SUN2000-450W and SUN2000-600W-P Series

Troubleshooting Guide

Issue	01
Date	2024-1-2



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About This Document

Purpose

This document describes the following optimizer models and common troubleshooting methods. Refer to this document during optimizer troubleshooting.

- SUN2000-450W
- SUN2000-600W-P

Intended Audience

This document is intended for:

- Installers
- Users

Change History

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

Issue 01 (2024-1-2)

This issue is the first official release.

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1 Product Overview

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

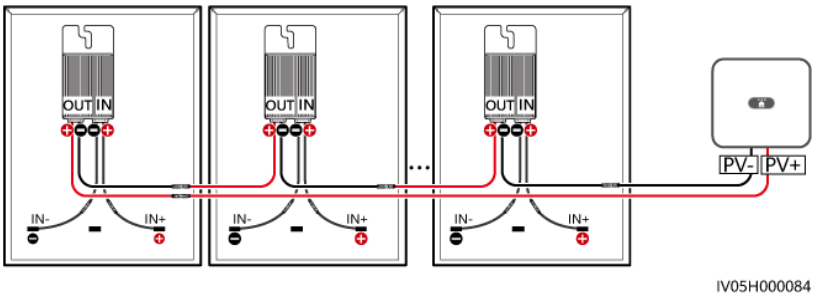
1.1 Application Scenarios

1. To ensure that the optimizers are successfully connected to PV modules, select PV modules whose output power cables meet the length requirements.
2. To minimize electromagnetic interference, minimize the distance between the positive and negative cables of an optimizer.
3. To ensure reliable communication between an inverter and optimizer, the AC and DC power cables of the inverter must be at least 10 cm away from the AC power cables of motor-type impact loads, such as air conditioners and elevators. It is recommended that the cables be routed in different troughs or pipes.

Full configuration: All PV modules are connected to optimizers.

In this scenario, the MPPT function, module-level shutdown and monitoring, and long-string design are supported.

Optimizers configured for all PV modules



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1.2 Functions and Features

1. Module-level MPPT: Implements maximum power point tracking of each PV module to improve the energy yield of the PV system.
2. Module-level shutdown: Adjusts the module output voltage to a safe range when the output is disconnected or the inverter shuts down.
3. Module-level monitoring: Monitors the operating status of each PV module.
4. Long PV string: If all PV modules are configured with optimizers, a PV string can contain more PV modules than a conventional PV string.

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2 Optimizer Knowledge

1. Optimizer installation:
   (1) User manuals: https://support.huawei.com/enterprise/en/fusionsolar/sun2000p-pid-22098206
   (2) Quick guides: https://support.huawei.com/enterprise/en/fusionsolar/sun2000p-pid-22098206
   (3) Installation videos: https://support.huawei.com/enterprise/en/fusionsolar/sun2000p-pid-22098206
2. Optimizer troubleshooting:
   (1) Optimizer Troubleshooting Guide
   (2) Robot FAQs

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3 Troubleshooting

3.1 Data to Be Collected Onsite

1. All logs of optimizers and inverters (For 40 kW and 50 kW inverters, expert logs need to be downloaded. Path: **Settings** > **Feature parameters** > **Expert** > **Inverter all logs**)
2. Inverter model and quantity; optimizer model and quantity, and string configuration

   Impedance measurement applies only to the SUN2000-450W and SUN2000-600W one-to-one optimizers.

   SUN2000 inverters and MERC inverters cannot be connected together. This document does not describe MERC optimizer troubleshooting.
3. Measurement:

   (1) R1: forward impedance of the extension cable of PV string 1 on the inverter side (multimeter probes: red - positive, black - negative)

   (2) R2: backward impedance of the extension cable of PV string 1 on the inverter side (multimeter probes: red - negative, black - positive)

   (3) N1: number of optimizers connected in PV string 1

   (4) N2: number of optimizers found in PV string 1

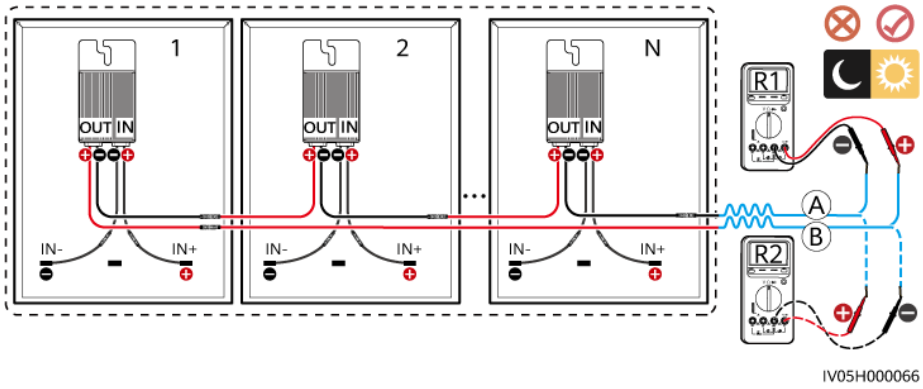
Criteria for determining whether the impedance is normal: R1 ≈ N1 x 1k (±10%) && R1 > R2

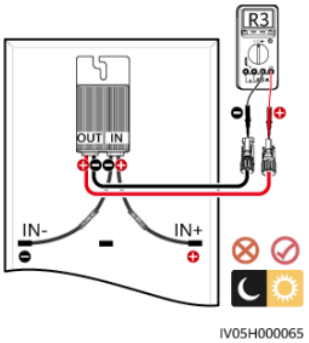
Impedance measurement and troubleshooting method:

Use a multimeter to measure the impedance of a PV string when the irradiance is adequate and the PV string voltage is less than 1 V. The impedance scale of the multimeter affects the measurement precision of the PV string output impedance and thus the value of the scale shall be less than 50 V and greater than the number of optimizers to be measured.

The measured PV string impedance must meet the following requirement: PV string impedance (R1 + R2)/2 kΩ ≈ N x 1 kΩ. For example, if there are 16 optimizers in a PV string, the PV string impedance should be about 16 kΩ. If the measured PV string impedance is abnormal, rectify the fault by referring to this section.

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PV String Resistance	Possible Cause	Suggestion
(R1 + R2)/2 kΩ is infinite.	• The PV string is open-circuited. • The cables are not connected to the same PV string.	• Rectify the open-circuited PV string. • Identify the string cables correctly.
(R1 + R2)/2 kΩ < N	Some optimizer output power cables are not connected.	Check whether PV modules and PV string cables are correctly connected.
(R1 + R2)/2 kΩ > N	• The actual number of optimizers in the PV string is greater than expected. • Some optimizer input power cables are not connected. • PV modules are not connected to optimizers but directly connected to PV strings. • The optimizer is faulty.	• Check whether the number of optimizers in the PV string is correct. • Check whether PV modules and PV string cables are correctly connected. • Check whether the output resistance of each optimizer is normal. 1. Disconnect the output power cables of the optimizers in the PV string. 2. Check whether the output resistance of each optimizer is normal. **Figure** Measuring the optimizer output resistance 

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Optimizer Output Resistance	Possible Cause	Suggestion
0.9 kΩ ≤ R3 ≤ 1.1 kΩ	The optimizer is normal.	-
R3 < 0.9 kΩ	If the probes of the multimeter are connected correctly, the optimizer is faulty. **NOTE** If the probes are reversely connected, the measured resistance is smaller than the resistance measured when the probes are correctly connected, which may be less than 0.9 kΩ.	Replace the optimizer.
R3 > 1.1 kΩ	• The irradiance is low. • The optimizer input power cables are not connected. • The optimizer output power cables are connected to the PV module output power cables. • The optimizer is faulty.	1. Measure the resistance when the irradiance is adequate. 2. Connect the optimizer input power cables. 3. Correct the optimizer cable connections. Connect the optimizer input power cables to the PV module output power cables. 4. If the resistance is still abnormal, replace the optimizer.

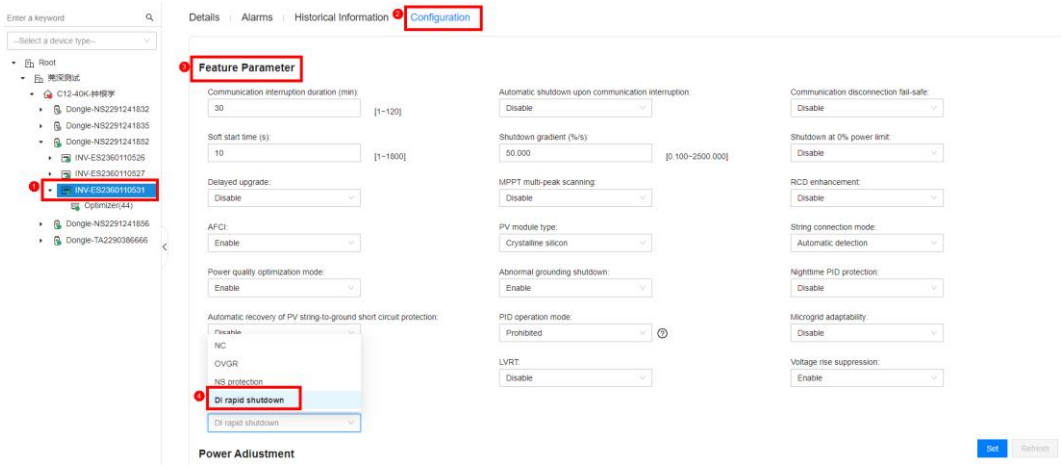
3.2 Optimizer Search Failure

Symptom: When an optimizer search command is issued through the management system or app, the message "Command search failed" is displayed.

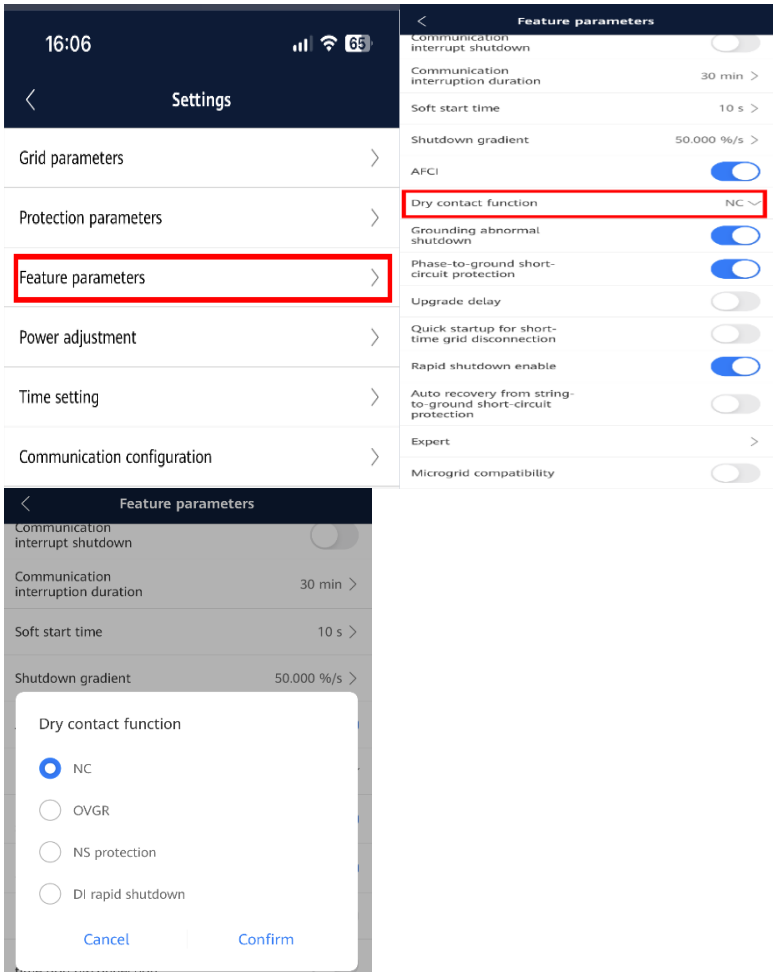
Cause 1: The dry contact function of the inverter is set to **DI rapid shutdown**, and thus optimizer search is not allowed. Check the following configurations on the management system and app.

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Management system:



App:



Solution: Change the dry contact function of the inverter to **NC**.

Cause 2: The inverter is faulty.

Solution: Replace the inverter and search again.

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3.3 Not All Optimizers Found in the Single-Inverter Scenario

3.3.1 Impedance Is Abnormal (R1 Is Much Greater Than N1)

Symptom: Not all optimizers are found. The measured PV string impedance on the inverter side does not match the actual number of optimizers (the impedance is high).

Cause 1: An anti-reverse diode or SPD is installed between the PV modules and the PV terminals of the inverter.



Solution: Bypass the anti-reverse diode and search again.

Cause 2: A safety box is installed between the PV modules and the PV terminals of the inverter, but the upstream or downstream terminals of the safety box are in poor contact.



Solution: Check the core wires in the upstream and downstream extension cable terminals of the safety box and re-crimp them. Then, search for optimizers again.

Cause 3: The terminals of the extension cables between the inverter and optimizers are in poor contact on the PV module side.

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Solution: Check the core wires in the extension cable terminals on the PV module side and re-crimp them. Then, search for optimizers again.

Incorrect terminal crimping:

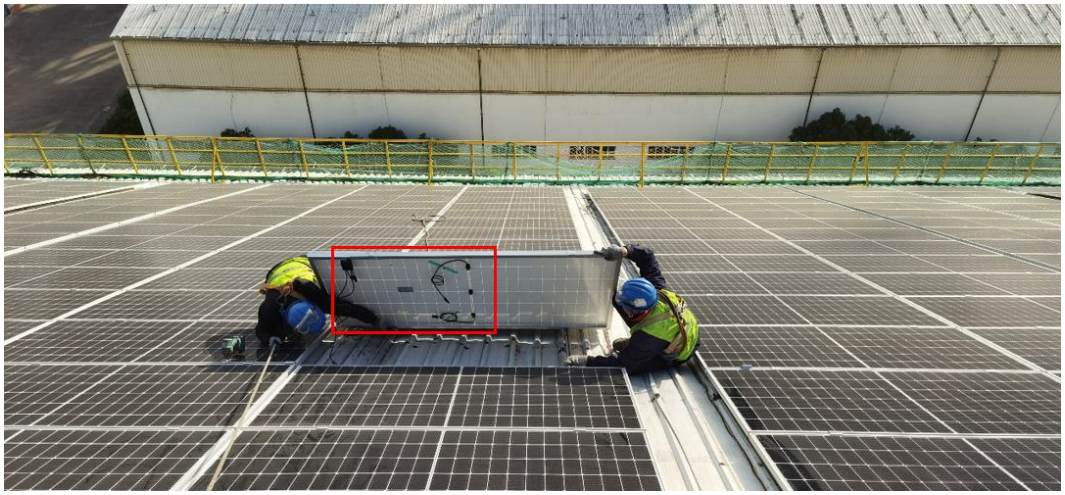


Correct terminal crimping:



Terminal crimping video: https://support.huawei.com/enterprise/en/fusionsolar/sun2000p-pid-22098206

Cause 4: The input cables of the optimizers that are not found are incorrectly connected.



Solution: Locate the installation position of an optimizer that is not found based on the optimizer physical layout diagram and the SNs of optimizers found, and check whether the input cable of the optimizer not found is correctly connected to the PV module.

Cause 5: A disconnection exists in the PV string (poor contact between the outputs of adjacent optimizers or in extension cable terminals).

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Solution: Check the core wires in the extension cable terminals between adjacent optimizers and re-crimp them. Then, search for optimizers again. If the fault persists, manually check whether a DC cable is disconnected.

Cause 6: The optimizers that are not found are faulty.

Solution: Check the output impedance of an optimizer that is not found. If the output impedance is not 1 kΩ, the optimizer is faulty and needs to be replaced.

3.3.2 Impedance Is Normal, but Not All Optimizers Are Found

Symptom: Not all optimizers are found, but the measured PV string impedance on the inverter side matches the number of connected optimizers.

Cause: The terminals of the extension cables between the inverter and optimizers are in poor contact on the inverter side.

Solution: Check the core wires in the extension cable terminals on the inverter side and re-crimp them. Then, search for optimizers again.

Incorrect terminal crimping:



Correct terminal crimping:



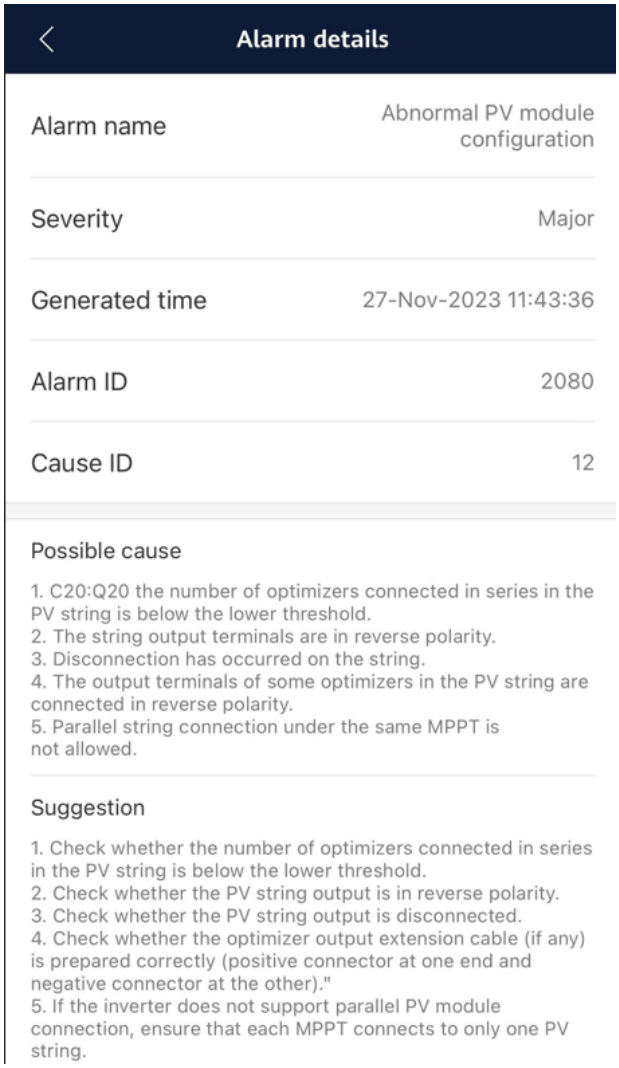
Terminal crimping video: https://support.huawei.com/enterprise/en/fusionsolar/sun2000p-pid-22098206

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3.4 Optimizer Offline

3.4.1 Inverter Alarm 2080-12

Symptom: The PV string impedance is abnormal. (If all optimizers are connected in reverse polarity, the forward impedance R1 of the PV string is less than the backward impedance R2. If some optimizers are connected in reverse polarity, the forward impedance R1 of the PV string is similar to the backward impedance R2.) During optimizer search, the inverter reports an "Abnormal PV module configuration" alarm or optimizers report an "Abnormal output voltage" alarm.



Cause: Some or all optimizers in the PV string are connected in reverse polarity.

Solution: Check whether the extension cables between adjacent optimizers are correct.

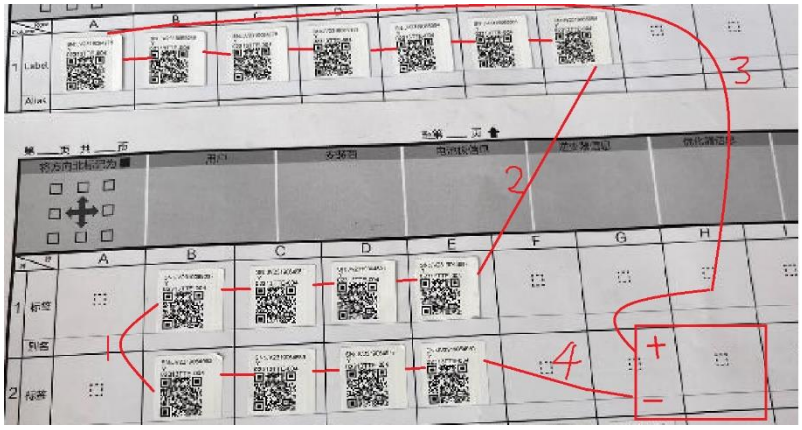
Case: XX site has one 10K-M1 inverter and a total of 29 optimizers in two PV strings (PV1: 14 optimizers; PV2: 15 optimizers, full configuration for both PV strings). All optimizers can be found but grid connection fails. An "Abnormal PV module configuration" alarm is displayed.

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Measure the impedance of PV1 (14 optimizers in total). The forward impedance is 14.45 kΩ, and the backward impedance is 13.4 kΩ. Connect PV1 to the inverter separately. All the optimizers can be found and grid connection is successful, indicating that PV1 is normal.

Measure the impedance of PV2 (15 optimizers in total). The forward impedance is 14.98 kΩ, and the backward impedance is 14.89 kΩ. Connect PV2 to the inverter separately. All the optimizers can be found, but grid connection fails. An "Abnormal PV module configuration" alarm is displayed.

Check the four extension cables for PV2 one by one. The first and last terminals of extension cables 1 and 2 are both male or female. As a result, the outputs of the four optimizers in the middle are connected in reverse polarity.



After the extension cables are replaced onsite, PV2 can connect to the power grid properly (the forward impedance is 15.5 kΩ and the backward impedance is 14.35 kΩ).

3.4.2 Optimizers Are Offline Occasionally, but Their Total Energy Yields Are Updating

Symptom: Certain optimizers are offline, but their total energy yields are updating.

Before an optimizer goes offline (energy yield: 225.965 kWh):

Optimizer No.	Optimizer Name	Total Yield(kWh)	Output Power(W)	Output Voltage(V)	Input Voltage(V)	Input Current(A)	Running Status	Operation
8.3.8	Optimizer	225.965	357.9	37.7	78.8	4.69	Operating	

After the optimizer goes offline:

Optimizer No.	Optimizer Name	Total Yield(kWh)	Output Power(W)	Output Voltage(V)	Input Voltage(V)	Input Current(A)	Running Status	Operation
8.3.8	Optimizer	-	-	-	-	-	Offline	

After a certain period of time, the optimizer recovers to operating status (the energy yield is updated to 226.026 kWh):

Optimizer No.	Optimizer Name	Total Yield(kWh)	Output Power(W)	Output Voltage(V)	Input Voltage(V)	Input Current(A)	Running Status	Operation
8.3.8	Optimizer	226.026	336.1	69.0	79.1	4.31	Operating	

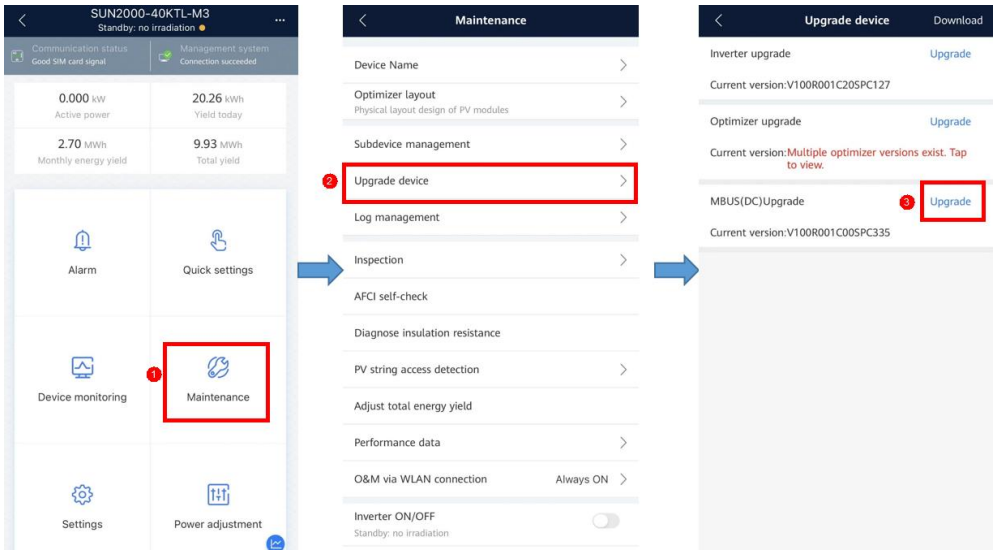
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Cause: The optimizers are shut down due to heartbeat issues.

Solution:

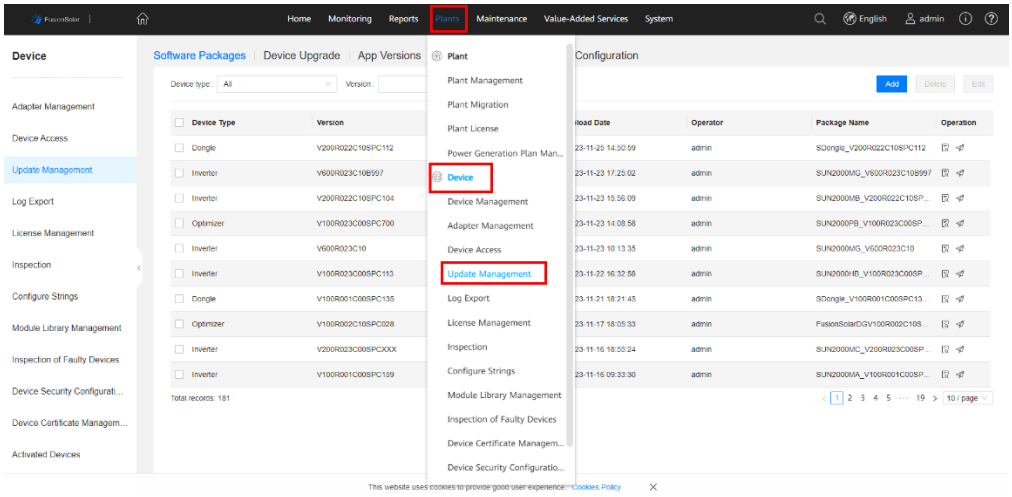
1. When the irradiance is good, upgrade the optimizer MBUS to SPC330 or later.

   Upgrade on the local app:



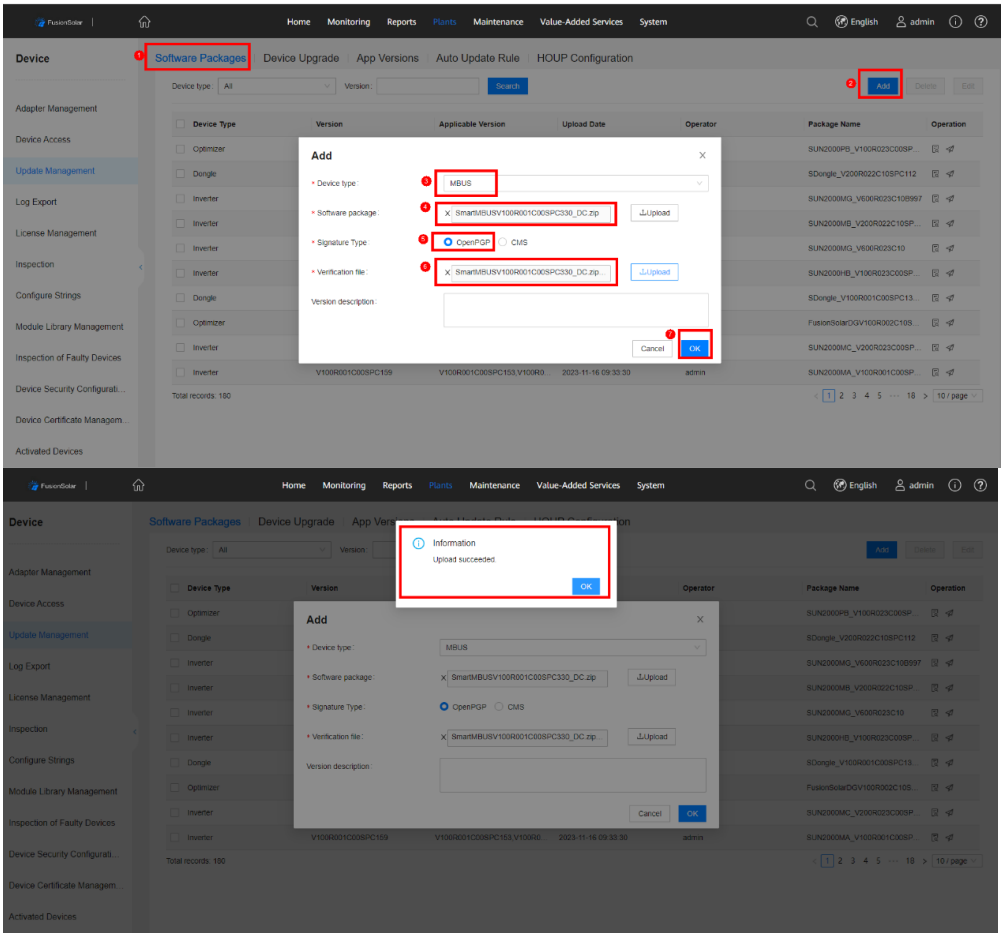
   Upgrade on the management system:

Step 1 Choose **Plants** > **Device** > **Update Management**.

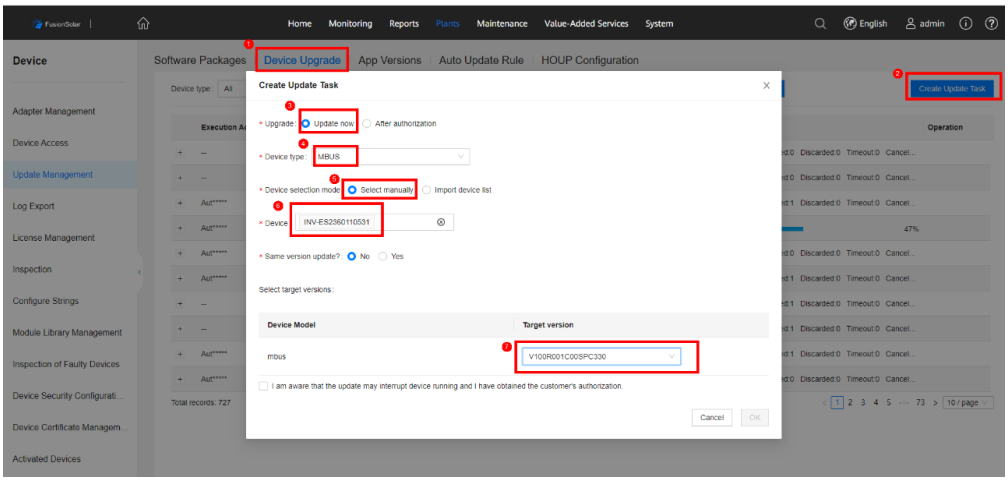


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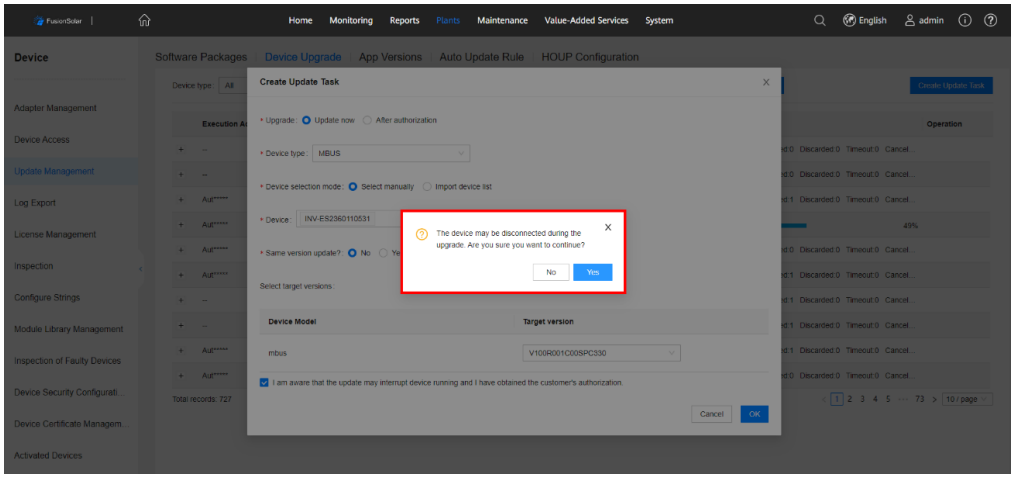
Step 2 On the **Software Packages** page, click **Add** to upload the software package.

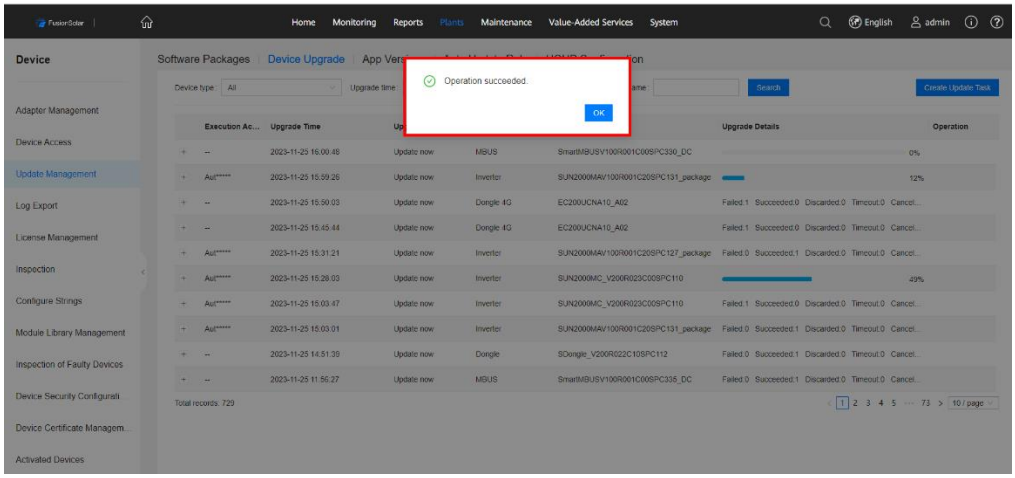


Step 3 Create an upgrade task on the **Device Upgrade** page.

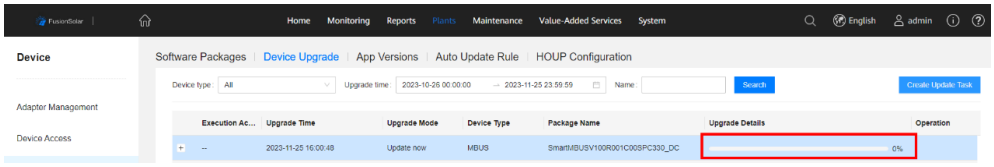


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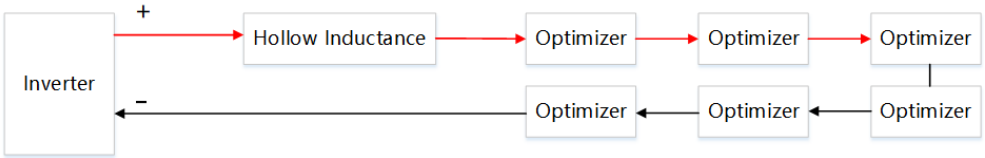


Step 4 After the upgrade task is created, check the upgrade progress and result on the upgrade page.



----End

2. If the problem persists after the MBUS is upgraded, you are advised to add an air core inductor. (If the inverter is installed indoors, you can install an air core inductor under the inverter. Otherwise, install the air core inductor under the PV modules.)



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3.4.3 Optimizers Are Offline for a Long Time, Power Parameters Are Available but the SNs Are Empty

Symptom: Certain optimizers are offline for a long time, their performance data is displayed properly, but the SNs are empty.

Cause: The EEPROM is faulty.

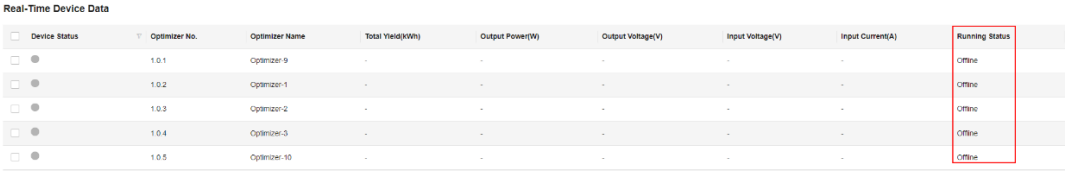
Solution:

1. When the irradiance is good, upgrade the inverter software to a specific restricted version, upgrade the optimizer DSP software to SPC019 or later, and search again. (The optimizer SNs change after the upgrade, so this method is not applicable to plants that require a physical layout diagram.)

   Note: Contact Huawei frontline personnel to obtain the inverter software of a specific restricted version.
2. If the plant requires a physical layout diagram, replace the offline optimizers.

3.4.4 Optimizers Are Offline for a Long Time, and the Inverter Reports the 2065-7 Alarm

Symptom: Optimizers are offline for a long time according to the management system. The customer measures the impedance of the PV string where the offline optimizers are located and then measure the impedance of each offline optimizer, which fluctuates between dozens of kilohms and several megohms.


Real-Time Device Data

Device Status	Optimizer No.	Optimizer Name	Total Yield(kWh)	Output Power(W)	Output Voltage(V)	Input Voltage(V)	Input Current(A)	Running Status
	1.0.1	Optimizer-9	-	-	-	-	-	Offline
	1.0.2	Optimizer-1	-	-	-	-	-	Offline
	1.0.3	Optimizer-2	-	-	-	-	-	Offline
	1.0.4	Optimizer-3	-	-	-	-	-	Offline
	1.0.5	Optimizer-10	-	-	-	-	-	Offline

Cause: The optimizers enter the loader state after an upgrade failure.

Solution:

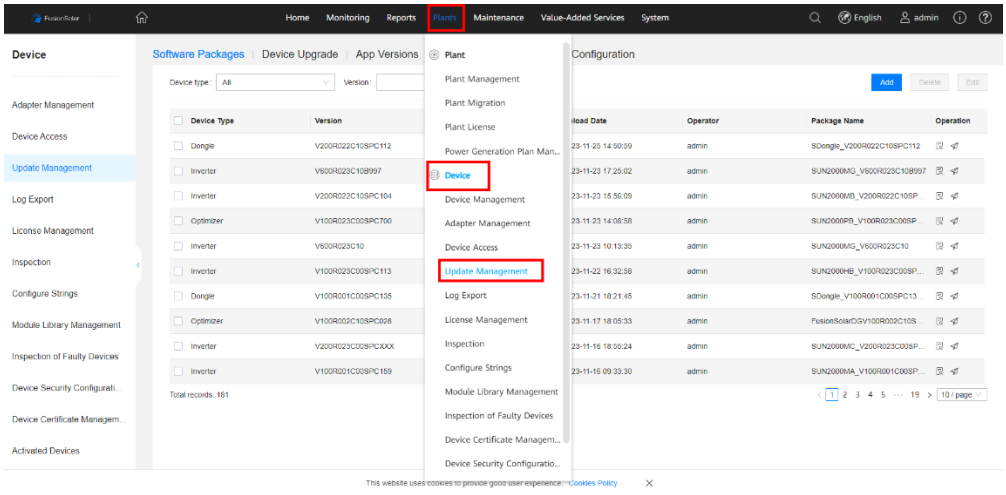
Remote troubleshooting:

1. Upgrade the MBUS of all optimizers to SPC330 or later.

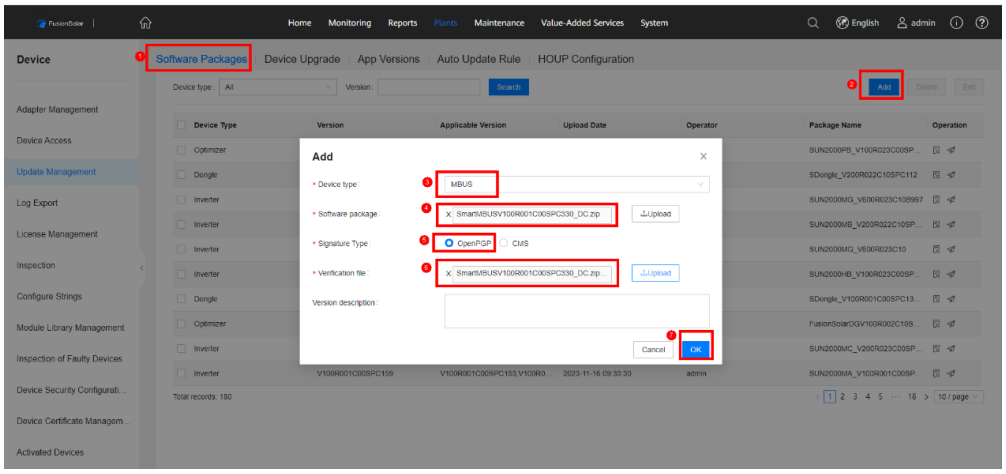
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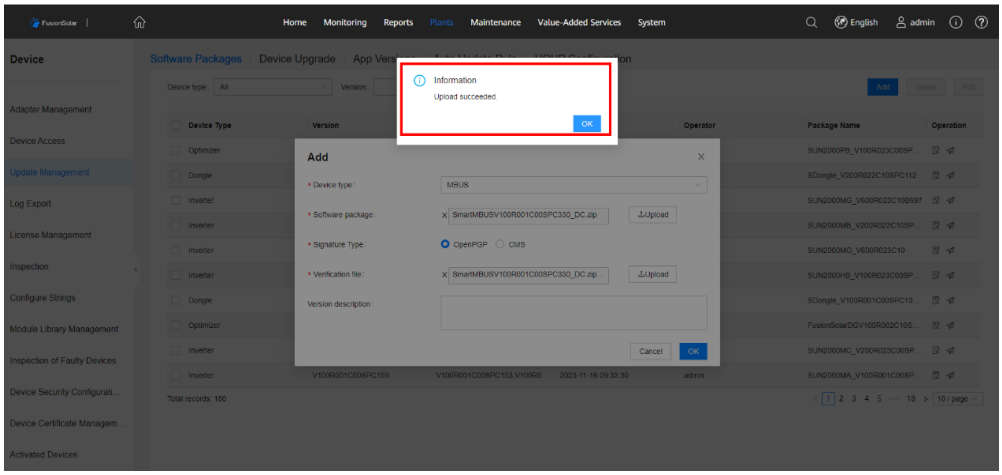
Upgrade the MBUS on the management system:

Step 1 Choose **Plants** > **Device** > **Update Management**.



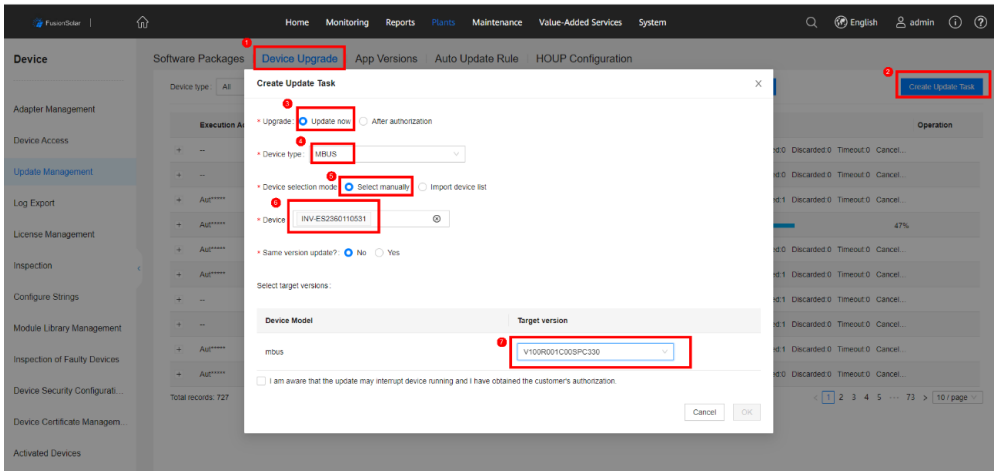
Step 2 On the **Software Packages** page, click **Add** to upload the software package.

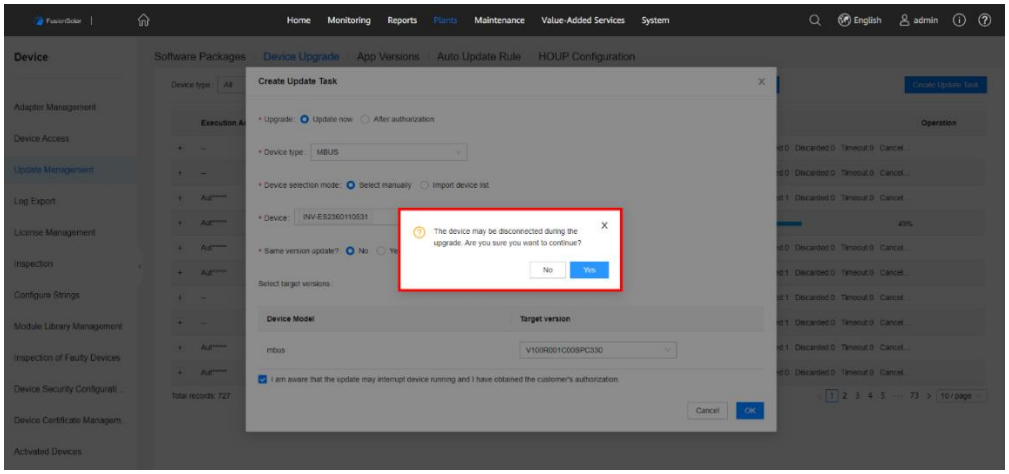


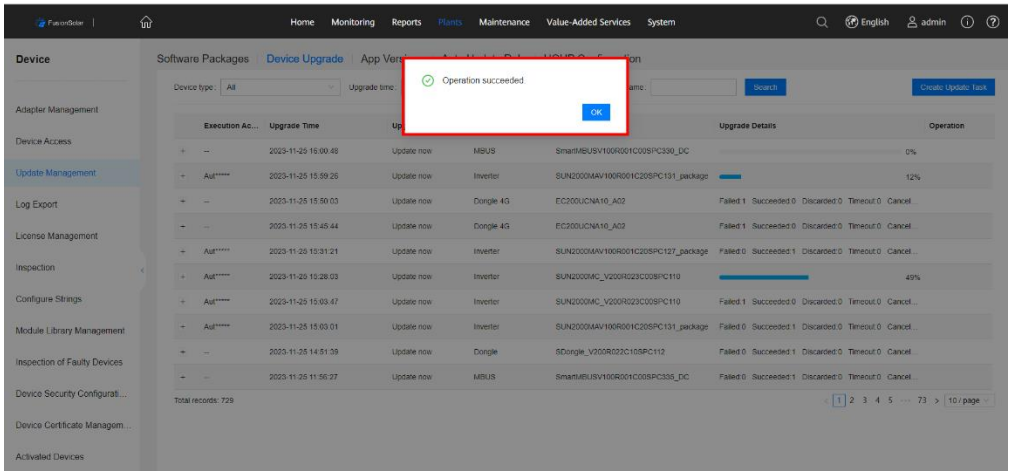


Step 3 Create an upgrade task on the **Device Upgrade** page.

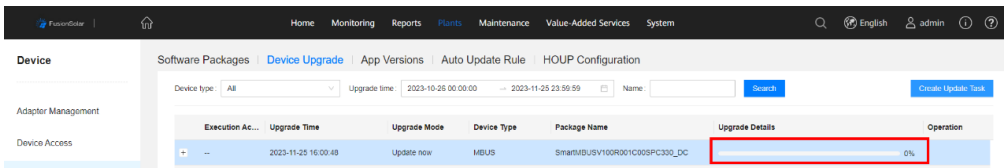
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Step 4 After the upgrade task is created, check the upgrade progress and result on the upgrade page.



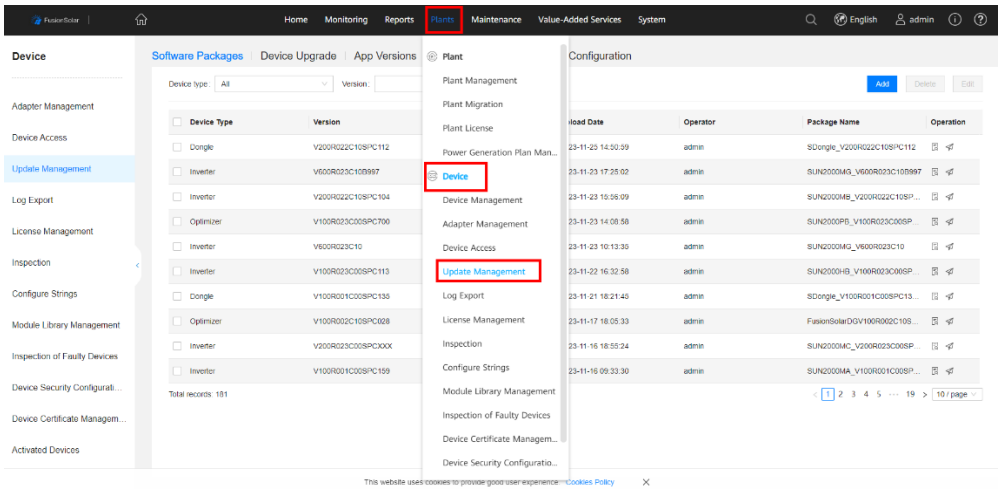
----End

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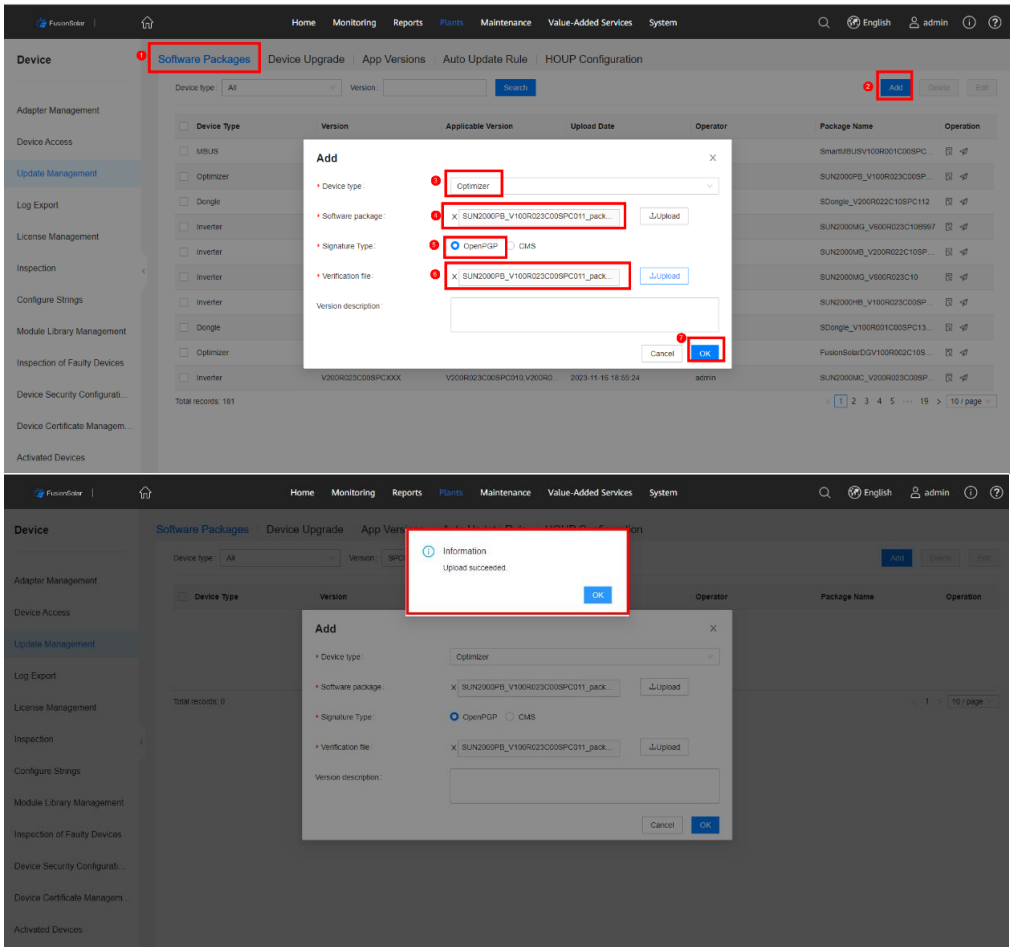
2. When the irradiance is good, upgrade the DSP software of the optimizers in the PV string to the latest version. After the upgrade is successful, the optimizers can work properly.

   Upgrade the DSP on the management system:

Step 1 Choose **Plants** > **Device** > **Update Management**.

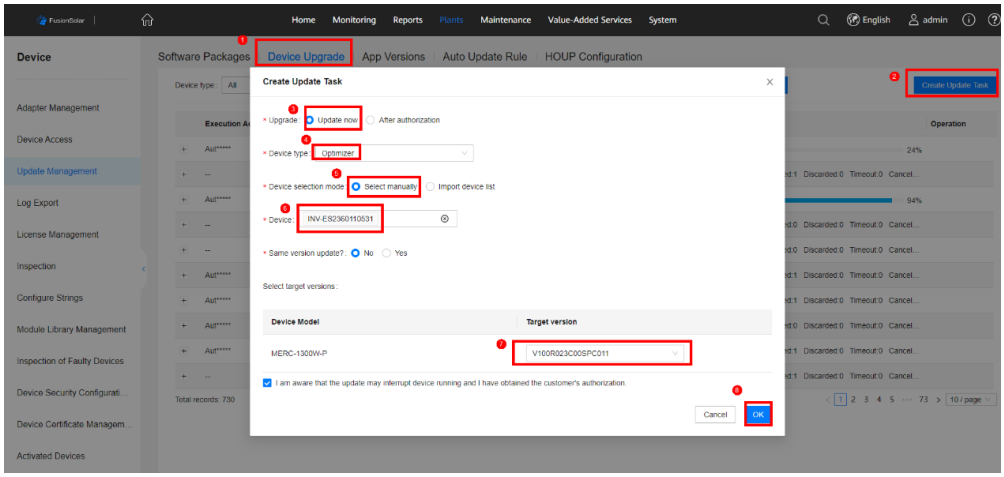


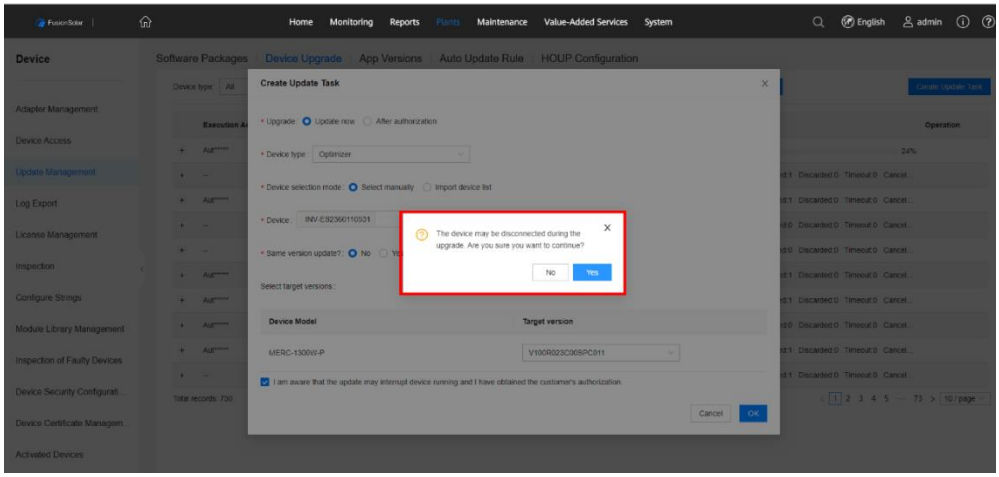
Step 2 On the **Software Packages** page, click **Add** to upload the software package.

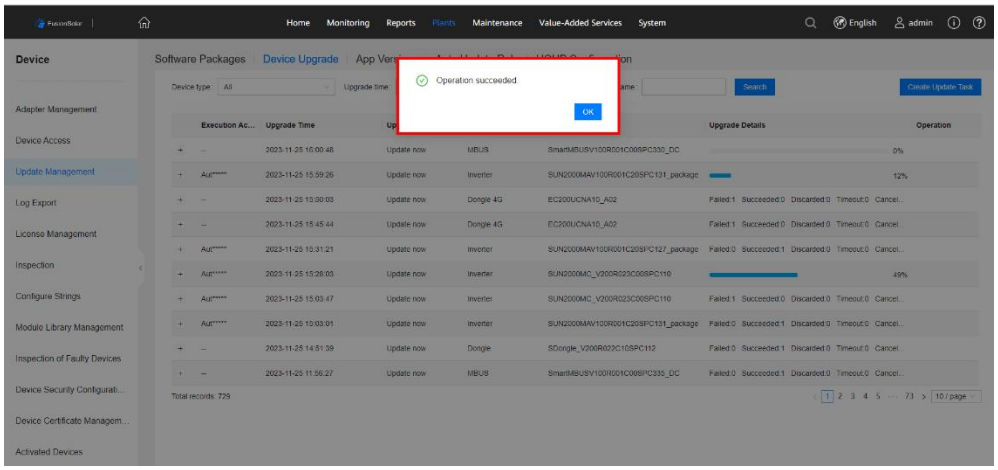


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Step 3 Create an upgrade task on the **Device Upgrade** page.



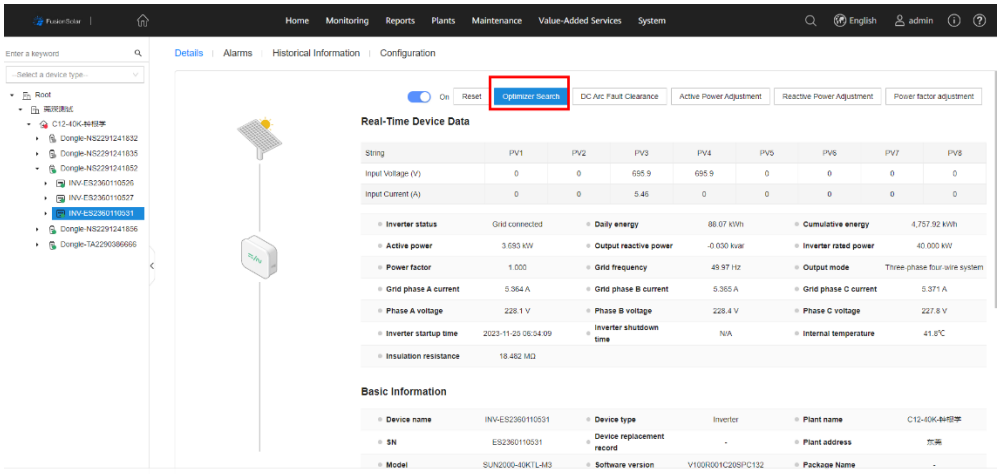




----End

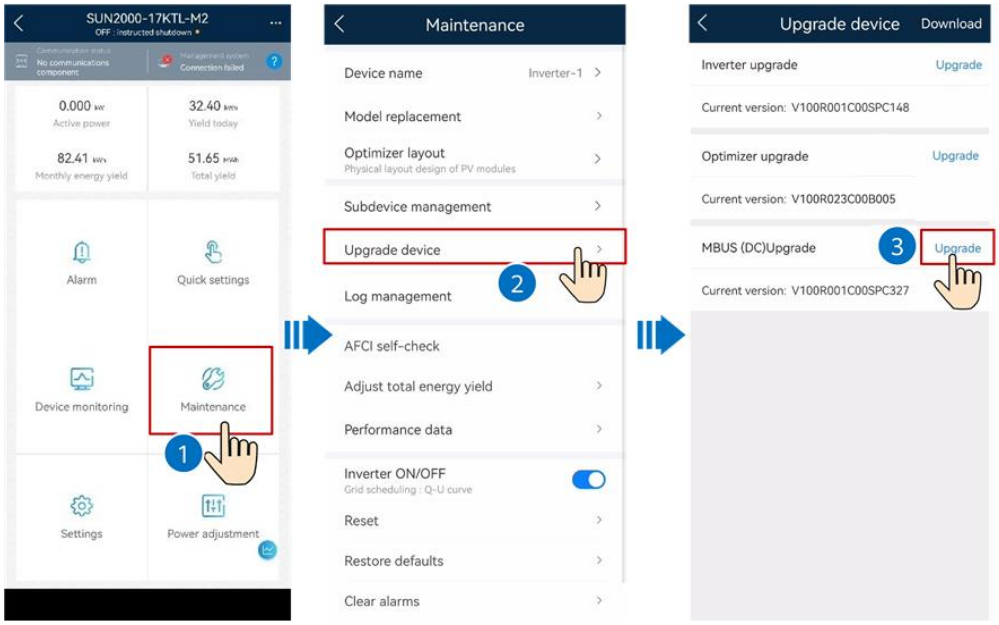
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3. After the upgrade is successful, perform the search again.



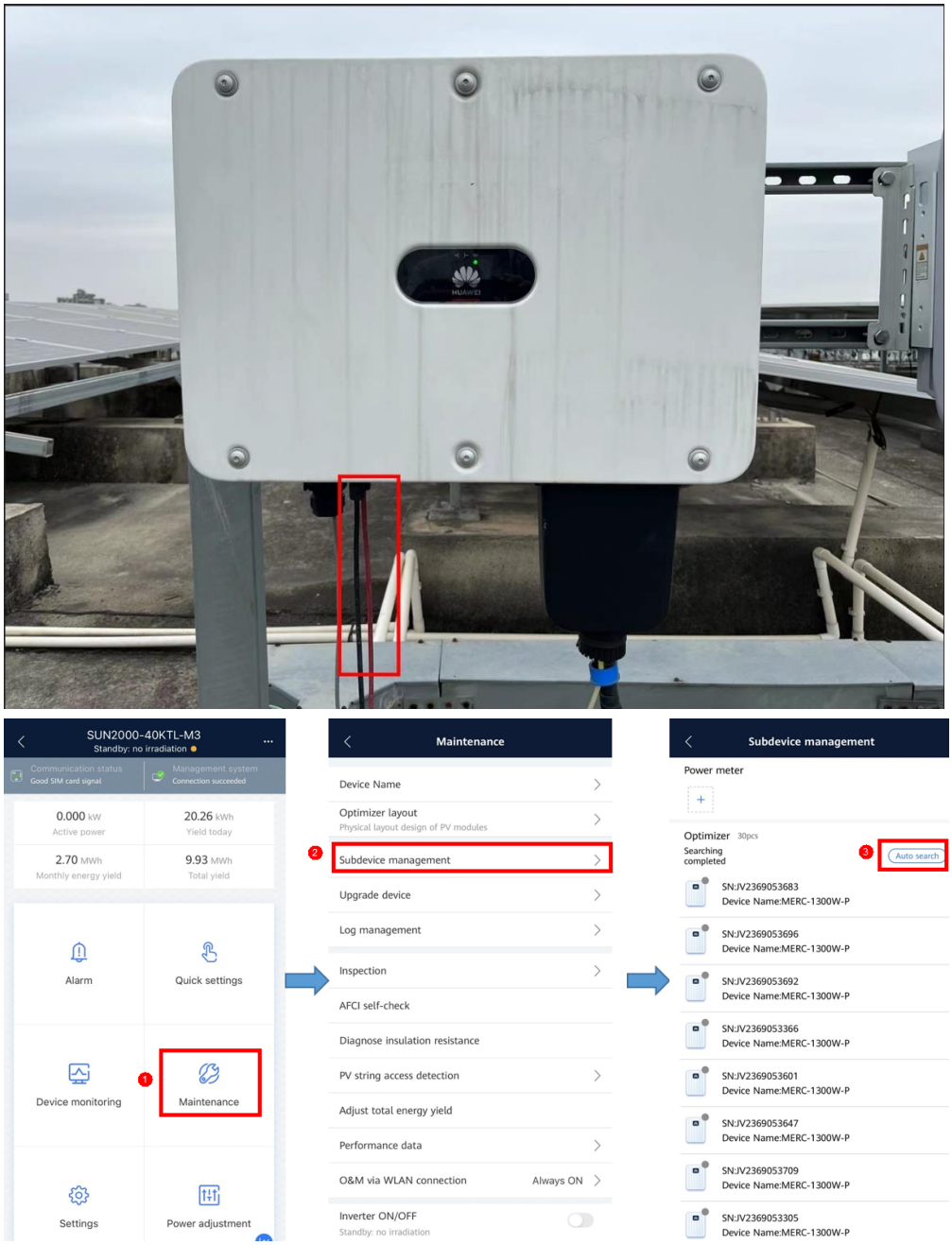
Local troubleshooting:

1. Upgrade the MBUS of all optimizers to SPC330 or later.



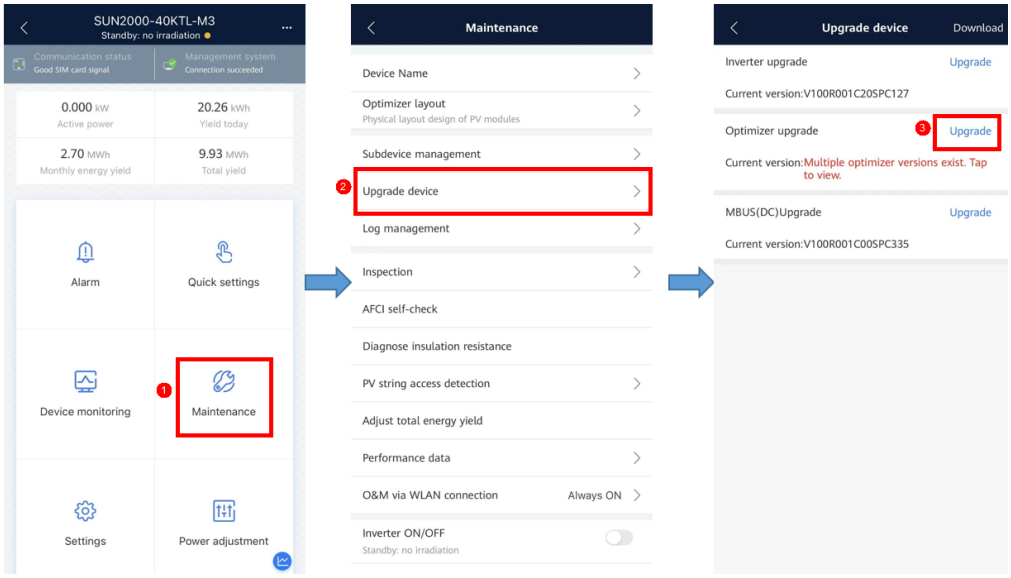
2. Remove all PV string cable terminals from the inverter, connect the PV string where the offline optimizers are located to the inverter separately (connect only one PV string at a time), and search for optimizers again. The number of found optimizers should be equal to the actual number of connected optimizers.

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3. When the irradiance is good, upgrade the DSP software of the optimizers in the PV string to the latest version. After the upgrade is successful, the optimizers can work properly.

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4. After the upgrade for each PV string is successful, connect all the PV strings to the inverter and search for optimizers again.



3.4.5 An Optimizer Is Offline and the Impedance is Abnormal (R1 Is Much Greater Than N1)

Symptom: The measured impedance of the PV string where the offline optimizer is located is infinite. After the inverter begins to work in on-grid mode, the PV string current is always 0.

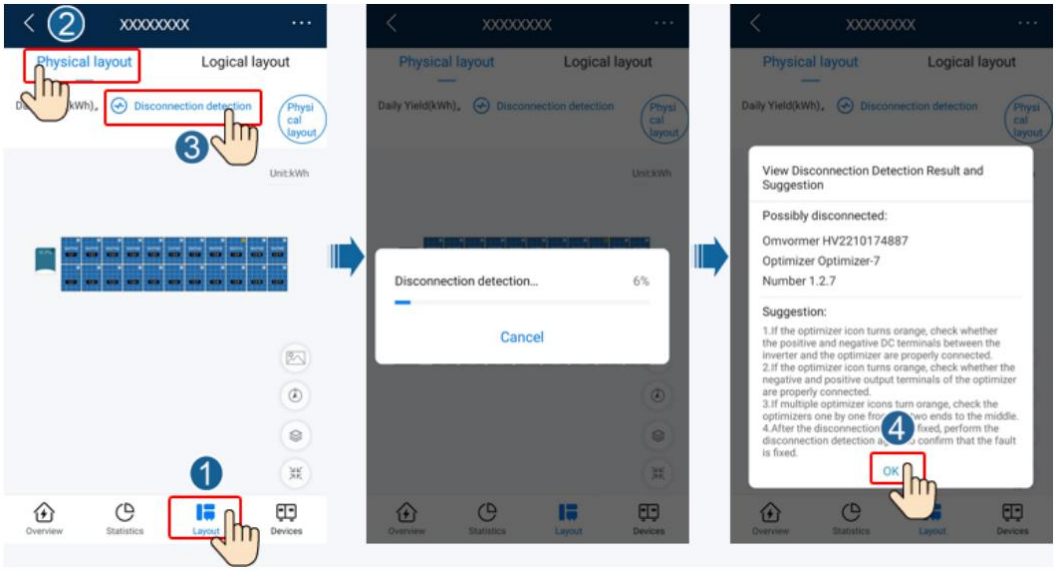
Cause: A disconnection occurs in the PV string.

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Solution: Use the disconnection detection function to locate the disconnection point. The procedure is as follows:

Step 1 Log in to the FusionSolar app and tap the plant name on the **Home** screen to access the plant screen.

Step 2 Choose **Layout**, tap **Disconnection detection** to check optimizer disconnection, and rectify the fault based on the result.



----End

3.5 Faults in the Multiple-Inverter Scenario

3.5.1 Impedance Is Normal

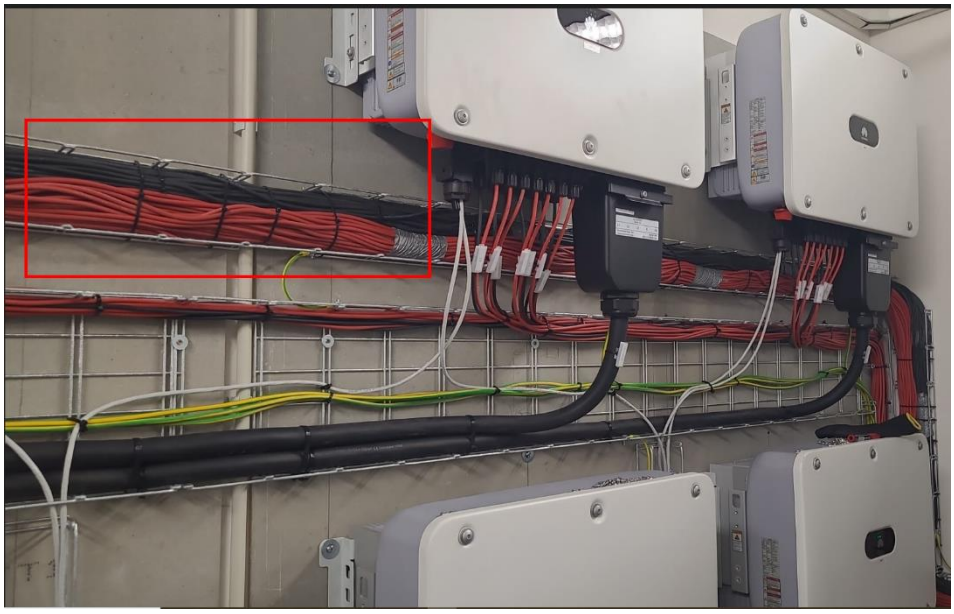
Symptom: Multiple inverters are used onsite. The positive and negative cables of optimizers are not routed close to each other. The measured impedance of each PV string connected to each inverter matches the number of connected optimizers, and either of the following conditions is met:

1. The number of optimizers found by certain inverters is greater than the number of connected optimizers, and the number of optimizers found by other inverters is less than the number of connected optimizers.
2. An inverter does not find all optimizers connected to it. The optimizers that are not found were connected to another inverter before.

Cause: Crosstalk occurs. The customer does not connect cables in accordance with the user manual, which requires that the positive and negative cables of the optimizers be routed close to each other to reduce the impact of EMC.

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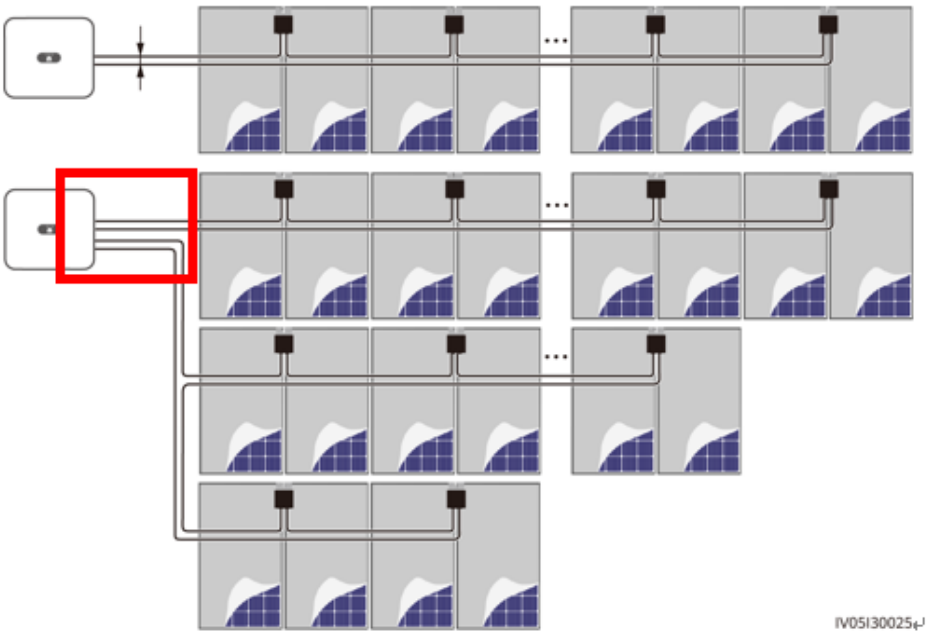
Incorrect cabling:



Requirement in the user manual:

NOTE

- To ensure reliable communication between the inverter and optimizer, route DC and AC power cables in different troughs with a spacing of more than 10 cm.
- To reduce the impact of electromagnetic compatibility (EMC), the positive and negative cables of the optimizer must be routed close to the home-run cable (to minimize the distance D), as shown in the following figures.



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Solution:

1. Workaround:

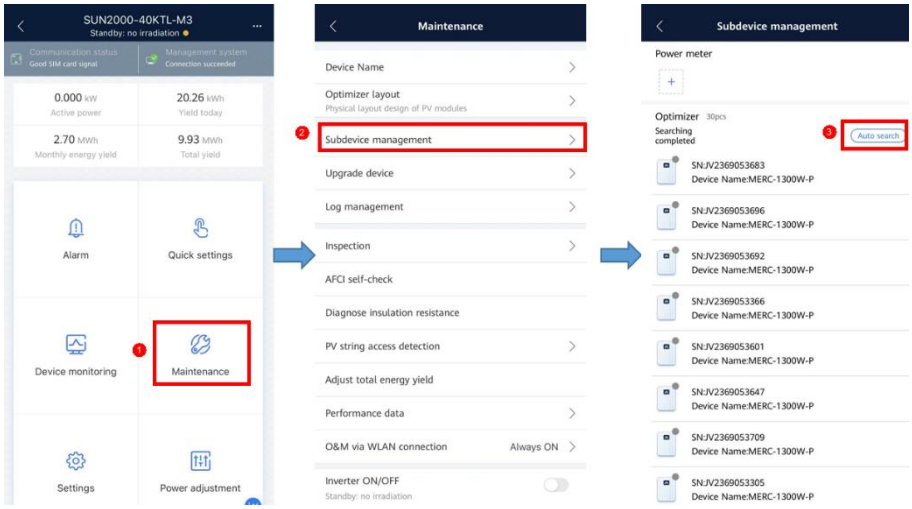
Step 1 Disconnect the AC and DC power supplies of the inverters for more than 5 minutes, and remove all PV string cable terminals from the inverters.



Step 2 After 5 minutes, connect all PV strings intended for the first inverter and search for optimizers. Ensure that the number of optimizers found is correct, grid connection is normal, and all the optimizers work properly.



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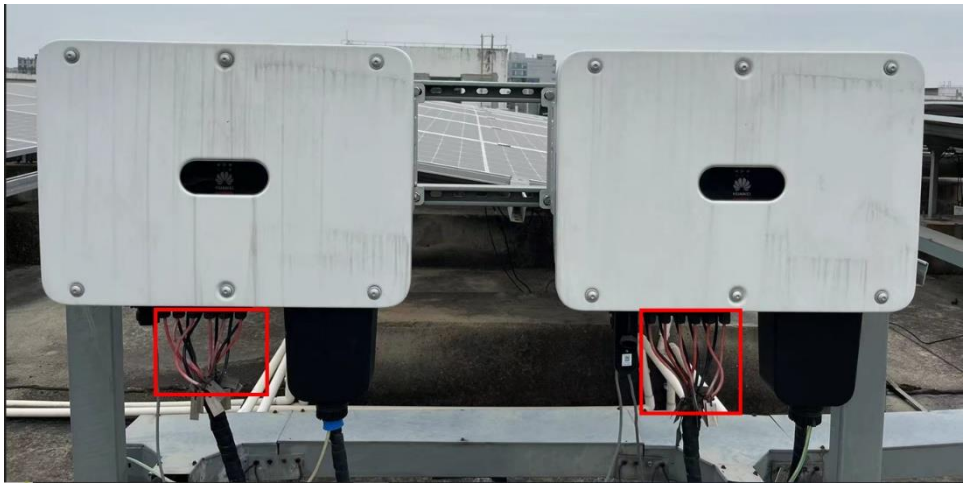
Step 3 Disconnect the AC and DC power supplies of the first inverter, and remove all the PV string cable terminals. Connect all PV strings intended for the second inverter and search for optimizers. Ensure that the number of optimizers found is correct, grid connection is normal, and all the optimizers work properly. Then, power off the second inverter and remove all the PV string cable terminals. Perform the same operations for the other inverters.



Step 4 After performing step 3 for all inverters, check that the number of optimizers found by each inverter is correct. Then, connect all PV string cable terminals to the

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corresponding inverters and power on the inverters. Note that you do not need to perform the search again after the PV strings are connected.



----End

2. Final solution: Correct the onsite cable connections according to the user manual. Ensure that the positive and negative cables of the optimizers are routed close to each other.

   Installation video:

   https://support.huawei.com/enterprise/en/fusionsolar/sun2000p-pid-22098206

3.5.2 Impedance Is Abnormal

For details, refer to the troubleshooting instructions in sections 3.3 and 3.4.

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