



# Thomas & Betts

## ANALYSIS OF NEC ®

2017 Code Changes: Article Section 690.12 Rapid Shutdown of  
PV Systems on Buildings  
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## Section 690.12 Rapid Shutdown of PV Systems on Buildings

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**690.12 Rapid Shutdown of PV Systems on Buildings.** PV system circuits installed on or in buildings shall include a rapid shutdown function to reduce shock hazard for emergency responders in accordance with 690.12(A) through (D).

*Exception: Ground mounted PV systems circuits that enter buildings, of which the sole purpose is to house PV system equipment, shall not be required to comply with 690.12.*

**(A) Controlled Conductors.** Requirements for controlled conductors shall apply to PV circuits supplied by the PV system.

**(B) Controlled Limits.** The use of the term *array boundary* in this section is defined as 305 mm (1 ft) from the array in all directions. Controlled conductors outside the array boundary shall comply with 690.12(B)(1) and inside the array boundary shall comply with 690.12(B)(2).

**(1) Outside the Array Boundary.** Controlled conductors located outside the boundary or more than 1 m (3 ft) from the point of entry inside a building shall be limited to not more than 30 volts within 30 seconds of rapid shutdown initiation. Voltage shall be measured between any two conductors and between any conductor and ground.

**(2) Inside the Array Boundary.** The PV system shall comply with one of the following:

(1) The PV array shall be listed or field labeled as a rapid shutdown PV array. Such a PV array shall be installed and used in accordance with the instructions included with the rapid shutdown PV array listing or field labeling.

Informational Note: A listed or field labeled rapid shutdown PV array is evaluated as an assembly or system as defined in the installation instructions to reduce but

not eliminate risk of electric shock hazard within a damaged PV array during fire-fighting procedures. These rapid shutdown PV arrays are designed to reduce shock hazards by methods such as limiting access to energized components, reducing the voltage difference between energized components, limiting the electric current that might flow in an electrical circuit involving personnel with increased resistance of the conductive circuit, or by a combination of such methods.

(2) Controlled conductors located inside the boundary or not more than 1 m (3 ft) from the point of penetration of the surface of the building shall be limited to not more than 80 volts within 30 seconds of rapid shutdown initiation. Voltage shall be measured between any two conductors and between any conductor and ground.

(3) PV arrays with no exposed wiring methods, no exposed conductive parts, and installed more than 2.5 m (8 ft) from exposed grounded conductive parts or ground shall not be required to comply with 690.12(B)(2).

The requirement of 690.12(B)(2) shall become effective January 1, 2019.

**(C) Initiation Device.** The initiation device(s) shall initiate the rapid shutdown function of the PV system. The device “off” position shall indicate that the rapid shutdown function has been initiated for all PV systems connected to that device. For one-family and two-family dwellings, an initiation device(s) shall be located at a readily accessible location outside the building.

The rapid shutdown initiation device(s) shall consist of at least one of the following:

(1) Service disconnecting means

(2) PV system disconnecting means

(3) Readily accessible switch that plainly indicates whether it is in the “off” or “on” position

Informational Note: One example of why an initiation device that complies with 690.12(C)(3) would be used is where a PV system is connected to an optional

standby system that remains energized upon loss of utility voltage.

Where multiple PV systems are installed with rapid shutdown functions on a single service, the initiation device(s) shall consist of not more than six switches or six sets of circuit breakers, or a combination of not more than six switches and sets of circuit breakers, mounted in a single enclosure, or in a group of separate enclosures. These initiation device(s) shall initiate the rapid shutdown of all PV systems with rapid shutdown functions on that service. Where auxiliary initiation devices are installed, these auxiliary devices shall control all PV systems with rapid shutdown functions on that service.

**(D) Equipment.** Equipment that performs the rapid shutdown functions, other than initiation devices such as listed disconnect switches, circuit breakers, or control switches, shall be listed for providing rapid shutdown protection.

Informational Note: Inverter input circuit conductors often remain energized for up to 5 minutes with inverters not listed for rapid shutdown.

## Analysis of the Change

The revision to 690.12 was developed by Code Making Panel 4 and is based on a combination of public inputs, and comments provided by the International Association of Fire Fighters (IAFF) and the Solar Energy Industries Association (SEIA). The revision included cooperation among many organizations and stakeholders impacted by the 690.12 rapid shutdown requirement. The NFPA organized a Fire Fighter Safety and PV Systems Task Group that included recommended language for the 2017 version of 690.12. One goal of this task group was to develop consensus language for 690.12. A section-by-section summary of the changes are described below.

Main paragraph: The prime reason for rapid shutdown is clearly stated in the main paragraph as relating to the reduced shock hazard for emergency responders. Section 690.12 is not intended to provide electrical isolation for electrical worker safety. That electrical isolation is covered by the disconnecting means requirements in Part III, Disconnecting Means, of Article 690.

Section (A): The PV system can only control the ac output of PV inverters on the PV supply side of the circuit. If that circuit is connected to a utility-connected circuit breaker, only the PV end of the circuit can be deenergized since the circuit breaker is connected to a utility source that may need to be separately turned off.

Section (B): Section 690.12(B)(2), related to within the array boundary, provides for two methods of compliance. The first method is a performance requirement that requires the PV array be evaluated as a rapid shutdown PV array. Currently, there is no standard for this option, but it is key that this

option be made available so that the standards process will see the need to develop a standard to which this equipment will be evaluated. It is expected that, once a standard is developed, many PV arrays will be listed and labeled for this function. However, some configurations may require field labeling which is why this option is also provided. The fire service has expressed concern that the lack of a rapid shutdown PV array standard may result in lesser safety than the 80 volts required in 690.12(B)(2)(b). To further clarify that the intent of this listing process is for fire fighter safety, the informational note clarifies the intent that a listed product will equivalent or lesser hazard than a system built in accordance with 690.12(B)(2)(b).

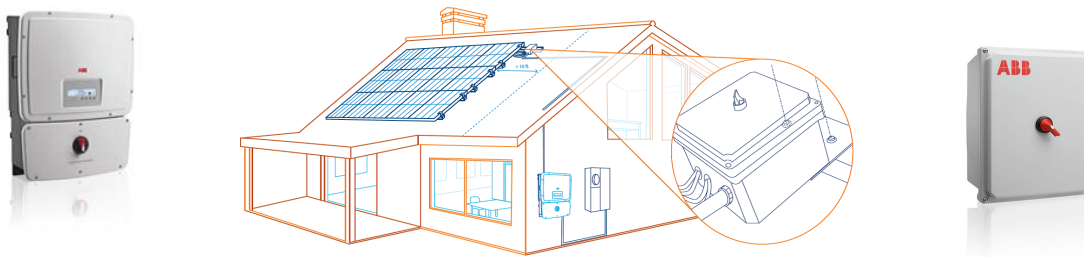
Section 690.12(B)(2)(c) is included to address PV arrays that present reduced shock hazard, other than 80 V arrays.

Section (C): The main paragraph has been added to clarify that the function of the initiation device is to initiate rapid shutdown. It further clarifies that an initiation device in the “off” position puts the PV system in the rapid shutdown mode. Lastly, the first paragraph requires that the rapid shutdown initiator be located on the outside of the building for one- and two-family dwellings. This was requested by the fire service as many service disconnects may be internal to a building and difficult for fire fighters to access.

Section (D): This section requires that an initiator in the “off” position requires that the PV system be in the rapid shutdown mode. If not initiators are turned “off” and the rapid shutdown system initiates on a loss of utility voltage, the fire fighter must know that they are unprotected until the initiator is moved to the “off” position since the power could be restored, which would reenergize the PV system (and potentially other ac wiring in the building).

## Products

### ABB's Rapid Shutdown Products



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# Contact Us

If you have any questions or require interpretation assistance, please contact the following:

David Kendall ..... 1-800-888-0211 Ext. 8879

Greg Steinman ..... 1-800-888-0211 Ext. 5719

Jean Blanc ..... 1-800-888-0211 Ext. 5670

Thomas & Betts Corporation

8155 T&B Blvd.

Memphis, TN 38125

[www.tnb.com](http://www.tnb.com)

Disclaimer: This is not intended to be an iteration of all the changes, but a reference of a change that may affect the Thomas & Betts, ABB & Baldor product lines. For a more in-depth document, please contact the International Association of Electrical Inspectors at [www.iaei.org](http://www.iaei.org).

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