The ground-fault protection is a blind spot and is a major safety concern in many photovoltaic plants. This can lead to undetected faults in grounded PV array conductors causing major fire accidents.

PV systems may be wired in several different configurations with respect to system grounding. The direct current (DC) side of the system may be directly grounded (e.g., one pole connected to earth) or ungrounded or the array may be grounded through a connection to the AC side ground. Systems also may or may not have galvanic isolation between the DC and AC sides. These design factors influence a system’s fault tolerance and response to ground faults, and add complexity to properly implementing ground fault protection. In PV plants, as well as in residential and commercial PV systems, mainly in the USA, the manufacturers of the PV modules recommend or require positive or negative grounding of the V generator when using thin-film and back-contact PV module; the positive or negative pole of the generator output is grounded, regardless of the grounding of the module frame. This configuration is determined by the inverter, which in most cases grounds the DC side by connecting one pole of the array to ground through a fuse or other overcurrent protection (MCB) device: this fuse or MCB is called a Ground Fault Detection Interruption (GFDI). In these cases we speak about “GFDI negative ground” or “GFDI positive ground” insulation monitoring option.

The triggering of the GFDI is usually coupled with a relay output which will stop the inverter as system should not run without proper grounding. From a standard view point only the UL 1741 standard specifies the maximum over current protection requirements for ground fault detection and interruption in PV inverters. As shown in the table below, these specifications are dependent on the size of the inverter.

<table>
<thead>
<tr>
<th>Inverter DC Rating (kW)</th>
<th>MaxGround Fault Current (Amps)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-25</td>
<td>1</td>
</tr>
<tr>
<td>25-50</td>
<td>2</td>
</tr>
<tr>
<td>50-100</td>
<td>3</td>
</tr>
<tr>
<td>100-250</td>
<td>4</td>
</tr>
<tr>
<td>&gt;250</td>
<td>5</td>
</tr>
</tbody>
</table>

Table 1: UL 1741 Ground Fault Detection Specifications vs. Inverter DC Rating

If a fault arises causing a ground fault to occur at the PV generator pole that is not grounded, the leakage current flows through the GFDI and back to the grounded pole, thus triggering the GFDI. The triggering of the GFDI interrupts the leakage current and the PV generator is not grounded by the ground fault (see figure 1, system example with a negative grounded pole). This interruption of the leakage current prevents damage to the system. During operation, a ground fault in the PV generator’s grounded pole causes some of the generator current to flow back to the solar generator via the GFDI (see figure 2). This can also trigger the GFDI.
**Frequently asked questions:**

1. **What does GFDI stand for?**
   GFDI stands for Ground Fault detection interrupter, which is a protection most commonly used in PV Plants.

2. **What is the basic function?**
   If a fault arises causing a ground fault to occur at the PV generator the triggering of the GFDI interrupts the leakage current. This interruption of the leakage current prevents damage to the system. Hence the GFDI basically protects the PV system against Ground faults.

3. **When do we have to use GFDI?**
   In case of “grounded PV systems”, meaning when the manufacturers of the PV modules recommend or require positive or negative grounding of the PV generator when using thin-film and back-contact PV modules.

4. **Which country is it commonly used?**
   This is commonly used in USA, however such requirements can basically come from any countries in the world where using thin-film PV modules.

5. **Which standard do we have to refer to for GFDI?**
   UL1741 is the standard referred to GFDI. The products are, however, tested as per UL489-B for 1000V DC.

6. **Which application is it used for?**
   In Utility Scale projects, the GFDI device is normally installed in the central inverter between the negative and the grounding. GFDIs are also used close to the inverter in residential and commercial PV systems mainly in USA.

7. **What are ABB solutions for GFDI?**
   a. S804U-PVSS High performance MCB @ 1000V DC PV are tested according to UL 489B for GFDI Applications.
   b. S500UC-K High Performance MCBs are tested and used by various inverter manufacturers for GFDI applications. These MCBs can be used up to 750V DC in 3 pole and 4 pole versions. They are tested as per IEC/EN 60947-2 and UL1077.

8. **Is GFDI requested and used only for PV application?**
   No, the GFDI is also used in AC systems mainly in the United States of America. In this case they are also referred to as GFCI- Ground Fault Current Interrupter.

9. **Is GFDI a kind of RCD but for DC application?**
   No, the GFDI does not ensure personal protection but only system protection.