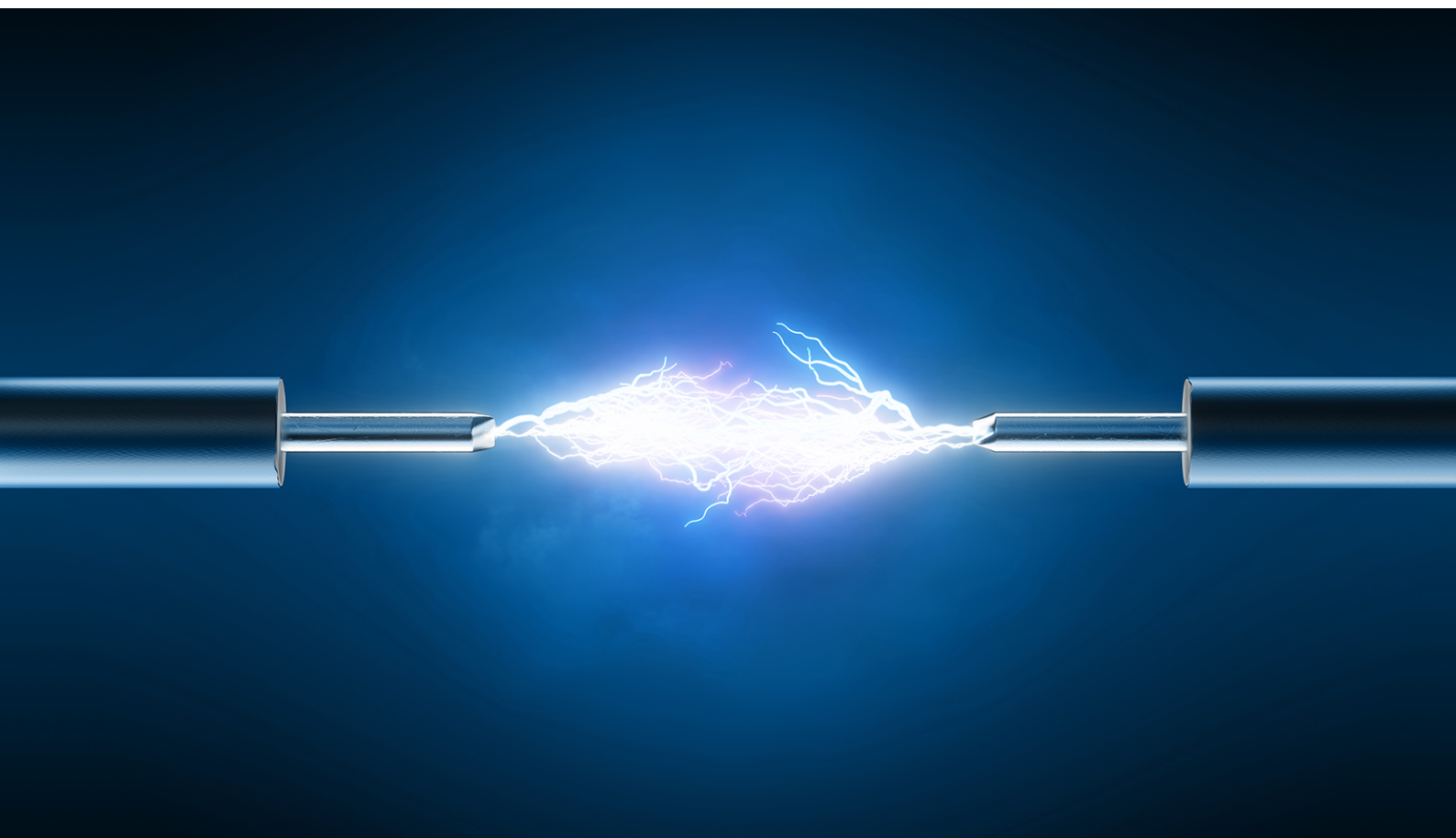




SUNNY TRIPOWER CORE1-US - Enhanced AFCI Event Handling

Table of Contents

1 Introduction 3

2 Enhanced Arc-Fault Event Handling 4

3 Resetting Inverter following an Arc-Fault Event 5

4 Event Messages..... 6

5 Frequently Asked Questions 7

1 Introduction

Sunny Tripower CORE1 (STP 33/50/62-US-41) inverters are equipped with integrated photovoltaic (PV) arc-fault protection as required for PV systems by National Electrical Code® ANSI/NFPA 70 (NEC). The inverters' arc-fault circuit interruption (AFCI) functionality is certified to Standard UL 1699B Edition 1 (August 2018), *Photovoltaic (PV) DC Arc-Fault Circuit Protection*, which defines requirements for PV arc-fault protection devices intended for use in solar photovoltaic electrical energy systems as described in NEC 690.11.

The AFCI functionality of Sunny Tripower CORE1 inverters can detect series arc-faults in the PV modules and array wiring of connected PV strings. The inverter interrupts an arcing fault by ceasing operation when an arc-fault is detected, thereby stopping the flow of current across a series fault.

The arc-fault protection of the CORE1 inverters has proven highly reliable, meaning that the inverters reliably detect and interrupt actual arc-faults in PV source circuits and are not typically susceptible to nuisance tripping from non-fault related disturbances. Arc-fault detection events issued by the inverters should be considered as reliable indications of actual faults in the indicated PV source circuits, and promptly and thoroughly investigated by qualified technicians to locate and correct any PV source circuit fault(s).

As required by UL 1699B, Sunny Tripower CORE1 inverters perform self-testing of AFCI circuitry prior to entering operation to ensure that AFCI is functioning properly and is capable of detecting arc-faults as intended. If an inverter fails AFCI self-testing, the inverter is not able to enter operation until the AFCI self-test is completed successfully.

2 Enhanced Arc-Fault Event Handling

As of 2017 NEC and per UL 1699B Edition 1, it is allowed for an inverter with arc-fault protection to automatically return to operation following the detection and interruption of an arc-fault. Sunny Tripower CORE1 inverters include enhanced arc-fault event handling which provides the option to enable AFCI with or without permanent operation inhibition following an arc-fault detection event.

The operation mode for AFCI is determined by the **Device > AFCI switched on** operating parameter setting. The setting of this parameter can be viewed and changed through the browser-based user interface of the inverter or a connected SMA Data Manager, or through Sunny Portal powered by ennexOS for inverters registered in Sunny Portal with an SMA Data Manager.

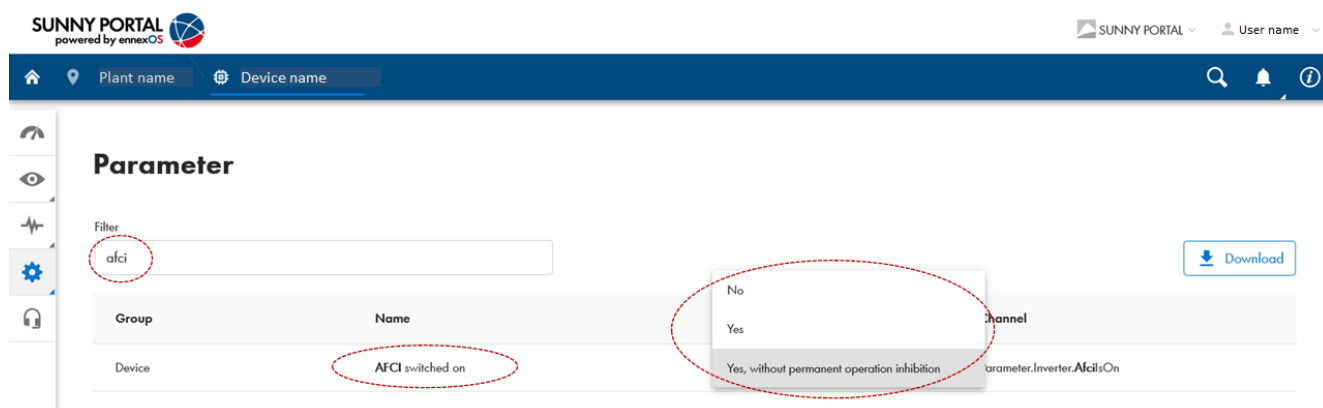


Figure 1: Setting parameter for AFCI operation mode via Sunny Portal powered by ennexOS

Parameter setting / AFCI operation mode	Behavior upon arc-fault detection
No AFCI not enabled	No arc-fault protection – no detection or interruption of arc-faults (not recommended)
Yes AFCI enabled with permanent operation inhibition	- Inverter stops operation to interrupt arcing fault - Inverter waits to be reset before returning to operation
Yes, without permanent operation inhibition AFCI enabled without permanent operation inhibition	- Inverter stops operation to interrupt arcing fault - Inverter automatically returns to operation after a brief time interval (approximately 10 minutes)

Enhanced arc-fault event handling is available with Sunny Tripower CORE1 inverters as of the firmware version noted in the table below.

Inverter	Type designation	Firmware version
Sunny Tripower CORE1-US	STP 33-US-41 STP 50-US-41 STP 62-US-41	03.12.21.R
Sunny Tripower CORE1-US	STP 50-US-40	Enhanced AFCI event handling not available – only AFCI with permanent operation inhibition

3 Resetting Inverter following an Arc-Fault Event

For inverters in which AFCI is enabled with permanent operation inhibition, an inverter that has stopped operation due to detection of an arc-fault (event ID 4301 or 4302) can be reset and returned to operation by selecting **Reset operation inhibition** for the **Device > Reset operating data** operating parameter setting. This parameter can be accessed through the browser-based user interface of the inverter or a connected SMA Data Manager, or through ennexOS Sunny Portal for inverters registered in Sunny Portal with an SMA Data Manager.

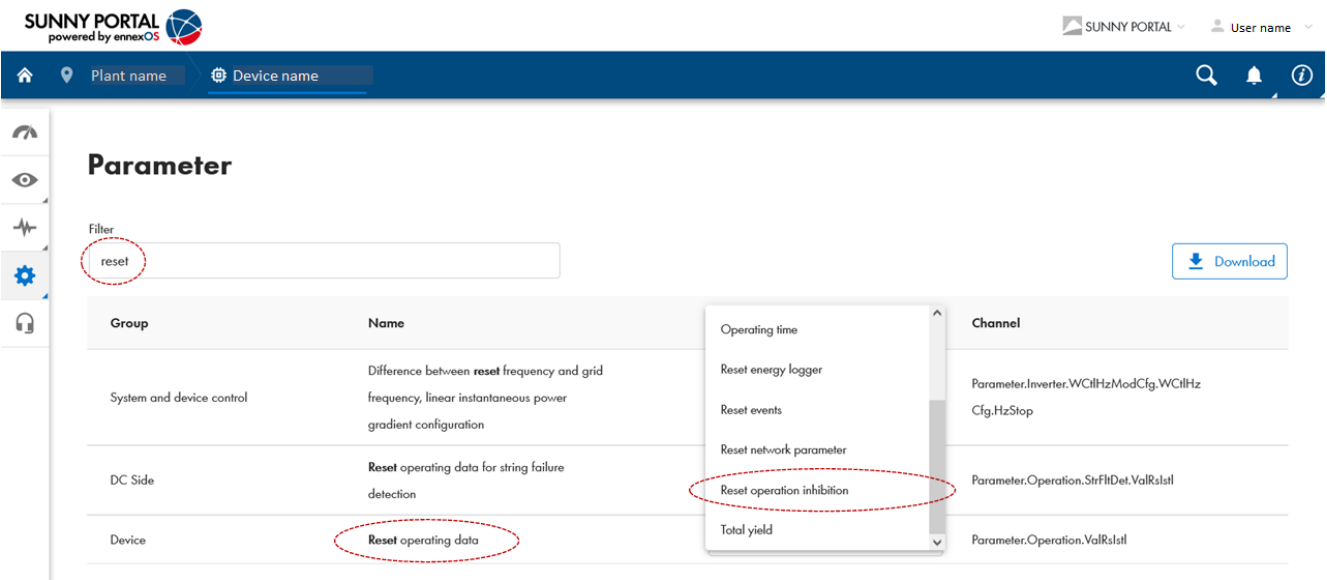


Figure 2: Resetting operation inhibition via Sunny Portal powered by ennexOS

4 Event Messages

The following event messages may be generated by the Sunny Tripower CORE1 inverters' AFCI functionality.

Event ID	Description / Explanation / Corrective measures
4301/4302	Ser. el. arc in string ABC/DEF detected by AFCI mod. Explanation: An arc-fault was detected in PV strings connected to the indicated input group (ABC or DEF). Corrective measures: Inspect the PV wiring and array to locate and correct the cause of the arc-fault.
8206/8210	Electric arc detected/Electric arc detected in 2nd string group Explanation: The inverter is waiting to be reset from an arc-fault detection event. See preceding event ID 4301/4302 for occurrence of the arc-fault detection. Corrective measures: Inspect the PV wiring and array to locate and correct the cause of the arc-fault. Perform reset of operation inhibition to return the inverter to operation (see Section 3, page 5).
8208	Self-test arc detection: Interference level too high Explanation: The AFCI self-test function failed during inverter startup. Corrective measures: Contact SMA Service Line for troubleshooting support and corrective measures.
8209/8212	Self-test arc detection: Signal level too low Explanation: The AFCI self-test function failed during inverter startup. Corrective measures: Contact SMA Service Line for troubleshooting support and corrective measures.

5 Frequently Asked Questions

Is it allowed for inverters to automatically return to operation following detection of an arc-fault?

Yes, as of 2017 NEC and UL 1699B Edition 1 it is no longer required that inverters must be manually reset following detection of an arc-fault. For projects permitted under 2014 NEC or earlier, check with the permitting authority having jurisdiction (AHJ) regarding the permissibility of setting inverters to automatically return to operation following detection of an arc-fault.

Is automatic reset of inverters following an arc-fault detection allowed for installations in Canada?

Canadian Electrical Code® CSA C22.1 and Canadian Standard C22.2 NO. 292-18 *DC Arc Fault Protection for Photovoltaic Applications* have not been harmonized with 2017 NEC and UL 1699B Edition 1 to allow automatic return to operation following an arc-fault detection event. For installations in Canada, check with the permitting authority having jurisdiction (AHJ) regarding the permissibility of setting inverters to automatically return to operation following detection of an arc-fault.

Is it safe for inverters to automatically return to operation following detection of an arc-fault?

Arc-fault protection equipment listed to UL 1699B Edition 1 is certified to detect and interrupt arc-faults before an electric arc reaches an energy level and/or duration where there is a risk of fire ignition. If an electric arc is detected again after the inverter returns to operation, the inverter will again cease operation to interrupt the arcing fault and issue an arc-fault event message.

Inverters that are set to AFCI without permanent operation inhibition should be closely monitored and recurring arc-fault events should be immediately investigated by qualified technicians. If it is not possible to immediately investigate the cause of faults, the inverter should be put into a non-operational condition until investigation and corrective measures can be completed. Recurring arc-faults can result in damage to adjacent conductors and system components which could lead to more extensive system failure and damage up to and including uncontrolled arcing and fire.

Is there any limit to the number of times an inverter will automatically reset following arc-fault detection?

No, for inverters in which AFCI is enabled without permanent operation inhibition, the inverter will automatically return to operation following each arc-fault detection event. There is no limitation to the number of automatic resets that can be performed.

Do repetitive arc-fault interruptions and automatic resets affect inverter reliability or service life?

No, interruption of arc-faults is performed in a manner that does not stress the internal components of the inverter.

What are some common causes of arc-faults in PV systems?

Arc-faults are the result of a failure in the intended continuity of a conductor, connection, module or other system components creating a gap across which circuit current flows in an arc. Common causes of arc-faults in PV systems are damaged or improperly assembled or mated PV connectors, loose terminal connections, or damage to PV modules.