

Commercial and Industrial Microgrid Energy Storage Solution

Quick Guide (With SmartLogger-based Microgrid Control)

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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
	Indicates a hazard with a high level of risk which, if not avoided, will result in death or serious injury.
	Indicates a hazard with a medium level of risk which, if not avoided, could result in death or serious injury.
	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 01 (2023-12-18)

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

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1 Solution Introduction

1.1 Networking Architecture

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

NOTICE

In off-grid scenarios, 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 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 50% of the PCS rated power can be connected and disconnected independently, and those greater than 50% 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 (2.5% of the PCS rated power), 2.5% 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 (5% of the PCS rated power), 5% even harmonics are allowed. When the PCS has no output fundamental wave current, loads with even harmonics cannot be connected.

1.1.1 On/Off-Grid PV+ESS System

The on/off-grid PV+ESS 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 system. Table 1-1 lists the components.

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

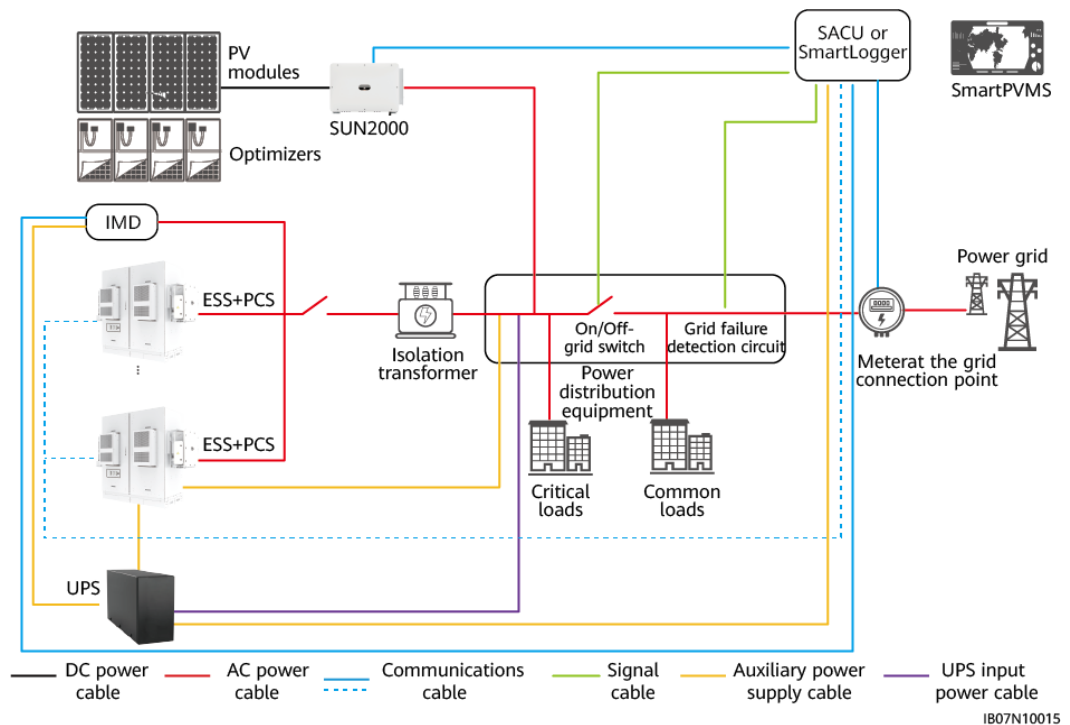


Table 1-1 Components of the on/off-grid PV+ESS system

Name	Model/Specifications	Quantity	Remarks
Smart String Energy Storage System (ESS)	<ul style="list-style-type: none"> LUNA2000-200KWH-2H1 LUNA2000-161KWH-2H1 LUNA2000-129KWH-2H1 LUNA2000-97KWH-1H1 	≤ 20	Purchased from the Company

Name	Model/Specifications	Quantity	Remarks
Smart Power Control System (PCS)	LUNA2000-100KTL-M1	≤ 20	Purchased from the Company. The quantity ratio of PCS to ESS is 1:1.
Smart PV inverter (SUN2000)	<ul style="list-style-type: none"> ● 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. Different models shall not be used together.
Smart PV Optimizer (SUN2000P)	<ul style="list-style-type: none"> ● 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). The SUN2000P is supported only by the SUN2000-50KTL-M3.

Name	Model/Specifications	Quantity	Remarks
SmartLogger 3000 (SmartLogger)	SmartLogger3000A	1	Purchased from the Company. Choose either SmartLogger or SACU.
Smart Array Controller (SACU)	<ul style="list-style-type: none"> SmartACU2000D-D-00 SmartACU2000D-D-06 	1	The SACU contains the SmartLogger, which can be used to manage devices in an array over the web user interface (WebUI) of the SmartLogger.
SmartModule	SmartModule1000A01	Depending on the actual networking architecture	Purchased from the Company (optional). The SmartModule is used with the SmartLogger or SACU.
Network switch	<ul style="list-style-type: none"> Unmanaged switch Eight or more 10M/100M auto-sensing RJ45 ports Industrial-grade operating temperature range: -40°C to +75°C, or otherwise determined based on local conditions Wide input voltage range: 9-60 V DC Support for guide rail mounting and wall mounting; IP30 or higher level of protection 	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)

Name	Model/Specifications	Quantity	Remarks
Power distribution equipment (including the on/off-grid switch and grid failure detection circuit)	<ul style="list-style-type: none"> • 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
UPS	<ul style="list-style-type: none"> • 1–3 kVA, online UPS, 220 V • Power backup duration \geq 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 Off-Grid PV+ESS System

The off-grid PV+ESS system applies to remote areas and islands without electricity. The ESS and 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 1-2 shows the networking architecture of the off-grid PV+ESS system. **Table 1-2** lists the components.

Figure 1-2 Networking architecture of the off-grid PV+ESS system

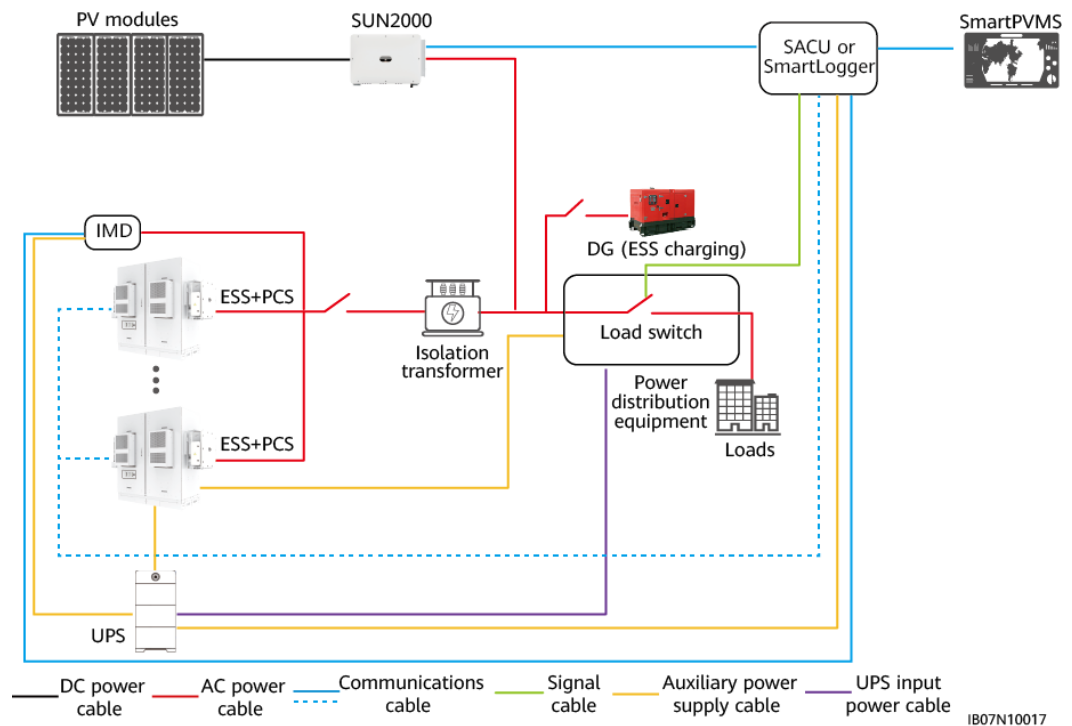


Table 1-2 Components of the off-grid PV+ESS system

Name	Model/Specifications	Quantity	Remarks
Smart String Energy Storage System (ESS)	<ul style="list-style-type: none"> 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 (SUN2000)	<ul style="list-style-type: none"> ● 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. Different models shall not be used together.
SmartLogger 3000 (SmartLogger)	SmartLogger3000A	1	Purchased from the Company. Choose either SmartLogger or SACU.
Smart Array Controller (SACU)	<ul style="list-style-type: none"> ● SmartACU2000D-D-00 ● SmartACU2000D-D-06 	1	The SACU contains the SmartLogger, which can be used to manage devices in an array over the web user interface (WebUI) of the SmartLogger.

Name	Model/Specifications	Quantity	Remarks
SmartModule	SmartModule1000A01	Depending on the actual networking architecture	Purchased from the Company (optional). The SmartModule is used with the SmartLogger or SACU.
Network switch	<ul style="list-style-type: none"> • Unmanaged switch • Eight or more 10M/100M auto-sensing RJ45 ports • Industrial-grade operating temperature range: -40°C to +75°C, or otherwise determined based on local conditions • Wide input voltage range: 9-60 V DC • Support for guide rail mounting and wall mounting; IP30 or higher level of protection 	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	<ul style="list-style-type: none"> • 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.
Diesel generator (DG)	Three-phase	-	Prepared by the customer (optional)

1.2 Communication Logic

One SACU or SmartLogger manages multiple ESSs, PCSs, and SUN2000s, one IMD, and one meter to form an array. Intra-array:

- The SUN2000s communicate with the SACU or SmartLogger, the IMD communicates with the SACU or SmartLogger, and the meter communicates with the SACU or SmartLogger over RS485.
- The ESSs communicate with the SACU or SmartLogger over FE in star or chain topology.
- The PCSs communicate with the SACU or SmartLogger over FE in star or ring topology.

Maximum communication distance of the SACU or SmartLogger:

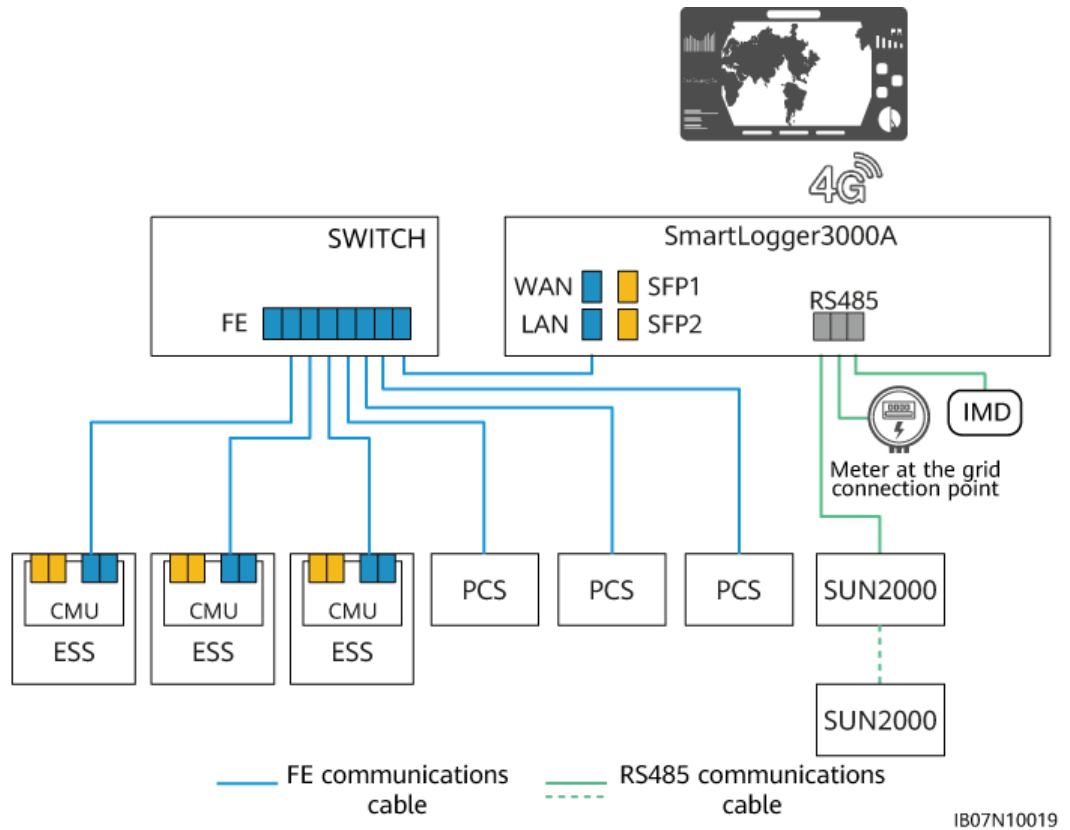
- RS485: 1000 m
- FE: 100 m

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 SmartLogger3000A is configured, and the customer needs to prepare at least one switch (quantity of 10M/100M auto-sensing Ethernet ports \geq 8). The quantities of switches and Ethernet ports are configured based on the quantities of ESSs and PCSs connected to the array.

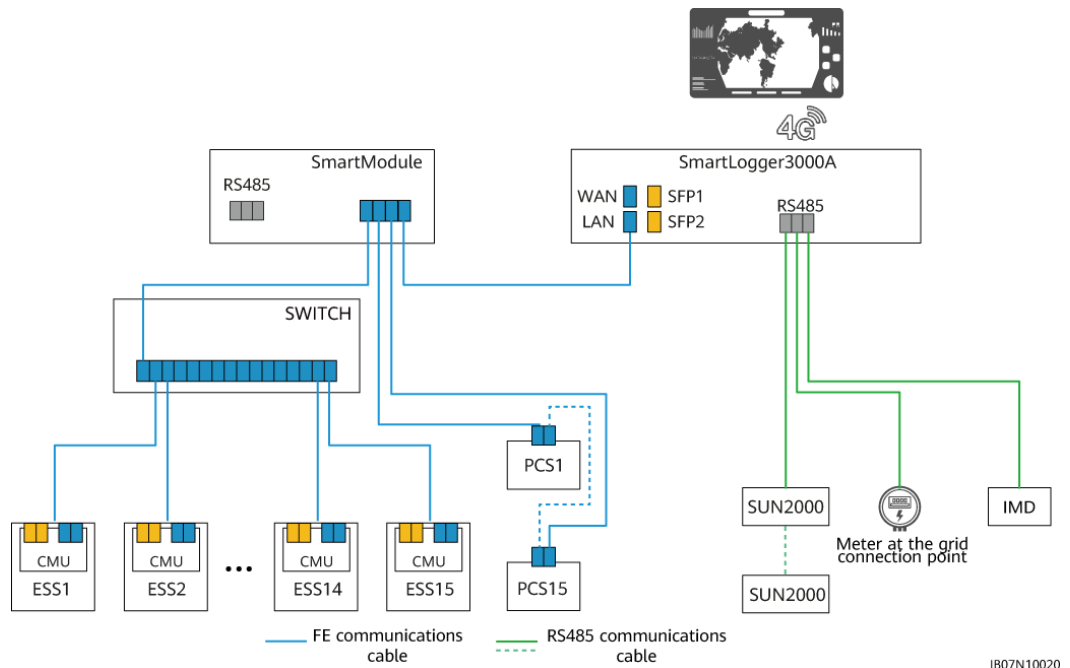
Figure 1-3 SmartLogger+ESS FE star+PCS FE star topology



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

In this scenario, the SmartLogger3000A is configured, and the customer needs to prepare at least one switch (10M/100M). The quantities of 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 15 PCSs.

Figure 1-4 SmartLogger+ESS FE star+PCS FE ring topology

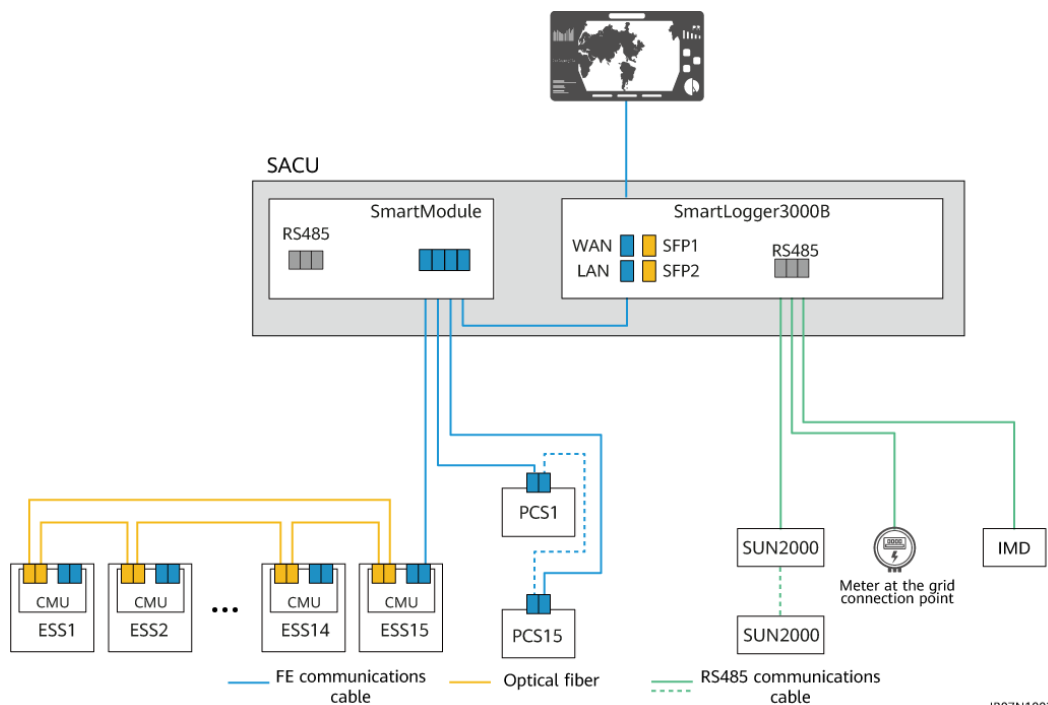


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Typical Scenario 3: SACU+ESS Fiber Ring+PCS FE Ring Topology

In this scenario, the SmartACU2000D-D-00 is configured, and the SmartModule needs to be configured in the SACU. The SACU communicates with the first ESS through FE, and ESSs communicate with each other through SFP optical fiber cascading. In the ESS fiber ring topology, a single fiber ring network supports a maximum of 15 ESSs.

Figure 1-5 SACU+ESS fiber ring+PCS FE ring topology

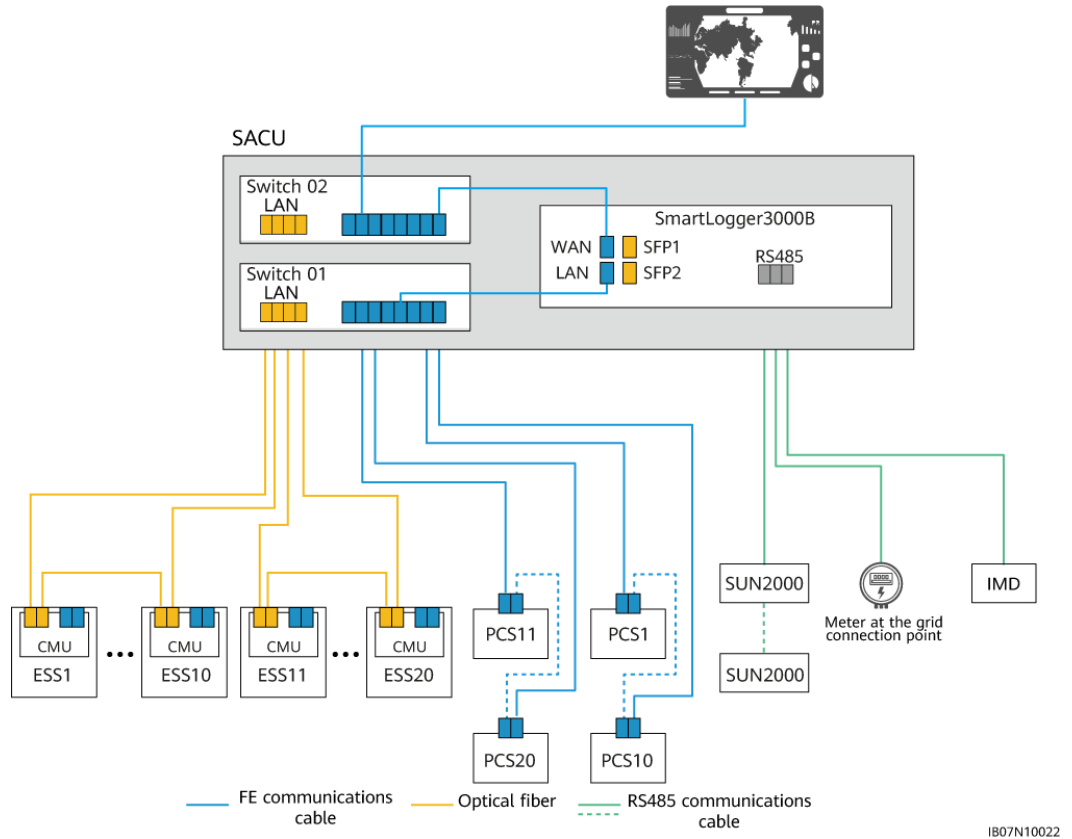


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Typical Scenario 4: SACU+ESS Fiber Ring+PCS FE Ring Topology

In this scenario, the SmartACU2000D-D-06 is configured and the SmartModule needs to be configured in the SACU. This topology is recommended when the quantity of ESSs ranges from 16 to 20.

Figure 1-6 SACU+ESS fiber ring+PCS FE ring topology



1.3 O&M Methods

Table 1-3 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, SUN2000s, and meters in the array.	Deployment commissioning	SmartLogger3000 User Manual

O&M Method	Description	Main Application Scenario	Reference Document
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 manage 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 SUN2000 to locally manage a single PCS, ESS, and SUN2000.	<ul style="list-style-type: none">• 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	<ul style="list-style-type: none">• 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:<ul style="list-style-type: none">– 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.
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 SUN2000 and SUN2000P	N/A

Step	Task	Precaution
4	Installing the DTSU666-HW	N/A
5	Installing the SACU or SmartLogger	<ul style="list-style-type: none"> • 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 DO 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 \leq 10 m. • Recommended: DI signal transmission distance \leq 10 m.
6	Installing PE cables	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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.
8	Installing AC power cables	<ul style="list-style-type: none"> • 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.

Step	Task	Precaution
9	Installing communication cables	For details about the cable connections, see 1.2 Communication Logic .

3 Check and Preparation Before Power-On

- 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

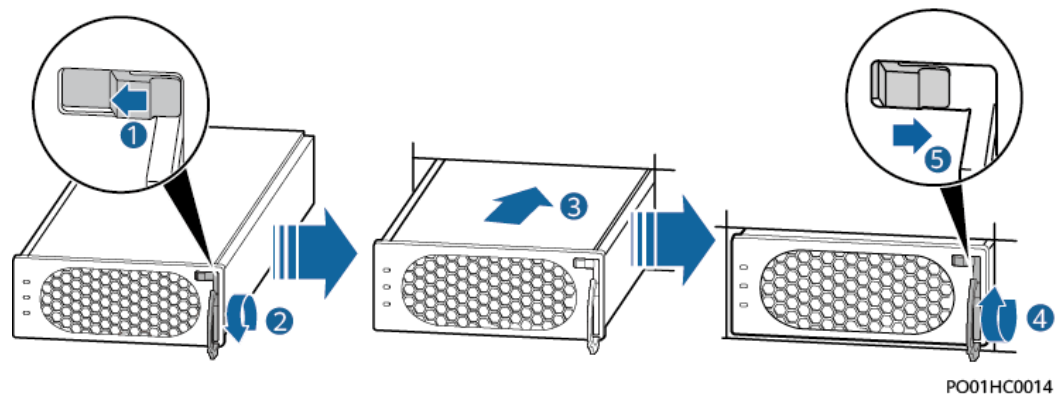
Ensure that cables are correctly and securely connected to the IMD according to the IMD user manual. If cables are incorrectly connected or in poor contact, the IMD cannot work properly and the insulation resistance detection function fails.

- 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



PO01HC0014

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 SUN2000 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 SACU or SmartLogger.
 - Off-grid scenario: The UPS supplies power to the CMU of the ESS and SACU or SmartLogger.
3. Log in to the SACU or 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 SACU or 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 System

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

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

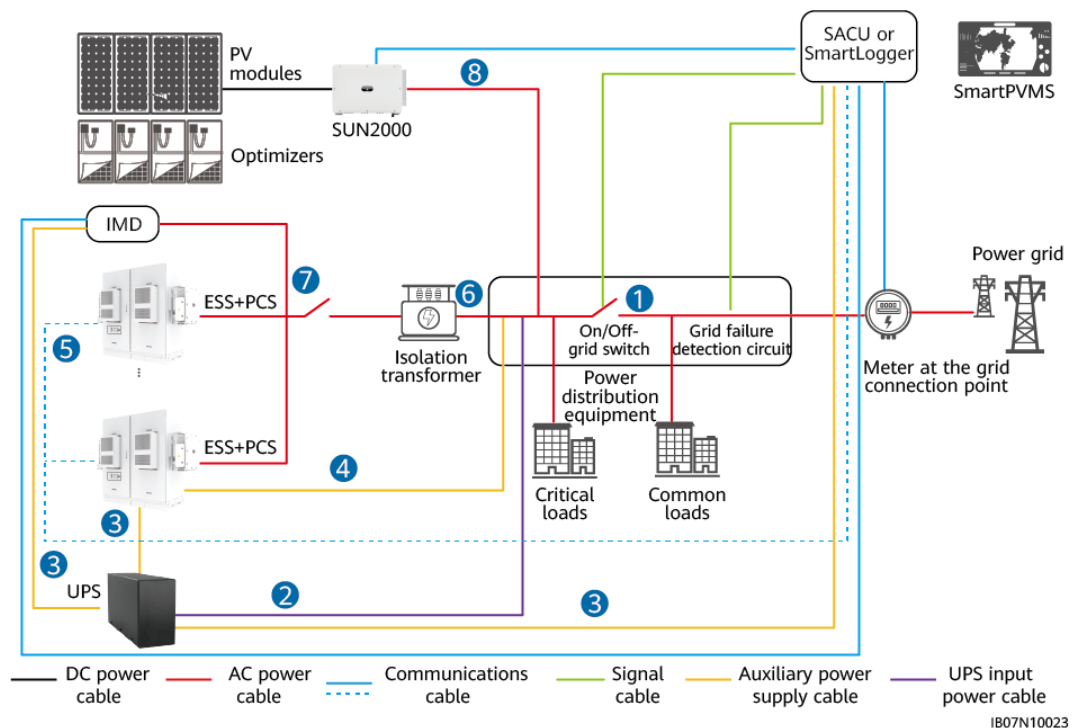


Table 4-1 Power-on process description of the on/off-grid PV+ESS system

Step	Task	Power-On Operation
1	Powering on the power distribution equipment	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 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)	<ol style="list-style-type: none"> 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 auxiliary power supply of the UPS-SACU or SmartLogger	<ol style="list-style-type: none"> 1. Turn on the SACU or SmartLogger power switch on the UPS side. 2. Turn on the switch on the SACU or SmartLogger side: <ul style="list-style-type: none"> • If the SACU is configured: SmartACU2000D-D-00: Turn on the SACU input switch QF03 and the three-phase input switch FU01 in the SACU. SmartACU2000D-D-06: Turn on the SACU input switch QF03. • If the SmartLogger3000A is configured, turn on the power switch (if any) between the SmartLogger3000A 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.

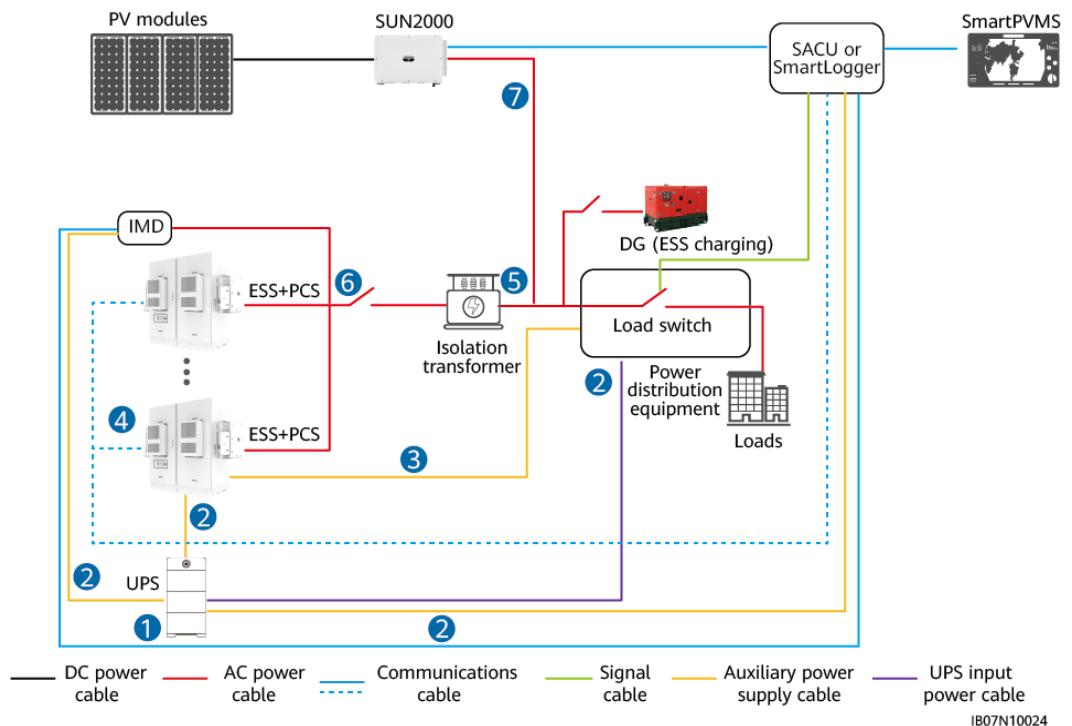
Step	Task	Power-On Operation
4	Powering on the ESS auxiliary power supply (such as for the air conditioners)	<ol style="list-style-type: none"> 1. Turn on the ESS auxiliary power switch on the power distribution equipment side. 2. Use a multimeter to check that the AC voltage is within the allowed range (220 V \pm10%). Then turn on the main AC switch 1FCB in the ESS. 3. Turn on the switches of the ESS power distribution system. <ol style="list-style-type: none"> 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\pm5 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 SUN2000	<p>Select a power-on method based on the inverter model.</p> <p>Method 1:</p> <ol style="list-style-type: none"> 1. Set the DC SWITCH to ON. When you hear a click, the switch is completely turned on. 2. The indicator is not steady red. <p>Method 2:</p> <ol style="list-style-type: none"> 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.
<p>Note: For details about the switch layout and operations of the devices prepared by the customer, see the documents provided by the vendors.</p>		

4.1.2 Off-Grid PV+ESS System

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

Figure 4-2 Power-on process of the off-grid PV+ESS system



IB07N10024

Table 4-2 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)	<ol style="list-style-type: none"> 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 auxiliary power supply of the UPS-SACU or SmartLogger	<ol style="list-style-type: none"> 1. Turn on the SACU or SmartLogger power switch on the UPS side. 2. Turn on the switch on the SACU or SmartLogger side: <ul style="list-style-type: none"> • If the SACU is configured: SmartACU2000D-D-00: Turn on the SACU input switch QF03 and the three-phase input switch FU01 in the SACU. SmartACU2000D-D-06: Turn on the SACU input switch QF03. • If the SmartLogger3000A is configured, turn on the power switch (if any) between the SmartLogger3000A 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)	<ol style="list-style-type: none"> 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. <ol style="list-style-type: none"> 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.

Step	Task	Power-On Operation
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.
6	Powering on the PCS	Turn on the AC switch between the PCS and the isolation transformer.
7	Powering on the SUN2000	<p>Select a power-on method based on the inverter model.</p> <p>Method 1:</p> <ol style="list-style-type: none"> 1. Set the DC SWITCH to ON. When you hear a click, the switch is completely turned on. 2. The indicator is not steady red. <p>Method 2:</p> <ol style="list-style-type: none"> 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.
<p>Note: For details about the switch layout and operations of the devices prepared by the customer, see the documents provided by the vendors.</p>		

4.2 Deployment Commissioning

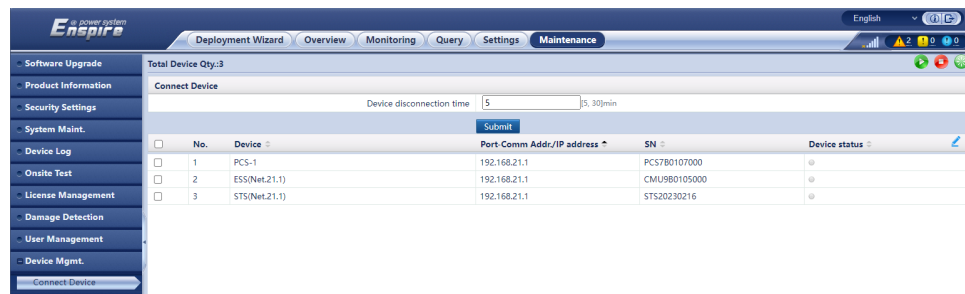
4.2.1 Preparations and WebUI Login

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 Preparations Before Deployment

Step 1 Click **Maintenance**, choose **Device Mgmt.** > **Connect Device**, and check that the devices are connected.

Figure 4-3 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 system: During initial connection, **Device status** of the PCS is yellow, and **Device status** of the ESS is green.
 - For the off-grid PV+ESS system: The UPS auxiliary power supply must be connected. **Device status** of the ESS is green (the CMU is green and the ESU is gray under **Monitoring**). After the topology is identified, the PCS is connected and its **Device status** is gray.
3. Click **Monitoring** and choose **ESS > ESU > ESR > Running Param.**. The quantity of ESMs displayed are 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 4-3 Setting the quantity of battery packs

ESS	Quantity of Battery Packs
LUNA2000-97KWH-1H1	6
LUNA2000-129KWH-2H1	8
LUNA2000-161KWH-2H1	10
LUNA2000-200KWH-2H1	12

- a. Check whether the communications cables to the battery packs are correctly and securely connected.
- b. 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 2 Check that the end-of-charge SOC is greater than the end-of-discharge SOC in the scenario where the microgrid control is implemented by the SmartLogger, and that the end-of-discharge SOC is less than the end-of-charge SOC in the scenario where the microgrid control is implemented by the SmartLogger. If these conditions are not met, the system may be abnormal. You are advised to retain the default values for the end-of-charge SOC (100%) and end-of-discharge SOC (5%). The end-of-charge SOC and end-of-discharge SOC in the scenario where the microgrid control is implemented by the SmartLogger shall range from 10% to 90%.

Path of the End-of-Charge/Discharge SOC on the WebUI
End-of-charge SOC: Monitoring > ESS > ESU > ESR > Running Param. > Charging cutoff SOC
End-of-charge SOC in the scenario where the microgrid control is implemented by the SmartLogger: Settings > Microgrid Control > Off-grid Control > Control Policy > End-of-charge SOC (off-grid)
End-of-discharge SOC: Monitoring > ESS > ESU > ESR > Running Param. > Discharge cutoff SOC
End-of-discharge SOC in the scenario where the microgrid control is implemented by the SmartLogger: Settings > Microgrid Control > Off-grid Control > Control Policy > End-of-discharge SOC (off-grid)

Step 3 Upgrade the software version.

NOTICE

- For the off-grid PV+ESS system, perform the subsequent commissioning steps first to ensure that the UPS has sufficient power for completing deployment commissioning. After the power supply and communication of the system are normal, upgrade the software version. For details about the ESS software upgrade, see [B ESS Software Upgrade Solution for the Off-Grid PV+ESS System](#).
 - Before upgrading the ESS, check whether an ESU alarm is generated. If yes, clear the alarm by referring to the alarm handling suggestions and then perform the upgrade.
 - Before upgrading the ESS, ensure that the SOC of the battery rack is greater than 30%. Otherwise, the delayed upgrade function may be triggered (only software is loaded without performing the upgrade). If the SOC is less than or equal to 30%, choose **Maintenance > Device Mgmt. > Force Start** and click **Starting up** to charge the battery rack. After the charging is complete, click **Stop** to exit force start.
1. Log in to the Support-E website and search for the latest software versions of the SmartLogger, PCS, ESS, and SUN2000 in [FusionSolar Software Download](#).
 2. Choose **Maintenance > Software Upgrade** to check the software versions of the SmartLogger, PCS, ESS, and SUN2000. If the software version of each

device is the latest version on the Support-E website, go to **step 4**. 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**.

Figure 4-4 Upgrading software



Step 4 Clear alarms.

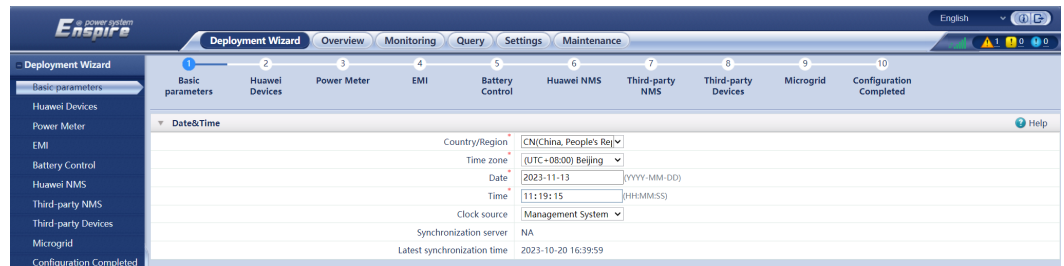
Clear the alarms that affect topology identification by referring to [C List of Alarms Affecting Topology Identification](#), and then search for the devices.

----End

4.2.3 Commissioning Using the Deployment Wizard

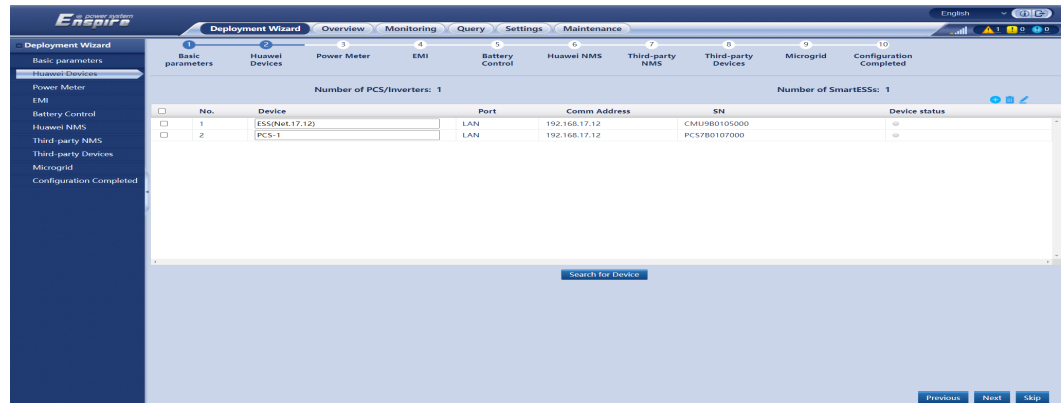
Step 1 Set basic parameters.

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

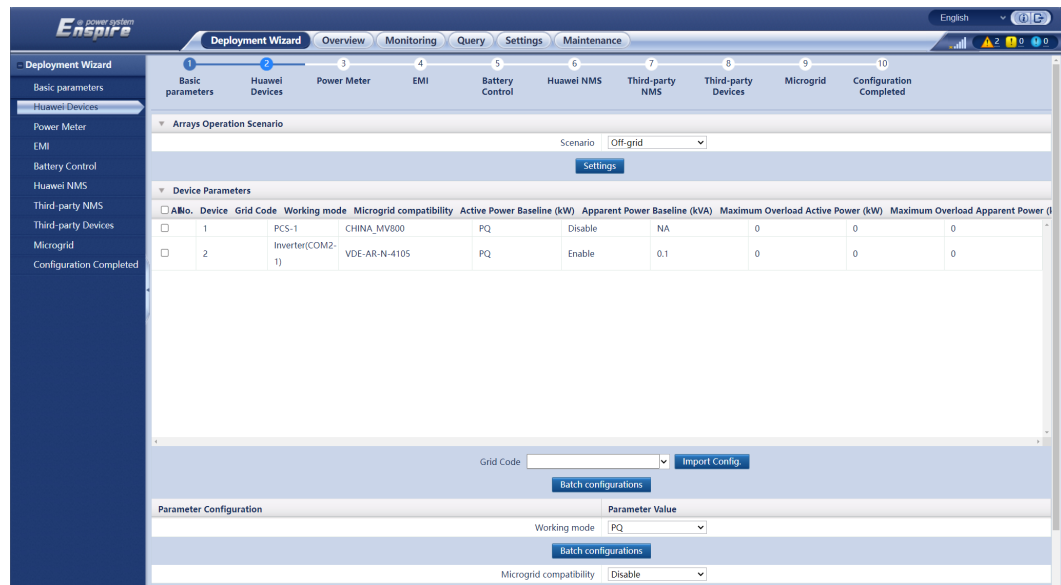


 NOTE

- 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



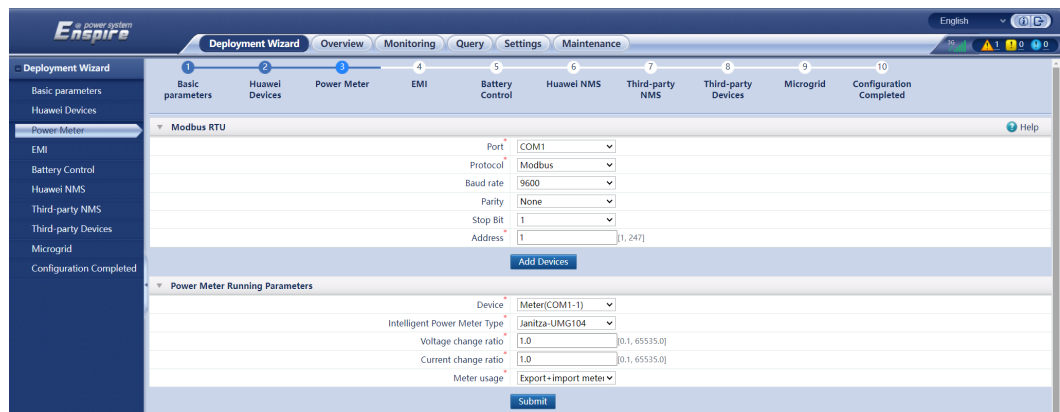
Parameter	Description
Scenario under Arrays Operation Scenario	<ul style="list-style-type: none"> In the off-grid scenario, set this parameter to Off-grid. In the on-grid scenario, set this parameter to On-grid. In the on/off-grid switching scenario, set this parameter to On/Off-grid.
Grid Code	Set the grid code of the country or region where the devices are used.
Working mode under Parameter Configuration	<ul style="list-style-type: none"> In the on-grid scenario, set this parameter to PQ. In the off-grid scenario, set this parameter to VSG.
Microgrid compatibility under Parameter Configuration	<ul style="list-style-type: none"> For the on-grid operation, set this parameter to Disable. For the off-grid operation, 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.

Parameter	Description
Maximum Overload Apparent Power (kVA) under Parameter Configuration	You are advised to retain the default value.

Step 4 Connect to power meters.

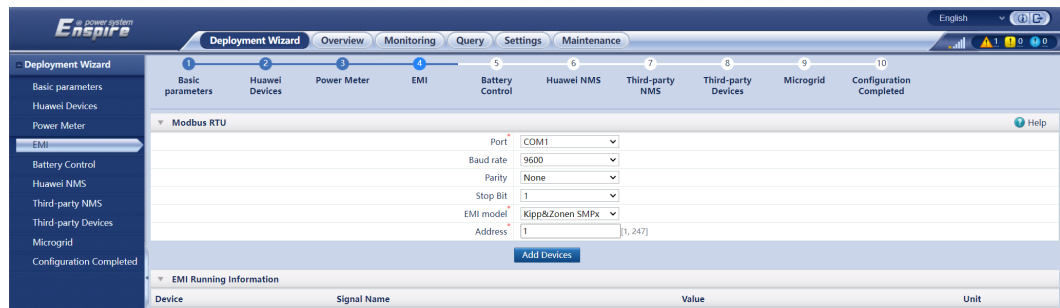
Set related parameters by referring to "[Setting Meter Parameters](#)" in the *SmartLogger3000 User Manual*.

Figure 4-8 Connecting to power meters



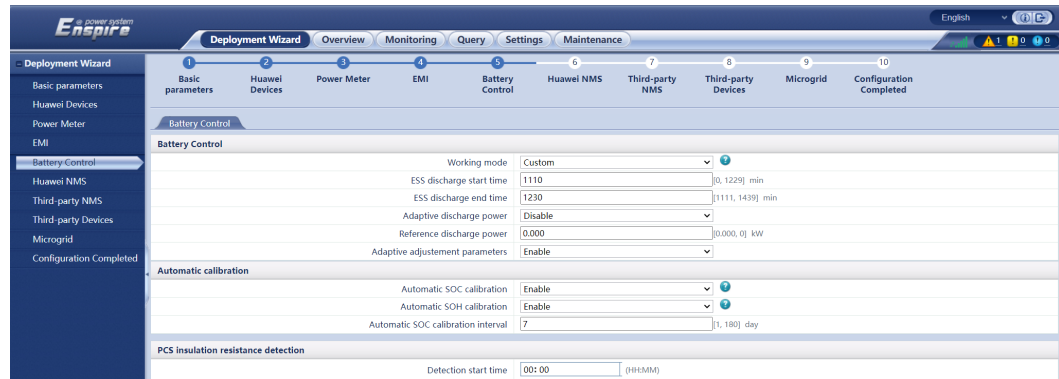
Step 5 (Optional) Connect to environment monitoring instruments (EMIs).

Figure 4-9 Connecting to EMIs



Step 6 Set battery control parameters.

Figure 4-10 Setting battery control parameters

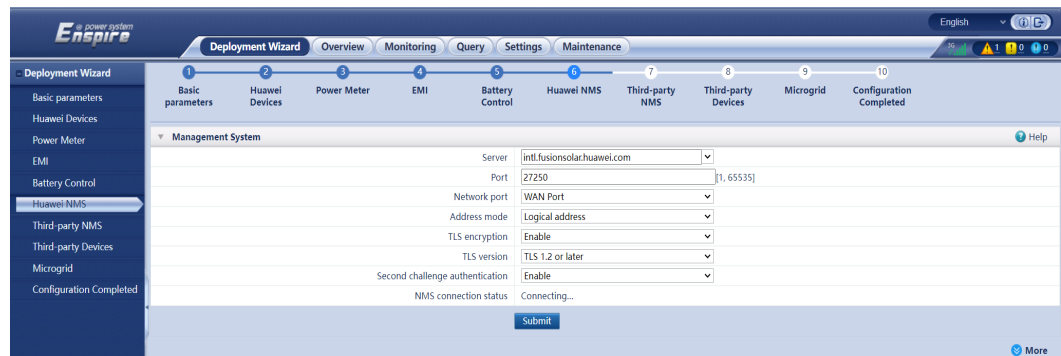


Parameter	Description
Working mode	Select a working mode based on the actual application scenario. Set this parameter only in the on-grid scenario.
Automatic SOC calibration	Set this parameter to Enable . Automatic charge and discharge calibration is allowed for battery racks. The ESS periodically calibrates 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. <ul style="list-style-type: none"> 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 Enable .
Automatic SOH calibration	Set this parameter to Disable .
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*.

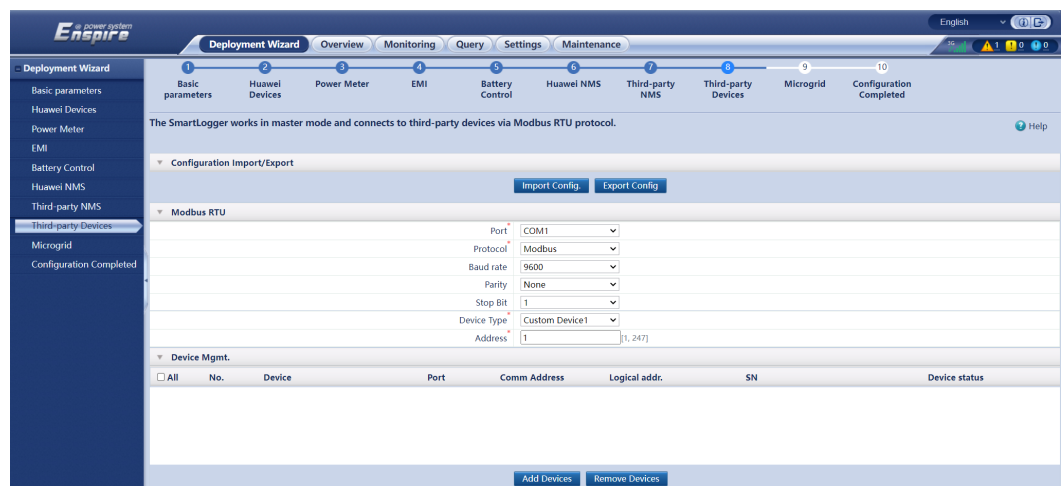
Figure 4-11 Connecting to a Huawei NMS



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 will 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 **No** in the **Do you want to connect the relay protection device?** dialog box.
2. Setting microgrid parameters

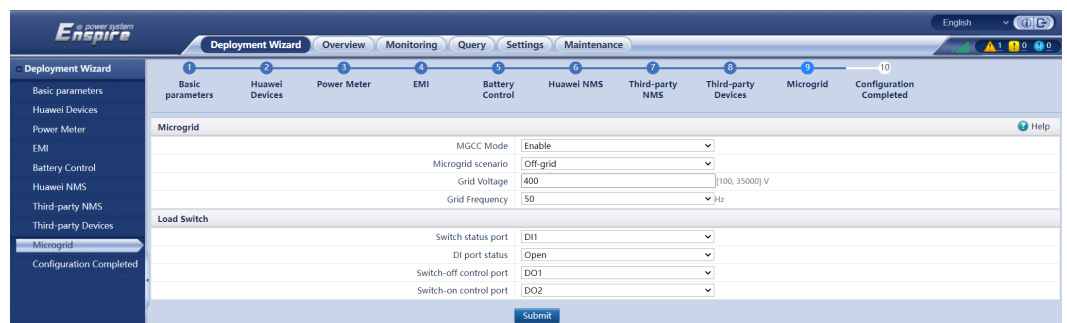


Table 4-4 Microgrid parameters

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 .
Microgrid scenario under Microgrid	In the on/off-grid switching scenario, set this parameter to On-grid/Off-grid (PQ/VSG) . This setting applies to PV+ESS on/off-grid scenarios in areas with stable mains power supply where on/off-grid switching is performed only under special circumstances and off-grid operation can be performed in PV+ESS collaborative control. In the off-grid scenario, set this parameter to Off-grid . This setting applies to PV+ESS off-grid scenarios in areas without mains power supply where long-term off-grid operation is performed in PV+ESS collaborative control. NOTE <ul style="list-style-type: none"> - 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), Scenario under Arrays Operation Scenario shall be set to On/Off-grid.
Grid Voltage under Microgrid	Set the rated voltage of the power grid.
Grid Frequency under Microgrid	Set the rated frequency of the power 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.

Parameter	Description
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 site requirements.
DI port status under Grid Failure Detection	
On/Off-grid switching mode under On/Off-grid switching	<p>You are advised to set this parameter to Auto. If Auto is selected but the customer needs to manually operate the switch onsite, you are advised to change the setting to No control.</p> <p>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.</p> <p>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.</p> <p>Manual: The on/off-grid switching will be triggered by manually turning on or off the switch at the grid connection point.</p>

- 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 under Load Switch	

Parameter	Description
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.

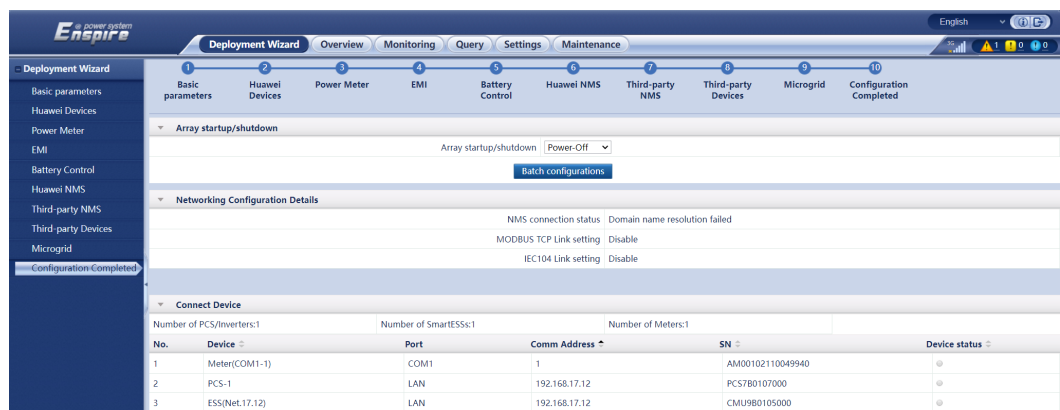
- After the microgrid parameter settings are complete, click **Submit**.

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

4.2.4 Checking the Phase Sequence

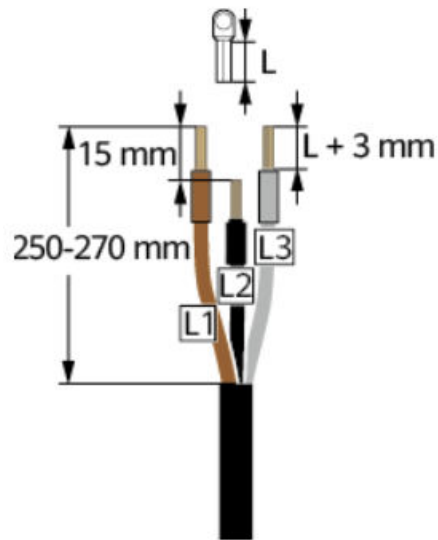
Phase sequence check is to confirm whether the phase sequence of AC power cables of the PCS is consistent with that of the transformer and power grid. If the phase sequences are inconsistent, off-grid operation may be abnormal.

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

5 Microgrid Settings

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

Table 5-1 General configuration parameters

Parameter	Description
Grid Voltage under Microgrid	Set the rated voltage of the power grid.
Grid Frequency under Microgrid	Set the rated frequency of the power grid.
Switch status port under On/Off-grid switch	Set these parameters based on the actual cable connections.
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 site requirements.

Parameter	Description
DI port status under Grid Failure Detection	
Secondary adjustment under Secondary Adjustment in Off-grid Scenario	Set this parameter to Enable .

Step 4 Choose **Settings > Microgrid Control > On-grid Control** to set on-grid control parameters.

Table 5-2 On-grid control parameters

Tab	Parameter	Description
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 .

Step 5 Choose **Settings > Microgrid Control > Off-grid Control** to set off-grid control parameters.

Table 5-3 Off-grid control parameters

Tab	Parameter	Description
Control Policy	End-of-discharge SOC (off-grid)	Set the minimum SOC for discharge in off-grid mode. The default value 10% is recommended.
	End-of-charge SOC (off-grid)	Set the maximum SOC for charge in off-grid mode. The default value 90% is recommended.
	Min. SOC for black start	Set the minimum SOC for black start. The default value 7% is recommended.

Tab	Parameter	Description
Charging	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 80. The value of SOC ranges from End-of-discharge SOC (off-grid) to End-of-charge SOC (off-grid) .
	Allowed Charge Power(%)	

 NOTE

Charging cutoff 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) > Min. SOC for black start > Discharge cutoff SOC

Step 6 Choose **Settings > Microgrid Control > On/Off-grid switching**, and set on/off-grid switching parameters.

Table 5-4 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	<p>You are advised to set this parameter to Auto. If Auto is selected but the customer needs to manually operate the switch onsite, you are advised to change the setting to No control.</p> <p>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.</p> <p>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.</p> <p>Manual: The on/off-grid switching will be triggered by manually turning on or off the switch at the grid connection point.</p>
Off-grid to On-grid	Off-grid to on-grid under Manual On-grid/Off-grid Switching	<p>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.</p>

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

Scenario	Commands and Operations Between the SmartLogger and Devices
From on-grid to off-grid	<ol style="list-style-type: none"> 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 SUN2000. 6. The SmartLogger sends PV and ESS power scheduling commands.

Scenario	Commands and Operations Between the SmartLogger and Devices
From off-grid to on-grid	<ol style="list-style-type: none"> 1. Grid recovery is detected. 2. The SmartLogger sends a command to shut down the SUN2000 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 SUN2000 and PCS.

Table 5-6 On/Off-grid switching mode (manual)

Scenario	Commands and Operations Between the SmartLogger and Devices
From on-grid to off-grid	<ol style="list-style-type: none"> 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 SUN2000 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 SUN2000. 8. The SmartLogger sends PV and ESS power scheduling commands.

Scenario	Commands and Operations Between the SmartLogger and Devices
From off-grid to on-grid	<ol style="list-style-type: none"> 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 SUN2000. 8. The SmartLogger sends PV and ESS power scheduling commands.

----End

5.2 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 5-7 General configuration parameters

Parameter	Description
Grid Voltage under Microgrid	Set the rated voltage of the power grid.
Grid Frequency under Microgrid	Set the rated frequency of the power grid.

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 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.
Secondary adjustment under Secondary Adjustment in Off-grid Scenario	Set this parameter to Enable .

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

Table 5-8 Off-grid control parameters

Tab	Parameter	Description
Control Policy	End-of-discharge SOC (off-grid)	Set the minimum SOC for discharge in off-grid mode. The default value 10% is recommended.
	End-of-charge SOC (off-grid)	Set the maximum SOC for charge in off-grid mode. The default value 90% is recommended.
	Min. SOC for black start	Set the minimum SOC for black start. The default value 7% is recommended.
	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.

Tab	Parameter	Description
	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.
	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.
Charging	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 80. The value of SOC ranges from End-of-discharge SOC (off-grid) to End-of-charge SOC (off-grid) .
	Allowed Charge Power(%)	

 NOTE

Charging cutoff 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) > Min. SOC for black start > Discharge cutoff SOC

Table 5-9 Off-grid PV+ESS system (description of the load shedding and automatic recovery process)

Scenario	Commands and Operations Between the SmartLogger and Devices
Off-grid	<ol style="list-style-type: none"> 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 a SUN2000 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 Min. SOC for black start, the ESS is black-started and the PV+ESS system resumes operation. 6. If the SOC is less than the Min. SOC for black start, 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

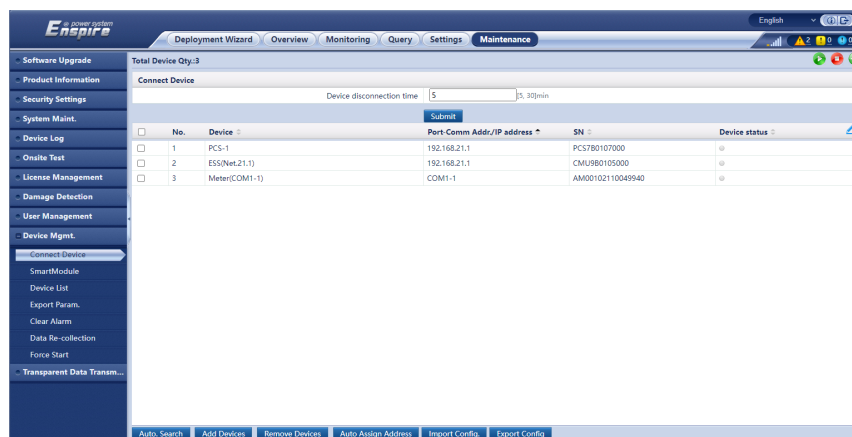
If you start and shut down the ESS and then need to start or black-start it again, you are advised to wait for a period of time greater than or equal to **Device disconnection time** (choose **Maintenance > Device Mgmt. > Connect Device** to view **Device disconnection time**) before startup or black start. Otherwise, the ESS may fail to be started or black-started.

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

Step 1 Log in to the SmartLogger WebUI. 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**.

Step 2 Send a startup command to the SUN2000, 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**

The preceding steps [Step 1](#) and [Step 2](#) have been completed after deployment commissioning. If a power failure occurs after deployment commissioning, perform steps [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 SACU or 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 end-of-charge SOC and end-of-discharge SOC 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 **Min. Battery SOC for Black Start**. Otherwise, black start may fail. This operation will change the setting of **On/Off-grid switching mode** to **No control**. Confirm before you continue.

Parameter	Description
Current Battery SOC	View the current battery SOC.
Min. Battery SOC for Black Start	View the minimum battery SOC for black start.
Black Start Progress	View the black start progress.
Status	<ul style="list-style-type: none"> ● 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 Min. Battery SOC for Black Start. <ul style="list-style-type: none"> – 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.

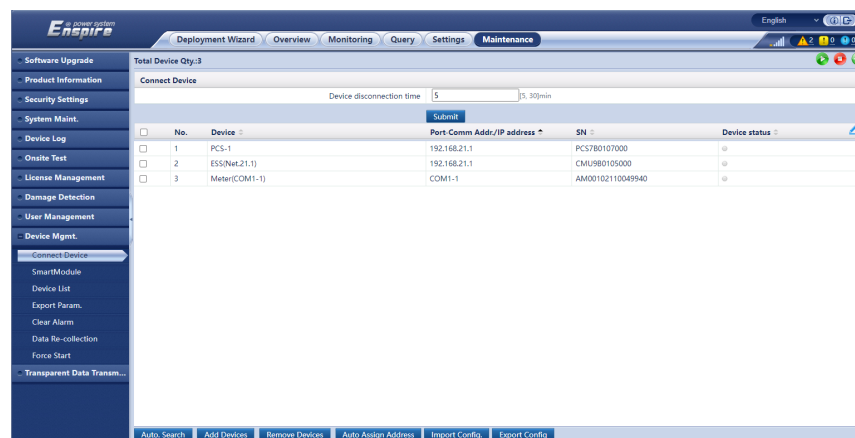
7 System Power-Off

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 SUN2000, 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	<ul style="list-style-type: none">• 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	<ul style="list-style-type: none">• LUNA2000-100KTL-M1 Smart Power Control System User Manual• LUNA2000-100KTL-M1 Smart Power Control System Quick Guide

Device	Document
SUN2000	<ul style="list-style-type: none"> • 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 Start Guide (AMPHENOL)
SUN2000P	<ul style="list-style-type: none"> • 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
SACU	<ul style="list-style-type: none"> • SmartACU2000D Smart Array Controller User Manual (with No PID Module) • SmartACU2000D Smart Array Controller Quick Guide (with No PID Module) • SmartACU2000D Smart Array Controller User Manual (Dual Opto-Electronic Ethernet Switches) • SmartACU2000D Smart Array Controller Quick Guide (Dual Opto-Electronic Ethernet Switches)
SmartLogger	<ul style="list-style-type: none"> • SmartLogger3000 User Manual • SmartLogger3000 Quick Guide
DTSU666-HW	DTSU666-HW Smart Power Sensor Quick Guide
FusionSolar app	FusionSolar App User Manual

Device	Document
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 DG) 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.

- Step 9** Perform a black start on the SmartLogger WebUI. For details, see the following steps:
1. For first-time deployment, choose **Deployment Wizard > Search for Device** and wait until the deployment topology is successfully identified. After the PCS is connected, upgrade the PCS.
 2. For non-first-time deployment, choose **Settings > Microgrid Control > Black Start** and click **Starting**.

NOTICE

For manual black start, before clicking **Starting** under **Settings > Microgrid Control > Black Start**, ensure that **Current Battery SOC** is higher than **Min. Battery SOC for Black Start**. Otherwise, black start may fail. This operation will change the setting of **On/Off-grid switching mode** to **No control**. Confirm before you continue.

- Step 10** 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

C

CMU Central Monitoring Unit

E

ESS Energy Storage System

F

FE Fast Ethernet

P

PCS Power Control System

PSU Power Supply Unit

S

SACU Smart Array Controller

SFP Small Form-factor
Pluggable

SOC State of Charge

SOH State of Health

U

UPS Uninterruptible Power
Supply