Complete and reliable solar circuit protection
Introduction

Benefits of Eaton’s circuit protection solutions

Complete and reliable circuit protection for photovoltaic (PV) balance-of-system

Eaton offers the industry’s most complete and reliable circuit protection for PV balance of system, from Bussmann® series fuses and fuse holders, and Eaton circuit breakers to safety switches and surge protection—we can provide comprehensive overcurrent and overvoltage protection anywhere in the PV system.

Unmatched global offering

Eaton offers a range of solar products with ratings up to 1500Vdc as well as UL®, IEC®, CSA® and CCC certifications specific for PV applications—ensuring fully supported and seamless global installations.

Legacy of technical expertise

For more than 100 years, Eaton has protected equipment and businesses from electrical hazards. We are the experts in safe system design and application. Our team of Application Engineers and Sales Engineers are dedicated to protecting your system, from specification to delivery. Additionally, the Bussmann Division’s Paul P. Gubany Center for High Power Technology is one of the industry’s most comprehensive testing facilities, and is available to test your systems to global agency standards.

Safe. Reliable. Complete.

Over the last 50 years, solar PV systems have evolved into a mature, sustainable and adaptive technology.

The unique nature of PV system power generation necessitates the need for new and effective electrical protection products for overcurrent, overvoltage and isolation events.

With an Eaton protected electrical system, you can optimize your renewable energy power generation capacity, knowing your equipment is safe. We are a single source for the entire AC and DC circuit protection and disconnecting means. We work closely with solar equipment manufacturers and, through coordinated research and development, have produced revolutionary new fuses and circuit breakers that, combined with a range of surge protective devices, offer complete protection for PV systems.

As a single source provider with over 100 years of proven technology, we provide complete circuit protection solutions that are safe and reliable so you can take full advantage of converting sunlight into usable energy while working with a bankable, industry-leading manufacturer.

Learn more at www.cooperbussmann.com/solar and www.eaton.com/solar.

Eaton has a complete portfolio of solar circuit protection solutions to meet your needs

- Photovoltaic Fuses
- DC/Solar Circuit Breakers
- Solar String Protectors
- Modular Fuse Holders
- Photovoltaic SPDs
- UL and IEC SPDs
- AC/DC Safety Switches
- High Speed Fuses
- AC Fuses
- AC Circuit Breakers
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How PV power systems work

PV cells are made from semi-conductor materials, such as polycrystalline silicon or thin film, that convert the sun’s light into DC electricity. PV cells are connected in series to create a PV module and increase voltage.

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**Protecting PV systems**

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**PV string protection**

**PV array protection**

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**Photovoltaic source circuits**

**Photovoltaic output circuits**

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*Figure 1: PV powered distribution network with NEC® defined circuits designated by arrows.*
Protecting PV systems

PV Modules are then connected in series to create a PV string and further increase voltage. PV Strings are next connected in parallel (often by a combiner box) to increase amperage. The resulting DC power is sent to an inverter to be converted from DC to AC and then supplied to the electric grid and consumed.

**Inverter protection**

Inverter input circuits

Inverter output circuits

NH/XL PV fuses and blocks

High speed fuses

AC molded case circuit breakers

Low voltage UL power fuses

Low voltage IEC power fuses

AC disconnect switches
Protecting PV systems

PV system standards

Unlike typical grid connected AC systems, the available short-circuit current within PV systems is limited, and the overcurrent protective devices (OCPDs) need to operate effectively on low levels of fault current. For this reason, Eaton has conducted extensive research and development of PV fuses and circuit breakers that are specifically designed and tested to protect PV systems with high DC voltages and low fault currents.

The International Electrotechnical Commissions (IEC) and Underwriters Laboratories (UL) recognize that the protection of PV systems is different than conventional electrical installations. This is reflected in IEC 60269-6 (gPV) and UL 248-19 for fuses and UL 489B for breakers that define specific characteristics an OCPD should meet for protecting PV systems. The range of Eaton OCPDs for PV string and PV array protection have been specifically designed to meet these standards.

PV fuses

• Fully tested to the requirements of IEC 60269-6 and exceed the requirements of operating at 1.45 x I_n (1.45 times the nominal current). They also meet the requirements of UL 248-19* that are very similar to the IEC standards, except they operate at 1.35 x I_n (1.35 times the nominal current).

• The current ratings assigned to PV fuses are defined by the performance requirements of IEC 60269-6 and UL 248-19 in order to protect PV modules during overcurrent situations. These IEC and UL ratings do not reflect a continuous service rating. The assigned service rating should be reduced at increased ambient temperatures.

• To ensure longevity of PV fuses, they should not be subjected to a continuous current of more than 80% of the assigned IEC and UL ratings.

PV Molded Case Circuit Breakers (MCCBs) and Molded Case Switches (MCS)

• Fully tested, met and exceeded to the requirements of UL 489B: operating at 1.35 x I_n (1.35 times the nominal current) within 1 or 2 hours depending on amp rating (50A or less or over 50A respectively) and calibrated at 50°C ambient temperature.

• The current ratings assigned to PV circuit breakers are defined by the performance requirements of UL 489B in order to protect PV modules during overcurrent situations. MCCBs and MCS* are listed for a continuous load application. The assigned service rating should be reduced at increased ambient temperatures above 50°C.

• PV circuit breakers come in two application ratings: 80% and 100%. To ensure longevity of PV circuit breakers, each rating should be properly applied: a continuous current of 80% or 100% of the assigned UL ratings.


PV array construction

• PV cells are combined to create a PV module
• PV modules are connected in series to create a PV string
• PV strings are connected in parallel to create a PV array

The total voltage of a PV module or PV array is determined by the number of individual cells connected in series with each size usually between 4” and 6” square. An individual PV module is made up of a series PV cells.

PV source circuits

The commonly used PV modules are made with 4”, 5” and 6” polycrystalline silicon, or thin film cells.

The Maximum-Power-Point (MPP) of the PV modules of equal PV cell dimensions can vary as much as 35% between manufacturers. When selecting the appropriate PV fuses, the specified Short-Circuit Current (I_sc) and reverse current characteristics specified by the manufacturer should be used.

The PV module manufacturer’s specifications should be consulted to confirm the PV module’s output amperage and voltage under the expected range of conditions for the proposed installation. These conditions are influenced by the ambient temperature, the sun’s incident angle and the amount of solar energy reaching the PV module. These are usually mentioned as coefficients on the manufacturer’s specifications.

Manufacturers also suggest the maximum series fuse rating or a reverse current rating. Both of these are based on PV modules withstanding 1.35 times this rating for two hours.
Protecting PV systems — source circuits

PV source circuit protection overview

Depending on the desired PV system capacity, there may be several PV strings connected in parallel to achieve higher amperage and subsequently more power.

Systems that have less than three PV strings will not generate enough fault current (short-circuit) to damage the PV modules, conductors or downstream equipment, and do not present a safety hazard, provided the conductor is correctly sized based on local codes and installation requirements.

When three or more PV strings are connected in parallel, a PV fuse on each PV string will protect the PV modules and conductors from overcurrent faults and help minimize any safety hazards. The PV fuse will also isolate the faulted PV string so the balance of the PV system can continue to generate electricity.

The difference between DC molded case switch and the DC disconnect switch solutions in Figure 3 is a different type of disconnect means. PV fuses are used for overcurrent protection in either case. MCS in this PV string combiner box provides the dual function of a disconnect means with remote OFF operation suitable for meeting the NEC® 2014 690.12 requirement for PV rapid shutdown.

NEC® 2014 Article 690.12 Rapid Shutdown

With NEC® 2014 Article 690.12 there is a requirement for Rapid shutdown of PV systems and it reads as follows:

“690.12 Rapid Shutdown of PV Systems on Buildings

PV system circuit installed on or in buildings shall include a rapid shutdown function that controls specific conductors in accordance with 690.12(1) through (5) as follows:

(1) Requirement of controlled conductors shall apply only to PV system conductors of more than 1.5 m (5 ft) in length inside a building, or more than 3 m (10 ft) from a PV array.

(2) Controlled conductors shall be limited to not more than 30 volts and 240 volt-amperes within 10 seconds of rapid shutdown initiation.

(3) Voltage and power shall be measured between any two conductors and between any conductor and ground.

(4) The rapid shutdown initiation methods shall be labeled in accordance with 690.56(B).

(5) Equipment that performs the rapid shutdown shall be listed and identified.”

First responders must contend with elements of a PV system that remain energized after the service disconnect is opened. This rapid shutdown requirement provides a zone outside of which the potential for shock has been mitigated. Conductors more than 5 feet inside a building or more than 10 feet from an array will be limited to a maximum of 30 V and 240VA within 10 seconds of activation of shutdown. Ten seconds allows time for any dc capacitor banks to discharge. Methods and designs for achieving proper rapid shutdown are not addressed (sic) by the NEC® but instead are addressed in the product standards for this type of equipment.

It should be remembered that PV module output changes with the operating temperature and the amount of sunlight it is exposed to. The amount of exposure is dependent on irradiance level, angle of incidence and the shading effect from trees, buildings and clouds. In operation, PV fuses and circuit breakers, as thermal devices, are influenced by ambient temperature. The PV OCPD’s ampacity should be derated according to the manufacturer’s published curves and NEC® 690 requirements.
Component standards and ratings

It is vital to understand component, terminal and conductor temperature ratings and deratings as they relate to PV installations.

Component ratings

Per UL 489B, PV circuit breakers are rated to standard test conditions in open air at 50°C.

In actual applications, ambient temperatures in enclosures can exceed 50°C.

When high ambient temperatures are encountered appropriate component derating must be taken into account in the specifying process.

See individual product technical detail sheets for specific information on derating and derating factors to use in determining the correct rating for the application.

Terminal ratings

The PV circuit breakers and molded case switch terminals listed in this document and catalog No. CA08100005E are rated for 75°C conductors. Fuse holders, blocks and disconnects may be rated for 75°C or less, depending on the type of terminal. Even though a 90°C conductor may be used, it must be applied at an ampacity as if it were a lower-rated conductor to match the component’s terminal temperature rating at 75°C per NEC® 110.14(C)(1)(a)(2).

Conductor ratings and sizing

Like circuit breakers and fuses, conductors are also rated to standard test conditions, although this is done for most conductors in open air at 30°C.

Per NEC® Table 310.15(B)(2)(a) conductors need to be derated to determine a conductor size that will safely carry the anticipated current generated by the PV system.

For more information on conductor sizing, see the Bussmann series publication No. 3002 Selecting Protective Devices (SPD) electrical protection handbook.

Selecting fuses for PV source circuits

While a full study of all the parameters is recommended, the following factors should be used when selecting a PV fuse to cover most installation variations:

- 1.56 for amps
- 1.20 for voltage

PV module specifications include:

- \( I_{sc} \) = Short-circuit current of one module at Standard Test Conditions (STC)
- \( V_{oc} \) = Open circuit voltage of one PV module at STC

Initial conditions for specifying PV fuses:

- \( N_s \) = Number of PV modules in series per PV string
- \( N_p \) = Number of PV strings in parallel per PV sub-array

Calculations to verify volts and amps:

- Fuse voltage rating \( \geq 1.20 \times V_{oc} \times N_s \)
- Fuse amp rating \( \geq 1.56 \times I_{sc} \)
- PV fuse amp rating \( \leq I_z^* \)

Eaton recommends using Bussmann series PV fuses in both the positive and negative conductors, each with adequate voltage rating (as above).

Additional considerations:

- Voltage rating — per NEC® Table 690.7, if the system is required to operate below -40°C (-40°F), replace the 1.20 factor with 1.25.
- Amp rating — additional derating may be required when the fuse is installed in a high ambient temperature environment. See individual fuse data sheets for derating curves.
- Fuse protection is required in any PV system that is connected to a battery.

Understanding total PV source circuit short-circuit current

The total short-circuit current in Figure 4 that will flow through Fuse 1 is the number of parallel source circuits \( (N_p) \) minus the faulted circuit that is no longer supplying power, multiplied by the total fault current for each PV source circuit \( I_{sc} \) plus a 1.25 factor per the NEC®, or:

\[
(N_p - 1) \times 1.25 \times I_{sc} = \text{Total short-circuit current.}
\]

Figure 4: Faulted PV source circuit.

* \( I_z \) Current capacity of conductors properly sized for the PV system.
Example — Selecting fuses for PV source circuits

Manufacturer’s module specifications include:

- $I_{sc} = 8.99A$ short-circuit current of one module at Standard Test Conditions (STC)
- $V_{oc} = 45.6V$ open circuit voltage of one PV module at STC
- PV cell type: polycrystalline silicon
- PV cell size: 125mm² (5”)
- PV cells and connection — 72 cells in series

PV installation set-up:

- $N_s = 18$ PV modules in series per PV string
- $N_p = 28$ PV strings in parallel per PV sub-array
  - PV module max ambient: 60°C (140°F)
  - PV module min ambient: -25°C (-13°F)

Calculation:

**Note:** when calculating for high ambient temperature applications, include the appropriate derating factors.

- Conductor size formula $\geq 1.56 \times I_{sc}$
  - $1.56 \times 8.99A = 14.02A$
- Conductor size: 14AWG*
  - 14AWG at 60°C $I_z = 25A^*$
  - $25A \times 0.71 = 17.75A$
- Array max $I_{sc-array} = (N_p -1) \times 1.25 \times I_{sc}$
  - $(28-1) \times 1.25 \times 8.99A = 303.4A$
- Array max $I_{sc-array} >$ conductor rating; PV source circuit fuses are needed

Once it’s determined that the maximum short-circuit current exceeds the conductor’s continuous current rating, selecting the correct PV source circuit fuse is as follows:

- Fuse amp rating $\geq 1.56 \times I_{sc}$
  - $1.56 \times 8.99A = 14.02A$
- Maximum system voltage $= 1.20 \times V_{oc} \times N_s$
  - $1.20 \times 45.6V \times 18 = 985V$

The required PV fuse needs to be 1000Vdc and 15A.

**Note:** fuse amp rating must be equal to or less than the $I_z$ ampacity of the selected conductor.

Bussmann part numbers are:

- PV-15A10F (ferrule - page 19)
- PV-15A10T (bolt fixing - page 19)
- PV-15A10-1P (PCB fixing - page 19)
- PV-15A10F-CT (in-line crimp terminal - page 19)

The selected PV fuses will protect the conductor and the PV source circuit against reverse current faults.

\* 75°C component terminal rating for 14AWG = 20A.
\** Conductor rating per NEC® Table 310.15(B)(2)(a) for 90°C copper wire.
Protecting PV systems — output circuits

PV output circuit and inverter input circuit protection overview

Selecting fuses for PV output circuits

While a full study of all the parameters is recommended, the following factors should be used when selecting the PV fuse to cover most installation variations:

- 1.56 for amps
- 1.20 for voltage

Initial conditions for specifying PV fuses:

\[
\begin{align*}
N_\text{s} & = \text{Number of PV modules in series per PV string} \\
N_\text{p} & = \text{Number of PV strings in parallel per PV sub-array} \\
N_\text{sub} & = \text{Number of PV sub-arrays in parallel per PV array} \\
I_{\text{sc}} & = \text{Short-circuit current of one PV module at Standard Test Conditions (STC)} \\
V_{\text{oc}} & = \text{Open circuit voltage of one PV module at STC}
\end{align*}
\]

Calculations to verify volts, amps and conductor size:

- Fuse voltage rating \( \geq 1.20 \times V_{\text{oc}} \times N_\text{s} \)
- PV output circuit amp rating \( \geq 1.56 \times I_{\text{sc}} \times N_\text{p} \)
- Inverter input circuit amp rating \( \geq 1.56 \times I_{\text{sc}} \times N_\text{p} \times N_\text{sub} \)
- PV fuse amp rating \( \leq I_z^* \)

Bussmann recommends using PV fuses on positive and negative conductors, each with adequate voltage rating. Selective coordination with PV string fuses may not be achieved under some fault conditions.

Additional considerations:

-Voltage rating — per NEC Table 690.7, if the system is required to operate below -40°C (-40°F), replace the 1.20 factor with 1.25.

- Amp rating — additional derating may be required when the fuse is installed in a high ambient temperature environment. See individual fuse data sheets for derating curves.

- Fuse protection is required in any PV system that is connected to a battery.

\* \( I_z \) Current capacity of conductors properly sized for the PV system.

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**Figure 5: PV output circuit protection (array protection) with NEC® defined circuits designated by arrows.**

Depending on the PV system capacity, there may be several PV output circuits (each output circuit consisting of multiple PV source circuits) connected in parallel to achieve higher ampacity and subsequently more power.

A PV Overcurrent Protective Device (OCPD) on each PV output circuit will protect the conductors from fault currents and help minimize any safety hazards. It will also isolate the faulted PV output circuit so that the rest of the PV system will continue generating electricity.

A PV OCPD positioned in the conductor that carries the combined power output from a number of PV output circuits should be protected by a PV output circuit OCPD. If a number of PV output circuits are subsequently combined prior to the inverter, then another PV OCPD should be incorporated. This would be termed the PV inverter input circuit as shown above.

It should be remembered that the PV module performance varies with temperature and irradiance level. In operation, PV OCPDs are influenced by ambient temperature and derating should be factored in when being specified.
Example — selecting fuses for PV output circuits

Manufacturer’s module specifications include:
\[ I_{sc} = 8.99\text{A} \text{ short-circuit current of one PV module at Standard Test Conditions (STC)} \]
\[ V_{oc} = 45.6\text{V} \text{ open circuit voltage of one PV module at STC} \]

PV installation set-up:
- \( N_s = 18 \) PV modules in series per PV string
- \( N_p = 8 \) PV strings in parallel per PV sub-array
- \( N_{sub} = 3 \) PV sub-arrays in parallel per PV array
  - PV module max ambient: 60°C (140°F)
  - PV module min ambient: -25°C (-13°F)

Calculation:
Note: When calculating for high ambient temperature applications, include the appropriate derating factors.

- Conductor size formula
  \[ \geq 1.56 \times I_{sc} \times N_p \]
  \[ = 1.56 \times 8.99\text{A} \times 8 \]
  \[ = 112\text{A} \]

- Conductor size: 1/0*
  \[ = 170\text{A}** \]
  \[ = 170\text{A} \times 0.71 \]
  \[ = 120.7\text{A} \]

- PV sub-array max \( I_{sc\_sub} = (N_{sub} - 1) \times N_p \times 1.25 \times I_{sc} \)
  \[ = (3-1) \times 8 \times 1.25 \times 8.99\text{A} \]
  \[ = 180\text{A} \]

- PV sub-array maximum fault current \( I_{sc\_sub} > \) conductor rating; PV fuses are required

- PV fuse amp rating
  \[ \geq 1.56 \times I_{sc} \times N_p \]
  \[ = 1.56 \times 8.99\text{A} \times 8 \]
  \[ = 112\text{A} \text{ min} \]

- PV fuse voltage rating
  \[ \geq 1.20 \times V_{oc} \times N_s \]
  \[ = 1.20 \times 45.6\text{V} \times 18 \]
  \[ = 985\text{V} \]

Therefore, select a standard 1000Vdc PV fuse rating of 125A.

Note: fuse amp rating must be equal to or less than the \( I_{\text{z}} \) ampacity of the selected conductor.

Bussmann series part numbers are:
- PV-125ANH1 (NH1 PV fuse, page 21)
- PV-125A-01XL (XL01 PV blade fixing fuse, page 22)
- PV-125A-01XL-B (XL01 PV bolt fixing fuse, page 22)

Example — inverter input circuit protection

If \( N_{sub} \) PV sub-arrays are to be further connected via a recombiner to the inverter input circuit, the PV array PV fuse rating should be at least:
\[ \geq 1.56 \times I_{sc} \times N_p \times N_{sub} \]
\[ = 1.56 \times 8.99\text{A} \times 8 \times 3 \]
\[ = 336\text{A min} \]

Therefore, a 1000Vdc 350A PV fuse should be selected.

Bussmann series part numbers are:
- PV-350ANH3 (NH3 PV fuse, page 21)
- PV-350A-2XL (XL2 PV blade fixing fuse, page 22)
- PV-350A-2XL-B (XL2 PV bolt fixing fuse, page 22)

* 75°C component terminal rating for 1/0 = 150A.
** Conductor rating per NEC® Table 310.15(B)(2)(a) for 90°C copper wire.
Selecting circuit breakers for PV output circuits

PV circuit breakers are available in 600 and 1000Vdc models with either 80% or 100% ratings. Understanding the difference between 80% and 100% rated circuit breakers is important. The major benefit of a 100% rated circuit breaker is the ability to apply 100% of its nameplate ampacity, allowing an opportunity for reduction in circuit breaker ampacity, frame size, conductor size and potentially the enclosure size.

80% rated circuit breaker
Combine the total ampacity of the PV source circuits using a 1.56 derating factor (module $I_{\text{sc}} \times 1.25 \times 1.25 \times \text{number of strings in parallel}$).

100% rated circuit breaker
Combine the total ampacity of the PV source circuits using a 1.25 derating factor (module $I_{\text{sc}} \times 1.25 \times \text{number of strings in parallel}$).

Initial conditions for specifying PV circuit breakers:
- $N_s = \text{Number of PV modules in series per PV string}$
- $N_p = \text{Number of PV strings in parallel per PV sub-array}$
- $N_{\text{sub}} = \text{Number of PV sub-arrays in parallel per PV array}$
- $I_{\text{sc}} = \text{Short-circuit current of one PV module at Standard Test Conditions (STC)}$
- $V_{\text{oc}} = \text{Open circuit voltage of one PV module at STC}$

Calculations to verify volts, amps and conductor size

80% rated breakers:
- Circuit breaker voltage rating $\geq 1.20 \times V_{\text{oc}} \times N_s$
- PV Output circuit amp rating $\geq 1.56 \times I_{\text{sc}} \times N_p$
- Inverter input circuit amp rating $\geq 1.56 \times I_{\text{sc}} \times N_p \times N_{\text{sub}}$
- PV Circuit breaker amp rating $\leq I_2^*$

100% rated breakers:
- Circuit breaker voltage rating $\geq 1.20 \times V_{\text{oc}} \times N_s$
- PV output circuit amp rating $\geq 1.25 \times I_{\text{sc}} \times N_p$
- Inverter input circuit amp rating $\geq 1.25 \times I_{\text{sc}} \times N_p \times N_{\text{sub}}$
- PV circuit breaker amp rating $\leq I_2^*$

Note: selective coordination with PV circuit breakers on the PV source circuits may not be achieved under some fault conditions.

Additional considerations:
- Voltage rating — per NEC Table 690.7, if the system is required to operate below -40°C (-40°F), replace the 1.20 factor with 1.25.
- Amp rating — additional derating may be required when the circuit breaker is installed in a high ambient temperature environment. See circuit breaker technical document for details.
- DC rated circuit breaker protection is required in any PV system that is connected to a battery.

Eaton Design Suggestion

**PV Molded case switches ease compliance with NEC® Rapid Shutdown requirement.**

The PV molded case switch shown in this PV source circuit combiner provides a dual function of a disconnect means with remote OFF operation suitable for the NEC® 2014 690.12 PV rapid shutdown requirement.

$\ast$ $I_2$ Current capacity of conductors properly sized for the PV system.
Example — selecting circuit breakers for PV output circuits

Manufacturer’s module specifications:

- \( I_{sc} = 8.99\text{A} \) short-circuit current of one PV module at Standard Test Conditions (STC)
- \( V_{oc} = 45.6\text{V} \) open circuit voltage of one PV module at STC

PV installation set-up:

- \( N_s = 18 \) PV strings in series per PV array
- \( N_p = 8 \) PV output circuits in parallel per PV output circuit combiner
- \( N_{sub} = 3 \) PV sub-arrays in parallel per PV array
  - Module max ambient: 60°C (140°F)
  - Module min ambient: -25°C (-13°F)

Calculations

Note: when calculating for high ambient temperature applications, include the appropriate derating factors.

80% rated molded case circuit breaker (1000Vdc) 50°C:

- Conductor size formula: \( \geq 1.56 \times I_{sc} \times N_p \)
  - \( = 1.56 \times 8.99\text{A} \times 8 \)
  - \( = 112\text{A} \)
- Conductor size: 1/0*
  - 1/0 at 60°C
  - \( I_z = 120.7\text{A} \)
- PV sub-array max \( I_{sc\_sub} = (N_{sub}-1) \times N_p \times 1.25 \times I_{sc} \)
  - \( = (3-1) \times 8 \times 1.25 \times 8.99\text{A} \)
  - \( = 180\text{A} \)
- PV sub-array maximum fault current \( I_{sc\_sub} \) > conductor withstand; PV circuit breakers are required
- PV circuit breaker
  - amp rating: \( \geq 1.25 \times I_{sc} \times N_p \)
    - \( = 1.25 \times 8.99\text{A} \times 8 \)
    - \( = 90\text{A} \) min
  - voltage rating: \( \geq 1.20 \times V_{oc} \times N_s \)
    - \( = 1.20 \times 45.6\text{V} \times 18 \)
    - \( = 985\text{V} \)

Therefore, a 1000Vdc 125 amp PV circuit breaker should be selected such as KDPV4125W. See page 27.

Note: circuit breaker amp rating must be equal to or less than the \( I_z \) ampacity of the selected conductor unless a standard rating in unavailable.

Example — inverter input circuit protection

If \( N_{sub} \) PV sub-arrays are to be further connected via a recombiner to the inverter input circuit, the PV array PV circuit breaker rating should be at least:

80% rated molded case circuit breaker (1000Vdc) 50°C:

- Conductor size formula: \( \geq 1.56 \times I_{sc} \times N_p \times N_{sub} \)
  - \( = 1.56 \times 8.99\text{A} \times 8 \times 3 \)
  - \( = 337\text{A} \) min

Therefore, a 1000Vdc 350A PV circuit breaker should be selected such as KDPV4350W, LGPV4350W or MDLPV3350W. See page 27.

100% rated molded case circuit breaker (1000Vdc) 50°C:

- Conductor size formula: \( \geq 1.25 \times I_{sc} \times N_p \times N_{sub} \)
  - \( = 1.25 \times 8.99\text{A} \times 8 \times 3 \)
  - \( = 337\text{A} \) min

Therefore, a 1000Vdc 300A PV circuit breaker should be selected such as CKDPV4300W, CLGPV4300W or CMDLPV3300W. See page 27.

Note: conductor size examples above are for comparison only.

---

* 75°C component terminal rating for: 1/0 = 150A
  2AWG = 115A
** Conductor rating per NEC® Table 310.15(B)(2)(a) for 90°C copper wire.
† Per NEC® 240.4(B), if the conductor ampacity does not correspond to a standard circuit breaker amp rating, it is permitted to select the next higher circuit breaker amp rating.
# Bussmann series PV fuses

<table>
<thead>
<tr>
<th>Body type</th>
<th>Body size</th>
<th>Fuse type</th>
<th>Catalog symbol</th>
<th>Rated current (amps)</th>
<th>Rated voltage (Vdc)</th>
<th>Agency information</th>
<th>Data sheet number</th>
<th>Block/holder series</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>In-line</strong></td>
<td>10x38mm</td>
<td>In-line ferrule</td>
<td>PV-(amp)A10F-CT</td>
<td>1, 2, 3, 3.5, 4, 5, 6, 8, 10, 12, 15, 20A</td>
<td>1000</td>
<td>— ✔ ✔ ✔</td>
<td>10150</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>10x38mm</td>
<td>In-line ferrule</td>
<td>HPV-DV-(amp)A</td>
<td>1, 2, 3, 3.5, 4, 5, 6, 8, 10, 12, 15, 20A</td>
<td>1000</td>
<td>— ✔ ✔ ✔</td>
<td>2157</td>
<td>N/A</td>
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<tr>
<td></td>
<td>10x38mm</td>
<td>Ferrule</td>
<td>PVM-(amp)</td>
<td>4, 5, 6, 7, 8, 9, 10, 12, 15, 20, 25, 30A</td>
<td>600</td>
<td>— ✔ ✔ ✔</td>
<td>2153</td>
<td>BMM HEB CHM</td>
</tr>
<tr>
<td><strong>Cylindrical</strong></td>
<td>10x38mm</td>
<td>Ferrule</td>
<td>PV-(amp)A10F</td>
<td>1, 2, 3, 3.5, 4, 5, 6, 8, 10, 12, 15, 20A</td>
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<td>✔ ✔ ✔</td>
<td>10121</td>
<td>CHPV N/A N/A N/A</td>
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<tr>
<td></td>
<td>Bolt fixing</td>
<td>PV-(amp)A10-T</td>
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</tr>
<tr>
<td></td>
<td>PCB (one pin)</td>
<td>PV-(amp)A10-1P</td>
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<td></td>
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</tr>
<tr>
<td></td>
<td>PCB (two pins)</td>
<td>PV-(amp)A10-2P</td>
<td></td>
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<td></td>
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<tr>
<td></td>
<td>14x51mm</td>
<td>Ferrule</td>
<td>PV-(amp)A14F</td>
<td>15, 20, 25, 32A</td>
<td>1000</td>
<td>✔ ✔ ✔ ✔</td>
<td>720132</td>
<td>CH14B-PV</td>
</tr>
<tr>
<td></td>
<td>14x65mm</td>
<td>Ferrule</td>
<td>PV-(amp)A14LF</td>
<td>2.25, 2.5, 3.0, 3.5, 4.0, 15, 20, 25, 32A</td>
<td>1300/1500</td>
<td>✔ ✔ ✔ ✔</td>
<td>720139</td>
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<tr>
<td><strong>UL RK5</strong></td>
<td>Ferrule</td>
<td>Class RK5</td>
<td>PVS-R-(amp)</td>
<td>20, 25, 30, 35, 40, 50, 60A, 70, 80, 90, 100, 110, 125, 150, 175, 200, 225, 250, 300, 350, 400A</td>
<td>600</td>
<td>— ✔ ✔ ✔</td>
<td>4203</td>
<td>RM60</td>
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<tr>
<td>Blade</td>
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<tr>
<td><strong>Square body</strong></td>
<td>NH1</td>
<td>Bladed</td>
<td>PV-(amp)ANH1</td>
<td>32, 40, 50, 63, 80, 100, 110, 125, 160, 175, 200A</td>
<td>1000</td>
<td>✔ ✔ ✔ ✔</td>
<td>720133</td>
<td>SD</td>
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<tr>
<td></td>
<td>Bolted</td>
<td>PV-(amp)ANH1-B</td>
<td>63, 80, 100, 125, 160, 200A</td>
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<td>NH2</td>
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<td>PV-(amp)ANH2</td>
<td>160, 200, 250A</td>
<td>1000</td>
<td>✔ ✔ ✔ ✔</td>
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<tr>
<td></td>
<td>Bolted</td>
<td>PV-(amp)ANH2-B</td>
<td>160, 200, 250A</td>
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<tr>
<td></td>
<td>NH3</td>
<td>Bladed</td>
<td>PV-(amp)ANH3</td>
<td>300, 315, 350, 355, 400A</td>
<td>1000</td>
<td>✔ ✔ ✔ ✔</td>
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<tr>
<td></td>
<td>Bolted</td>
<td>PV-(amp)ANH3-B</td>
<td>315, 355, 400A</td>
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</tr>
<tr>
<td></td>
<td>01XL</td>
<td>Bladed</td>
<td>PV-(amp)A-01XL</td>
<td>63, 80, 100, 125, 160A</td>
<td>1000</td>
<td>✔ ✔ ✔</td>
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</tr>
<tr>
<td></td>
<td>Bolted</td>
<td>PV-(amp)A-01XL-B</td>
<td>125, 160A</td>
<td></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td></td>
<td>Bladed</td>
<td>PV-(amp)A-01XL-15</td>
<td>50, 63, 80</td>
<td>1500</td>
<td>✔ ✔ ✔</td>
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<tr>
<td></td>
<td>Bolted</td>
<td>PV-(amp)A-01XL-15-B</td>
<td>100, 125, 160A</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>1XL</td>
<td>Bladed</td>
<td>PV-(amp)A-1XL</td>
<td>200A</td>
<td>1000</td>
<td>✔ ✔ ✔</td>
<td>2162</td>
<td>SB</td>
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<tr>
<td></td>
<td>Bolted</td>
<td>PV-(amp)A-1XL-B</td>
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<tr>
<td></td>
<td>Bladed</td>
<td>PV-(amp)A-1XL-15</td>
<td>100, 125, 160, 200A</td>
<td>1500</td>
<td>✔ ✔ ✔</td>
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<tr>
<td></td>
<td>Bolted</td>
<td>PV-(amp)A-1XL-8-15</td>
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<td>2XL</td>
<td>Bladed</td>
<td>PV-(amp)A-2XL</td>
<td>200A</td>
<td>1000</td>
<td>✔ ✔ ✔</td>
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<td>Bolted</td>
<td>PV-(amp)A-2XL-8</td>
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<td>Bolted</td>
<td>PV-(amp)A-2XL-15-B</td>
<td>125, 160, 200, 250A</td>
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<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>3L</td>
<td>Bladed</td>
<td>PV-(amp)A-3L</td>
<td>350, 400, 500, 600, 630A</td>
<td>1000</td>
<td>✔ ✔ ✔</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Bolted</td>
<td>PV-(amp)A-3L-B</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bladed</td>
<td>PV-(amp)A-3L-15</td>
<td>250, 315, 355, 400A</td>
<td>1500</td>
<td>✔ ✔ ✔</td>
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</tr>
<tr>
<td></td>
<td>Bolted</td>
<td>PV-(amp)A-3L-15-B</td>
<td></td>
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<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

* IEC 60269-6.
** 1 to 15A only.
† Pending.
‡ 630A thermally rated to UL only.
†† 160A @ 1200Vdc.
### Bussmann series PV fuse holders and blocks

<table>
<thead>
<tr>
<th>Fuse size</th>
<th>Holder/Part numbers</th>
<th>Poles</th>
<th>Rated voltage (Vdc)</th>
<th>Description</th>
<th>Data sheet number</th>
</tr>
</thead>
<tbody>
<tr>
<td>10x38</td>
<td>CHPV</td>
<td>1</td>
<td>1000</td>
<td>IP20 DIN-Rail mount finger-safe holder</td>
<td>3185'</td>
</tr>
<tr>
<td></td>
<td>CHPV1U</td>
<td></td>
<td></td>
<td>IP20 DIN-Rail mount finger-safe holder w/ open fuse indication</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CHPV1U</td>
<td></td>
<td></td>
<td>IP20 DIN-Rail mount finger-safe holder</td>
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</tr>
<tr>
<td></td>
<td>CHPV2U</td>
<td>2</td>
<td></td>
<td>IP20 DIN-Rail mount finger-safe holder w/ open fuse indication</td>
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</tr>
<tr>
<td>14x51</td>
<td>CH14</td>
<td>1</td>
<td>1000</td>
<td>IP20 DIN-Rail mount finger-safe holder</td>
<td>720148</td>
</tr>
<tr>
<td></td>
<td>CH141B-PV</td>
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</tr>
<tr>
<td>RK5</td>
<td>RM60</td>
<td>1</td>
<td>600</td>
<td>70-100A single-pole fuse blocks with optional IP20 covers</td>
<td>3192'</td>
</tr>
<tr>
<td></td>
<td>RM60100-1CR</td>
<td></td>
<td></td>
<td>110-200A single-pole fuse blocks with optional IP20 covers</td>
<td></td>
</tr>
<tr>
<td></td>
<td>RM60200-1CR</td>
<td></td>
<td></td>
<td>225-400A single-pole fuse blocks with optional IP20 covers</td>
<td></td>
</tr>
<tr>
<td></td>
<td>RM60400-1CR</td>
<td></td>
<td></td>
<td>450-600A single-pole fuse blocks with optional IP20 covers</td>
<td></td>
</tr>
<tr>
<td>NH1</td>
<td>SD_D-PV</td>
<td>1</td>
<td>1000</td>
<td>IP20 finger-safe holder</td>
<td>720149</td>
</tr>
<tr>
<td>NH2</td>
<td>SD_D-PV</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NH3</td>
<td>SD_D-PV</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>01XL</td>
<td>SB_XL-S</td>
<td>1</td>
<td>1500</td>
<td>XL fuse block</td>
<td>10066</td>
</tr>
<tr>
<td>1XL</td>
<td>SB_XL-S</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>2XL</td>
<td>SB_XL-S</td>
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<tr>
<td>3XL</td>
<td>SB3L-S</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In-line</td>
<td>HPV-HPV-DV_A</td>
<td>1</td>
<td>1000</td>
<td>Single-pole, in-line fuse holder and fuse (1 to 20A)</td>
<td>2157</td>
</tr>
</tbody>
</table>

† Literature reorder number.

†† Requires range of protection accessories.

### System volts/fuses

#### 600V
- 10x38mm
- RK5

#### 1000V
- 10x38mm
- 14x51mm
- NH
- XL
- In-line

#### 1500V
- XL

---

15
**10x38mm Bussmann series PVM fuses — 600Vdc, 4-30A**

**Description:**
A range of UL 248-19 fast-acting 600Vdc midget fuses specifically designed to protect solar power systems in extreme ambient temperature, high cycling and low level fault current conditions (reverse current, multi-array fault).

**Dimensions:**
- 10x38mm (⅛” x 1 ½”)

**Ratings:**
- Volts: 600Vdc to UL 248-19
- Amps: 4-30A
- IR: 50kA DC (4-30A)

**Watts loss (W) at rated current:**

<table>
<thead>
<tr>
<th>Amps</th>
<th>0.8 x IR*</th>
<th>1.0 x IR*</th>
</tr>
</thead>
<tbody>
<tr>
<td>10A:</td>
<td>1.0W</td>
<td>1.9W</td>
</tr>
<tr>
<td>15A:</td>
<td>1.0W</td>
<td>1.7W</td>
</tr>
<tr>
<td>30A:</td>
<td>1.6W</td>
<td>2.9W</td>
</tr>
</tbody>
</table>

*IR* = Rated current.

**Agency information:**
- UL Listed 248-19, Guide JFGA, File E335324
- CSA Component Certified C22.2, Class 1422-30, File 53787.
- RoHS compliant

**Recommended fuse blocks and holders:**

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
<th>Doc No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHM</td>
<td>600V DIN-Rail fuse holder</td>
<td>Lit No. 3185</td>
</tr>
<tr>
<td>CHPV</td>
<td>1000V DIN-Rail fuse holder</td>
<td>Lit No. 3185</td>
</tr>
<tr>
<td>HEB</td>
<td>600V In-line fuse holder</td>
<td>DS No. 2127</td>
</tr>
<tr>
<td>HEB</td>
<td>600V 1-, 2- and 3-pole blocks</td>
<td>DS No. 10241</td>
</tr>
<tr>
<td>1A3400-</td>
<td>PCB fuseclip</td>
<td>DS No. 2131</td>
</tr>
</tbody>
</table>

**Catalog numbers (amp):**

<table>
<thead>
<tr>
<th>PVM-4</th>
<th>PVM-7</th>
<th>PVM-10</th>
<th>PVM-20</th>
</tr>
</thead>
<tbody>
<tr>
<td>PVM-5</td>
<td>PVM-8</td>
<td>PVM-12</td>
<td>PVM-25</td>
</tr>
<tr>
<td>PVM-6</td>
<td>PVM-9</td>
<td>PVM-15</td>
<td>PVM-30</td>
</tr>
</tbody>
</table>

**Features and benefits:**
- Specifically designed to protect solar power systems in extreme ambient temperature per UL 248-19
- Capable of withstanding high cycling and low level fault current conditions

**Typical applications:**
- Combiner boxes
- PV Wire harnesses

Data sheet: 2153
RK5 Bussmann series PVS-R fuses — 600Vdc, 20-400A

Description:
A range of UL 248-19 fast-acting 600Vdc Class RK5 fuses specifically designed to protect solar power systems in extreme ambient temperature, high cycling and low level fault current conditions (reverse current, multi-array fault).

Dimensions:
- Standard Class RK5 case sizes by amp rating.

Ratings:
- Volts — 600Vac to UL 248-12
  600Vdc to UL 248-19
- Amps — 20-400A
- IR — 200kA RMS Sym. AC
  20kA DC (20-60A)
  10kA DC (70-400A)

Agency information:
- CSA Component Certified C22.2.

Catalog numbers (amp):
PVS-R-20       PVS-R-70       PVS-R-175
PVS-R-25       PVS-R-80       PVS-R-200
PVS-R-30       PVS-R-90       PVS-R-225
PVS-R-35       PVS-R-100      PVS-R-250
PVS-R-40       PVS-R-110      PVS-R-300
PVS-R-50       PVS-R-125      PVS-R-350
PVS-R-60       PVS-R-150      PVS-R-400

Features and benefits:
- Current limitation for non-inductive circuits provides Class RK5 current-limiting response to ground fault and short-circuit conditions
- Designed for the protection and isolation of PV systems

Typical applications:
- Inverters
- DC safety switches
- Reinjector boxes

Recommended fuse blocks:

<table>
<thead>
<tr>
<th>Fuse amps</th>
<th>1-Pole</th>
<th>2-Pole</th>
<th>3-Pole</th>
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<tbody>
<tr>
<td>0-30</td>
<td>RM60030-1</td>
<td>RM60030-2</td>
<td>RM60030-3</td>
</tr>
<tr>
<td>35-60</td>
<td>RM60060-1</td>
<td>RM60060-2</td>
<td>RM60060-3</td>
</tr>
<tr>
<td>70-100</td>
<td>RM60100-1CR</td>
<td>RM60100-2CR</td>
<td>RM60100-3CR</td>
</tr>
<tr>
<td>110-200</td>
<td>RM60200-1CR</td>
<td>RM60200-2CR</td>
<td>RM60200-3CR</td>
</tr>
<tr>
<td>225-400</td>
<td>RM60400-1CR</td>
<td>RM60400-2CR</td>
<td>RM60400-3CR</td>
</tr>
<tr>
<td>450-600</td>
<td>RM60600-1CR</td>
<td>RM60600-2CR</td>
<td>RM60100-3CR</td>
</tr>
</tbody>
</table>

For additional information on the 0-60A RM600 600V fuse blocks, see data sheet No. 10241.

For additional information on the 70-600 amp RM 600V fuse blocks, see product brochure No. 3192.

Recommended DC safety switch:

30-200A RK5
DC safety switch
Lit No. 3156
10x38mm Bussmann series PV fuses — 1000Vdc, 1-20A

**Description:**
A range 10x38mm, 1000Vdc PV fuses for the protection and isolation of photovoltaic strings. The fuses are specifically designed for use in PV systems with extreme ambient temperature, high cycling and low fault current conditions (reverse current, multi-array fault) string arrays. Available with four mounting styles for application flexibility.

**Basic fuse size:**
- 10x38mm

**Catalog symbols:**
- PV-(amp)A10F (cylindrical)
- PV-(amp)A10-T (bolt mounting)
- PV-(amp)A10-1P (single PCB tab)
- PV-(amp)A10-2P (dual PCB tab)
- PV-(amp)10F-CT (in-line, crimp terminals)

**Time constant:**
- 1-3ms

**PV fuse coordination:**
With thin film cells and 4”, 5” and 6” crystalline silicon cells

**Agency information:**
- UL Listed to 248-19 *, Guide JFGA, File E335324
- IEC 60269-6 (gPV)
- CSA File 53787, Class 1422-30, 20A pending
- CCC (1-20A) (25-30A pending)
- RoHS compliant
  * Except crimp terminal version that is UL Recognized to UL 248-19, Guide JFGA2, File E335324.

**Features and benefits:**
- Meets UL and IEC photovoltaic standards for global acceptance
- Low watts loss performance for energy efficiency
- Low temperature rise for more precise sizing
- In-line crimp terminal version is easy to apply in wire harness construction

**Typical applications:**
- Combiner boxes • Inverters • PV wire harnesses

**Recommended fuse holders and fuseclips:**

<table>
<thead>
<tr>
<th>Part number</th>
<th>Description</th>
<th>Data sheet No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHPV_</td>
<td>1- and 2-pole modular fuse holders with optional open fuse indication</td>
<td>Lit No. 3185</td>
</tr>
<tr>
<td>BPVM</td>
<td>1- and 2-pole modular fuse blocks</td>
<td>10265</td>
</tr>
<tr>
<td>1A3400-09</td>
<td>PCB fuseclip</td>
<td>2131</td>
</tr>
<tr>
<td>HP-DV-_A</td>
<td>In-line fuse holder assembly</td>
<td>2157</td>
</tr>
</tbody>
</table>

**Catalog numbers (amp)/electrical characteristics:**

<table>
<thead>
<tr>
<th>Cylindrical ferrerule</th>
<th>Bolt fixing</th>
<th>PCB fixing single pin</th>
<th>PCB fixing double pin</th>
<th>In-line with crimp terminal</th>
<th>Rated amps</th>
<th>Rated volts (Vdc)</th>
<th>Interrupting rating</th>
<th>Pre-arcing (Vdc)</th>
<th>Total @ rated volts (%)</th>
<th>Watts loss (Watts)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PV-1A10F</td>
<td>PV-1A10-T</td>
<td>PV-1A10-1P</td>
<td>PV-1A10-2P</td>
<td>PV-1A10F-CT</td>
<td>1</td>
<td>1000</td>
<td>50kA</td>
<td>0.15</td>
<td>0.4</td>
<td>0.8</td>
</tr>
<tr>
<td>PV-2A10F</td>
<td>PV-2A10-T</td>
<td>PV-2A10-1P</td>
<td>PV-2A10-2P</td>
<td>PV-2A10F-CT</td>
<td>2</td>
<td>1000</td>
<td>50kA</td>
<td>1.2</td>
<td>3.4</td>
<td>0.6</td>
</tr>
<tr>
<td>PV-3A10F</td>
<td>PV-3A10-T</td>
<td>PV-3A10-1P</td>
<td>PV-3A10-2P</td>
<td>PV-3A10F-CT</td>
<td>3</td>
<td>1000</td>
<td>50kA</td>
<td>4</td>
<td>11</td>
<td>0.8</td>
</tr>
<tr>
<td>PV-3-5A10F</td>
<td>PV-3-5A10-T</td>
<td>PV-3-5A10-1P</td>
<td>PV-3-5A10-2P</td>
<td>PV-3-5A10F-CT</td>
<td>3.5</td>
<td>1000</td>
<td>50kA</td>
<td>6.6</td>
<td>18</td>
<td>0.9</td>
</tr>
<tr>
<td>PV-4A10F</td>
<td>PV-4A10-T</td>
<td>PV-4A10-1P</td>
<td>PV-4A10-2P</td>
<td>PV-4A10F-CT</td>
<td>4</td>
<td>1000</td>
<td>50kA</td>
<td>9.5</td>
<td>26</td>
<td>1.0</td>
</tr>
<tr>
<td>PV-5A10F</td>
<td>PV-5A10-T</td>
<td>PV-5A10-1P</td>
<td>PV-5A10-2P</td>
<td>PV-5A10F-CT</td>
<td>5</td>
<td>1000</td>
<td>50kA</td>
<td>19</td>
<td>50</td>
<td>1.0</td>
</tr>
<tr>
<td>PV-6A10F</td>
<td>PV-6A10-T</td>
<td>PV-6A10-1P</td>
<td>PV-6A10-2P</td>
<td>PV-6A10F-CT</td>
<td>6</td>
<td>1000</td>
<td>50kA</td>
<td>30</td>
<td>90</td>
<td>1.1</td>
</tr>
<tr>
<td>PV-8A10F</td>
<td>PV-8A10-T</td>
<td>PV-8A10-1P</td>
<td>PV-8A10-2P</td>
<td>PV-8A10F-CT</td>
<td>8</td>
<td>1000</td>
<td>50kA</td>
<td>3</td>
<td>32</td>
<td>1.2</td>
</tr>
<tr>
<td>PV-10A10F</td>
<td>PV-10A10-T</td>
<td>PV-10A10-1P</td>
<td>PV-10A10-2P</td>
<td>PV-10A10F-CT</td>
<td>10</td>
<td>1000</td>
<td>50kA</td>
<td>7</td>
<td>70</td>
<td>1.2</td>
</tr>
<tr>
<td>PV-12A10F</td>
<td>PV-12A10-T</td>
<td>PV-12A10-1P</td>
<td>PV-12A10-2P</td>
<td>PV-12A10F-CT</td>
<td>12</td>
<td>1000</td>
<td>50kA</td>
<td>12</td>
<td>120</td>
<td>1.5</td>
</tr>
<tr>
<td>PV-20A10F</td>
<td>PV-20A10-T</td>
<td>PV-20A10-1P</td>
<td>PV-20A10-2P</td>
<td>PV-20A10F-CT</td>
<td>20</td>
<td>1000</td>
<td>50kA</td>
<td>34</td>
<td>350</td>
<td>2.1</td>
</tr>
</tbody>
</table>

**Data sheet: 10121**
1000V PV fuses

14x51mm Bussmann series PV fuses — 1000/1100Vdc, 15-32A

Description:
A range of 14x51mm PV fuses specifically designed for protecting and isolating photovoltaic strings. These fuses are capable of interrupting low overcurrents associated with faulted PV systems (reverse current, multi-array fault).

Ratings:
Volts — 1000Vdc (25 and 32A)
— 1100Vdc (15 and 20A)
Amps — 15-32A
IR — 10kA

Agency information:
• UL Listed, Guide JFGA, File E335324. Photovoltaic to UL 248-19
• IEC 60269-6 gPV
• CSA pending
• CCC pending

Catalog numbers/electrical characteristics:

<table>
<thead>
<tr>
<th>Catalog number</th>
<th>Rated amps</th>
<th>Rated volts DC</th>
<th>Pre-arcing</th>
<th>Total @ rated volts</th>
<th>Watts loss</th>
<th>0.8I₀</th>
<th>I₀</th>
</tr>
</thead>
<tbody>
<tr>
<td>PV-15A14F</td>
<td>15</td>
<td>1100</td>
<td>14</td>
<td>265</td>
<td>2.1</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>PV-20A14F</td>
<td>20</td>
<td>1100</td>
<td>27</td>
<td>568</td>
<td>2.7</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>PV-25A14F</td>
<td>25</td>
<td>1000</td>
<td>65</td>
<td>943</td>
<td>2.7</td>
<td>5.1</td>
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</tr>
<tr>
<td>PV-32A14F</td>
<td>32</td>
<td>1000</td>
<td>120</td>
<td>1740</td>
<td>3.3</td>
<td>6.2</td>
<td></td>
</tr>
</tbody>
</table>

Features and benefits:
• Specifically designed to provide fast-acting protection under low fault current conditions associated with PV systems
• High DC voltage rating
• Demonstrated performance in extreme temperature cycling conditions

Typical applications:
• Combiner boxes
• Inverters

Recommended fuse holder:
CH141B-PV DIN-Rail modular fuse holder
See data sheet No. 720148 for more information.

Data sheet: 720132
Bussmann series NH fuses — 1000Vdc, NH1, 2, 3, 32-400A

Description:
A range of NH size PV fuses specifically designed for protecting and isolating photovoltaic array combiners and disconnects. These fuses are capable of interrupting low overcurrents associated with faulted PV systems (reverse current, multi-array fault).

Ratings:
- Volts: 1000Vdc
- Amps: 32-400A
- IR: 50kA

Agency information:
- UL Listed, Guide JFGA, File E335324. PV to UL 248-19
- IEC 60269-6 gPV
- CSA Class 1422-30, File 53787 (32-160A)
- CCC pending

Blade version catalog numbers/characteristics:

<table>
<thead>
<tr>
<th>Fuse size</th>
<th>Catalog number</th>
<th>Rated amps</th>
<th>Pre-arc rating</th>
<th>Total @ rated volts</th>
<th>Watts loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>NH1</td>
<td>PV-32ANH1</td>
<td>32</td>
<td>80</td>
<td>720</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>PV-40ANH1</td>
<td>40</td>
<td>185</td>
<td>1670</td>
<td>5</td>
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<td></td>
<td>PV-50ANH1</td>
<td>50</td>
<td>400</td>
<td>3600</td>
<td>6</td>
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<tr>
<td></td>
<td>PV-63ANH1</td>
<td>63</td>
<td>470</td>
<td>4300</td>
<td>6</td>
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<tr>
<td></td>
<td>PV-80ANH1</td>
<td>80</td>
<td>640</td>
<td>5760</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>PV-100ANH1</td>
<td>100</td>
<td>1300</td>
<td>11,700</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>PV-110ANH1</td>
<td>110</td>
<td>2100</td>
<td>18,900</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>PV-125ANH1</td>
<td>125</td>
<td>2600</td>
<td>23,400</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>PV-160ANH1</td>
<td>160</td>
<td>5200</td>
<td>46,800</td>
<td>14</td>
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<tr>
<td></td>
<td>PV-175ANH1</td>
<td>175</td>
<td>8300</td>
<td>74,700</td>
<td>15</td>
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<tr>
<td></td>
<td>PV-200ANH1</td>
<td>200</td>
<td>10,200</td>
<td>82,000</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>PV-160ANH2</td>
<td>160</td>
<td>4600</td>
<td>37,000</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>PV-200ANH2</td>
<td>200</td>
<td>9500</td>
<td>76,000</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>PV-250ANH2</td>
<td>250</td>
<td>17,000</td>
<td>136,000</td>
<td>19</td>
</tr>
<tr>
<td>NH2</td>
<td>PV-300ANH3</td>
<td>300</td>
<td>32,000</td>
<td>260,000</td>
<td>24</td>
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<tr>
<td></td>
<td>PV-315ANH3</td>
<td>315</td>
<td>32,000</td>
<td>260,000</td>
<td>26</td>
</tr>
<tr>
<td></td>
<td>PV-350ANH3</td>
<td>350</td>
<td>44,500</td>
<td>370,000</td>
<td>27</td>
</tr>
<tr>
<td></td>
<td>PV-355ANH3</td>
<td>355</td>
<td>44,500</td>
<td>370,000</td>
<td>28</td>
</tr>
<tr>
<td></td>
<td>PV-400ANH3</td>
<td>400</td>
<td>67,500</td>
<td>550,000</td>
<td>30</td>
</tr>
</tbody>
</table>

Features and benefits:
- Compact size saves panel space and extends design flexibility
- Low power loss for greater efficiency and lower operating temperature
- Global agency standards simplifies design considerations for worldwide markets
- Dual indication feature and optional microswitches make system monitoring easier

Typical applications:
- Recombiner boxes
- Inverters

Recommended fuse blocks:

<table>
<thead>
<tr>
<th>Fuse size</th>
<th>Fuse block</th>
</tr>
</thead>
<tbody>
<tr>
<td>NH1</td>
<td>SD1-D-PV</td>
</tr>
<tr>
<td>NH2</td>
<td>SD2-D-PV</td>
</tr>
<tr>
<td>NH3</td>
<td>SD3-D-PV</td>
</tr>
</tbody>
</table>

See data sheet No. 720149 for more information.

Optional microswitches:

<table>
<thead>
<tr>
<th>Part number</th>
<th>Tab size/num (mm (inch))</th>
<th>Connection</th>
<th>Volts</th>
<th>Amps</th>
</tr>
</thead>
<tbody>
<tr>
<td>170H0236</td>
<td>230/0.3 (0.078)</td>
<td>Quick connect</td>
<td>250</td>
<td>2</td>
</tr>
<tr>
<td>170H0238</td>
<td>110/0.8 (0.031)</td>
<td>Quick connect</td>
<td>250</td>
<td>2</td>
</tr>
<tr>
<td>BVL50</td>
<td>187/4.8 (0.074)</td>
<td>Quick connect</td>
<td>250</td>
<td>6</td>
</tr>
</tbody>
</table>

Data sheet: 720133
Bussmann series XL Fuses — 1000Vdc, XL01, 1, 2, 3, 63-630A

Description:
A range of XL size PV fuses specifically designed for protecting and isolating photovoltaic array combiners and disconnects. These fuses are capable of interrupting low overcurrents associated with faulted PV systems (reverse current, multi-array fault). Available with optional microswitches for use in monitoring systems.

Catalog symbols:
Blade — PV-(amp)A(size)XL
Bolt-in — PV-(amp)A(size)XL-B

Agency information:
• UL 248-19, Guide JFGA, File E335324
• IEC 60269-6
• CSA Class 1422-30, File 53787
• RoHS compliant

Features and benefits:
• Specifically designed to provide fast-acting protection under low fault current conditions associated with PV systems
• High DC voltage rating
• Variety of mounting options for flexibility
• Demonstrated performance in extreme temperature cycling conditions

Typical applications:
• Recombiner boxes • Inverters

Recommended fuse holders:

<table>
<thead>
<tr>
<th>Fuse size</th>
<th>Bladed version</th>
<th>Bolt-in version</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>01XL</td>
<td>PV-63A-01XL</td>
<td>PV-63A-01XL-B</td>
<td>1-pole block</td>
</tr>
<tr>
<td>1XL</td>
<td>PV-80A-01XL</td>
<td>PV-80A-01XL-B</td>
<td>1-pole block</td>
</tr>
<tr>
<td>2XL</td>
<td>PV-100A-01XL</td>
<td>PV-100A-01XL-B</td>
<td>1-pole block</td>
</tr>
<tr>
<td>3L</td>
<td>PV-125A-01XL</td>
<td>PV-125A-01XL-B</td>
<td>1-pole block</td>
</tr>
<tr>
<td>63-630A</td>
<td>PV-160A-01XL</td>
<td>PV-160A-01XL-B</td>
<td>1-pole block</td>
</tr>
</tbody>
</table>

See data sheet No. 10066 for more information.

Optional microswitches:
Blade — 170H0235 or 170H0237 for size 01XL
— 170H0236 or 170H0238 for sizes 1XL, 2XL and 3L
Bolt-in — 170H0069 for all sizes

Catalog numbers (amp)/electrical characteristics:

<table>
<thead>
<tr>
<th>Fuse size</th>
<th>Bladed version</th>
<th>Bolt-in version</th>
<th>Rated amps</th>
<th>Rated volts (Vdc)</th>
<th>Interrupting rating</th>
<th>I2t (A²s)</th>
<th>Total @ rated volts</th>
<th>Watts loss</th>
<th>Pre-arching</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>PV-63A-01XL</td>
<td>PV-63A-01XL-B</td>
<td>63</td>
<td>1000</td>
<td>50kA</td>
<td>260</td>
<td>1900</td>
<td>13</td>
<td>24</td>
</tr>
<tr>
<td>1</td>
<td>PV-80A-01XL</td>
<td>PV-80A-01XL-B</td>
<td>80</td>
<td>1000</td>
<td>50kA</td>
<td>490</td>
<td>3600</td>
<td>17</td>
<td>29</td>
</tr>
<tr>
<td>2</td>
<td>PV-100A-01XL</td>
<td>PV-100A-01XL-B</td>
<td>100</td>
<td>1000</td>
<td>50kA</td>
<td>870</td>
<td>6300</td>
<td>18</td>
<td>32</td>
</tr>
<tr>
<td>3</td>
<td>PV-125A-01XL</td>
<td>PV-125A-01XL-B</td>
<td>125</td>
<td>1000</td>
<td>50kA</td>
<td>1930</td>
<td>13,900</td>
<td>20</td>
<td>40</td>
</tr>
<tr>
<td>63-630A</td>
<td>PV-160A-01XL</td>
<td>PV-160A-01XL-B</td>
<td>160</td>
<td>1000</td>
<td>50kA</td>
<td>3900</td>
<td>28,100</td>
<td>22</td>
<td>44</td>
</tr>
</tbody>
</table>

See data sheet No. 10066 for more information.

* 630A thermally rated to UL only.

Data sheet: 10201
14x65mm Bussmann series PV fuses — 1300/1500Vdc, 2.5-32A

**Description:**
A range of 14x65mm package PV fuses specifically designed for protecting and isolating photovoltaic strings. These fuse links are capable of interrupting low overcurrents associated with faulted PV systems (reverse current, multi-array fault). Available in three mounting styles for application flexibility.

**Basic fuse size:**
14x65mm

**Catalog symbols and mounting style:**
- PV-(amp)A14LF (cylindrical)
- PV-(amp)A14L-T (cylindrical with tags)
- PV-(amp)A14LF10F (cylindrical with 10mm fixings)

**Agency information:**
- UL Listed, Guide JFGA, File E335324, Photovoltaic to UL 248-19
- IEC 60269-6 gPV
- CSA pending
- CCC pending
- RoHS compliant

**Features and benefits:**
- Specifically designed to provide fast-acting protection under low fault current conditions associated with PV systems
- Variety of mounting options for flexibility
- Fuses meet UL and IEC photovoltaic standards for global product acceptance
- Low watts loss for greater PV system efficiency
- Low heat rise permits more precise sizing

**Typical applications:**
- Combiner boxes
- Inverters

**Dimensions/configurations - mm:**

**Catalog numbers (amp)/electrical characteristics:**

<table>
<thead>
<tr>
<th>Cylindrical</th>
<th>Cylindrical with tags</th>
<th>Cylindrical with 10mm fixings</th>
<th>Rated amps</th>
<th>Rated volts (Vdc)</th>
<th>Interrupting rating</th>
<th>Pt (A's)</th>
<th>Total at rated voltage</th>
<th>Watts loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>PV-2.25A14LF</td>
<td>PV-2.25A14L-T</td>
<td>PV-2.25A14LF10F</td>
<td>2.25</td>
<td>1500</td>
<td>10kA</td>
<td>4</td>
<td>8</td>
<td>1.4</td>
</tr>
<tr>
<td>PV-2.5A14LF</td>
<td>PV-2.5A14L-T</td>
<td>PV-2.5A14LF10F</td>
<td>2.5</td>
<td>1500</td>
<td>10kA</td>
<td>5</td>
<td>10</td>
<td>1.5</td>
</tr>
<tr>
<td>PV-3A14LF</td>
<td>PV-3A14L-T</td>
<td>PV-3A14LF10F</td>
<td>3.0</td>
<td>1500</td>
<td>10kA</td>
<td>8</td>
<td>14</td>
<td>1.7</td>
</tr>
<tr>
<td>PV-3.5A14LF</td>
<td>PV-3.5A14L-T</td>
<td>PV-3.5A14LF10F</td>
<td>3.5</td>
<td>1500</td>
<td>10kA</td>
<td>12</td>
<td>23</td>
<td>1.8</td>
</tr>
<tr>
<td>PV-4A14LF</td>
<td>PV-4A14L-T</td>
<td>PV-4A14LF10F</td>
<td>4.0</td>
<td>1500</td>
<td>10kA</td>
<td>18</td>
<td>34</td>
<td>2.0</td>
</tr>
<tr>
<td>PV-15A14LF</td>
<td>PV-15A14L-T</td>
<td>PV-15A14LF10F</td>
<td>15</td>
<td>1500</td>
<td>10kA</td>
<td>14</td>
<td>160</td>
<td>3.2</td>
</tr>
<tr>
<td>PV-20A14LF</td>
<td>PV-20A14L-T</td>
<td>PV-20A14LF10F</td>
<td>20</td>
<td>1500</td>
<td>10kA</td>
<td>34</td>
<td>400</td>
<td>3.6</td>
</tr>
<tr>
<td>PV-25A14LF</td>
<td>PV-25A14L-T</td>
<td>PV-25A14LF10F</td>
<td>25</td>
<td>1300</td>
<td>10kA</td>
<td>65</td>
<td>550</td>
<td>4.1</td>
</tr>
<tr>
<td>PV-32A14LF</td>
<td>PV-32A14L-T</td>
<td>PV-32A14LF10F</td>
<td>32</td>
<td>1300</td>
<td>10kA</td>
<td>105</td>
<td>900</td>
<td>5.7</td>
</tr>
</tbody>
</table>

Data sheet: 1172
1500V PV fuses

Bussmann series XL PV Fuses — 1500Vdc, XL01, 1, 2, 3, 50-400A

Description:
A complete range of XL size PV fuses specifically designed for protecting and isolating photovoltaic array combiners and disconnects. These fuses are capable of interrupting low overcurrents associated with faulted PV systems (reverse current, multi-array fault). Available with optional microswitches for use in monitoring systems.

Catalog symbols:
Blade — PV-(amp)A(size)XL-15
Bolt-in — PV-(amp)A(size)XL-B-15

Agency information:
- UL Listed, Guide JFGA, File E335324. Photovoltaic to UL 248-19
- IEC 60269-6 gPV
- CSA Class 1422-30, File 53787
- RoHS compliant

Features and benefits:
- Specifically designed to provide fast-acting protection under low fault current conditions associated with PV systems
- Variety of mounting options for flexibility

Typical applications:
- Combiner boxes
- Inverters

Recommended fuse holders:

<table>
<thead>
<tr>
<th>Fuse size</th>
<th>Bladed version</th>
<th>Bolt-in version</th>
<th>Part number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>PV-50A-01XL-15</td>
<td>PV-50A-01XL-B-15</td>
<td>SB1XL-S</td>
<td>1-pole block</td>
</tr>
<tr>
<td>01</td>
<td>PV-63A-01XL-15</td>
<td>PV-63A-01XL-B-15</td>
<td>SB1XL-S</td>
<td>1-pole block</td>
</tr>
<tr>
<td>01</td>
<td>PV-80A-01XL-15</td>
<td>PV-80A-01XL-B-15</td>
<td>SB2XL-S</td>
<td>1-pole block</td>
</tr>
<tr>
<td>01</td>
<td>PV-100A-01XL-15</td>
<td>PV-100A-01XL-B-15</td>
<td>SB3L-S</td>
<td>1-pole block</td>
</tr>
</tbody>
</table>

See data sheet No. 10066 for more information.

Optional microswitches:
Blade — 170H0235 or 170H0237 for size 01XL
Bolt-in — 170H0235 or 170H0238 for sizes 1XL, 2XL and 3L

Catalog numbers (amp)/electrical characteristics:

<table>
<thead>
<tr>
<th>Fuse size</th>
<th>Bladed version</th>
<th>Bolt-in version</th>
<th>Rated amps</th>
<th>Rated volts (Vdc)</th>
<th>Interrupting rating</th>
<th>PT (A²s)</th>
<th>Total @ rated volts</th>
<th>Watts loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>PV-100A-1XL-15</td>
<td>PV-100A-1XL-B-15</td>
<td>100</td>
<td>1500</td>
<td>30kA</td>
<td>75</td>
<td>1000</td>
<td>14</td>
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<tr>
<td>1</td>
<td>PV-125A-1XL-15</td>
<td>PV-125A-1XL-B-15</td>
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<td>1500</td>
<td>30kA</td>
<td>362</td>
<td>2250</td>
<td>15</td>
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<td>2</td>
<td>PV-125A-2XL-15</td>
<td>PV-125A-2XL-B-15</td>
<td>125</td>
<td>1500</td>
<td>30kA</td>
<td>565</td>
<td>3300</td>
<td>19</td>
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<tr>
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<td>PV-200A-2XL-15</td>
<td>PV-200A-2XL-B-15</td>
<td>200</td>
<td>1500</td>
<td>30kA</td>
<td>2200</td>
<td>10,500</td>
<td>23</td>
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<tr>
<td>3</td>
<td>PV-250A-2XL-15</td>
<td>PV-250A-2XL-B-15</td>
<td>250</td>
<td>1500</td>
<td>30kA</td>
<td>5000</td>
<td>24,000</td>
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<tr>
<td>3</td>
<td>PV-315A-3XL-15</td>
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<td>184,000</td>
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<tr>
<td>3</td>
<td>PV-400A-3XL-15</td>
<td>PV-400A-3XL-B-15</td>
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<td>1500</td>
<td>30kA</td>
<td>58,000</td>
<td>240,000</td>
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Data sheet: 10201
Bussmann series HPV fuse assembly — 1000Vdc, 1-20A

**Description:**
Single-pole, non-serviceable photovoltaic in-line fuse holder and fuse assembly in an IP67 dust tight and temporary water immersion resistant insulating boot for use in photovoltaic wire harnesses. Final assembly of conductors (customer supplied), insulating boots and labeling to be performed by customer following the directions contained in instruction leaflet No. 3A1963.

**Catalog symbol:**
HPV-DV-(amp)A

**Ratings:**
- Volts: 1000Vdc
- Amps: 1-20A
- IR: 33kA DC

**Conductors:**
- 75°C/90°C Cu stranded 12-10AWG PV wire

**Terminals:**
- Crimp connection for single, stranded 12-10AWG PV conductor

**Boot material:**
- UL 5VA flammability resistant rated elastomer. UV resistant to UL F1 suitable for outdoor use.

**Operating and storage temperature range:**
- -40°C to +90°C

**Agency information:**
- UL Listed to 4248-1 and 4248-18. File E348242
- RoHS compliant
- IP20 finger-safe
- IP67

**Dimensions - mm:**
- Inner insulating boot: 11.1 x 0.7, Ø 13.1 x 1.0
- Outer insulating boot: 29.0 x 1.0, Ø 27.6 x 1.0
- Fuse element: 15.2 x 0.7

**Typical applications:**
- PV String wire harness protection

**Recommended tools:**
- Sta-Kon™ terminal crimping tool, p/n ERG4002
- Multi-contact assembly tool, p/n PV-RWZ with PV-KOII and PV-KOIII tapered spindles

**Packing:**
Bulk packed in cartons, 180 fuse assemblies per carton. Carton weight 19.3 Lbs (8.7543 kg). Fuse assemblies poly bagged with PV fuse element, two insulating boots (for lineside and loadside), and one pressure sensitive warning label to be applied on outside after complete assembly to the wire harness. For fuse element performance specifications and derating curves see data sheet No. 10121.

**Catalog numbers/electrical characteristics:**

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<tr>
<th>Catalog number</th>
<th>Rated amps</th>
<th>Rated voltage (Vdc)</th>
<th>Pre-arcning</th>
<th>Total @ rated volts</th>
<th>Watts loss</th>
<th>ln</th>
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<td>1000</td>
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<td>1000</td>
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<td>1000</td>
<td>12.0</td>
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<td>34.0</td>
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</table>

Data sheet: 2157
PVGard™ solar circuit breakers are part of a product family that combines a disconnect with overcurrent protection in one device to protect photovoltaic systems. PVGard breakers can also be used as a disconnect means in combiner box and inverter applications to save space.

PVGard breakers conform to the UL 489B standard for photovoltaic molded-case circuit breakers and switches, and are designed specifically for the high- and low-temperature demands of PV installations and undergo extreme ambient cycling tests. Trip units calibrate at 50°C ambient to ensure continuous operation in higher temperature environments.

Rigorous third-party testing includes limited and standard fault current tests, electrical and mechanical endurance, dielectric voltage withstand and temperature tests. PVGard products are stand-alone devices that do not require jumpers to be UL 489B listed devices.

PVGard breakers are available with accessories to provide string status, enable remote trip and ON/OFF operation, and can be customized to site requirements.

Two PVGard lineups:
- 600Vdc per-pole breakers and switches for residential and light commercial applications
- 1000Vdc poles-in-series breakers and switches for commercial and utility-scale solar systems

Available accessories:
- Flexible shaft handle mechanisms
- Electrical operator
- Undervoltage release
- Lock-off devices
- Rotary handle mechanisms
- Shunt trip
- Alarm lockout
- Terminals
- End cap kits
- Auxiliary switch

Features and benefits:
- Meets and exceeds the UL 489B standards for PV molded case circuit breakers and switches
- Designed to meet higher voltage and lower fault current levels of solar systems
- 50°C Calibrated 100% and 80% rated breakers available
- Tested to extreme ambient conditions from –40° to +90°C
- Can handle bidirectional current flow and be applied in grounded, ungrounded or bipolar systems
- Full complement of accessories for status, signaling, lockout/tagout and remote ON/OFF operation
- Ability to open on signal from DC arc or ground fault detector
- Wide range of current ratings increases options for matching incoming strings

600Vdc part number system*

<table>
<thead>
<tr>
<th>Feature</th>
<th>Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>80% rated</td>
<td>JGPVS 3 125 W</td>
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<tr>
<td>Number of poles in series</td>
<td></td>
</tr>
<tr>
<td>Amp rating</td>
<td></td>
</tr>
<tr>
<td>Without terminals - order separately</td>
<td></td>
</tr>
<tr>
<td>100% rated</td>
<td>C JGPVS 3 125 W</td>
</tr>
<tr>
<td>Circuit breaker frame family</td>
<td></td>
</tr>
<tr>
<td>Number of poles in series</td>
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</tr>
<tr>
<td>Amp rating</td>
<td></td>
</tr>
<tr>
<td>Without terminals - order separately</td>
<td></td>
</tr>
</tbody>
</table>

1000Vdc part number system*

<table>
<thead>
<tr>
<th>Feature</th>
<th>Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>80% rated</td>
<td>KDPV 4 175 W</td>
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<tr>
<td>80% circuit breaker frame family</td>
<td></td>
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<tr>
<td>Number of poles in series</td>
<td></td>
</tr>
<tr>
<td>Amp rating</td>
<td></td>
</tr>
<tr>
<td>Without terminals - order separately</td>
<td></td>
</tr>
<tr>
<td>100% rated</td>
<td>C KDPV 4 175 W</td>
</tr>
<tr>
<td>100% rating</td>
<td></td>
</tr>
<tr>
<td>Circuit breaker frame family</td>
<td></td>
</tr>
<tr>
<td>Number of poles in series</td>
<td></td>
</tr>
<tr>
<td>Amp rating</td>
<td></td>
</tr>
<tr>
<td>Without terminals - order separately</td>
<td></td>
</tr>
</tbody>
</table>

Technical Data: TD01211004E

* See catalog CA08100005E for specific details on finished part number configuration.
DC molded case circuit breakers and switches

600Vdc PVGard PV circuit breaker ratings:

<table>
<thead>
<tr>
<th>Frame</th>
<th>JG PVS</th>
<th>KD PVS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of poles</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Amps</td>
<td>90, 100, 125, 150, 175, 200, 225, 250A</td>
<td>100, 125, 150, 175, 200, 225, 250, 300, 350, 400A</td>
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<tr>
<td>Maximum voltage rating</td>
<td>600 Vdc</td>
<td>600 Vdc</td>
</tr>
<tr>
<td>Interrupting capacity at 600Vdc</td>
<td>1.2kA</td>
<td>3kA</td>
</tr>
<tr>
<td>Design ambient temperature</td>
<td>50°C</td>
<td>50°C</td>
</tr>
<tr>
<td>Third-party certification</td>
<td>UL 489B</td>
<td>UL 489B</td>
</tr>
<tr>
<td>Suitable for reverse-feed applications</td>
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<td>Yes</td>
</tr>
</tbody>
</table>

Terminals - order separately. See catalog No. CA08100005E for details.

1000Vdc PVGard PV circuit breakers ratings:

<table>
<thead>
<tr>
<th>Frame</th>
<th>FD PV</th>
<th>KD PV</th>
<th>LG PV</th>
<th>MDL PV</th>
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</thead>
<tbody>
<tr>
<td>Number of poles in series</td>
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<td>4</td>
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<td>3</td>
</tr>
<tr>
<td>Amps</td>
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<td>125, 150, 175, 200, 225, 250, 300, 350A</td>
<td>250, 300, 350, 400A, 450, 500, 600A</td>
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</tr>
<tr>
<td>Maximum voltage rating</td>
<td>1000Vdc</td>
<td>1000Vdc</td>
<td>1000Vdc</td>
<td>1000Vdc</td>
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<tr>
<td>Interrupting capacity at 1000Vdc</td>
<td>3kA</td>
<td>5kA</td>
<td>5kA</td>
<td>7.5kA</td>
</tr>
<tr>
<td>Design ambient temperature</td>
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<td>50°C</td>
<td>50°C</td>
<td>50°C</td>
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<td>Third-party certification</td>
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<td>UL 489B</td>
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<tr>
<td>Suitable for reverse-feed applications</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Terminals - order separately. See catalog No. CA08100005E for details.

Series connection wiring diagrams for DC application

**JG PVS, KD PVS — 600Vdc per-pole**

Suitable for grounded or ungrounded systems.
Suitable for quantity (3) 600Vdc circuits.

**FD PV, KD PV, LG PV — 1000Vdc, four poles-in-series**

Suitable for use on ungrounded systems, or grounded systems that have one end of load (A) connected to grounded terminal, opposite poles in series connection.

**MDL PV — 1000Vdc, three poles-in-series**

Suitable for use on ungrounded systems, or grounded systems that have one end of load (A) connected to grounded terminal, opposite poles in series connection.

1. Poles in series connection is customer supplied. Use rated cable per NEC®.
2. For grounded systems, all poles in series must be connected on non-grounded terminal, with load connected to grounded terminal.

Technical Data: TD01211004E
DC molded case circuit breakers and switches

Dimensions - in (mm):
600Vdc PVGard

1000Vdc PVGard

Technical Data: TD01211004E
Industry-leading breakers and switches for direct current applications

The Eaton DC breaker family is engineered to address the highest performance requirements while providing numerous accessories to fit different site specifications. Today’s direct current applications have expanded to include solar photovoltaics, electric vehicle charging stations, battery storage and UPS systems, as well as commercial and industrial DC distribution.

Advantages

Applying more than 80 years of circuit breaker innovation, Eaton provides reliable circuit protection for DC applications ranging from 15A to 3000A emphasizing:

• Reliable operation
• Robust performance
• Enhanced safety
• Improved sustainability

Reliable operation, enhanced safety

Eaton breakers meet or exceed rigorous quality standards established by UL, providing premium quality and reliability. The DC breaker family is UL 489 Listed and exceeds the requirements in UL 489 Supplement SC for UPS applications. Eaton breakers are tested for use in both ungrounded and select grounded applications, with poles connected in series to operate at the maximum voltages shown in the table on the following page.

Robust performance

Eaton DC breakers have a contact design that forces the contact arms apart with magnetic repulsion during fault conditions. Thermal-magnetic trip units provide reliable overload and superior short-circuit protection, engineered to protect the wire and the equipment downstream of the circuit breaker from damage.

Available features and accessories

• Horizontal or vertical mounting
• Shunt trip
• Auxiliary switch
• Bell alarm
• Combination alarm/auxiliary switch
• Undervoltage release
• Handle mechanisms
• Padlockable handle lock hasp
• Electrical operators

600Vdc circuit breaker part number system

Part number*  
HFDDC 3 150 K
Frame family  
Number of poles  
Trip unit amp rating  
Series C and G configurations and accessories

* See catalog CA08100005E for specific details on finished part number configuration.
## DC molded case circuit breakers and switches

### 500Vdc or 600Vdc three-pole dimensions - in (mm):

<table>
<thead>
<tr>
<th>DC Breaker Type</th>
<th>Min Amps</th>
<th>Max Amps</th>
<th>IR (kA) @ 125Vdc</th>
<th>Poles in Series</th>
<th>IR (kA) @ 250Vdc</th>
<th>Poles in Series</th>
<th>IR (kA) @ 500Vdc</th>
<th>Poles in Series</th>
<th>IR (kA) @ 600Vdc</th>
<th>Poles in Series</th>
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<tbody>
<tr>
<td>EGEDC</td>
<td>25</td>
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<td>35</td>
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<td>35</td>
<td>—</td>
<td>—</td>
<td>3</td>
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<tr>
<td>EGSDC</td>
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<td>2</td>
<td>50</td>
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<td>100</td>
<td>35</td>
<td>1</td>
<td>42</td>
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<td>50</td>
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<td>50</td>
<td>—</td>
<td>—</td>
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<td>HMDLDC</td>
<td>300</td>
<td>800</td>
<td>42</td>
<td>1</td>
<td>50</td>
<td>2</td>
<td>50</td>
<td>—</td>
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<td>3</td>
</tr>
<tr>
<td>NBDC</td>
<td>700</td>
<td>1200</td>
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<td>2</td>
<td>50</td>
<td>—</td>
<td>—</td>
<td>3</td>
</tr>
<tr>
<td>RGHDC</td>
<td>1600</td>
<td>3000</td>
<td>50</td>
<td>1</td>
<td>50</td>
<td>2</td>
<td>50</td>
<td>—</td>
<td>—</td>
<td>3</td>
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</table>

* Four-pole frame with two poles wired parallel.

### DC breaker terminal wire ranges and rear connectors:

<table>
<thead>
<tr>
<th>Circuit Breaker</th>
<th>Max Breaker Amps</th>
<th>Terminal Body Material</th>
<th>Wire Type</th>
<th>AWG Wire Range (number of conductors)</th>
<th>Metric Wire Range (mm²)</th>
<th>Number of Terminals Included</th>
<th>Standard Terminal Catalog Number</th>
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<tbody>
<tr>
<td>EGEDC, EGSDC, EHDC</td>
<td>100</td>
<td>Aluminum</td>
<td>Cu/Al</td>
<td>14–1/0 (1)</td>
<td>2.5–50 (1)</td>
<td>3</td>
<td>3TA125EF</td>
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<tr>
<td>HFDDC</td>
<td>100</td>
<td>Steel</td>
<td>Cu/Al</td>
<td>14–10 (1)</td>
<td>2.5–4 (1)</td>
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<td>3TA100FB</td>
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<tr>
<td>JGEDC, JGSDC, JGHDc</td>
<td>225</td>
<td>Aluminum</td>
<td>Cu/Al</td>
<td>4–4/0 (1)</td>
<td>25–95 (1)</td>
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<td>3TA225FD</td>
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<tr>
<td>HJDDC</td>
<td>225</td>
<td>Stainless Steel</td>
<td>Cu</td>
<td>4–350kcmil (1)</td>
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<td>HKDDC</td>
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<td>Cu/Al</td>
<td>3–500kcmil (1)</td>
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<td>TA300K</td>
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<tr>
<td>LGEDC, LGSDC, LGHDC</td>
<td>400</td>
<td>Aluminum</td>
<td>Cu/Al</td>
<td>3–250kcmil (2)</td>
<td>95–120</td>
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<tr>
<td>HMDLDC</td>
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<td>Aluminum</td>
<td>Cu/Al</td>
<td>3–350kcmil (2)</td>
<td>95–150</td>
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<td>NBDC</td>
<td>700</td>
<td>Aluminum</td>
<td>Cu/Al</td>
<td>3–400kcmil (3)</td>
<td>95–185</td>
<td>1</td>
<td>3TA800MA2</td>
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<tr>
<td>RGHDC (rear connectors)</td>
<td>1600</td>
<td>Copper</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>1</td>
<td>B2500RD</td>
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Technical Data: PA01215001E
Bussmann series PV SPDs
— 600/1000/1200Vdc overvoltage,
— 1000Vdc lightning arrester

**Description:**
Our range of Bussmann series PV surge protective devices (SPDs) provides complete system protection with PV ADVANCE to suppress lightning current and PV PRO or PV HEAVY DUTY to suppress overvoltage events. Together, they protect the DC voltage section of a PV system.

**Catalog numbers:**

**PV PRO** — (base + three modules) bi-pole systems
- 600Vdc
  - W/O remote signaling: BSPP3600YPV
  - With remote signaling: BSPP3600YPVR
  - Replacement module: BPP300SYSYPV
- 1000Vdc
  - W/O remote signaling: BSPP31000YPV
  - With remote signaling: BSPP31000YPVR
  - Replacement module: BPP500SYSYPV

**PV HEAVY DUTY** — (base + three modules) bi-pole systems
- 600Vdc
  - W/O remote signaling: BSPH3600YPV
  - With remote signaling: BSPH3600YPVR
  - Replacement modules: Outer (2) BPH300YPV Center (2) BPM300YPV
- 1000Vdc
  - W/O remote signaling: BSPH31000YPV
  - With remote signaling: BSPH31000YPVR
  - Replacement modules: Outer (2) BPH500YPV Center (1) BPM500YPV
- 1200Vdc
  - W/O remote signaling: BSPH31200YPV
  - With remote signaling: BSPH31200YPVR
  - Replacement modules: Outer (2) BPH600YPV Center (1) BPM600YPV

**PV HEAVY DUTY** — (base + two modules) mono-pole systems
- 600Vdc
  - W/O remote signaling: BSPH2600YPV
  - With remote signaling: BSPH2600YPVR
  - Replacement modules: Left BPH300YPV Right BPM300YPV

**PV ADVANCE** — (complete assembly)
- 1000Vdc: BSPS31000PV (complete assembly)

---

**Overvoltage surge protection**

**PV PRO** (Performance)
- 600, 1000Vdc
- Bi-Pole

**PV HEAVY DUTY** (Safety)
- 600, 1000, 1200Vdc
- Mono-Pole, Bi-Pole
- Integrated overcurrent protection for complete device isolation and enhanced safety

**Lightning current protection**

**PV ADVANCE** (Lightning)
- Combined lightning current and surge protection

---

**Nominal system voltage V₀**

<table>
<thead>
<tr>
<th>PV PRO</th>
<th>PV HEAVY DUTY</th>
<th>PV ADVANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>600, 1000Vdc</td>
<td>600, 1000, 1200Vdc</td>
<td>Up to 1000Vdc</td>
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**System type**

<table>
<thead>
<tr>
<th>PV PRO</th>
<th>PV HEAVY DUTY</th>
<th>PV ADVANCE</th>
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</thead>
<tbody>
<tr>
<td>Bi-pole</td>
<td>Mono-pole, bi-pole</td>
<td>Bi-pole</td>
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</tbody>
</table>

**Protection from**

<table>
<thead>
<tr>
<th>PV PRO</th>
<th>PV HEAVY DUTY</th>
<th>PV ADVANCE</th>
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<tbody>
<tr>
<td>Surge</td>
<td>Surge</td>
<td>Direct/indirect lightning currents</td>
</tr>
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</table>

**Wiring configuration / applications**

<table>
<thead>
<tr>
<th>PV PRO</th>
<th>PV HEAVY DUTY</th>
<th>PV ADVANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>“I” and “Y” configuration applications B, C and D</td>
<td>“I” and “Y” configuration applications B, C, D and E</td>
<td>Application A</td>
</tr>
</tbody>
</table>

**Nominal discharge current Iₙ - IEC**

<table>
<thead>
<tr>
<th>PV PRO</th>
<th>PV HEAVY DUTY</th>
<th>PV ADVANCE</th>
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</thead>
<tbody>
<tr>
<td>20kA</td>
<td>12.5kA</td>
<td>100kA</td>
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**Nominal discharge current (8x20µs) Iₙ - UL**

<table>
<thead>
<tr>
<th>PV PRO</th>
<th>PV HEAVY DUTY</th>
<th>PV ADVANCE</th>
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</thead>
<tbody>
<tr>
<td>20kA</td>
<td>10kA</td>
<td>—</td>
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</table>

**Impulse current rating (10/350µs) Iₘₚ**

<table>
<thead>
<tr>
<th>PV PRO</th>
<th>PV HEAVY DUTY</th>
<th>PV ADVANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>—</td>
<td>—</td>
<td>50kA</td>
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**Max. discharge current (8x20µs) Iₘₜₐₓ**

<table>
<thead>
<tr>
<th>PV PRO</th>
<th>PV HEAVY DUTY</th>
<th>PV ADVANCE</th>
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<tbody>
<tr>
<td>40kA</td>
<td>25kA</td>
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**PV short-circuit current rating Iₛₕₚv**

<table>
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<th>PV PRO</th>
<th>PV HEAVY DUTY</th>
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<td>125A</td>
<td>1000A</td>
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**Technology**

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<th>PV PRO</th>
<th>PV HEAVY DUTY</th>
<th>PV ADVANCE</th>
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<tbody>
<tr>
<td>MOV</td>
<td>MOV SCI</td>
<td>Trigger Spark Gap</td>
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**Agency information**

<table>
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<th>PV PRO</th>
<th>PV HEAVY DUTY</th>
<th>PV ADVANCE</th>
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</thead>
<tbody>
<tr>
<td>UL Recognized, EN 50539-11</td>
<td>UL Recognized, EN 50539-11</td>
<td>IEC 61643-11</td>
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**Product warranty**

<table>
<thead>
<tr>
<th>PV PRO</th>
<th>PV HEAVY DUTY</th>
<th>PV ADVANCE</th>
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</thead>
<tbody>
<tr>
<td>2 Years</td>
<td>5 Years</td>
<td>5 Years</td>
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**Typical product application**

<table>
<thead>
<tr>
<th>PV PRO</th>
<th>PV HEAVY DUTY</th>
<th>PV ADVANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Combiner boxes</td>
<td>Recombiner boxes / inverters</td>
<td>Arrays / inverters</td>
</tr>
</tbody>
</table>

*See limited warranty statement (3A1502) for details.*
Bussmann series PV PRO — performance
- UL 1449 3rd Edition Recognized, and EN 50539-11 SPDs for most popular bi-pole protection up to 600Vdc and 1000Vdc
- Modular DIN-Rail mounting with IP20 finger-safe construction makes it easy to install and maintain
- Built-in thermal disconnect technology eliminates the need for any additional fuse installation and wiring
- easyID™ local visual indication and optional remote contact signaling make status monitoring simple
- Two-year warranty

Module circuit diagram

![Module circuit diagram](image)

Shown with optional remote contact signaling
* For remote signaling contact, add “R” suffix to the part number. E.g., BSPP3600YPVR

PV PRO “Y” series connection

![PV PRO “Y” series connection](image)

Series connection of modules between line and ground extends MOV life and permits higher voltage ratings.

Bussmann series PV HEAVY DUTY — safety
- Patented, fast-acting hybrid Short-Circuit Interrupting (SCI) technology isolates system to prevent damage caused by DC arcs
- UL 1449 3rd Edition Recognized and EN 50539-11 SPDs for enhanced mono- and bi-pole system protection up to 600, 1000 and 1200Vdc
- Modular DIN-Rail mounting with IP20 finger-safe construction makes it easy to install and maintain
- easyID™ local visual indication and optional remote contact signaling make status monitoring simple
- Five-year warranty

Module circuit diagrams

![Module circuit diagrams](image)

PV HEAVY DUTY SCI technology

SCI technology utilizes an internal fast-acting fuse to fully isolate the SPD when a fault condition is encountered.
1. Normal operating state; conduction path is through MOV to ground.
2. MOV failure trips thermal disconnect, moving contact off the MOV and starts DC arc.
3. As contact moves, DC arc is extinguished and the contact engages the fuse.
4. Fuse opens, isolating the SPD from the system, allowing safe module replacement and continued flow of power from PV arrays to inverter.

Data sheet: 10091
Data sheets: 2055 (3-module) and 2145 (2-module)
**Bussmann series PV ADVANCE — lightning**

- Class I SPD per IEC 61643-11 standards for PV systems up to 1000V DC
- Complements and enhances total PV system protection when used in combination with PV HEAVY DUTY or PV PRO SPDs up to 1000Vdc
- Protects arrays and inverters from direct and indirect lightning strikes, and damaging surges
- Triple terminals allow multiple PV string protection with one device
- High lightning current discharge capacity using Trigger Spark Gap (TSG) technology eliminates DC short-circuit currents up to 100A DC
- Five-year warranty

**Data sheet: 2148**

**PV wiring applications**

**Application A:** circuit diagram and application wiring for two energized poles/modes up to 1000Vdc systems

**Application B:** “Y” configuration - two energized poles/modes 600, 1000 and 1200Vdc* systems

**Application C:** “I” configuration - one energized pole/mode 600Vdc and 1000Vdc systems only

**Application D:** “I” Configuration - one energized pole/mode 600Vdc and 1000Vdc** systems

**Application E:** “I” configuration - one energized pole/mode 600Vdc mono-pole systems only

* BSPP31200YPV(R) only.
** BSPP31000YPV(R) 1000Vdc one energized pole/mode requires the following:
1. Use a suitable electrical insulator to keep a 10mm min. safety distance from the PV-SPD and other grounded parts in the housing.
2. No metal covers are permitted in the area of the module release button.
Quik-Spec™ Coordination Panelboards

Quik-Spec Coordination Panelboard (QSCP) for solar applications

This highly configurable, compact fusible distribution panel has up to 200kA SCCR and uses the Bussmann series Compact Circuit Protector Base (CCPB) along with the time-delay or fast-acting Class CF CUBEFuse for its branch circuit disconnect means.

Its unique properties provide advantages when designing and installing large rooftop systems utilizing string inverters. It can help keep the cost of the AC balance-of-system within budget by providing a UL 67 solution that permits combining the AC circuits from the string inverters into a single AC output.

Specific configurations of the QSCP can provide protection against high fault current levels — especially if there is a high available fault current on the AC side of the system from the utility — while keeping balance of system reasonable by using non-fused disconnects on the lineside of the string inverters.

The available NEMA 3R enclosure allows the QSCP to be installed outdoors and withstand an extreme temperature range from \(-\)°F \((-\)°C\) to \(\)°F \(\)°C\). And by utilizing the UL Class CF fast-acting CUBEFuse, a lower ambient derating factor can be applied so that fuse and conductor sizing can be reduced.

**Specifications**

- UL Listed and cULus to CSA Standard 22.2 No. 29.
- Same footprint as traditional circuit breaker panelboards 20 inches wide, and 40% smaller than standard fusible panelboards.
- Up to 400A mains, 200kA SCCR and 100A branches with 18, 30 and 42 branch positions.

Data sheet No. 1160

**Eaton reference materials**

**Bussmann series high speed fuse application guide No. 3160**

A 40-page guide on the selection and application of Bussmann series high speed fuses for protecting semiconductor devices, including inverters.

**Eaton molded case circuit breaker (MCCB) full line catalog No. CA08100005E**

Over 430 pages covering the AC and DC circuit protection MCCB products available from Eaton, including UL and IEC MCCBs, internal and external accessories, and more.

**Bussmann series UL and data signal SPD guide for North American applications No. 3193**

A 56-page guide on the application of UL Type 1, 2 and 3 surge protective devices for AC power systems along with UL 497B data signal SPDs for protecting twisted pair conductors, coaxial cable and RJ45 Ethernet data lines.

**Bussmann series Selecting Protective Devices (SPD) No. 3002**

Over 275 pages on the selection and application of overcurrent and overvoltage protective devices for electrical power distribution systems and machinery.

**Bussmann series electrical full line catalog No. 1007**

Over 530 pages covering the circuit protection products and gear available from Eaton’s Bussmann Division, including UL and IEC low voltage power fuses, blocks, holders and more.
## More Eaton products for PV systems

<table>
<thead>
<tr>
<th>Bussmann series UL low voltage power fuses</th>
<th>Bussmann series IEC low voltage power fuses</th>
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</thead>
<tbody>
<tr>
<td>- Class CC - up to 100A</td>
<td>- CSA Type P and D</td>
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<tr>
<td>- Class CF - up to 100A</td>
<td>- HRC Form II</td>
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<tr>
<td>- Class J - up to 600A</td>
<td>- BS88</td>
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<tr>
<td>- Class RK1 - up to 600A</td>
<td>- DIN Type D</td>
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<tr>
<td>- Class RK5 - up to 600A</td>
<td>- NH HRC</td>
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<td>- gG/gL</td>
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<thead>
<tr>
<th>Bussmann series AC rotary disconnect switches</th>
<th>Bussmann series DC safety switches</th>
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<tbody>
<tr>
<td>- 600Vac</td>
<td>- 600Vdc</td>
</tr>
<tr>
<td>- 250Vdc*</td>
<td>- 30, 60, 100 and 200A</td>
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<tr>
<td>- NEMA® 1, 3R, 12, 4, 4X</td>
<td>- Fusible and non-fusible</td>
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<tr>
<td>- UL 98</td>
<td>- NEMA 3R, 12, 4X</td>
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<td>* On select switches.</td>
<td>- UL 98, UL 50</td>
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<table>
<thead>
<tr>
<th>Bussmann series high speed fuses</th>
<th>Bussmann series UL and IEC SPDs</th>
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<tbody>
<tr>
<td>- North American</td>
<td>- UL SPDs (up to 600V)</td>
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<tr>
<td>- Square body</td>
<td>- Type 1, NEMA 1 and 4X</td>
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<td>- BS88</td>
<td>- Type 2, DIN-Rail</td>
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<td>- Ferrule</td>
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<td>- Class I and II</td>
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<td>- Up to 4-poles</td>
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<thead>
<tr>
<th>Bussmann series DIN-Rail terminal blocks</th>
<th>Eaton general DC molded case circuit breakers and switches</th>
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<tr>
<td>- Feed-through</td>
<td>- 600Vdc (up to 750Vdc)</td>
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<tr>
<td>- Double level</td>
<td>- Up to 3000A</td>
</tr>
<tr>
<td>- Disconnect</td>
<td>- Various interrupting ratings up to 65kAIC</td>
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<tr>
<td>- Grounding</td>
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<td>- Fuse holder</td>
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<td>- Internally jumpered</td>
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<td>- Test</td>
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<th>Eaton AC molded case circuit breakers and switches</th>
<th>Bussmann series data signal surge protective devices</th>
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<tr>
<td>- 600V (up to 1000Vac)</td>
<td>- Universal 4-wire</td>
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<tr>
<td>- Up to 2500A</td>
<td>- BNC coaxial cable</td>
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<td>- Various interrupting ratings up to 200kAIC</td>
<td>- RJ45 Ethernet</td>
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<tr>
<th>Bussmann series modular fuse holders</th>
<th>Bussmann series modular knifeblade fuse blocks</th>
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</thead>
<tbody>
<tr>
<td>- DIN-Rail mount</td>
<td>- Class J, R and H (K)</td>
</tr>
<tr>
<td>- Up to 4-poles</td>
<td>- 70 to 600A</td>
</tr>
<tr>
<td>- Class CC and J</td>
<td>- Optional finger-safe covers</td>
</tr>
<tr>
<td>- 8x32, 10x38, 14x51 and 22x58mm</td>
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</table>
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