

## Ground Fault Protection Device

Morningstar's Ground Fault Protection Device (GFPD) Family, Models GFPD-150V and GFPD-600V, increases safety and design flexibility in off-grid and on-grid photovoltaic (PV) systems. Ground fault protection is used in electrical systems to prevent current from following any unintended paths during a ground fault. It is critical to detect any stray current and to interrupt (break) the circuit until safe operation can be restored. A current imbalance between the primary +/- PV conductors entering the charger/inverter may indicate a ground fault condition. Morningstar's GFPD will detect this condition and break the circuit on both the positive and negative legs. Disconnecting both poles ensures interruption of the ground fault current.

The GFPD enables system design flexibility. Morningstar designed the GFPD to be easily paired with our world-leading TriStar MPPT™ charge controller during on-site installation. Additionally, the GFPD will work just as well in systems with mixed vendor components.

Morningstar's GFPD is a superior solution to ground fault protection. With its custom molded equipment ground terminals, installation and troubleshooting are simplified. Furthermore, the GFPD breaks the entire PV array circuit during a fault condition and requires no special labeling on the battery enclosure. The following pages contain a side-by-side comparison between Morningstar's GFPD and other solutions.

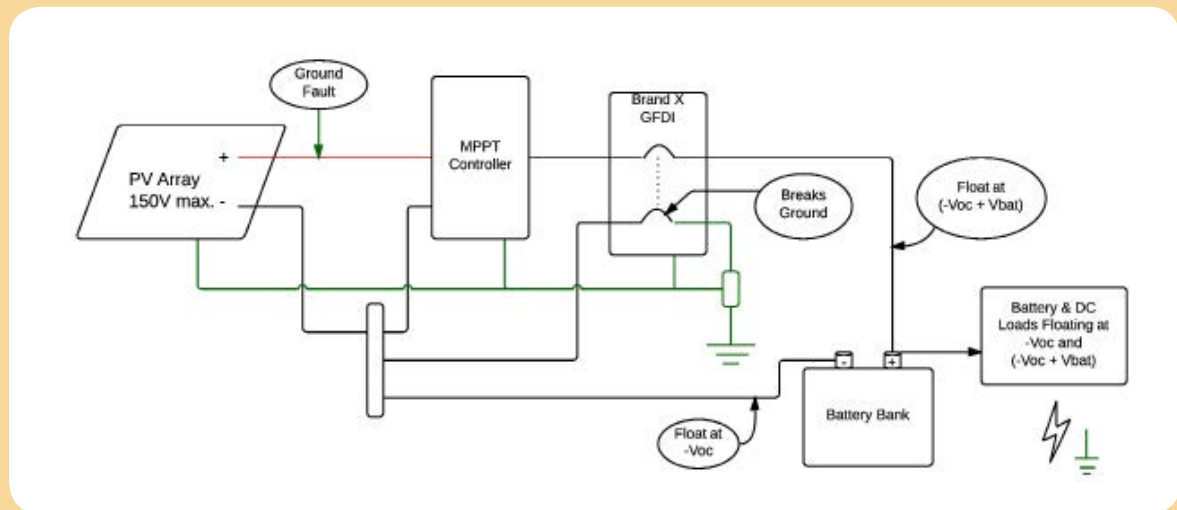


### Safety Features

- Breaks the connection to the PV array during a fault condition
- Leaves the battery and DC loads grounded under all conditions
- Eliminates the danger of an ungrounded battery and therefore requires no special labeling at the battery location
- Features audible and visual indications
- Performs precise current measurement with no fuses
- Includes push-button test circuit



## Illustration: Why Other Ground Fault Protection Device Solutions Are Inferior



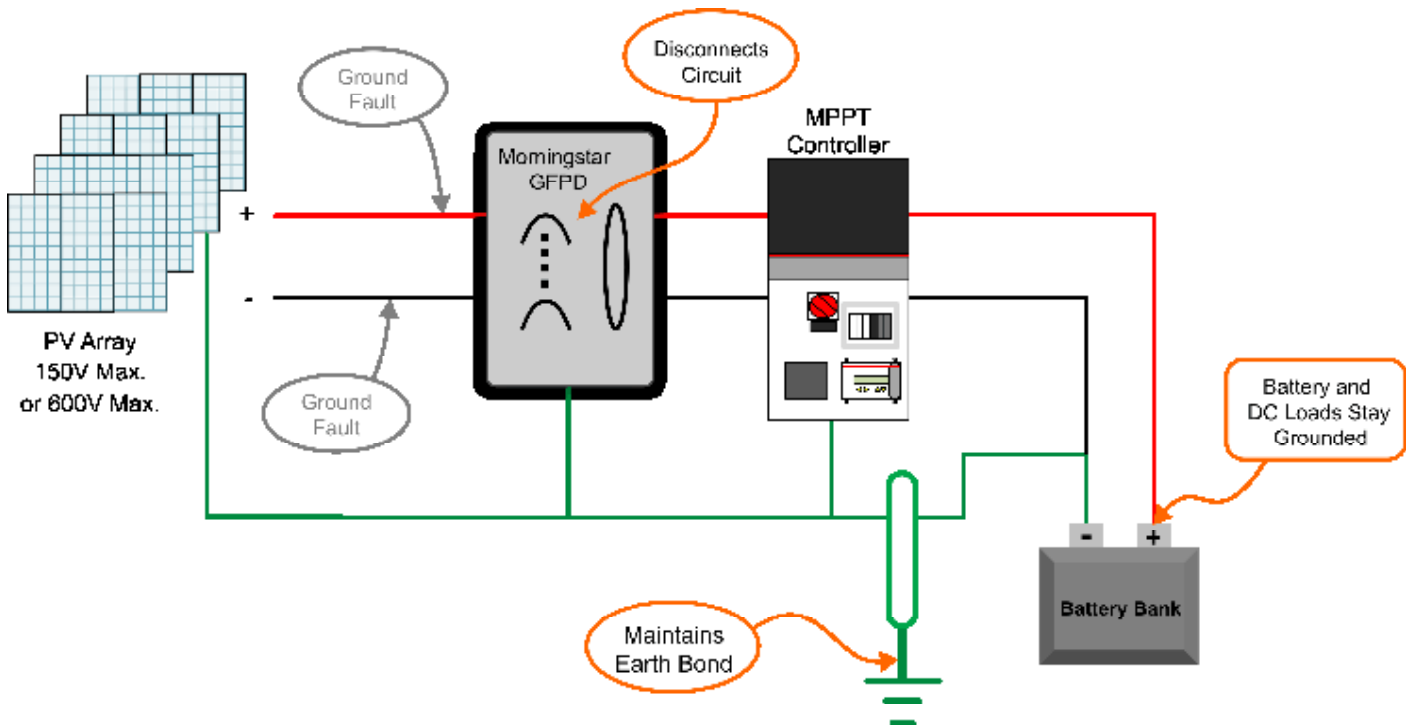
One of the main issues with other ground fault detection/interruption (GFDI) products is that these all break the bond to the grounded conductor. When this occurs, not only is the earth bond compromised but the battery and DC loads can also be left ungrounded and floating. For a negatively grounded system this means that the negative side of the battery and loads can float to negative  $V_{oc}$  in relation to ground and the positive side can float to  $(\text{negative } V_{oc} + V_{bat})$ .

Sample Scenario: In the case of a 150V MPPT controller, this could introduce users to dangerous array voltage from the DC loads-to-ground, which could cause a personal safety hazard. It is also possible that with these other GFDI solutions, the newly introduced higher voltage scenario could create a DC (load-side) spark safety hazard.

Other ground fault detection interruption solutions are inferior because:

- They break the earth bond.
  - A 1A fuse in bond creates a very unstable earth bond.
  - Others solutions do not isolate the normally grounded conductor of the faulted circuit.
- Normally grounded components (more conductors, battery and DC loads) can float to a potential different from ground (negative  $V_{oc}$  levels).
  - This creates a safety hazard, and as such requires a second Ground Fault Warning Label at the battery bank.
- Their fuses must be replaced.
  - Fuses are crude. They do not blow at precise currents and replacements are often unavailable at remote sites.
- They are not ideal for PV systems with multiple controllers. If they are used in systems with multiple controllers, then the following may occur:
  - Only one earth bond means that all controllers in the system will disconnect during a ground fault, thus causing solar charging to cease.
  - Only one earth bond means that the number of controllers that can be connected to a battery bank is limited to the number of ganged breakers in a GFDI.
  - Some GFDIs may be set up to disconnect the inverter and/or DC load(s) for added protection from floating voltages, thus causing loads to shut down.

# Morningstar's GFPD Solution



- Maintains the integrity of earth bond for battery and loads
- Trips at lower fault current with greater accuracy
- Breaks both conductors in the faulted circuit and completely isolates PV source circuits
- Does not require an extra warning label at the battery bank as per U.S. National Electric Code requirements
- Provides design flexibility to meet a wide range of configurations:
  - Positive and negative ground
  - Large and small arrays
- Makes it easier to locate and troubleshoot ground faults
- Powered via the PV system's battery bank
- Equipped with both visual and audible alarms
- Built to support both single controller and multiple controllers systems:
  - Morningstar's GFPD will only shut off affected controllers, while maintaining the system earth bond.
  - All loads will continue to operate safely with the battery remaining bonded to ground.
  - Multiple controllers and GFPDs can be added on an as-needed basis.



The Morningstar GFPD supports a wide range of battery voltages (12V, 24V, 36V, 48 Vdc nominal systems) and many advanced design features for simplified installation. The GFPD is equipped with:

- A bi-color LED to provide operating status, GFPD events and module or wiring faults
- A notification and alarm feature, providing an extra safety measure:
  - Detects a ground fault condition
  - Indicates when the PV system's battery bank voltage is getting critically low
- A simple test button feature for an installer to press to simulate a trip event when checking wiring and switches

	GFPD-150V	GFPD-600V
<b>ELECTRICAL</b>		
Input Voltage	10-72 Vdc	10-72 Vdc
Self-Consumption	<0.5W	<0.5W
Ground Fault Threshold Current	300 mA +/- 10%	300 mA +/- 10%
Number of Poles	2	2
Maximum Solar Voltage	150V	600V
Maximum Solar Current	60A	50A
Trip Method	Relay	Relay
Output Trip Signal	12V	12V
Nominal System Voltage	12/24/36/48 Vdc	12/24/36/48 Vdc
<b>MECHANICAL</b>		
Mounting Post Size	DIN- and Panel-Mount Options	DIN- and Panel-Mount Options
Terminal	up to 13 mm <sup>2</sup> / 6 AWG	up to 13 mm <sup>2</sup> / 6 AWG
Dimensions	26.9 x 12.8 x 11.2 cm / 10.6 x 5.1 x 4.4 in	35.7 x 22.1 x 10.6 cm / 14.1 x 8.7 x 4.2 in
Weight	2.0 kg / 4.4 lbs.	4.4 kg / 8.9 lbs.
<b>ENVIRONMENTAL</b>		
Ambient Operating Temperature	-40 °C to +60 °C / -40 °F to +140 °F	-40 °C to +60 °C / -40 °F to +140 °F
Storage Temperature Range	-55 °C to +85 °C / -67 °F to +185 °F	-55 °C to +85 °C / -67 °F to +185 °F
Humidity Tolerance	Up to 100%	Up to 100%
Tropicalization	PCB Conformal Coating	PCB Conformal Coating
<b>ELECTRONIC PROTECTIONS</b>		
Reverse Polarity	YES	YES
Disconnected Feedback Signal Circuit Detection	YES	YES

**CERTIFICATIONS**

CE, RoHS and REACH Compliant
UL 1741 and CSA C22.2 No. 107.1-01 Listed
GFPD-150V is UL-489 Listed
GFPD-600V is UL-1077 Listed
Meets EMC Directives (Immunity, Emissions and Safety)
FCC Class B Part 15 Compliant
U.S. National Electrical Code (NEC) 690.5 Compliant for use as a GFPD device
Manufactured in a Certified ISO 9001 Facility



**MORNINGSTAR**  
World's Leading Solar Controllers & Inverters

[www.morningstarcorp.com/GFPD](http://www.morningstarcorp.com/GFPD)

Morningstar Corporation is a registered trademark and the Morningstar Name, the Morningstar Logo and the TriStar MPPT name are all trademarks of Morningstar Corporation.

© 2013 Morningstar Corporation. All rights reserved.