Understanding Earthing

Recent updates to the Australian Standards relating to photovoltaic systems (AS/NZS 5033:2012) have led to questions about the difference between functional earthing and equipotential bonding in photovoltaic systems. This article aims to clarify what is meant when terms like earthing and bonding are used, and to briefly explain why each of these methods is needed.

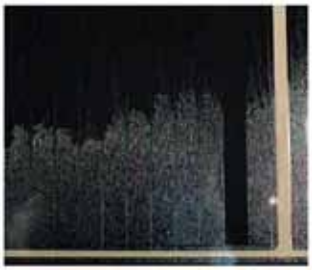
What is functional earthing?

To 'functionally earth' an array, means to physically connect either the positive or negative conductor of the array to earth, and thereby referencing the DC side of the installation to earth. According to AS/NZS 5033:2012, the connection between the conductor and earth must be done on the inverter side of the array isolator. This connection can be made inside the inverter or on the array cables but should not be confused with the earth connection of the inverter.

What is equipotential bonding?

In the case of PV arrays, equipotential bonding refers to connecting each module frame and any metal mounting system parts (e.g. mounting rails; top image) to an earth conductor. This conductor is then connected back to the earth in the MEN system, and must be a minimum of 4 mm^2 (as per AS/NZS 3000).

When do you need functional earthing?

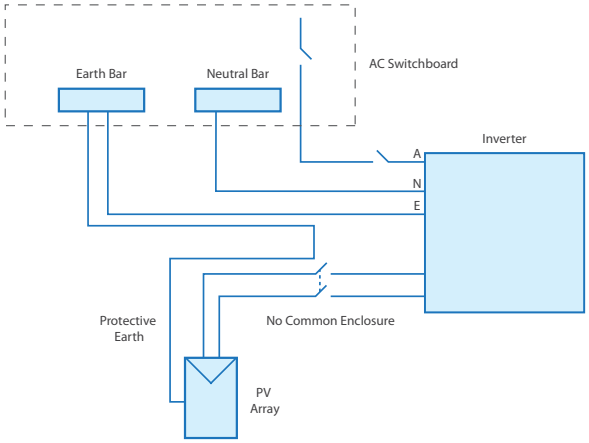


http://www.lightningman.com.au/images/PV_image2.jpg

Some modules require functional earthing so that they operate correctly (performance) or so that they do not corrode internally. Thin-film modules generally need to be negatively earthed, to prevent 'bar-graph' corrosion inside the module (middle image). Back-contact modules (e.g. Sunpower) also occasionally need to be positively earthed to achieve their rated efficiency; this will be stated in the installation instructions.

When do you need equipotential bonding?

Equipotential bonding is always required in PV systems. Recently, PV modules were downgraded from the Class II to Class I insulation classification, necessitating this change. Additionally; when a PV array is connected to a transformerless (TL) inverter, high-frequency switching occurs within the inverter and can cause a small AC-like fluctuation in the array cables. The array cables are effectively capacitively coupled to the module frames, and over time this induces a voltage on the module frames. To eliminate this voltage, any array (whether coupled to a TL inverter or otherwise) needs to have equipotential bonding on all array frames and mounting rails (bottom image).



What configurations are NOT allowed?

You are NOT allowed to connect a functionally earthed array to a TL (non-separated) inverter. The configuration is not permitted owing to the high probability that the inverter will introduce DC into the AC electricity grid.

Summary

Below is a table with the different types of system configurations stemming from the presence of a TL inverter and also functional earthing.

Inverter type	Is there functional earthing?	Is equipotential bonding required?
Separated inverter	No	Yes
Non-separated inverter	No	Yes
Separated inverter	Yes	Yes
THIS CONFIGURATION IS NOT PERMITTED		
Non-separated inverter	Yes	N/A

P 1300 265 525 E info@gses.com.au **www.gses.com.au**
EDUCATION | TRAINING | ENGINEERING | CONSULTANCY