Introduction

New developments in PV manufacturing technology may require additional measures in the design of the entire PV power plant. Some of these new technologies should be used only in combination with specific inverters. Mastervolt's broad and diversified inverter portfolio offers optimal solutions for each module technology.

This document provides important information regarding PV modules which require special attention in inverter choice.

Potential induced degradation

The requirements imposed by the module technologies can be divided into two categories.

1. TCO corrosion

In some thin film modules there is a risk of TCO corrosion. TCO stands for Transparent Conductive Oxide and is the electrically conductive layer directly on top of the semiconductor material of the solar cell. Damages to this layer result in power loss and cannot be repaired. TCO corrosion occurs when a solar module has a positive potential with respect to the ground. When no preventive measures are taken this effect is noticeable after several months or even years.

2. Polarization effect

Certain back contacted solar cells suffer from the "polarization effect" when negative potential to the ground exists. Such cells have different electric field from conventional solar cells which is concentrated at the back of the solar cell. A static negative surface charge can build up on the Anti Reflective Coating (ARC) of such cells. The polarization effect is –in contrast to TCO corrosion- reversible. The timescale to the occurrence of this effect is days and the recovery can take weeks.

With conventional crystalline solar cells, which is still by far the largest share of modules, no correlation between degradation and high voltage induced leakage currents can be proved.

New technologies and new innovations within the existing module technologies follow each other on a fast pace. Unfortunately, a lot of module manufacturers do not put their functional grounding requirements in their datasheets. Therefore it is of great importance to read the installation instructions or to contact the module manufacturer directly. Such information has to be known before making any choices in the PV installation project.

Functional grounding

During ordinary operation one half of the PV panels has a positive potential to the ground and one half has a negative potential.

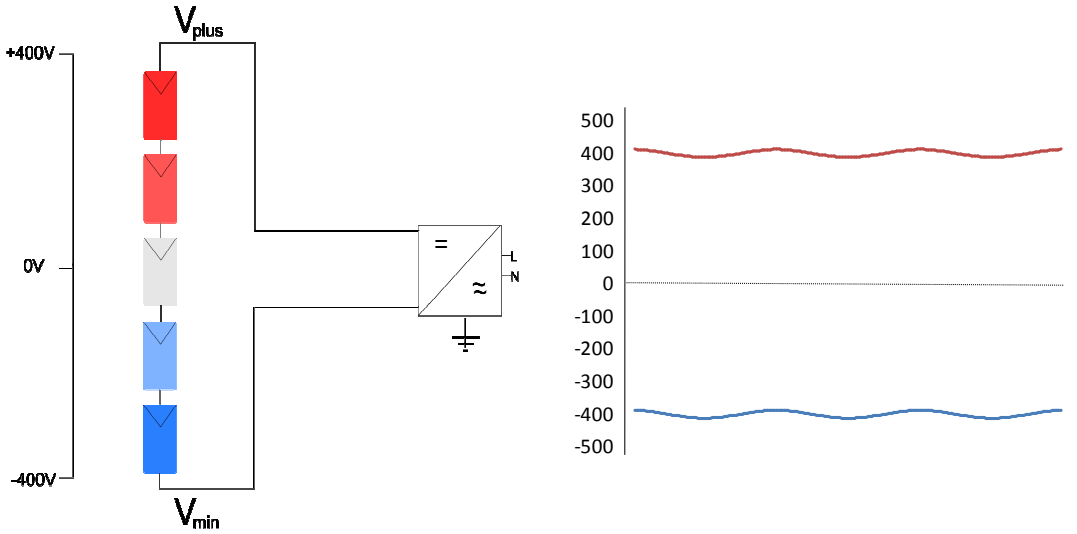

Figure 1: Potential of ordinary PV system.

Negative potential between the array and the ground can be prevented by connecting this negative potential directly to the ground. This kind of grounding is called *functional* grounding as it is not meant to improve safety via this grounding connection.

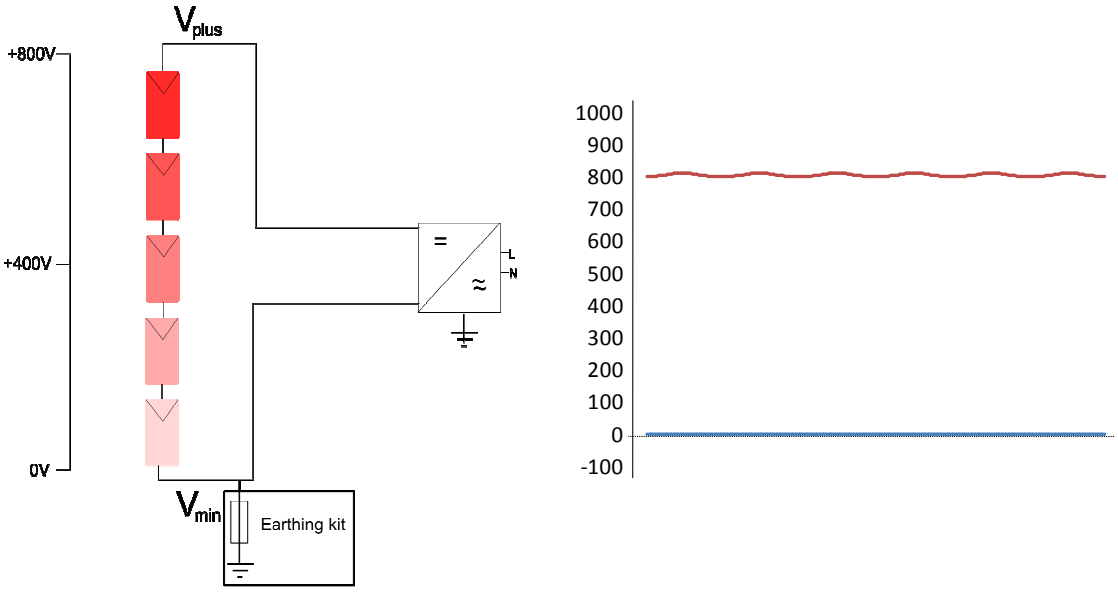

Figure 2: (Negative) functional grounding to the positive potential via earthing kit.

Positive functional grounding is also possible by connecting the positive PV array to the ground via the earthing kit. Not all inverters are suitable for a straightforward connected of the PV array to the ground. The next section deals with the different possibilities.

Inverter types

Modern inverters can be arranged in two categories: Isolated and non-isolated inverters.

1. Isolated inverter

An isolated inverter has a High Frequency (HF) or Low Frequency (LF) transformer inside which provides a galvanic isolation between the DC (solar) and AC (grid).

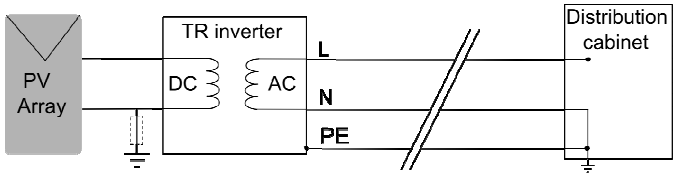

Figure 3: Representation of a galvanically isolated inverter connected to the grid. Functional grounding is allowed.

Because of this isolation, the potential with respect to the ground can be different on both AC and DC side. This means the positive or negative pole of the array can be grounded.

Care has to be taken when multiple MPP tracker inputs of an inverter are used in combination with functional grounding [Mastervolt Sunmaster XS6500]. To prevent a ground loop through the device both of the inputs have to be paralleled.

2. Non-isolated inverter

In a transformerless inverter there is always some kind of connection between AC and DC side. This means that it is not possible to alter the potential with respect to ground on the DC side.

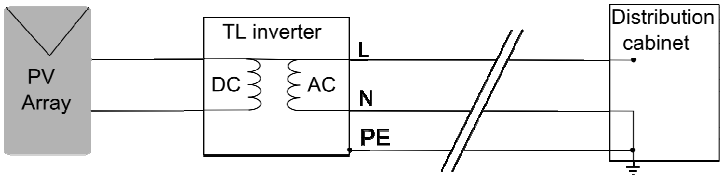

Figure 4: Representation of a transformerless inverter connected to the grid. Functional grounding is not allowed.

Isolation can be added with a low frequency (50Hz) transformer between the AC side of the inverter and the grid. The disadvantages of a low frequency transformer are additional losses and costs.

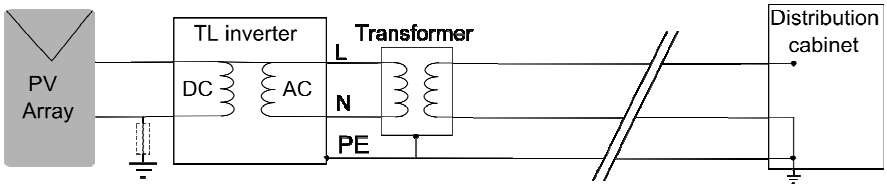

Figure 5: Representation of a transformerless inverter connected to the grid via a low frequency transformer. Functional grounding is allowed.

It is not allowed to use the two MPP trackers on individually grounded arrays. When multiple arrays are used they should all be connected in parallel (both the positive and negative inputs).

A more complicated situation arises when multiple inverters are set up in a larger installation. It is not possible to connect multiple inverters to a single transformer and individually ground the arrays. The most straightforward solution is to attach an isolation transformer to each individual inverter. Another alternative is to use a single large transformer with isolated windings for each inverter on the secondary side.

Mastervolt portfolio

The Mastervolt portfolio consists of a high frequency transformer based range and a transformerless range.

High frequency transformer inverters:
Soladin 600 / SunMaster XS2000, XS3200, XS4300, XS6500 / SunMaster XL10, XL15, IS10, IS15
All these inverters are especially suitable for use in combination with modules which require functional grounding.
The ground fault detection in the inverter has to be switched off.

Transformerless inverters:
SunMaster ES4.6TL / SunMaster CS10TL, CS12TL, CS15TL, CS20TL, CS30TL
Transformerless inverters without an additional transformer are not suited when functional grounding is required.
The IT20 low frequency transformer is available for the CS15TL and CS20TL when galvanic isolation is needed. This transformer is optimized for efficiency and will turn off at night to prevent unnecessary losses.

Grounding kit:
Mastervolt provides a grounding kit. This kit includes a 1A fuse to connect the array to the ground.