

PV Arc-Fault Circuit Interrupter



Direct Current Arc-Fault Detection in PV Systems

Sunny Boy - Overview

Section 690.11 of ANSI/NFPA 70®, National Electrical Code® 2011 Edition (2011 NEC) sets new requirements for photovoltaic (PV) systems installed on or penetrating a building. These requirements apply to newly installed PV systems with a maximum voltage of 80 volts or greater. Such PV systems must be equipped with direct current (DC) arc-fault circuit protection.

DC arc-fault circuit protection provides supplementary protection against fires that may arise as a result of arcing faults in PV system components or wiring.

SMA Sunny Boy US inverters are now available with integrated Arc Fault Circuit Interrupter (AFCI) functionality. Integrating AFCI functionality within the PV system inverter eliminates the cost and effort of installing additional arc-fault circuit protection components to meet 2011 NEC section 690.11 requirements.

1. What are PV Arc-Faults?

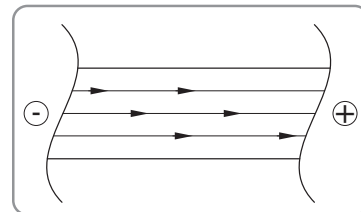
2011 NEC Section 690.11 requires detection and interruption of “arcing faults resulting from a failure in the intended continuity of a conductor, connection, module, or other system component.” This requirement describes what are commonly called “series” arc-faults and does not include “parallel” arc-faults resulting from a failure in insulation between two conductors.

How are Arc-Faults Formed?

In a series arc-fault a conductor is interrupted, creating a gap in the conductive path while current is flowing. This creates a spark that ionizes the surrounding air, producing plasma. If the current is sufficiently high, enough plasma is created to keep the current flowing across the gap in the conductive path. The current is now conducted via the plasma and is visible as an electric arc.

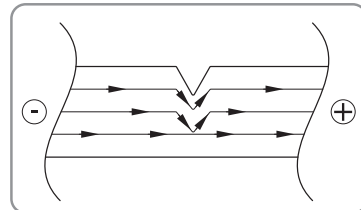
1. Unbroken conductor:

- » The flow of current is uninhibited.



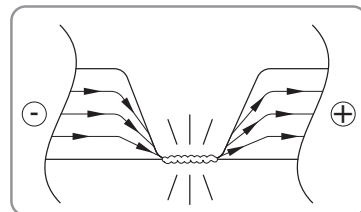
2. Damaged conductor (increased resistance):

- » The current density is increased.
- » The temperature of the conductor rises.
- » The conductor melts.



3. Interrupted conductor (failure in continuity):

- » The conductor is destroyed by heat.
- » Plasma is created due to ionization.
- » The current flows in the form of an electric arc.



What are the Causes of Arc-Faults?

Arc-faults in PV systems may be the result of faulty components, installation errors, or mechanical damage and aging occurring after installation. Some common examples for arc-fault causes include:

- » Damaged, pinched or abraded conductors.
- » Loose or separated connections or terminations.
- » Cracked or corroded solder joints in modules or other components.

2. Arc-Fault Protection Requirements

Code Requirements

2011 NEC Section 690.11 requires that PV systems installed on buildings with a maximum system voltage of 80 volts or more be equipped with a listed means of detecting and interrupting series arc-faults in PV source and output circuits. Following detection of an arc-fault, operation of the PV system must be disabled. The system must provide a visual indication that an arc-fault has been detected, and the system must be manually restarted to reset the error and resume operation.

This requirement may be enforced as listed PV AFCI devices become available where state and local Authorities Having Jurisdiction (AHJ's) have adopted 2011 NEC.

Product Listing Standard

The listing standard for certification of PV AFCI devices is UL Subject 1699B, Photovoltaic (PV) DC Arc-Fault Circuit Protection, which requires PV AFCI devices to behave according to the requirements of 2011 NEC Section 690.11. UL Subject 1699B stipulates that a PV AFCI device must detect an electric arc of 300 W or more, and interrupt it within a maximum time period of two seconds.



3. Integrated SMA Solution

SMA Sunny Boy US inverters available with integrated Arc Fault Circuit Interrupter (AFCI) functionality are fully compliant with 2011 NEC Section 690.11 and have been tested and certified to the requirements of UL Subject 1699B.

SMA's AFCI solution fully integrates the arc-fault detection and interruption functionality within the inverter. When an arc-fault is detected the inverter immediately stops operation, interrupting the flow of current across the arc. The inverter displays an error message indicating that an arc-fault has been detected, and also transmits an error message through its remote monitoring communications interfaces. A manual restart process is required to resume system operations.

Integrating AFCI functionality within the PV system inverter eliminates the cost and effort of installing additional arc-fault circuit protection components to meet 2011 NEC section 690.11 requirements.

The following Sunny Boy US inverters are available with integrated AFCI functionality:

Inverter Type	Model Designation	Availability
SB 3000-US/3800-US/4000-US	SB XX00-US-12	Q3 - 2012
SB 5000-US/6000-US/7000-US/8000-US	SB X000-US-12	Q3 - 2012
SB 6000-11000TL-US	SB XX000TL-US-12	Q3 - 2012
SB 3000TL-US/4000TL-US/5000TL-US	SB X000TL-US-22	Q2 - 2013

SMA America, LLC
+1 916 625 0870
www.SMA-America.com