

# SolarEdge systems - Inverter arc detection - Application Note – EU and ROW

## Revision history

- Version 1.5, November 2023 – Added exceptions to EU and APAC inverter compliance
- Version 1.4, March 2020 - Merged North America and Europe/APAC versions.

## Electric arcs and related standards

An electric arc is an ongoing high-energy discharge, resulting from a current passing through a normally non-conductive material such as air.

When connectors or cables in a PV system are improperly connected or are damaged, the electric current may pass through the air, causing an electric arc. Arcs generate heat which can cause fires and they also pose an electrocution risk to those working near them. As PV systems age and connectors and cables degrade, the risk of electric arcs, while still low, increases.

In North America, UL/CSA safety requirements pertaining to arcs (UL1699B), requiring the ability to detect and terminate an arc through inverter shut down. The system has to remain shut down until an installer has checked the site and replaced any components if needed. Only then can the system be manually restarted.

In Europe and APAC, there are currently no standards for arc fault detection. In addition, there is no IEC or EN product standard available for arc fault detection (however there are recommendations in installation standards, e.g. IEC 62548). Since the risk of arcs in PV systems exists everywhere, arc fault detection is recommended and may be required in the future.

## Arc fault detection in SolarEdge systems

### North America

SolarEdge inverters with model numbers 3000H/9K and higher are compliant with the North American UL1699B safety requirement, and are designed to detect arcs as specified in this standard. After detection, the power is and inverter interrupt production, and, as required by this standard, a qualified person must re-enable the inverter after properly checking the installation.

The above-mentioned inverter models (excluding the Single Phase Inverter with compact technology) with CPU version 3.19xx / 4.xx and higher support Arc Fault Circuit Interruption (AFCI) functionality as follows:

- In inverters with DSP1 version 1.210.787 (single phase inverters) / 1.13.702 (three phase inverters) and above, the AFCI function is enabled by default.

- In inverters with lower versions that support AFCI, the AFCI function is disabled by default. The AFCI function can be enabled from the inverter menu, as described in the section, Enabling and Testing Arc Fault Detection.

When AFCI is enabled, the inverter performs an automatic self-test for the arc fault detector each time the inverter “wakes-up” or is switched ON.

## Canadian electric code

The Power Optimizer is a DC/DC converter located at the PV modules. Once an arc is detected, the Power Optimizer stops production instantly. This is SolarEdge’s SafeDC™ technology and is commonly referred to as “module level shutdown”. Optimizer outputs are connected in series to build a DC output circuit that connects to the inverter which also stops production when an arc is detected.

Canadian Electric Code 2015 has specific requirements for protection against damage from rodents. Rule 64-210(5) states: *“Where the DC arc-fault protection referred to in Rule 64-216 is not located at the module, photovoltaic source circuit conductors and cables installed on or above a building and installed in accordance with Subrules (1), (2) and (3) shall be provided with mechanical protection, in the form of an enclosed raceway or other acceptable material to protect against damage from rodents.”* The SolarEdge DC arc-fault prevention and protection is located at both the module level and the inverter level. Therefore, PV arrays with SolarEdge Power Optimizers and inverters do not require additional mechanical protection of the conductors to comply with 64-210(5).

For additional information refer to [Safety Risks & Solutions in PV Systems for North America](#)

In the event of rodent damage that results in a fault on the Power Optimizer DC input conductors, the available fault current and voltage are limited to the input of the Power Optimizer. In the event of rodent damage at the DC output conductors that results in a fault, the available fault current is zero and the voltage is less than 30V<sub>DC</sub><sup>1</sup>.

## Europe and APAC

SolarEdge inverters with model numbers 2200H/3K and higher are compliant with the North American UL1699B safety requirement. The same inverters with CPU version 3.19xx/4.xx and higher support Arc Fault Circuit Interruption (AFCI) functionality. When AFCI is enabled, the inverter performs continuous arc testing.

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<sup>1</sup>Each Power Optimizer has an output of 1V when the system is shut down. To comply with rapid shutdown, string length is limited to 30 Power Optimizers in series, resulting in no more than 30V present on the DC circuit conductors after a fault is detected.

There are two modes of inverter reconnection after an arc detection event:

- Manual Reconnect - The system must be manually restarted on site following inverter shut down.
- Auto Reconnect - Reconnects the system automatically after grid reconnection time according to the country-specific setting. If no country-specific reconnection time is specified, the default reconnection time is 30 seconds following inverter shutdown. If the arc detection persists, the inverter again disconnects and reconnects after the grid connection time, which is doubled following each detection, until the event is resolved.



#### IMPORTANT NOTE

The following list of single-phase and three-phase inverters are not compliant with the North American UL1699B safety requirement. These exclusions are **ONLY** relevant for Europe and APAC.

#### Single-phase:

- SE8000H-RW000BEN4
- SE8000H-RWBMNBF54
- SE10000H-RWBMNBF54
- SE8250H-AUL00BEU4
- SE10000H-AUL00BEU4
- SE10000H-AUSNBBX14
- SE8250H-AUSNBBX14

#### Three-phase:

- SExK-RWBTExxxx
- SExK-AUBxxxxxx

## Enable and test arc fault detection

The following sections describe the process for enabling and testing arc fault detection using SetApp or the inverter LCD display.

### Using SetApp

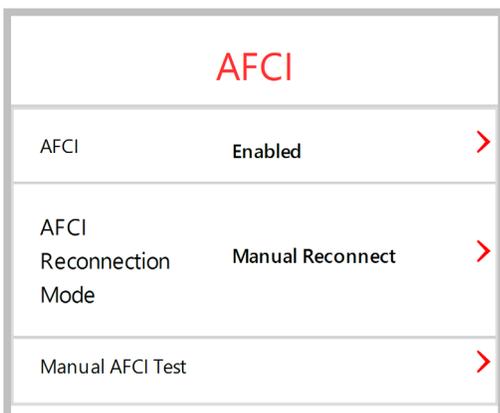
1. Access SetApp from your mobile device and select **Commissioning > Maintenance**. The Maintenance screen displays.



The screenshot shows the 'Maintenance' screen in the SetApp. At the top is the solar**edge** logo and the title 'Maintenance'. Below the title is a list of settings, each with a red chevron icon on the right side. The settings are: Date and Time (Jan-5-2020 09:45am), Temperature (Celsius), Reset Counters, Factory Reset, Arc Fault Circuit Interrupter (AFCI) (Manual Reconnect), Firmware Upgrade, Diagnostics, and Standby Mode (Enabled).

solar <b>edge</b>	
Maintenance	
Date and Time	Jan-5-2020 09:45am
Temperature	Celsius
Reset Counters	
Factory Reset	
Arc Fault Circuit Interrupter (AFCI)	Manual Reconnect
Firmware Upgrade	
Diagnostics	
Standby Mode	Enabled

2. Select **Arc Fault Circuit Interrupter (AFCI)**. The AFCI screen displays.



The screenshot shows the 'AFCI' screen in the SetApp. At the top is the title 'AFCI'. Below the title is a list of settings, each with a red chevron icon on the right side. The settings are: AFCI (Enabled), AFCI Reconnection Mode (Manual Reconnect), and Manual AFCI Test.

AFCI	
AFCI	Enabled
AFCI Reconnection Mode	Manual Reconnect
Manual AFCI Test	

### 3. Select **AFCI**.

#### To enable Manual Reconnect or Automatic Reconnect (Europe and APAC only):

1. In the AFCI screen tap **AFCI Reconnection Mode**.
2. Select **Manual Reconnect** or **Automatic Reconnect**.



#### To manually test the arc detection functionality:

1. Power ON the inverter.
2. In the AFCI screen select **Manual AFCI Test**.

If the test is successful, the following message displays:



Inverter production is interrupted simulating a detected arc, and one of the following error codes displays:

- Single phase inverter error codes: 18xC, 18xD
- Three phase inverter error codes: 8xC, 8xD, 8xBA



### To resume system operation, perform a manual restart as follows:

Power OFF the inverter and then ON again. The inverter performs an arc detection self-test and starts normal operation.

### To troubleshoot self-test failures:

If the self-test fails, SetApp displays an error message indicating that the arc detector hardware failed during the wake-up tests.

Error Code 18x8D
AFCI
self-test failed

If the inverter is connected to the monitoring platform, the error is displayed there as well.

The inverter continuously repeats the arc detection self-test until it is successful. If the problem persists, contact SolarEdge support.

## Using the inverter LCD display

### To enable or disable arc detection:

1. Enter Setup mode and scroll to the **Maintenance** menu.
2. Select **AFCI < En/Dis >**.

```
A F C I < E n / D i s >  
A F C I M o d e < M A N / A U T O >
```

3. Select **Enable** or **Disable**.

### To enable Manual Reconnect or Auto Reconnect (Europe and APAC only):

1. Enter Setup mode and scroll to the **Maintenance** menu.
2. Select **AFCI Mode < MAN / AUTO >** and choose **Manual Reconnect** or **Auto Reconnect**.

```
M a n u a l R e c o n n e c t  
A u t o R e c o n n e c t
```

### To manually test the arc detection functionality:

1. Power ON the inverter.
2. Select **Maintenance > Manual AFCI Test**.

If the test is successful, the following message displays:

```
Manual Test PASS
```

Inverter production is interrupted simulating a detected arc, and one of the following error codes displays:

- Single phase inverter error codes: 18xC, 3x11
- Three phase inverter error codes: 8xC, 8xBA

```
Error Code 18xC  
Arc Fault Detected
```

**To resume system operation, perform a manual restart as follows:**

Power OFF the inverter and then ON again. The inverter performs an arc detection self-test and starts normal operation.

**To troubleshoot self-test failures:**

If the self-test fails, an error message displays indicating that the arc detector hardware failed during the wake-up tests.

```
Error Code 18x8D  
AFCI  
self-test failed
```

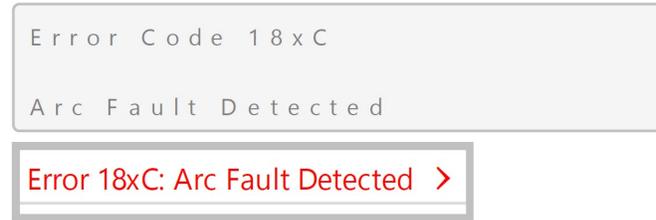
If the inverter is connected to the monitoring platform, the error is displayed there as well.

The inverter continuously repeats the arc detection self-test until it is successful.

If the problem persists, contact support.

## Troubleshoot arc fault events

The inverter continuously performs arc detection while producing power. If an electric arc is detected, the inverter stops producing power, and an error code is displayed on the LCD or in SetApp, as shown below.



- Single phase inverter error codes: 18xC, 3x11
- Three phase inverter error codes: 8xC, 8xBA

If the inverter is connected to the monitoring platform, the error is displayed there as well.

If one of these messages displays, perform the following:

1. Power OFF the inverter.
2. Check all PV strings for the correct open-circuit voltage:
  - Inspect all connections and cables between the Power Optimizers in the strings. Verify that they are connected properly by firmly pushing and pulling the plugs and verifying that the connectors are locked.
  - Inspect all connections and cables between the PV modules and the Power Optimizers. Verify that they are connected properly by firmly pushing and pulling the plugs and verifying that the connectors are locked.
  - Verify that the strings are firmly attached to the terminal blocks (if applicable).
  - Verify that all site-made connectors are firmly connected to their conductors by pulling from the conductor side of the connection.

If the system is set to Manual Reconnect, perform the following:

1. Power OFF the inverter.
2. Power ON the inverter.

The inverter performs an arc detection self-test and starts normal operation.