ 5 kVA • Power backup duration ≥ 1 hour	1	Prepared by the customer

Name	Model/Specifications	Quantity	Remarks
IMD	DOLD RN5897.12/011, used with the coupler DOLD RP5898/61	1	Prepared by the customer. Do not connect the measurement cable of the IMD to circuit breakers or switches to prevent the measurement loop from being disconnected.
Genset	Three-phase	-	Prepared by the customer (optional)

1.2 Communication Logic

One SmartLogger manages multiple ESSs, PCSs, inverters, one IMD, and one meter to form an array. In the array:

- The inverters communicate with the SmartLogger, the IMD communicates with the SmartLogger, and the meter communicates with the SmartLogger over RS485.
- The ESSs communicate with the SmartLogger over FE in star or chain topology.
- The PCSs communicate with the SmartLogger over FE in star or ring topology.

The maximum communication distance of the SmartLogger is as follows:

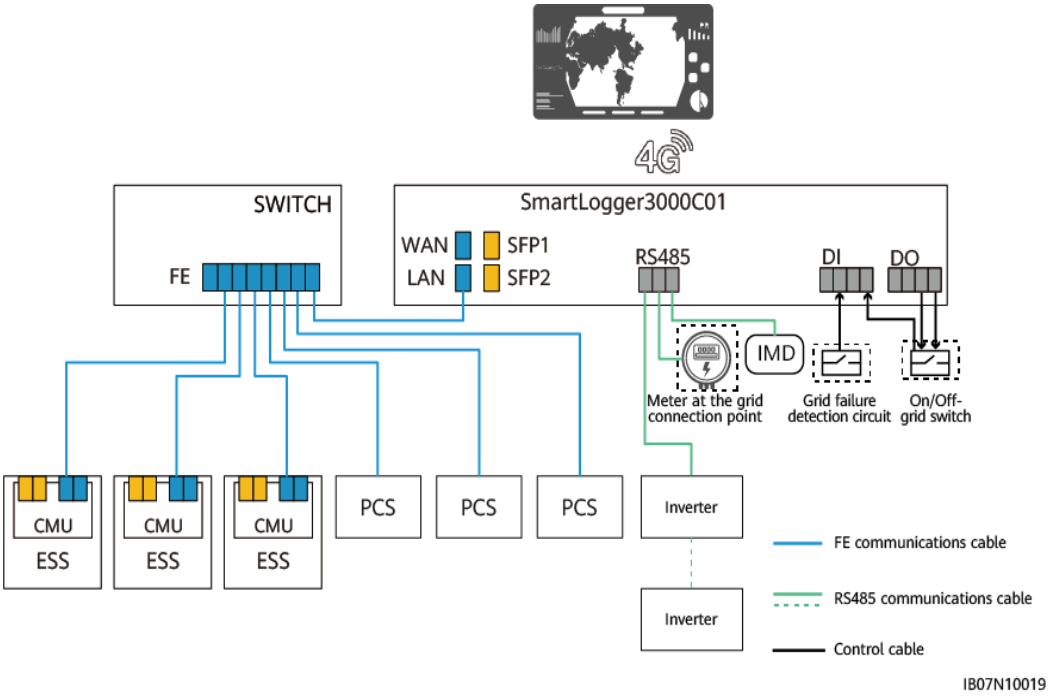
- RS485: 1000 m
- FE: 100 m

Select either of the following topologies based on the quantities of ESSs and PCSs in the array as well as the deployment of optical fibers.

Typical Scenario 1: SmartLogger+ESS FE Star+PCS FE Star Topology

In this scenario, the SmartLogger3000C01 is configured, and the customer needs to prepare at least one network switch (quantity of 10M/100M auto-sensing Ethernet ports ≥ 8). The quantities of network switches and Ethernet ports are configured based on the quantities of ESSs and PCSs connected to the array.

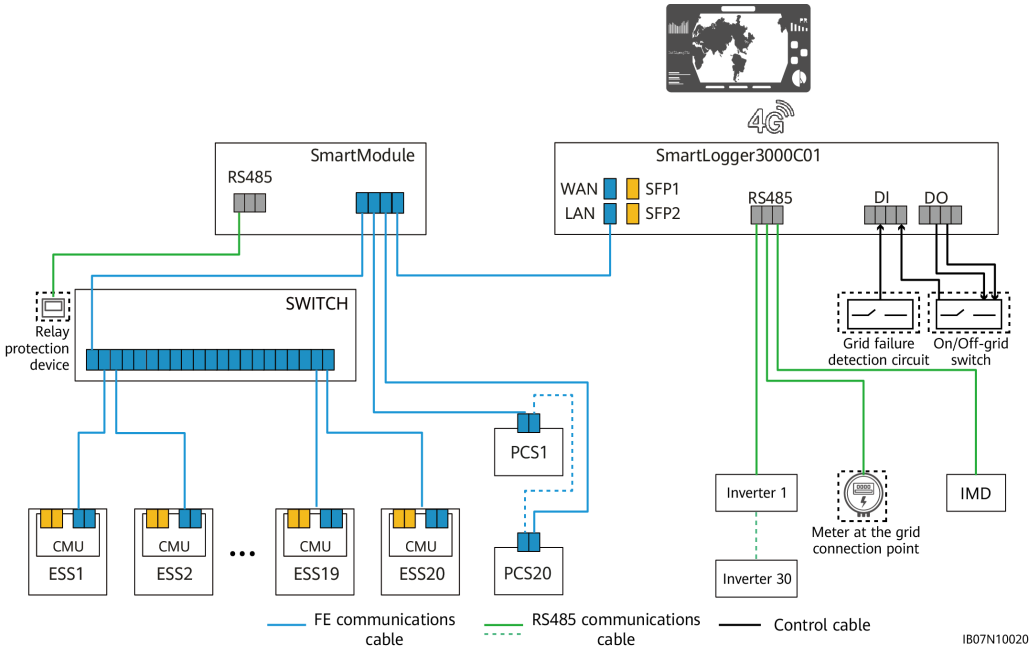
Figure 1-5 SmartLogger+ESS FE star+PCS FE star topology (the devices in the dotted boxes are optional)



Typical Scenario 2: SmartLogger+ESS FE Star+PCS FE Ring Topology

In this scenario, the SmartLogger3000C01 is configured, and the customer needs to prepare at least one network switch (10M/100M). The quantities of network switches and Ethernet ports are configured based on the quantities of ESSs and PCSs connected to the array. In the PCS FE ring topology, a single FE ring network supports a maximum of 20 PCSs.

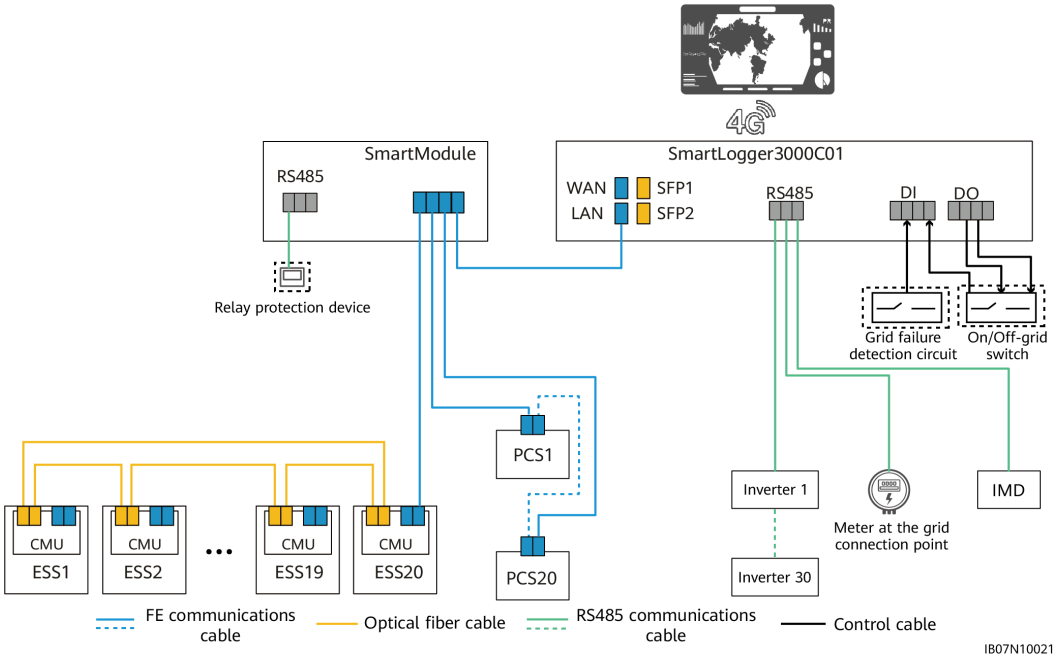
Figure 1-6 SmartLogger+ESS FE star+PCS FE ring topology (the devices in the dotted boxes are optional)



Typical Scenario 3: SmartLogger+ESS Fiber Ring+PCS FE Ring Topology

In this scenario, the SmartLogger3000C01 and SmartModule are configured, and the customer needs to prepare at least one network switch (10M/100M). The SmartLogger3000C01 communicates with the first ESS over FE. ESSs are cascaded over SFP optical fibers. A maximum of 20 ESSs are supported in a fiber ring network. In the PCS FE ring topology, a single FE ring network supports a maximum of 20 PCSs.

Figure 1-7 SmartLogger+ESS FE fiber ring+PCS FE ring topology (the devices in the dotted boxes are optional)



1.3 O&M Methods

Table 1-4 O&M methods

O&M Method	Description	Main Application Scenario	Reference Document
SmartLogger WebUI	A PC is connected to the SmartLogger in the SACU to manage the ESSs, PCSs, inverters, and meters in the array.	Deployment commissioning	SmartLogger3000 User Manual
SmartPVMS	The SmartPVMS is deployed on a public network. It displays the current and historical running status of power plants and supports intelligent alarm reporting, analysis, diagnosis, and O&M.	Viewing plant information and managing devices at a site after deployment and commissioning	iMaster NetEco V600R023C00 FusionSolar SmartPVMS User Manual
Local app	The app is locally connected to the PCS, the CMU of the ESS, and the inverter to locally manage a single PCS, ESS, and inverter.	• Modifying the parameters of a single device locally • Upgrading the software version of a single device locally	FusionSolar App User Manual

2 Installation and Cable Connection

This section describes the process, precautions, and connections for installing devices and connecting cables in the solution. For details, see the user manuals or quick guides of the corresponding devices. To obtain the documents, see **A Reference Documents**.

Table 2-1 Device installation and cable connection process

Step	Task	Precaution
1	Installing the ESS	• Ensure that the foundation levelness meets the requirements (deviation ≤ 3 mm). • You are advised to use a forklift and battery installation tray kit to install battery packs. The kit is not delivered with the product and needs to be purchased separately from the Company. • When installing battery copper bars: – Manually insert the nut into the screw plate, and then use an insulated torque socket wrench with an extension rod to completely secure the nut in place. This prevents the screw thread from being stuck or stripped due to the deviation of the nut position. – Preinstall nuts with the recommended torque of 27 N·m. – After installing nuts, check that the torque is 27 N·m. Use a marker to mark the nuts after the torque is verified. • When connecting the UPS AC input power cable (5FCB): – Remove the short-circuiting bar from 1–2 and insert it to 2–3 on the XU terminal block. – Remove the short-circuiting bar from 4–5 and insert it to 5–6 on the XU terminal block.

Step	Task	Precaution
2	Installing the PCS	Install the PCS on the side of the ESS using the delivered mounting brackets (including M12 bolt assemblies).
3	Installing the inverter and SUN2000P	N/A
4	Installing the DTSU666-HW	N/A
5	Installing the SmartLogger	• If the on/off-grid switch is configured, ensure that the DI and DO cables to the on/off-grid switch are connected. • If the grid failure detection circuit is configured, ensure that the DI cable connected to the grid failure detection circuit is connected. • The DO port supports a maximum of 12 V signal voltage. The NC/COM is a normally closed contact and the NO/COM is a normally open contact. Recommended: DO signal transmission distance ≤ 10 m. • Recommended: DI signal transmission distance ≤ 10 m.
6	Installing PE cables	• The ground point inside the ESS must be connected, and the ground point outside the ESS is optional. • The ground point in the AC maintenance compartment of the PCS serves only as the equipotential bonding point of the PE point and cannot replace the PE point of the enclosure. • The ground points of all PCSs in the same array need to be connected to ensure equipotential bonding to ground cables. • To enhance the corrosion resistance of a ground terminal, you are advised to apply silicone grease or paint on it after connecting the ground cable.
7	Installing DC power cables	• DC power cables (with corrugated pipes) between the ESS and PCS are delivered with the ESS. • Reserve sufficient length for the DC power cables between the ESS and the PCS, and add angle steel in the middle of the foundation to support the cables and reduce the stress on the cables.

Step	Task	Precaution
8	Installing AC power cables	• When the inverters and PCSs are connected in parallel respectively on the two sides of the isolation transformer, the cable length between each PCS and the parallel connection point must be greater than or equal to 6 m. • AC power cables must be connected in the correct phase sequence. Ensure that the phase sequence of the AC power cables of the PCS is consistent with that of the isolation transformer and power grid. Otherwise, the system may fail to run properly.
9	Installing communications cables	For details about the cable connections, see **1.2 Communication Logic**.

3 Check and Preparation Before Power-On

NOTICE

Do not open the cabinet door when the humidity is high (relative humidity ≥ 80% continuously), for example, on rainy days. If the cabinet door is open for 0.5 hour or longer when the humidity is high, manually perform forced dehumidification in off-grid and on/off-grid scenarios. Otherwise, the equipment may fail or the microgrid may collapse. Perform dehumidification as follows:

1. Check that the auxiliary AC power supply to the ESS is powered on. In off-grid scenarios, the genset or other external auxiliary power supply is used. In on/off-grid scenarios, the power grid supplies auxiliary power when available.
2. Log in to the SmartLogger WebUI and choose **Monitoring** > **ESS** > **CMU** > **Running Param.**
3. Choose **Temper And Hum > Control mode**, set **Control mode** to **Manual**, and submit the settings.
4. Click **Starting up** and confirm the operation to start forced dehumidification. View the alarm information to check that the system has started forced dehumidification. The alarm will be automatically cleared after the dehumidification is complete, which takes about 10 to 20 minutes.

Step 1 Perform the check before power-on by referring to the "Check Before Power-On" section in the user manual of each device.

NOTICE

Ensure that cables are correctly and securely connected to the IMD according to the IMD user manual. If cables are incorrectly connected or in poor contact, the IMD cannot work properly and the insulation resistance detection function fails.

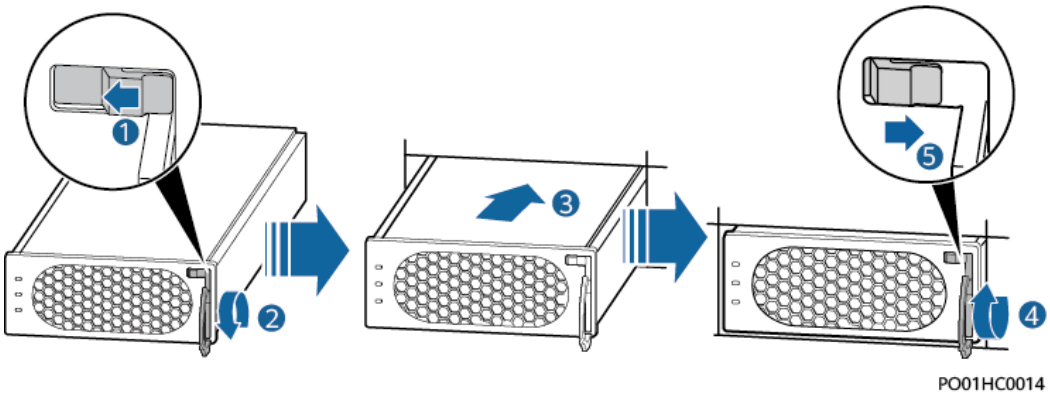
Step 2 Check whether the phase sequence of the AC power cables between the PCS and the isolation transformer is consistent. If not, adjust the wiring sequence of the AC power cables.

Step 3 Install the PSU in the ESS.

CAUTION

In an outdoor scenario, you are advised to power on the PSU within 24 hours after unpacking. If the PSU cannot be powered on in time, place it in a dry indoor environment without corrosive gas.

Figure 3-1 Installing the PSU



Step 4 Check the switch status.

1. Check that the switches on both sides of the isolation transformer are off.
2. Check that the switch between the PCS AC side and the isolation transformer and that the switch between the inverter AC side and the isolation transformer are turned off.

Step 5 Perform the ESS fire suppression system acceptance test.

CAUTION

System power-on and commissioning can be performed only after the ESS fire suppression system passes the acceptance test.

1. Remove foreign objects from the ESS, collect auxiliary materials, and take away flammable objects such as cardboards.
2. Perform the following steps to power on the ESS auxiliary power supply:
   - On-grid scenario: The power grid supplies power to the UPS, and the UPS supplies power to the CMU of the ESS and the SmartLogger.
   - Off-grid scenario: The UPS supplies power to the CMU of the ESS and the SmartLogger.
3. Log in to the SmartLogger WebUI. The following alarms shall not be generated. If any of the following alarms is generated, clear the alarm according to the alarm handling suggestions:
   - 3826 Combustible Gas Alarm
   - 3832 Fire Alarm
   - 3831 Built-in Fire Suppression Module Pressure Low
   - 3847 Built-in Fire Suppression Pressure Low for Extended Periods

- 3838 T/H Sensor Communication Failure
- 3840 CO Sensor Communication Failure
- 3850 Combustible Gas Detection Malfunction

4. Check whether the reading of the pressure gauge on the rack mounted fire extinguishing system is normal.
5. Remove the communications cables between the rack mounted fire extinguishing system and the CMU. The SmartLogger WebUI shall report related alarms.

----End

4 System Power-On and Commissioning

CAUTION

During the power-on procedure, power off the batteries immediately if any fault is detected. Rectify the fault before proceeding with the procedure.

4.1 Device Power-On

4.1.1 On/Off-Grid PV+ESS (PQ/VSG) System

Power on the on/off-grid PV+ESS (PQ/VSG) system when an external power supply is available.

Figure 4-1 Power-on process of the on/off-grid PV+ESS (PQ/VSG) system

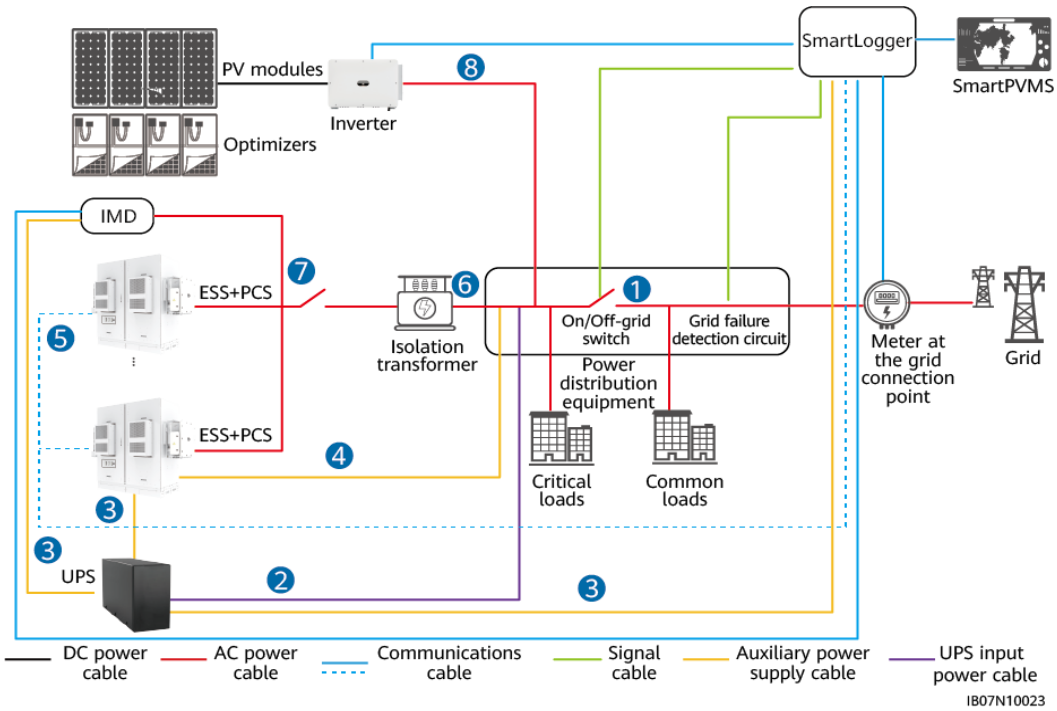


Table 4-1 Power-on process description of the on/off-grid PV+ESS (PQ/VSG) system

Step	Task	Power-On Operation
1	Powering on the power distribution equipment	1. Turn on the on/off-grid switch in the power distribution equipment. 2. Turn on the switch of the grid failure detection circuit 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-ESS auxiliary power supply (for black start)	1. Turn on the ESS power switch on the UPS side. 2. Turn on the UPS cable inlet switch 5FCB in the ESS.
	Powering on the UPS-SmartLogger auxiliary power supply	1. Turn on the SmartLogger power switch on the UPS side. 2. Turn on the switch on the SmartLogger side: Turn on the power switch (if any) between the SmartLogger and the UPS based on site requirements.
	Powering on the UPS-IMD auxiliary power supply	Turn on the IMD power switch on the UPS side.

Step	Task	Power-On Operation
4	Powering on the ESS auxiliary power supply (such as for the air conditioners)	1. Turn on the ESS auxiliary power switch on the power distribution equipment side. 2. Use a multimeter to check that the AC voltage is within the allowed range (220 V ±10%). Then turn on the main AC switch 1FCB in the ESS. 3. Turn on the switches of the ESS power distribution system. a. Turn on the 12 V adapter switch 1FCB1. b. Turn on the PSU switch 1FCB2. c. (Optional) Turn on the 220 V maintenance socket switch 1FB1. d. On the embedded power subrack (SK1), turn on the DC/DC switch 2FCB1, DC light power switch 2FCB2, TCUE power switch 2FCB3, fan 1 switch 2FCB6, fan 2 switch 2FCB7, air conditioner 1 switch 2FCB8, and air conditioner 2 switch 2FCB9 in sequence. e. Use a multimeter to check that the output voltage of the embedded power subrack (SK1) is 53 V±5 V.
5	Powering on the ESS-Smart Rack Controller	Turn on DC switch 1Q1 in the ESS (on the battery rack side).
	Powering on the Smart Rack Controller-PCS	Turn on DC switch 1Q2 in the ESS.
6	Powering on the isolation transformer	For details, see the documents provided by the vendor.
7	Powering on the PCS	Turn on the AC switch between the PCS and the isolation transformer.

Step	Task	Power-On Operation
8	Powering on the inverter	**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.		

4.1.2 On/Off-Grid PV+ESS (VSG) System

Power on the on/off-grid PV+ESS (VSG) system when an external power supply is available.

Figure 4-2 Power-on process of the on/off-grid PV+ESS (VSG) system

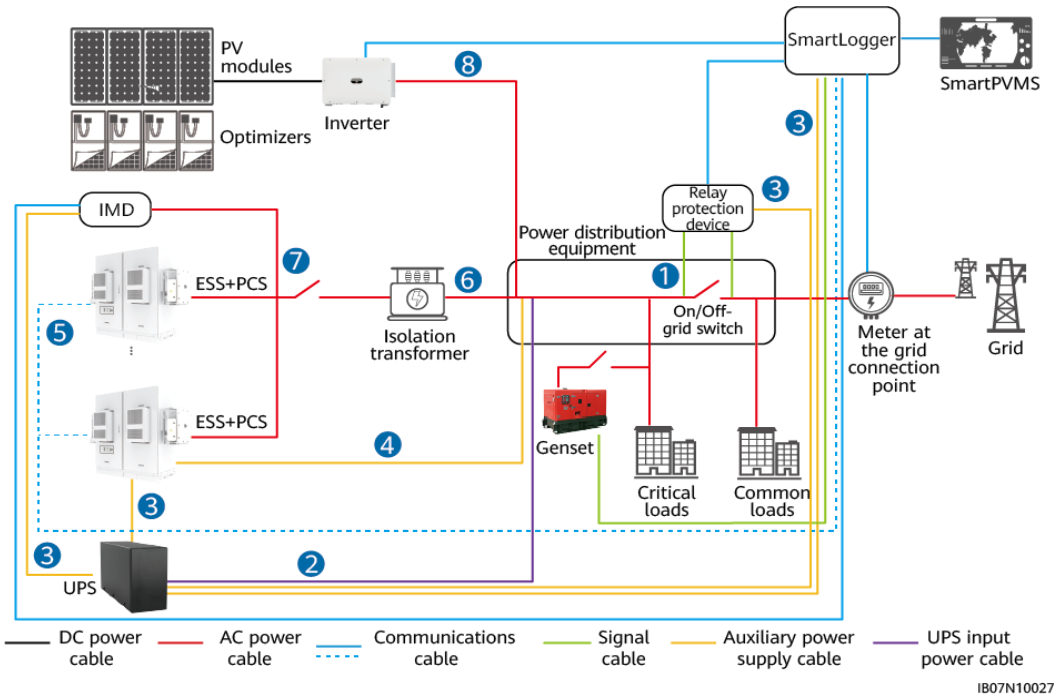


Table 4-2 Power-on process description of the on/off-grid PV+ESS (VSG) system

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-ESS auxiliary power supply (for black start)	1. Turn on the ESS power switch on the UPS side. 2. Turn on the UPS cable inlet switch 5FCB in the ESS.
	Powering on the UPS-SmartLogger auxiliary power supply	1. Turn on the SmartLogger power switch on the UPS side. 2. Turn on the switch on the SmartLogger side: Turn on the power switch (if any) between the SmartLogger and the UPS based on site requirements.
	Powering on the UPS-IMD auxiliary power supply	Turn on the IMD power switch on the UPS side.
	Powering on the UPS-relay protection device auxiliary power supply	Turn on the power switch of the relay protection device on the UPS side.

Step	Task	Power-On Operation
4	Powering on the ESS auxiliary power supply (such as for the air conditioners)	1. Turn on the ESS auxiliary power switch on the power distribution equipment side. 2. Use a multimeter to check that the AC voltage is within the allowed range (220 V ±10%). Then turn on the main AC switch 1FCB in the ESS. 3. Turn on the switches of the ESS power distribution system. a. Turn on the 12 V adapter switch 1FCB1. b. Turn on the PSU switch 1FCB2. c. (Optional) Turn on the 220 V maintenance socket switch 1FB1. d. On the embedded power subrack (SK1), turn on the DC/DC switch 2FCB1, DC light power switch 2FCB2, TCUE power switch 2FCB3, fan 1 switch 2FCB6, fan 2 switch 2FCB7, air conditioner 1 switch 2FCB8, and air conditioner 2 switch 2FCB9 in sequence. e. Use a multimeter to check that the output voltage of the embedded power subrack (SK1) is 53 V±5 V.
5	Powering on the ESS-Smart Rack Controller	Turn on DC switch 1Q1 in the ESS (on the battery rack side).
	Powering on the Smart Rack Controller-PCS	Turn on DC switch 1Q2 in the ESS.
6	Powering on the isolation transformer	For details, see the documents provided by the vendor.
7	Powering on the PCS	Turn on the AC switch between the PCS and the isolation transformer.

Step	Task	Power-On Operation
8	Powering on the inverter	**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.		

4.1.3 Off-Grid PV+ESS System

Power on the off-grid PV+ESS system when the UPS can supply power, the genset is not running, and the power distribution equipment has no power supply.

Figure 4-3 Power-on process of the off-grid PV+ESS system

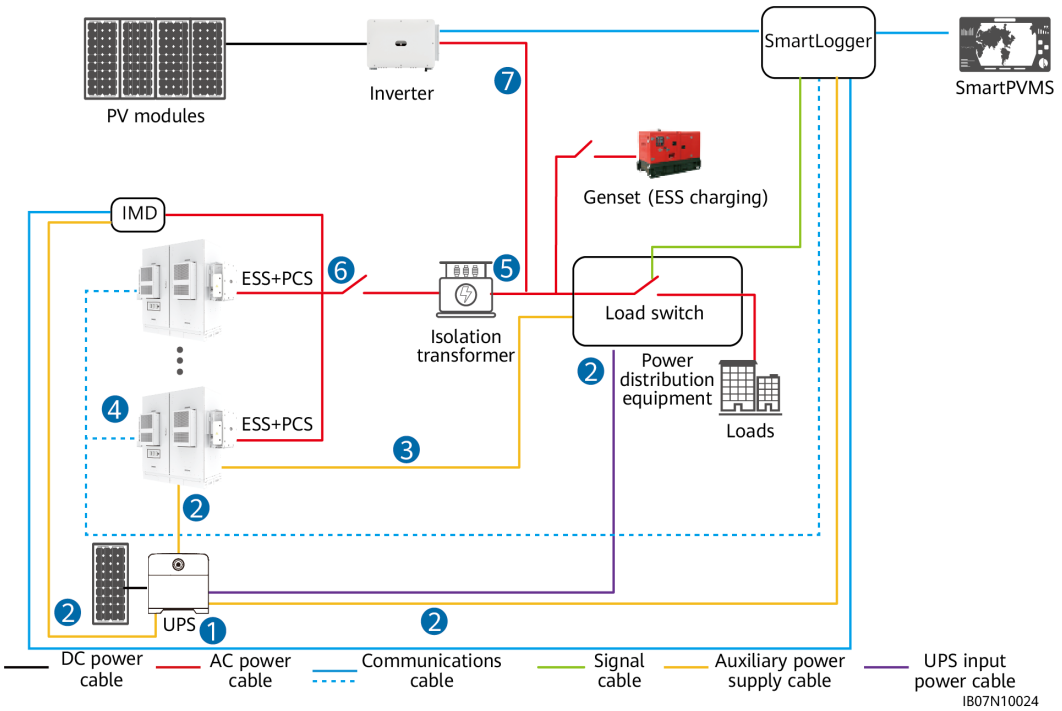


Table 4-3 Power-on process description of the off-grid PV+ESS system

Step	Task	Power-On Operation
1	Starting the UPS	For details, see the documents provided by the vendor.
2	-	Turn on the UPS power switch on the power distribution equipment side.
	Powering on the UPS-ESS auxiliary power supply (for black start)	1. Turn on the ESS power switch on the UPS side. 2. Turn on the UPS cable inlet switch 5FCB in the ESS.
	Powering on the UPS-SmartLogger auxiliary power supply	1. Turn on the SmartLogger power switch on the UPS side. 2. Turn on the switch on the SmartLogger side: Turn on the power switch (if any) between the SmartLogger and the UPS based on site requirements.
	Powering on the UPS-IMD auxiliary power supply	Turn on the IMD power switch on the UPS side.
3	Powering on the ESS auxiliary power supply (such as for the air conditioners)	1. Turn on the ESS auxiliary power switch on the power distribution equipment side. 2. Turn on the switches of the ESS power distribution system. a. Turn on the 12 V adapter switch 1FCB1. b. Turn on the PSU switch 1FCB2. c. (Optional) Turn on the 220 V maintenance socket switch 1FB1. d. On the embedded power subrack (SK1), turn on the DC/DC switch 2FCB1, DC light power switch 2FCB2, TCUE power switch 2FCB3, fan 1 switch 2FCB6, fan 2 switch 2FCB7, air conditioner 1 switch 2FCB8, and air conditioner 2 switch 2FCB9 in sequence.
4	Powering on the ESS-Smart Rack Controller	Turn on DC switch 1Q1 in the ESS (on the battery rack side).
	Powering on the Smart Rack Controller-PCS	Turn on DC switch 1Q2 in the ESS.
5	Powering on the isolation transformer	For details, see the documents provided by the vendor.

Step	Task	Power-On Operation
6	Powering on the PCS	Turn on the AC switch between the PCS and the isolation transformer.
7	Powering on the inverter	**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.		

4.2 Deployment Commissioning

4.2.1 Preparations and WebUI Login

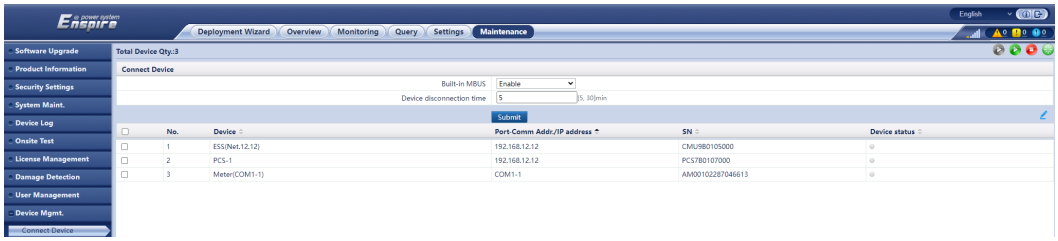
The SmartLogger WebUI is used for power-on and commissioning. For details about the preparations and WebUI login, see the **SmartLogger3000 User Manual**.

4.2.2 Software Upgrade

Prerequisites

Click **Maintenance**, choose **Device Mgmt.** > **Connect Device**, and check that the devices are connected.

Figure 4-4 Checking device connection



1. Check whether the quantity of devices connected to the SmartLogger is correct.

   If not all devices are connected, check and ensure that the cascading cables between devices, the connection positions of the communications cables between devices and the SmartLogger, and the indicator status are normal. Then click **Auto. Search**.

2. Check whether **Device status** of each device is normal.
   - For the on/off-grid PV+ESS (PQ/VSG) or (VSG) system: During initial connection, **Device status** of the PCS is yellow, and **Device status** of the ESS is green.
   - PV+ESS off-grid system: During initial connection, the UPS auxiliary power supply must be connected and **Device status** of the ESS must be green. Wait until **Search for Device** under **Deployment Wizard** > **Huawei Devices** is successful and then connect the PCS.

On/Off-Grid PV+ESS (PQ/VSG) or (VSG) System

1. Log in to the Support-E website and search for the latest software versions of the SmartLogger, PCS, ESS, and inverter in **FusionSolar Software Download**.
2. Choose **Maintenance** > **Software Upgrade** to check the software versions of the SmartLogger, PCS, ESS, and inverter. If the software version of each device is the latest version on the Support-E website, go to **4.2.3 Preparations Before Deployment**. Otherwise, go to the next step.
3. Click **Choose File**, select the target software package, and click **Upload**. After the upload is complete, click **Software Upgrade**. Before upgrading the ESS, choose **Monitoring > ESS > ESU > Running Param.**, and check whether **Enable delayed upgrade** is set to **Disable**. If no, set it to **Disable** and then upgrade the ESS.

   NOTE

   For versions earlier than SmartLogger V300R023C00SPC010, a maximum of 20 MB files can be uploaded. If a version earlier than SmartLogger V300R023C00SPC010 needs to be upgraded to SmartLogger V300R023C00SPC010 or later, decompress the SmartLogger upgrade package to **SmartLogger3000.zip** and **SmartLogger3000_bsp.zip**. Upload **SmartLogger3000.zip** and perform the upgrade. Then upload **SmartLogger3000_bsp.zip** and perform the upgrade.

Off-Grid PV+ESS System

1. Log in to the Support-E website and search for the latest software versions of the SmartLogger, ESS, and inverter in **FusionSolar Software Download**.
2. Choose **Maintenance** > **Software Upgrade** to check the software versions of the SmartLogger, ESS, and inverter. If the software version of each device is the latest version on the Support-E website, go to **4.2.3 Preparations Before Deployment**. Otherwise, go to the next step.
3. Click **Choose File**, select the target software packages of the SmartLogger and inverter, and click **Upload**. After the upload is complete, click **Software Upgrade**.

NOTE

For versions earlier than SmartLogger V300R023C00SPC010, a maximum of 20 MB files can be uploaded. If a version earlier than SmartLogger V300R023C00SPC010 needs to be upgraded to SmartLogger V300R023C00SPC010 or later, decompress the SmartLogger upgrade package to **SmartLogger3000.zip** and **SmartLogger3000_bsp.zip**. Upload **SmartLogger3000.zip** and perform the upgrade. Then upload **SmartLogger3000_bsp.zip** and perform the upgrade.

4. Choose **Monitoring > ESS > ESU > Running Param.**, check whether **Enable delayed upgrade** is set to **Disable**. If no, set it to **Disable** and then upgrade the ESS. For details, see **B ESS Software Upgrade Solution for the Off-Grid PV+ESS System**.
5. Choose **Maintenance** > **Software Upgrade** to check the PCS software version. If the software version is the latest version on the Support-E website, you do not need to upgrade the PCS. If not, click **Choose File**, select the target software package of the PCS, and click **Upload**. After the upload is complete, click **Software Upgrade**. In the off-grid scenario, if the system is powered on for the first time, the PCS has no power so it cannot connect to the SmartLogger. Wait until **Search for Device** under **Deployment Wizard** > **Huawei Devices** is successful and the PCS is powered on and connected before upgrading the PCS.

4.2.3 Preparations Before Deployment

Step 1 To manually add an IMD, click **Add Devices** and set IMD access parameters.

Parameter	Description
Device Type	Set this parameter to **IMD**.
Port number	The IMD uses RS485 communication. Set the COM port connected to the IMD based on site requirements.
Address	Set the IMD communications address based on site requirements.
Device model	DOLD RN5897.12/011

Step 2 Click **Monitoring** and choose **ESS** > **ESU** > **ESR** > **Running Param.** Check that the quantity of ESMs displayed is the same as the actual quantity of battery packs connected and the ESM indicators are not red.

- If the quantity of ESMs is incorrect:

Table 4-4 Setting the quantity of battery packs

ESS	Quantity of Battery Packs
LUNA2000-97KWH-1H1	6
LUNA2000-129KWH-2H1	8
LUNA2000-161KWH-2H1	10

ESS	Quantity of Battery Packs
LUNA2000-200KWH-2H1	12

1. Check whether the communications cables to the battery packs are correctly and securely connected.
2. Delete invalid modules under **Running Param.** on the ESU page. Then, choose **Maintenance** > **Device Mgmt.** > **Connect Device** and click **Auto. Search**.

- If an ESM indicator is red, clear the ESM alarm according to the alarm handling suggestions.

Step 3 Clear alarms.

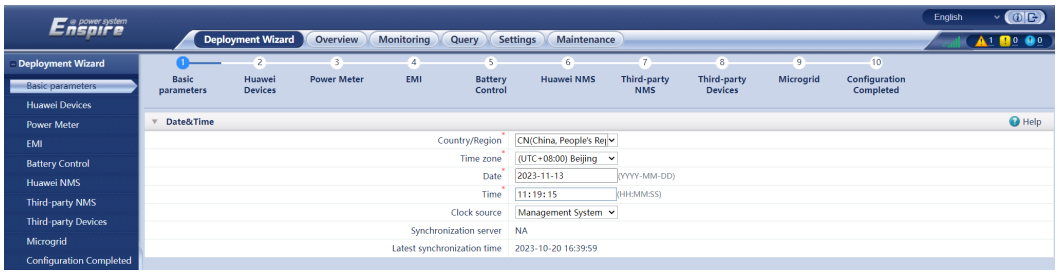
Clear the alarms that affect topology identification by referring to **C List of Alarms Affecting Topology Identification**, and then search for the devices.

----End

4.2.4 Commissioning Using the Deployment Wizard

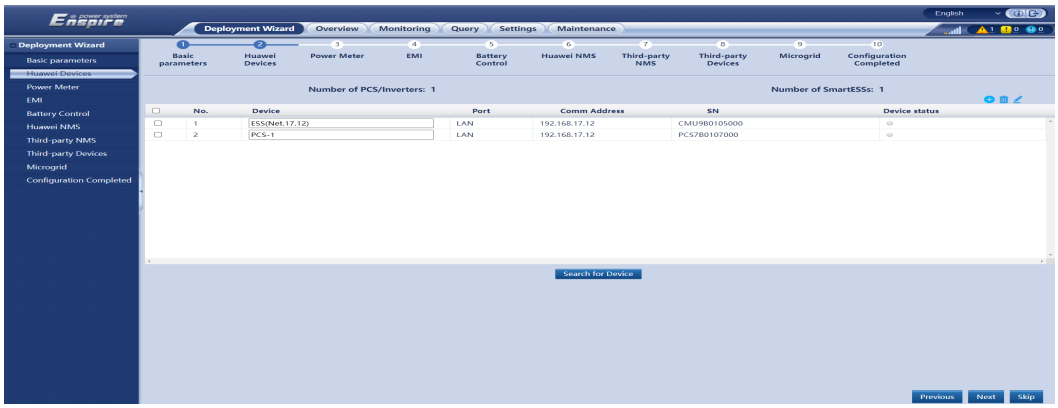
Step 1 Set basic parameters.

Figure 4-5 Setting basic parameters



Step 2 After the ESS is started, you are advised to wait for a period of time greater than or equal to **Device disconnection time** (choose **Maintenance** > **Device Mgmt.** > **Connect Device** to view **Device disconnection time**), and then click **Search for Device** to check cable connections and allocate addresses.

Figure 4-6 Searching for devices

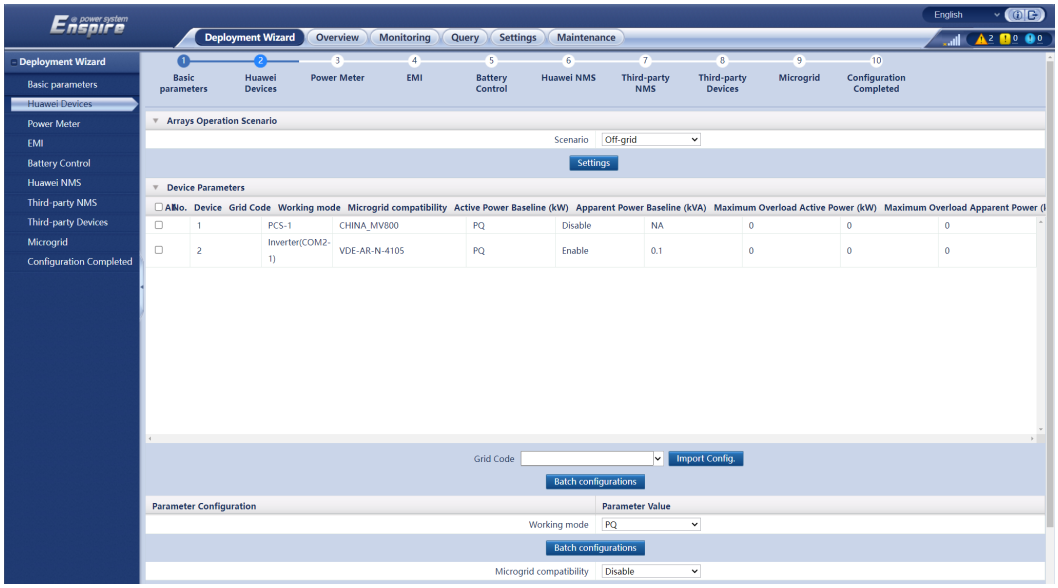


NOTE

- During the process of **Search for Device**, do not perform upgrade operations (such as upgrading through the app, management system, or WebUI).
- When you click **Search for Device**, cable connections (DC and AC) will be checked before device search (not applicable to third-party devices), and device addresses will be automatically allocated.
- After the cable connection check and device search are complete, if a cable connection alarm is generated, you can click the alarm icon to view the corresponding alarm information.
- If an alarm is generated when the cable connection check fails, click the alarm icon to view the alarm cause and handling suggestions. After the fault is rectified, click **Search for Device** again to check the cable connections. For details about alarms, see **C List of Alarms Affecting Topology Identification**.
- After the cable connection check and device search are complete, click to view the corresponding topology information.
- After a device is added or deleted, you need to click **Search for Device** again in **Deployment Wizard**. Otherwise, the system topology will not be updated.

Step 3 After the device search is complete, set the grid connection state based on site requirements.

Figure 4-7 Parameter settings after device search



Parameter	Description
Scenario under **Arrays Operation Scenario**	• In the off-grid scenario, set this parameter to **Off-grid**. • In the **On-grid/Off-grid (VSG)** or **On-grid/Off-grid (PQ/VSG)** scenario, set this parameter to **On-grid/Off-grid**.

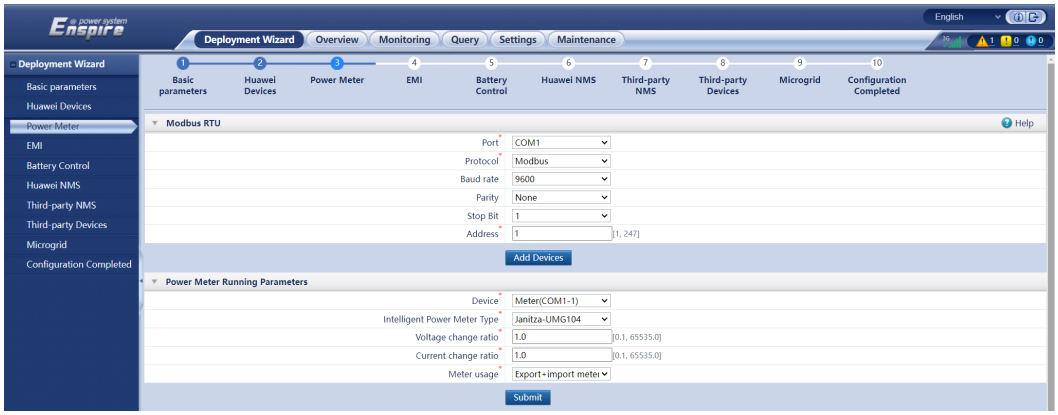
Parameter	Description
Grid Code	Set the PCS and inverter grid code of the country or region where the devices are used.
Working mode under **Parameter Configuration**	This parameter needs to be set only for the PCS. • In the **Off-grid** or **On-grid/Off-grid (VSG)** scenario, set this parameter to **VSG**. • In the **On-grid/Off-grid (PQ/VSG)** scenario: – Set this parameter to **PQ** for on-grid operation. – Set this parameter to **VSG** for off-grid operation.
Microgrid compatibility under **Parameter Configuration**	This parameter needs to be set only for the inverter. • If **Working mode** under **Parameter Configuration** is set to **PQ**, set this parameter to **Disable**. • If **Working mode** under **Parameter Configuration** is set to **VSG**, set this parameter to **Enable**.
Active Power Baseline (kW) under **Parameter Configuration**	You are advised to retain the default value.
Apparent Power Baseline (kVA) under **Parameter Configuration**	You are advised to retain the default value.
Maximum Overload Active Power (kW) under **Parameter Configuration**	You are advised to retain the default value.
Maximum Overload Apparent Power (kVA) under **Parameter Configuration**	You are advised to retain the default value.

Step 4 (Optional) Connect to power meters.

Set related parameters by referring to "**Setting Meter Parameters**" in the *SmartLogger3000 User Manual*.

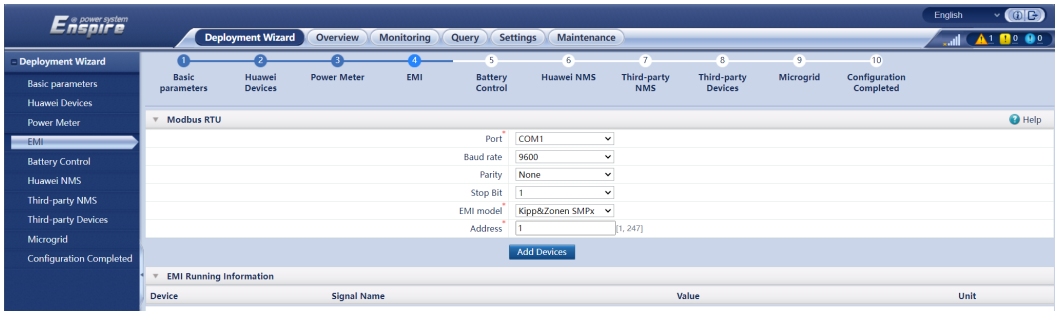
Parameter	Description	Remarks
Current change ratio	If the power meter does not have a current transformer (CT), set this parameter to **1**. If the power meter has a CT, set this parameter based on the actual CT ratio of the power meter.	**NOTE** If both the power meter and the SmartLogger support the settings of the PT ratio and CT ratio, you can only set them either on the power meter or the SmartLogger. You are advised to set these parameters on the power meter.
Voltage change ratio	If the power meter does not have a potential transformer (PT), set this parameter to **1**. If the power meter has a PT, set this parameter based on the actual PT ratio of the power meter.	

Figure 4-8 Connecting to power meters



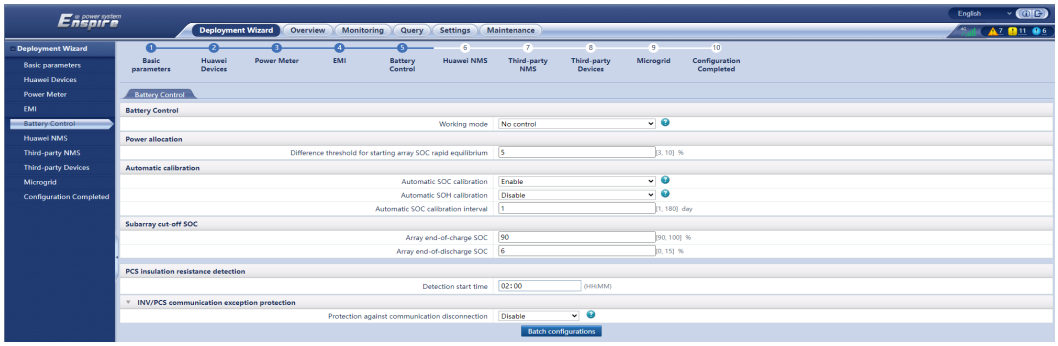
Step 5 (Optional) Connect to environment monitoring instruments (EMIs).

Figure 4-9 Connecting to EMIs



Step 6 Set battery control parameters.

Figure 4-10 Setting battery control parameters



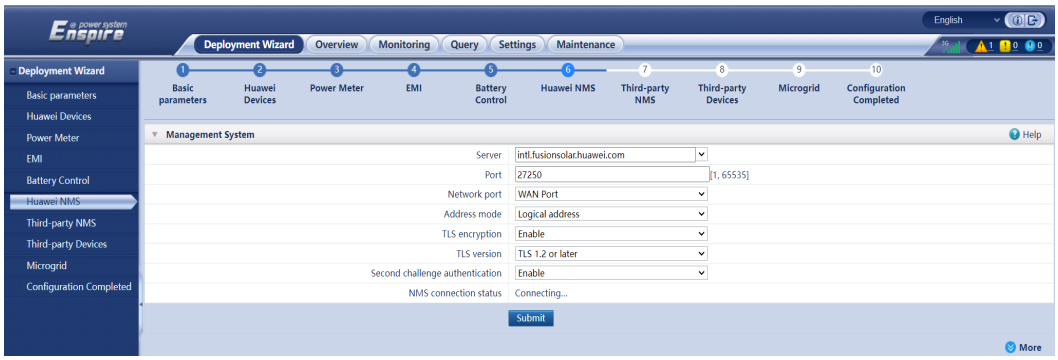
Parameter	Description
Working mode	Select a working mode based on the actual application scenario. Set this parameter only in the on-grid scenario.
Automatic SOC calibration	Set this parameter to **Enable**. Automatic charge and discharge calibration is allowed for battery racks. The ESS periodically calibrates the SOC rack by rack. During the calibration, the end-of-charge SOC and end-of-discharge SOC settings will be overridden so that the ESS can be fully charged or discharged. • On-grid scenario: Automatic charge calibration is allowed for battery racks. • Off-grid scenario: Automatic discharge calibration is allowed for battery racks.
Automatic SOC calibration interval	Set this parameter to **7**. This parameter is displayed when **Automatic SOC calibration** is set to **Enable**.
Automatic SOH calibration	• If this parameter is set to **Enable**, the ESS periodically calibrates the SOH rack by rack. During the calibration, the end-of-charge SOC and end-of-discharge SOC settings will be overridden. • If this parameter is set to **Disable**, automatic SOH calibration is disabled for battery racks.
Array end-of-charge SOC	Set the SOC threshold for stopping array charging. The default value is 100%. The default value is recommended. Set this parameter as required.
Array end-of-discharge SOC	Set the SOC threshold for stopping array discharging. The default value is 5%. The default value is recommended. Set this parameter as required.

Parameter	Description
Detection start time	Set the start time of the PCS insulation resistance detection. The default value is 02:00. If a dialog box **You are advised to change the insulation resistance detection time to the optimal time: *XX:XX*** is displayed, you are advised to click **Confirm** and set **Detection start time** to the optimal time.

Step 7 Connect to a Huawei network management system (NMS).

Set related parameters by referring to "**Setting Parameters for Connecting to the Management System**" (content related to a Huawei NMS) in the *SmartLogger3000 User Manual*.

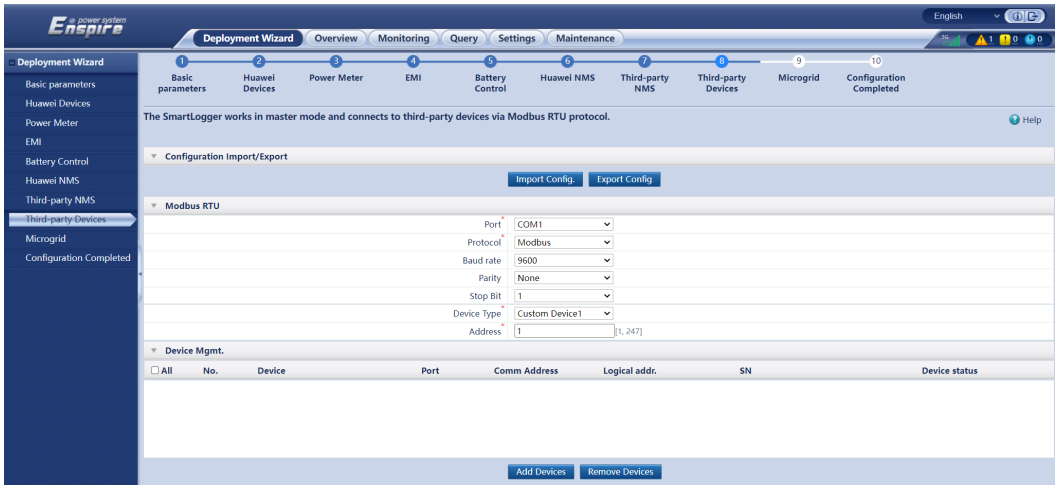
Figure 4-11 Connecting to a Huawei NMS



Step 8 Connect to a third-party NMS. Connecting to a third-party NMS is not recommended. If you forcibly enable both the MGCC mode and the Modbus TCP, IEC 104, and GOOSE settings of a third-party NMS, the microgrid may be unstable.

Step 9 Connect to third-party devices (if any).

Figure 4-12 Connecting to third-party devices



Step 10 Set microgrid parameters.

1. Select **Yes** or **No** in the **Do you want to connect the relay protection device?** dialog box based on the actual situation. In the on/off-grid PV+ESS (VSG) scenario, a relay protection device must be connected. Select **Yes** and set relay protection device parameters. In other scenarios, the relay protection device is not required.

Table 4-5 Relay protection device parameters

Parameter	Description
Port	Set the COM port connected to **Relay protection device** based on the actual cable connections.
Baud rate	Set the baud rate, check mode, parity, stop bit, and address of **Relay protection device** to be consistent with the communications parameters of the relay protection device.
Parity	
Stop Bit	
Address	
Device Type	Set this parameter to **Relay protection device**.
Device model	Set this parameter to **Easergy P3U30**.

2. Setting microgrid parameters

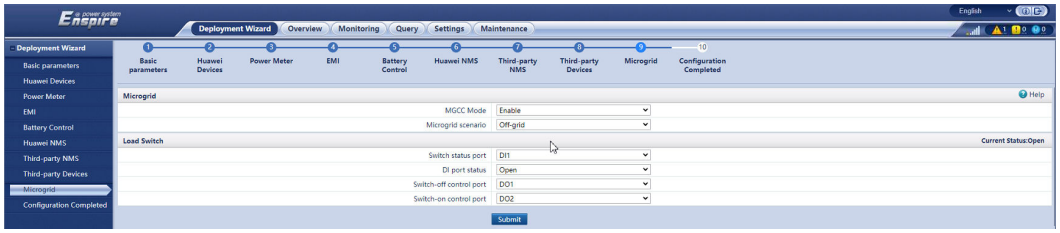


Table 4-6 Microgrid parameters

Parameter	Description
MGCC Mode under **Microgrid**	Set this parameter to **Enable**. When **MGCC Mode** is enabled, Modbus TCP, IEC 104, and GOOSE settings are disabled and the SmartLogger does not respond to scheduling commands from the EMS. (Set **Working mode** to **Charge/Discharge based on grid dispatch** on the **Battery Control** tab page and set **Active power control mode** to **Remote communication scheduling** on the **Power Adjustment** tab page.) Enable this function only when the EMS is not required. If you forcibly enable both the MGCC mode and the Modbus TCP, IEC 104, and GOOSE settings, the microgrid may be unstable. By default, this parameter is set to **Disable**.

Parameter	Description
Microgrid scenario under **Microgrid**	– In the off-grid scenario, set this parameter to **Off-grid**. – In the on/off-grid (PQ/VSG) scenario, set this parameter to **On-grid/Off-grid (PQ/VSG)**. – In the on/off-grid (VSG) scenario, set this parameter to **On-grid/Off-grid (VSG)**. **On-grid/Off-grid (VSG)** can be set only after the relay protection device is successfully connected. **NOTE** – If **Microgrid scenario** is set to **Off-grid**, **Scenario** under **Arrays Operation Scenario** shall be set to **Off-grid**. – If **Microgrid scenario** is set to **On-grid/Off-grid (PQ/VSG)** or **On-grid/Off-grid (VSG)**, **Scenario** under **Arrays Operation Scenario** shall be set to **On/Off-grid**.

– If **Microgrid scenario** is set to **On-grid/Off-grid (PQ/VSG)**, refer to the following parameter description.

Parameter	Description
Switch status port under **On/Off-grid switch**	Set these parameters based on the actual cable connections. **DI port status** can be set to **Open** and **Close**. If the actual status of the on-grid/off-grid switch is inconsistent with **Status**, change the setting of **DI port status**.
DI port status under **On/Off-grid switch**	
Switch-off control port under **On/Off-grid switch**	Set the DO port for turning off the on/off-grid switch based on the actual cable connections.
Switch-on control port under **On/Off-grid switch**	Set the DO port for turning on the on/off-grid switch based on the actual cable connections.
DI port under **Grid Failure Detection**	Set these parameters based on the actual cable connections.
DI port status under **Grid Failure Detection**	

Parameter	Description
On/Off-grid switching mode under **On/Off-grid switching**	You are advised to set this parameter to **Auto**. ■ **No control**: All the operations involved in the on/off-grid switching are manually performed. If the customer needs to repair the equipment, you are advised to set this parameter to **No control**. ■ **Auto**: The on/off-grid switching will be performed automatically based on the status of the mains power. When you set **On/Off-grid switching mode** to this mode, an immediate on/off-grid switching may be triggered, depending on the status of the mains power. ■ **Manual**: You need to manually turn on or off the on/off-grid switch at the grid connection point.

– If **Microgrid scenario** is set to **On-grid/Off-grid (VSG)**, refer to the following parameter description.

Parameter	Description
Genset start/stop control port under **Genset**	■ If the genset is controlled by the SmartLogger, set the DO port that controls genset startup and shutdown based on the actual cable connections. ■ If the genset is controlled by the ATS, set this parameter to **No**.
Auto switching to on-grid under **Automatic Off-grid to On-grid Switching**	■ **Enable**: Enable the function of automatic switching from off-grid to on-grid state. ■ **Disable**: Disable the function of automatic switching from off-grid to on-grid state.

– If **Microgrid scenario** is set to **Off-grid**, refer to the following parameter description.

Parameter	Description
Switch status port under **Load Switch**	Set these parameters based on the actual cable connections. If you need to modify the parameters after the settings are submitted, the automatic control function of the load switch may fail. This function can be restored only after the SmartLogger is restarted or the black start is successful in the off-grid scenario. **DI port status** can be set to **Open** and **Close**. If the actual status of the load switch is inconsistent with **Status**, change the setting of **DI port status**.
DI port status under **Load Switch**	
Switch-off control port under **Load Switch**	Set the DO port for turning off the load switch based on the actual cable connections.
Switch-on control port under **Load Switch**	Set the DO port for turning on the load switch based on the actual cable connections.

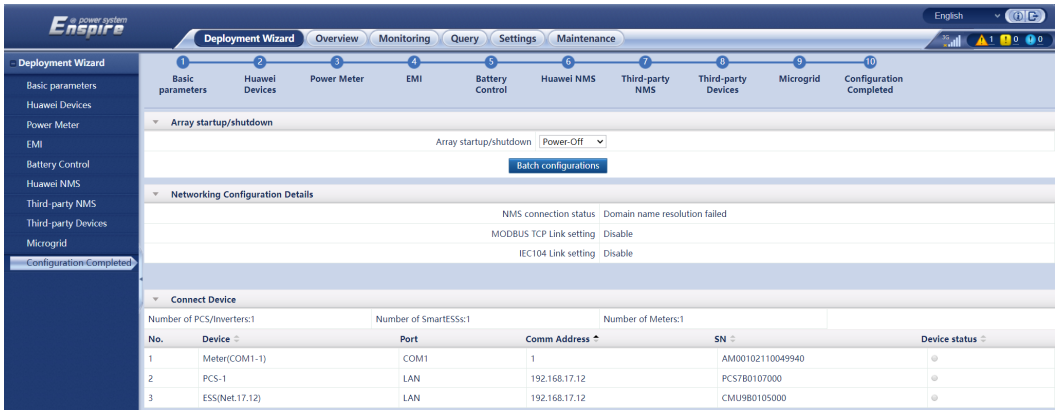
- After the microgrid parameter settings are complete, click **Submit**.

Step 11 Click **Finish**.

NOTICE

Do not click **Batch configurations** shown in the following figure to send the array startup/shutdown command, because this will affect the phase sequence check.

Figure 4-13 Completing the configuration



----End

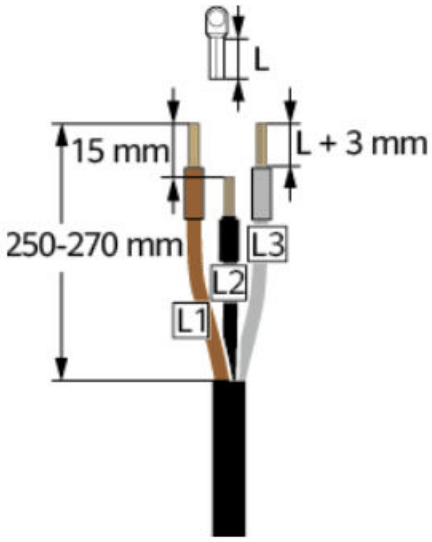
4.2.5 Checking the Phase Sequence

Phase sequence check is to confirm whether the phase sequence of AC power cables of the PCS is consistent with that of the transformer and power grid. If the phase sequences are inconsistent, off-grid operation may be abnormal.

Step 1 Log in to the SmartLogger WebUI, choose **Overview** > **Active Alarm**, and check whether the PCS reports a **Reverse Phase Sequence on AC Side** alarm.

Step 2 If the PCS reports a **Reverse Phase Sequence on AC Side** alarm:

1. Shut down the PCS, and turn off the power switches on the AC and DC sides of the PCS.
2. Correct the wiring sequence of the PCS AC power cables. If the PCS AC power cable is a multi-core cable, you are advised to exchange L1 and L3 shown in the following figure to meet the stripping length requirement.



3. Turn on the power switches on the AC and DC sides of the PCS.
4. Restart the PCS. Check and ensure that no **Reverse Phase Sequence on AC Side** alarm is reported.

----End

4.2.6 Switch Inspection

Switch inspection is to manually turn on and off the on/off-grid switch or load switch in order to check whether the switch or relay protection device is correctly configured.

DANGER

- Ensure that the equipment is not damaged before you operate the on/off-grid switch or load switch. Otherwise, electric shocks or fire may occur.
- When operating the on/off-grid switch or load switch, wear insulated gloves and use insulated tools to prevent electric shocks or short circuits.
- Non-standard and improper operations may result in fire 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.

On-grid/Off-grid (PQ/VSG)

Step 1 Choose **Settings** > **Microgrid Control** > **On/Off-grid switching** > **General Configuration**, and set **On/Off-grid switching mode** to **No control**.

Step 2 Choose **Maintenance** > **Device Mgmt.** > **Connect Device** and click  .

Step 3 Manually turn on or off the on/off-grid switch onsite. Then, on the SmartLogger WebUI, choose **Settings** > **Microgrid Control** > **General Configuration** > **On/Off-grid switch** and check whether **Status** changes. If yes, the DI cable connection is normal. If no, check whether the DI cable to **Switch status port** of the on/off-grid switch is properly connected.

Step 4 Choose **Settings** > **Microgrid Control** > **General Configuration** > **On/Off-grid switch** and check whether **Status** is consistent with the actual on/off-grid switch status. If no, change the setting of **DI port status** to ensure that the status is consistent.

Step 5 Choose **Settings** > **Microgrid Control** > **On/Off-grid switching** > **On/Off-grid switch control** and click **Open**. Then check onsite whether the actual status of the on/off-grid switch is off. If the actual status of the on/off-grid switch is not off, check whether **Switch-off control port** is configured. If yes, check the DO cable connection to **Switch-off control port**.

Step 6 Choose **Settings** > **Microgrid Control** > **On/Off-grid switching** > **On/Off-grid switch control** and click **Close**. Then check onsite whether the actual status of the on/off-grid switch is on. If the actual status of the on/off-grid switch is not on, check whether **Switch-on control port** is configured. If yes, check the DO cable connection to **Switch-on control port**.

Step 7 After the on/off grid switch inspection is complete, choose **Settings** > **Microgrid Control** > **On/Off-grid switching** > **General Configuration**, and set **On/Off-grid switching mode** to **Auto**.

----End

On-grid/Off-grid (VSG)

Step 1 Choose **Settings** > **Microgrid Control** > **On/Off-grid switching**. On the **On-grid to Off-grid** tab page, set **Switch to Off-grid** to **Disable**. On the **Off-grid to On-grid** tab page, set **Off-grid to on-grid** to **Disable**.

Step 2 Choose **Maintenance** > **Device Mgmt.** > **Connect Device** and click  .

Step 3 Choose **Settings** > **Microgrid Control** > **On/Off-grid switching** > **On/Off-grid switch control** and click **Open**. Then check whether **Status of switch at grid connection point** is consistent with the actual status of the on/off-grid switch. If no, check whether the configuration or cable connection of the relay protection device is correct.

Step 4 Choose **Settings** > **Microgrid Control** > **On/Off-grid switching** > **On/Off-grid switch control** and click **Close**. Then check whether **Status of switch at grid connection point** is consistent with the actual status of the on/off-grid switch. If no, check whether the configuration or cable connection of the relay protection device is correct.

Step 5 After the on/off grid switch inspection is complete, choose **Maintenance** > **Device Mgmt.** > **Connect Device** and click  .

Step 6 Choose **Settings** > **Microgrid Control** > **On/Off-grid switching**. On the **On-grid to Off-grid** tab page, set **Switch to Off-grid** to **Enable**. On the **Off-grid to On-grid** tab page, set **Off-grid to on-grid** to **Enable**.

----End

Off-grid

Step 1 Choose **Maintenance** > **Device Mgmt.** > **Connect Device** and click  .

Step 2 Manually turn on or off the load switch onsite. Then, on the SmartLogger WebUI, choose **Settings** > **Microgrid Control** > **General Configuration** > **Load Switch** and check whether **Status** changes. If yes, the DI cable connection is normal. If no, check whether the DI cable connection to **Switch status port** is normal.

Step 3 Choose **Settings** > **Microgrid Control** > **General Configuration** > **Load Switch** and check whether **Status** is consistent with the actual load switch status. If no, change **DI port status** to ensure that the status is consistent.

Step 4 Choose **Settings** > **Microgrid Control** > **General Configuration** > **Load control** and check whether the **Open** button is available. If yes, click **Open** and then check onsite whether the actual status of the load switch is off. If no, check whether the DO cable connection to **Switch-off control port** is normal.

Step 5 Choose **Settings** > **Microgrid Control** > **General Configuration** > **Load control** and check whether the **Close** button is available. If yes, click **Close** and then check onsite whether the actual status of the load switch is on. If no, check whether the DO cable connection to **Switch-on control port** is normal.

Step 6 After the load switch inspection is complete, choose **Settings** > **Microgrid Control** > **Black Start** and click **Starting**.

----End

5 Microgrid Control

5.1 On-grid/Off-grid (PQ/VSG)

Step 1 Set **MGCC Mode** to **Enable**. This parameter can be modified only under **Deployment Wizard** > **Microgrid** > **Microgrid**.

Step 2 Set **Microgrid scenario** to **On-grid/Off-grid (PQ/VSG)**. This parameter can be modified only under **Deployment Wizard** > **Microgrid** > **Microgrid**. **Scenario** under **Arrays Operation Scenario** shall be set to **On/Off-grid**

Step 3 Choose **Settings** > **Microgrid Control** > **General Configuration** and set general configuration parameters.

Table 5-1 General configuration parameters

Parameter	Description
Switch status port under **On/Off-grid switch**	Set these parameters based on the actual cable connections. **DI port status** can be set to **Open** and **Close**. If the actual status of the on-grid/off-grid switch is inconsistent with **Status**, change the setting of **DI port status**.
DI port status under **On/Off-grid switch**	
Switch-off control port under **On/Off-grid switch**	Set the DO port for turning off the on/off-grid switch based on the actual cable connections.
Switch-on control port under **On/Off-grid switch**	Set the DO port for turning on the on/off-grid switch based on the actual cable connections.
DI port under **Grid Failure Detection**	Set these parameters based on the actual cable connections.
DI port status under **Grid Failure Detection**	

Step 4 Choose **Settings** > **Microgrid Control** > **Dispatch Control** to set dispatch control parameters.

Table 5-2 Dispatch control parameters

Tab	Parameter	Description
Control Policy	End-of-charge SOC (off-grid)	Set the maximum SOC for charge in off-grid mode. The default value 90% is recommended.
	End-of-discharge SOC (off-grid)	Set the minimum SOC for discharge in off-grid mode. The default value 10% is recommended.
Charging	Real-time SOC (%)	The output power of the inverter is controlled based on the current battery SOC to meet the battery charge power adjustment target. The value of **Allowed Charge Power (%)** ranges from 0 to 70. The value of SOC ranges from **End-of-discharge SOC (off-grid)** to **End-of-charge SOC (off-grid)**.
	Allowed Charge Power (%)	
Power Backup	Off-grid power backup	Set this parameter to **Enable**. The off-grid power backup function is enabled. 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 (%)	In on-grid mode, set **Min. SOC for off-grid power backup**. The default value 40% is recommended. The precision of the off-grid backup power SOC is 1%. This parameter is displayed when **Off-grid power backup** is set to **Enable**.
	Prioritize off-grid power backup	When this function is enabled, if the current SOC is less than or equal to **Min. SOC for off-grid power backup**, the ESS stops discharging and is charged by PV power preferentially. In this case, the current on-grid ESS scheduling policy becomes invalid.
	Draw power from grid for off-grid power backup	This parameter is displayed when **Prioritize off-grid power backup** is set to **Enable**. • **Disable**: The ESS is not allowed to obtain power from the grid for off-grid power backup. • **Allow**: The ESS is allowed to obtain power from the grid for off-grid power backup.

Tab	Parameter	Description
	Charge power for off-grid power backup (kW)	This parameter is displayed when **Draw power from grid for off-grid power backup** is set to **Allow**. Set the power for charging by the grid for off-grid power backup. The default value is 100 kW, and the value range is [0.0, 50000.0].

NOTE

Array end-of-charge SOC > **End-of-charge SOC (off-grid)** ≥ **Backup power SOC for peak shaving** ≥ **Min. SOC for off-grid power backup** > **End-of-discharge SOC (off-grid)** > **Array end-of-discharge SOC**

Step 5 Choose **Settings** > **Microgrid Control** > **On/Off-grid switching**, and set on/off-grid switching parameters.

Table 5-3 On/Off-grid switching parameters

Tab	Parameter	Description
General Configuration	Automatic microgrid adaptability control	You are advised to set this parameter to **Enable**. • **Enable**: When the system switches from on-grid to off-grid mode, the microgrid adaptability of the inverter is automatically enabled. When the system switches from off-grid to on-grid mode, the microgrid adaptability of the inverter is automatically disabled. • **Disable**: The automatic microgrid adaptability control function is disabled. The microgrid adaptability of the inverter is not automatically set during on/off-grid switching.

Tab	Parameter	Description
	On/Off-grid switching mode	You are advised to set this parameter to **Auto**. ● **No control**: All the operations involved in the on/off-grid switching are manually performed. If the customer needs to repair the equipment, you are advised to set this parameter to **No control**. ● **Auto**: The on/off-grid switching will be performed automatically based on the status of the mains power. When you set **On/Off-grid switching mode** to this mode, an immediate on/off-grid switching may be triggered, depending on the status of the mains power. ● **Manual**: You need to manually turn on or off the on/off-grid switch at the grid connection point.
Off-grid to On-grid	**Off-grid to on-grid** under **Manual On-grid/Off-grid Switching**	If **On/Off-grid switching mode** is set to **Manual**, click **Off-grid to on-grid** before switching from off-grid to on-grid mode. After the PV+ESS system shuts down, turn on the on/off-grid switch locally. After the switch is turned on, the PV+ESS system automatically restarts.
On/Off-grid switch control	On/Off-grid switch control	● **Close**: The on/off-grid switch is turned on, switching the system from off-grid to on-grid state. Click **Off-grid to on-grid** before switch-on. ● **Open**: The on/off-grid switch is turned off, switching the system from on-grid to off-grid state. **NOTE** ● In the on/off-grid (PQ/VSG) scenario, the on/off-grid switching will be performed according to the status of the on/off-grid switch only when **On/Off-grid switching mode** is set to **Auto** or **Manual**. ● In the on/off-grid (PQ/VSG) scenario, the **Close** and **Open** buttons are available only when the DO ports of **Switch-off control port** and **Switch-on control port** under **On/Off-grid switch** are configured. ● When the on/off-grid switch is on, the **Close** button is grayed out, and the **Open** button is available. ● When the on/off-grid switch is in invalid state, the **Close** and **Open** buttons are grayed out.

Table 5-4 On/Off-grid switching mode (automatic)

Scenario	Command and Operation Between the SmartLogger and Devices
From on-grid to off-grid	1. Grid failure is detected. 2. The on/off-grid switch is automatically turned off. 3. The SmartLogger sends a command to set **Working mode** from **PQ** to **VSG** under **Monitoring** > **PCS** > **Running Param.** > **Feature Parameters** to start the ESS. 4. The SmartLogger sends a command to set **Microgrid compatibility** to **Enable** under **Monitoring** > **Inverter** > **Running Param.** > **Feature Parameters**. 5. The SmartLogger sends a command to start the inverter. 6. The SmartLogger sends PV and ESS power scheduling commands.
From off-grid to on-grid	1. Grid recovery is detected. 2. The SmartLogger sends a command to shut down the inverter and PCS. 3. The SmartLogger sends a command to turn on the on/off-grid switch and receives the switch-on status. 4. The SmartLogger sends a command to set **Working mode** from **VSG** to **PQ** under **Monitoring** > **PCS** > **Running Param.** > **Feature Parameters**. 5. The SmartLogger sends a command to set **Microgrid compatibility** to **Disable** under **Monitoring** > **Inverter** > **Running Param.** > **Feature Parameters**. 6. The SmartLogger sends a command to start the inverter and PCS.

Table 5-5 On/Off-grid switching mode (manual)

Scenario	Command and Operation Between the SmartLogger and Devices
From on-grid to off-grid	1. The user turns off the on/off-grid switch locally. 2. The SmartLogger detects that the on/off-grid switch is turned off. 3. The SmartLogger sends a command to shut down the inverter and PCS. 4. The SmartLogger sends a command to black-start the ESS. During the black start, the SmartLogger sets **Working mode** from **PQ** to **VSG** under **Monitoring** > **PCS** > **Running Param.** > **Feature Parameters**. 5. After the black start is complete, the ESS starts. 6. The SmartLogger sends a command to set **Microgrid compatibility** to **Enable** under **Monitoring** > **Inverter** > **Running Param.** > **Feature Parameters**. 7. The SmartLogger sends a command to start the inverter. 8. The SmartLogger sends PV and ESS power scheduling commands.
From off-grid to on-grid	1. Click the **Off-grid to on-grid** button on the SmartLogger WebUI to shut down the PV+ESS system. 2. The user turns on the on/off-grid switch locally. 3. The SmartLogger detects that the on/off-grid switch is turned on and the system connects to the power grid. 4. The SmartLogger sends a command to set **Working mode** from **VSG** to **PQ** under **Monitoring** > **PCS** > **Running Param.** > **Feature Parameters**. 5. The SmartLogger sends a command to start the ESS. 6. The SmartLogger sends a command to set **Microgrid compatibility** to **Disable** under **Monitoring** > **Inverter** > **Running Param.** > **Feature Parameters**. 7. The SmartLogger sends a command to start the inverter. 8. The SmartLogger sends PV and ESS power scheduling commands.

----End

5.2 On-grid/Off-grid (VSG)

Step 1 Set **MGCC Mode** to **Enable**. This parameter can be modified only under **Deployment Wizard** > **Microgrid** > **Microgrid**.

Step 2 Set **Microgrid scenario** to **On-grid/Off-grid (VSG)**. This parameter can be modified only under **Deployment Wizard** > **Microgrid** > **Microgrid**. **Scenario** under **Arrays Operation Scenario** shall be set to **On/Off-grid**

Step 3 Choose **Settings** > **Microgrid Control** > **General Configuration** and set general configuration parameters.

Table 5-6 General configuration parameters

Parameter	Description
Genset start/stop control port under **Genset**	• If the genset is controlled by the SmartLogger, set the DO port that controls genset startup and shutdown based on the actual cable connections. • If the genset is controlled by the ATS, set this parameter to **No**.

Step 4 Choose **Settings** > **Microgrid Control** > **Dispatch Control** to set dispatch control parameters.

Table 5-7 Dispatch control parameters

Tab	Parameter	Description
Control Policy	End-of-charge SOC (on-grid)	Set the maximum SOC for charge in on-grid mode. The default value 90% is recommended.
	End-of-charge SOC (off-grid)	Set the maximum SOC for charge in off-grid mode. The default value 90% is recommended.
	End-of-discharge SOC (off-grid)	Set the minimum SOC for discharge in off-grid mode. The default value 10% is recommended.
Charging	Real-time SOC (%)	The output power of the inverter is controlled based on the current battery SOC to meet the battery charge power adjustment target. The value of **Allowed Charge Power (%)** ranges from 0 to 70. The value of SOC ranges from **End-of-discharge SOC (off-grid)** to **End-of-charge SOC (off-grid)**.
	Allowed Charge Power (%)	

Tab	Parameter	Description
Genset Control	Genset Auto Control	• **Enable**: Enable the automatic control of genset startup and shutdown. If the ESS is shut down, the genset automatically starts to supply power to loads. • **Disable**: Disable the automatic control of genset startup and shutdown.
	Genset Manual Control	• **Power-On**: Manually start the genset. • **Power-Off**: Manually shut down the genset.
Power Backup	Off-grid power backup	Set this parameter to **Enable**. The off-grid power backup function is enabled. 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 (%)	In on-grid mode, set **Min. SOC for off-grid power backup**. The default value 40% is recommended. The precision of the off-grid backup power SOC is 1%. This parameter is displayed when **Off-grid power backup** is set to **Enable**.
	Prioritize off-grid power backup	When this function is enabled, if the current SOC is less than or equal to **Min. SOC for off-grid power backup**, the ESS stops discharging and is charged by PV power preferentially. In this case, the current on-grid ESS scheduling policy becomes invalid.
	Draw power from grid for off-grid power backup	This parameter is displayed when **Prioritize off-grid power backup** is set to **Enable**. • **Disable**: The ESS is not allowed to obtain power from the grid for off-grid power backup. • **Allow**: The ESS is allowed to obtain power from the grid for off-grid power backup.
	Charge power for off-grid power backup (kW)	This parameter is displayed when **Draw power from grid for off-grid power backup** is set to **Allow**. Set the power for charging by the grid for off-grid power backup. The default value is 100 kW, and the value range is [0.0, 50000.0].

NOTE

Array end-of-charge SOC > **End-of-charge SOC (on-grid)** or **End-of-charge SOC (off-grid)** ≥ **Backup power SOC for peak shaving** ≥ **Min. SOC for off-grid power backup** > **End-of-discharge SOC (off-grid)** > **Array end-of-discharge SOC**

Step 5 Choose **Settings** > **Microgrid Control** > **On/Off-grid switching**, and set on/off-grid switching parameters.

Table 5-8 On/Off-grid switching parameters

Tab	Parameter	Description
On-grid to Off-grid	**Switch to Off-grid** under **Planned switching control**	After the planned switching control is started, the on/off-grid switch is turned off and the system enters off-grid state.
Off-grid to On-grid	**Auto switching to on-grid** under **Automatic Off-grid to On-grid Switching**	• **Enable**: If the mains voltage is stable, the system automatically switches from off-grid to on-grid state after the synchronization of the relay protection device is successful. • **Disable**: Disable the function of automatic switching from off-grid to on-grid.
	Setting value of high voltage under **Criteria of Stable Grid**	Set the allowed error range of the mains voltage. If the voltage is within [Setting value of high voltage, 110]% of the rated voltage, the voltage is considered stable.
	Continuous power available for under **Criteria of Stable Grid**	Set the minimum time for which the mains voltage remains stable.
	Max switching time under **Conditions for Off-grid to On-grid Switching**	Set the maximum time for switching from off-grid to on-grid. **Max switching time** must be greater than the maximum duration for the synchronization check of the relay protection device.
	Off-grid to on-grid under **Manual On-grid/Off-grid Switching**	Set **Auto switching to on-grid** to **Disable**. To switch from off-grid to on-grid, click **Off-grid to on-grid** first. When the mains voltage is stable, synchronization will be performed. After the synchronization is successful, the on/off-grid switch is turned on and the system enters on-grid state.

Tab	Parameter	Description
On/Off-grid switch control	On/Off-grid switch control	This function is used only to check the status of the on/off-grid switch. Before the check, the array shall be shut down. • **Close**: The on/off-grid switch is turned on and the system checks whether the relay protection device has correctly controlled the switch-on. • **Open**: The on/off-grid switch is turned off and the system checks whether the relay protection device has correctly controlled the switch-off. **NOTE** • In the on/off grid (VSG) scenario, if the relay protection device is offline, the **Close** and **Open** buttons are grayed out. • When the on/off-grid switch is off, the **Close** button is available, and the **Open** button is grayed out. • When the on/off-grid switch is on, the **Close** button is grayed out, and the **Open** button is available. • When the on/off-grid switch is in invalid state, the **Close** and **Open** buttons are grayed out.

From on-grid to off-grid

Scenario	Command and Operation Between the SmartLogger and Devices
Unplanned switching from on-grid to off-grid	1. The grid fails. 2. When detecting the grid failure, the relay protection device automatically turns off the on/off-grid switch. 3. The SmartLogger sends a command to set **Microgrid compatibility** to **Enable** under **Monitoring** > **Inverter** > **Running Param.** > **Feature Parameters**. 4. The SmartLogger receives the switch-off signal from the on/off-grid switch. The system enters off-grid state and executes the off-grid scheduling policy.

Scenario	Command and Operation Between the SmartLogger and Devices
Planned switching from on-grid to off-grid	1. Click the **Switch to Off-grid** button on the SmartLogger WebUI. 2. The SmartLogger sends a command to adjust the power at the grid connection point. 3. The SmartLogger sends a command to set **Microgrid compatibility** to **Enable** under **Monitoring** > **Inverter** > **Running Param.** > **Feature Parameters**. 4. The SmartLogger checks whether the power adjustment at the grid connection point is successful. If yes, the SmartLogger sends a command to the relay protection device to turn off the on/off-grid switch and the system enters off-grid state. If no, the switching failed, an alarm is reported, and on-grid operation continues.

Table 5-9 Off-grid to on-grid

Scenario	Command and Operation Between the SmartLogger and Devices
Auto switching to on-grid	1. Set **Auto switching to on-grid** to **Enable** on the SmartLogger WebUI. 2. The SmartLogger checks that the mains voltage is stable. 3. The SmartLogger checks whether the PCS is shut down. **If all PCSs are shut down:** a. The SmartLogger checks whether the genset is connected. If yes, the SmartLogger sends a command to shut down the genset. b. The SmartLogger sends a command to the relay protection device to turn on the on/off-grid switch. c. The SmartLogger sends a command to start the PV+ESS system. **If a PCS is not shut down:** a. The SmartLogger sends a command to the relay protection device to start the synchronous switch-on and the secondary adjustment of the voltage and frequency. b. The SmartLogger checks whether the synchronous switch-on of the relay protection device is successful. If yes, go to **Step 4**. If no, go back to **Step a**. 4. The SmartLogger checks whether the on/off-grid switch is turned on successfully. If yes, the switching from off-grid to on-grid is successful. If no, a switching failure alarm is reported.

Scenario	Command and Operation Between the SmartLogger and Devices
Manual switching to on-grid	1. Click the **Off-grid to on-grid** button on the SmartLogger WebUI to shut down the PV+ESS system. 2. The SmartLogger checks that the mains voltage is stable. 3. The SmartLogger checks whether the PCS is shut down. **If all PCSs are shut down:** a. The SmartLogger checks whether the genset is connected. If yes, the SmartLogger sends a command to shut down the genset. b. The SmartLogger sends a command to the relay protection device to turn on the on/off-grid switch. c. The SmartLogger sends a command to start the PV+ESS system. **If a PCS is not shut down:** a. The SmartLogger sends a command to the relay protection device to start the synchronous switch-on and the secondary adjustment of the voltage and frequency. b. The SmartLogger checks whether the synchronous switch-on of the relay protection device is successful. If yes, go to **Step 4**. If no, go back to **Step a**. 4. The SmartLogger checks whether the on/off-grid switch is turned on successfully. If yes, the switching from off-grid to on-grid is successful. If no, a switching failure alarm is reported.

Step 6 Choose **Monitoring** > **PCS** > **Running Info.** and obtain the actual grid voltage based on the average of **AB/BC/CA line voltage of grid**. Choose **Monitoring** > **PCS** > **Running Param.** > **Grid Parameters** and view the voltage level and grid code voltage.

If the absolute deviation between the actual grid voltage and the grid code voltage ranges is [2%, 5%] for a long time, the MGCC will fail to adjust the PCS voltage, and the reactive power of the PCS will occupy the active power of the PCS. To solve this problem, choose **Monitoring** > **PCS** > **Running Param.** > **Feature Parameters**, and set **VSG output voltage correction coefficient** to adjust the PCS output voltage. If the absolute deviation between the actual grid voltage and the grid code voltage is greater than 5% for a long time, you are not advised to set **Microgrid scenario** to **On-grid/Off-grid (VSG)**.

Table 5-10 Adjustment scheme for the VSG output voltage correction coefficient

Deviation Between the Actual Grid Voltage and the Grid Code Voltage (%)	VSG Output Voltage Correction Coefficient (%)
–5	95
–4	96
–3	97
–2	98
2	102
3	103
4	104
5	105

----End

5.3 Off-grid

Step 1 Set **MGCC Mode** to **Enable**. This parameter can be modified only under **Deployment Wizard** > **Microgrid** > **Microgrid**.

Step 2 Set **Microgrid scenario** to **Off-grid**. This parameter can be modified only under **Deployment Wizard** > **Microgrid** > **Microgrid**.

Step 3 Choose **Settings** > **Microgrid Control** > **General Configuration** and set general configuration parameters.

Table 5-11 General configuration parameters

Parameter	Description
Switch status port under **Load Switch**	Set these parameters based on the actual cable connections. If you need to modify the parameters after the settings are submitted, the automatic control function of the load switch may fail. This function can be restored only after the SmartLogger is restarted or the black start is successful in the off-grid scenario. **DI port status** can be set to **Open** and **Close**. If the actual status of the load switch is inconsistent with **Status**, change the setting of **DI port status**.
DI port status under **Load Switch**	
Switch-off control port under **Load Switch**	Set the DO port for turning off the load switch based on the actual cable connections.

Parameter	Description
Switch-on control port under **Load Switch**	Set the DO port for turning on the load switch based on the actual cable connections.

Step 4 Choose **Settings** > **Microgrid Control** > **Off-grid Control** to set off-grid control parameters.

Table 5-12 Off-grid control parameters

Tab	Parameter	Description
Control Policy	End-of-charge SOC (off-grid)	Set the maximum SOC for charge in off-grid mode. The default value 90% is recommended.
	SOC threshold for stopping load shedding	Set the SOC threshold for stopping load shedding. The default value 30% is recommended. If the SOC is greater than or equal to **SOC threshold for stopping load shedding**, the load switch is automatically turned on to supply power to loads. If you manually turn on or off the load switch, the automatic control function of the load switch will be automatically disabled. This function can be restored only after the SmartLogger is restarted or the black start is successful in the off-grid scenario.
	SOC threshold for starting load shedding	Set the SOC threshold for starting load shedding. The default value 20% is recommended. If the SOC is less than or equal to **SOC threshold for starting load shedding**, the load switch is automatically turned off to reduce the ESS discharge power. If you manually turn on or off the load switch, the automatic control function of the load switch will be automatically disabled. This function can be restored only after the SmartLogger is restarted or the black start is successful in the off-grid scenario.
	End-of-discharge SOC (off-grid)	Set the minimum SOC for discharge in off-grid mode. The default value 10% is recommended.
	Min PV voltage for black start	Set the minimum PV voltage for black start. After the solar irradiance recovers, the inverter PV voltage increases. If the PV1 voltage of an inverter is greater than or equal to **Min PV voltage for black start**, the black start function may be enabled.

Tab	Parameter	Description
Charging	Real-time SOC (%)	The output power of the inverter is controlled based on the current battery SOC to meet the battery charge power adjustment target. The value of **Allowed Charge Power (%)** ranges from 0 to 70. The value of SOC ranges from **End-of-discharge SOC (off-grid)** to **End-of-charge SOC (off-grid)**.
	Allowed Charge Power (%)	
Load control	Manual Load Control	**Close**: Loads are connected. **Open**: Loads are disconnected. **NOTE** • In the off-grid scenario, the **Close** and **Open** buttons are available only when the DO ports of **Switch-off control port** and **Switch-on control port** under **Load Switch** are configured. • When the load switch is off, the **Close** button is available, and the **Open** button is grayed out. • When the load switch is on, the **Close** button is grayed out, and the **Open** button is available. • When the load switch is in invalid state, the **Close** and **Open** buttons are grayed out.

NOTE

Array end-of-charge SOC > **End-of-charge SOC (off-grid)** ≥ **SOC threshold for stopping load shedding** > **SOC threshold for starting load shedding** > **End-of-discharge SOC (off-grid)** > **Array end-of-discharge SOC**

Table 5-13 Off-grid PV+ESS system (description of the load shedding and automatic recovery process)

Scenario	Command and Operation Between the SmartLogger and Devices
Off-grid	1. The ESS is off-grid and running properly. 2. If the current battery SOC is less than or equal to **SOC threshold for starting load shedding**, the SmartLogger sends a command to turn off the load switch, powering off all loads. 3. After load shedding, if PV power is generated to charge the ESS and the SOC is greater than or equal to **SOC threshold for stopping load shedding**, the SmartLogger sends a command to turn on the load switch, supplying power to loads. 4. If no PV power is available to charge the ESS and the SOC is less than or equal to **End-of-discharge SOC (off-grid)**, the ESS is shut down within 5 minutes. 5. After the ESS is shut down, if the PV1 voltage of an inverter is greater than or equal to the **Min PV voltage for black start** for at least 1 hour and the battery SOC is greater than or equal to the **Array end-of-discharge SOC**, the ESS is black-started and the PV+ESS system resumes operation. 6. If the SOC is less than the **Array end-of-discharge SOC**, the PV+ESS system shuts down and remote black start cannot be performed. In this case, technical engineers are required to handle the problem onsite.

----End

6 System Operations

NOTICE

- If you start and shut down the ESS and then need to start or black-start it again, you are advised to wait for a period of time greater than or equal to **Device disconnection time** (choose **Maintenance** > **Device Mgmt.** > **Connect Device** to view **Device disconnection time**) before startup or black start. Otherwise, the ESS may fail to be started or black-started.
- When the SOC is lower than **Array end-of-discharge SOC**, the ESS cannot start properly in VSG mode.

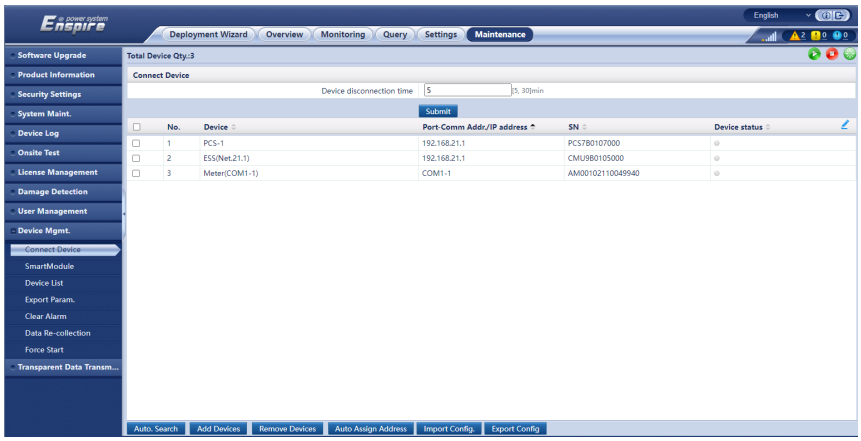
Starting the Array on the SmartLogger WebUI in On-Grid Mode

Step 1 Log in to the SmartLogger WebUI.

- In the **On-grid/Off-grid (PQ/VSG)** scenario, choose **Monitoring** > **PCS** > **Running Param.** > **Feature Parameters** and set **Working mode** to **PQ**. Choose **Monitoring** > **Inverter** > **Running Param.** > **Feature Parameters** and set **Microgrid compatibility** to **Disable**.
- In the **On-grid/Off-grid (VSG)** scenario, choose **Monitoring** > **PCS** > **Running Param.** > **Feature Parameters** and set **Working mode** to **VSG**. Choose **Monitoring** > **Inverter** > **Running Param.** > **Feature Parameters** and set **Microgrid compatibility** to **Enable**.

Step 2 Send a startup command to the inverter, PCS, and Smart Rack Controller.

Method 1 (array-level): Choose **Maintenance** > **Connect Device**, and click  .



Method 2 (bus-level): Choose **Overview** > **Plant Running Info.**, and click  .

Step 3 Choose **Overview** > **Plant Running Info.** on the SmartLogger and check whether the meter power, ESS power, and PV power match.

----End

NOTE

If **Step 1** and **Step 2** are complete after deployment commissioning, skip them. If a power failure occurs after deployment commissioning, perform **Step 1** and **Step 2** to start the array.

Starting the Array Using the Black Start Function in Off-Grid Mode

NOTICE

- The plant design shall ensure that the inrush current of each load line does not cause overcurrent protection after black start is successful.
- The control logic of black start is implemented by the MGCC, and the power supply for startup is the ESS.
- During black start, the secondary circuits such as the SmartLogger and the CMU of the ESS shall have a power supply, which can be provided by the UPS.
- During black start, the ESS array shall have adequate dischargeable power for the black start (depending on the isolation transformer specifications and inrush current in the system).
- To prevent PCS protection caused by the excitation inrush current when the isolation transformer is switched on during black start, the isolation transformer and lines also need to be started simultaneously.
- If forced dehumidification of the ESS is triggered during the black start, the black start function cannot take effect properly. Therefore, before the black start, ensure that the ESS cabinet doors are closed in a timely manner and that there is no condensation in the ESS (for example, there is no water drop in the ESS).
- In off-grid scenarios, it is recommended that the SOC during ESS charge/discharge operations in the scenario where the microgrid control is implemented by the SmartLogger range from 10% to 90% to ensure that the black start function works properly.

Choose **Settings** > **Microgrid Control** > **Black Start** to view the black start status and perform black start manually.

NOTICE

For manual black start, before clicking **Starting** under **Settings** > **Microgrid Control** > **Black Start**, ensure that **Current Battery SOC** is higher than 2%. Otherwise, black start may fail.

Parameter	Description
Current Battery SOC	View the current battery SOC.
Black Start Progress	View the black start progress.

Parameter	Description
Status	• Black start failed. Cause: All ESSs are offline. • Black start failed. Cause: No ESS is available for black start. • Black start failed. Cause: No PCS is available for black start. • Black start failed. Cause: No PCS is prepared for black start. • Black start failed. Cause: No PCS has established the voltage for black start. • Manual black start in progress • Automatic black start in progress: The current battery SOC is higher than **Array end-of-discharge SOC**. – When **MGCC Mode** is set to **Enable**, **Microgrid scenario** is set to **On-grid/Off-grid (PQ/VSG)**, and **On/Off-grid switching mode** is set to **Auto**, black start is automatically triggered if the mains triggers the on/off-grid switching. – When **MGCC Mode** is set to **Enable**, **Microgrid scenario** is set to **On-grid/Off-grid (PQ/VSG)**, and **On/Off-grid switching mode** is set to **Manual**, black start is automatically triggered if you turn off on-grid/off-grid switch locally to trigger the on/off-grid switching manually. – When **MGCC Mode** is set to **Enable**, if the voltage on the PCS AC side is abnormal (less than 30% of the rated voltage on the PCS AC side) and the PCS is shut down abnormally, black start is automatically triggered. – When **MGCC Mode** is set to **Enable** and **Microgrid scenario** is set to **Off-grid**, if the solar irradiance recovers for inverters and no PCS is running, turn off the load switch and then the black start is automatically triggered. • Black start succeeded.

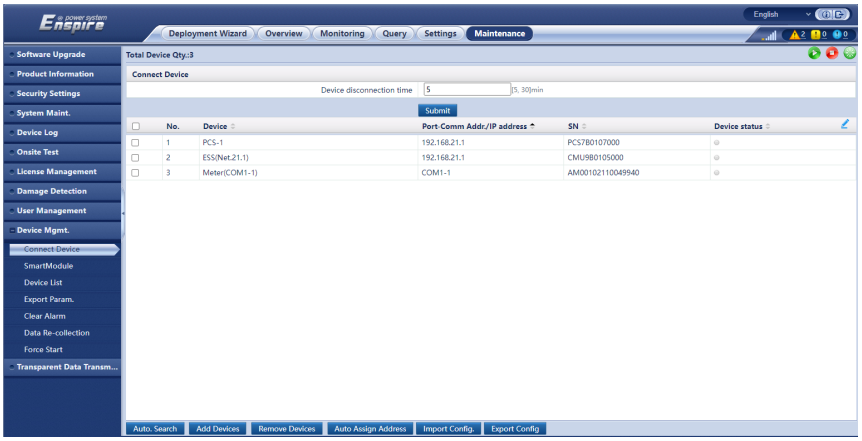
7 System Power-Off

If you need to power off the system during maintenance, use the SmartLogger to power off the system.

Step 1 Send a shutdown command.

1. Log in to the SmartLogger WebUI and send a shutdown command to the inverter, PCS, and Smart Rack Controller.

   Method 1 (array-level): Choose **Maintenance** > **Connect Device**, and click  .

   Method 2 (bus-level): Choose **Overview** > **Plant Running Info.**, and click  .

2. Choose **Monitoring** > **Inverter** > **Running Info.** Check **Device status** and **Active power** to verify that the shutdown is successful.
3. Choose **Monitoring** > **PCS** > **Running Info**. Check **Device status**, **Active power**, and **DC voltage** to verify that the shutdown is successful.
4. Choose **Monitoring** > **CMU** > **Running Info**. Check **Rated power** and **Total output voltage of rectifiers** to verify that the shutdown is successful.

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 **4.1 Device Power-On** in the reverse order.

NOTE

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

----End

A Reference Documents

Device	Document
ESS	• LUNA2000-(97KWH-1H1, 129KWH-2H1, 161KWH-2H1, 200KWH-2H1) Smart String ESS User Manual • LUNA2000-(97KWH-1H1, 129KWH-2H1, 161KWH-2H1, 200KWH-2H1) Smart String ESS Maintenance Manual • LUNA2000-(97KWH-1H1, 129KWH-2H1, 161KWH-2H1, 200KWH-2H1) Smart String ESS Quick Guide
PCS	• LUNA2000-100KTL-M1 Smart Power Control System User Manual • LUNA2000-100KTL-M1 Smart Power Control System Quick Guide

Device	Document
Inverter	• SUN2000-(20KTL, 29.9KTL, 30KTL, 36KTL, 40KTL)-M3 User Manual • SUN2000-(20KTL, 29.9KTL, 30KTL, 36KTL, 40KTL)-M3 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) User Manual • SUN2000-(50KTL-ZHM3, 50KTL-M3) Quick Guide • SUN2000-(75KTL, 100KTL, 110KTL, 125KTL) Series User Manual • SUN2000-(75KTL, 100KTL, 110KTL, 125KTL) Series Quick Guide • SUN2000-(100KTL, 110KTL, 115KTL)-M2 User Manual • SUN2000-(100KTL, 110KTL)-M2 Quick Guide (STAUBLI) • SUN2000-(75KTL-M1, 100KTL-M2, 110KTL-M2, 115KTL-M2) Quick Guide
SUN2000P	• MERC Smart PV Optimizer User Manual • 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
SmartLogger	• SmartLogger3000 User Manual • SmartLogger3000 Quick Guide
DTSU666-HW	DTSU666-HW Smart Power Sensor Quick Guide
FusionSolar app	FusionSolar App User Manual
iMaster NetEco	iMaster NetEco V600R023C00 FusionSolar SmartPVMS User Manual

B ESS Software Upgrade Solution for the Off-Grid PV+ESS System

Multiple ESSs in an Array

For non-first-time deployment, start one ESS and upgrade the software of the other ESSs. After the other ESSs are upgraded, upgrade the software of the ESS that is not upgraded.

For first-time deployment, each ESS must be upgraded separately. For details about how to upgrade a single ESS, see **Only One ESS in an Array**.

Only One ESS in an Array

Prerequisites:

The customer needs to prepare a temporary mobile power supply (such as a UPS or genset) and related cables to provide the auxiliary power supply for the ESS air conditioners. The requirements for the temporary power supply are as follows:

- Voltage: 220 V AC
- Power: ≥ 5 kVA
- Power backup duration: ≥ 30 minutes

Procedure:

Step 1 Prepare the upgrade software package: Log in to the Support-E website and search for the latest ESS software version in **FusionSolar Software Download**.

Step 2 Prepare a temporary power supply, cables, and wiring tools.

Step 3 Turn off the load switch.

Step 4 Shut down the ESS and PCS on the SmartLogger WebUI.

Step 5 Connect the temporary power supply to the 220 V AC input terminal of the auxiliary power supply for the ESS air conditioners (1FCB; you are advised to connect the temporary power supply to the power distribution equipment).

Step 6 Upgrade the software on the SmartLogger WebUI: Click **Choose File**, select the target software package, and click **Upload**. After the upload is complete, click **Software Upgrade**.

Step 7 After the upgrade is complete, remove the temporary power supply and related cables, and restore the cable connections on the power distribution equipment.

Step 8 The CMU indicator turns green and then wait for a period of time greater than or equal to **Device disconnection time**.

NOTICE

- If you start and shut down the ESS and then need to start or black-start it again, you are advised to wait for a period of time greater than or equal to **Device disconnection time** (choose **Maintenance** > **Device Mgmt.** > **Connect Device** to view **Device disconnection time**) before startup or black start. Otherwise, the ESS may fail to be started or black-started.
- When the SOC is lower than **Array end-of-discharge SOC**, the ESS cannot start properly in VSG mode.

Step 9 Turn on the load switch.

----End

C List of Alarms Affecting Topology Identification

Alarm ID	Alarm Name	Cause ID
1140	Array Black Start Failed	2, 3, 4, 6, 7, 8
3013	Battery Pack Communication of Rack Controller Abnormal	2
3014	Rack Controller Abnormal	3
3015	Battery Side Overvoltage on Rack Controller	1
3016	Battery Side Undervoltage on Rack Controller	1
3017	Battery Side Short Circuit on Rack Controller	1
3018	Battery Side Reverse Polarity on Rack Controller	1
3019	Bus Side Overvoltage on Rack Controller	1
3020	Bus Side Reverse Polarity on Rack Controller	1
3021	Insulation Resistance of Rack Controller Abnormal	1
3022	Rack Controller Temperature High	1
3023	Battery Terminal Overtemperature on Rack Controller	1

Alarm ID	Alarm Name	Cause ID
3024	Bus Terminal Overtemperature on Rack Controller	1
3025	Rack Controller Version Mismatch	1
3027	Battery Pack Monitoring Board Abnormal	1, 21
3028	Battery Pack Abnormal	1, 6
3029	Battery Pack Locked	1, 2, 5
3030	Battery Pack Fan Fault	1
3032	Battery Pack Overvoltage	1
3034	Rack Controller Cable Connection Abnormal	1, 2
3035	Battery Pack Positions of Rack Controller Abnormal	1
3036	Optimization Unit of Battery Pack Abnormal	1
3037	Overtemperature on Optimization Unit of Battery Pack	1
3038	Overtemperature on Optimization Unit Terminal of Battery Pack	1
3039	Battery Pack Optimization Unit Version Mismatch	1
3040	Incorrect Bus Connection on Rack Controller	1
3041	Loose Connection of Battery Pack Copper Bar	1
3042	Rapid Shutdown Cable Connection of Battery Pack Abnormal	1, 2, 3
3044	Battery Pack Overcurrent	1
3045	Battery Pack Temperature High	1
3046	Battery Pack Temperature Low	1
3047	Battery Pack Undervoltage	4
3052	External DC Auxiliary Power Supply of Rack Controller Fault	1

Alarm ID	Alarm Name	Cause ID
3054	Rack Controller Temperature Abnormal	2
3056	Emergency Power-Off	1
3058	Version Incompatible Between Rack Controller and Battery Packs	1
3060	Incompatible ESM	1
3800	Water Alarm	1, 2
3801	Door Status Alarm	1, 2, 3, 4, 5, 6
3826	Combustible Gas Alarm	1
3827	Ambient Temperature High	1, 2
3830	Temperature and Humidity Control Malfunction	1
3849	Air Exhaust Malfunction	1, 2
3850	Combustible Gas Detection Malfunction	1
3856	Battery Fault Protection	1, 2
3858	48 V DC Auxiliary Power Supply Faulty	1
3859	Forced Dehumidification Started	1

D Digital Power Customer Service

https://digitalpower.huawei.com/robotchat/

E Contact Information

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

https://digitalpower.huawei.com

Path: **About Us** > **Contact Us** > **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

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F Acronyms and Abbreviations

A

ATS	Automatic Transfer Switch

C

CMU	Central Monitoring Unit

E

ESS	Energy Storage System

F

FE	Fast Ethernet

P

PCS	Power Control System
PSU	Power Supply Unit

S

SFP	Small Form-factor Pluggable

SOC	State of Charge
SOH	State of Health

U

UPS	Uninterruptible Power Supply