



SG250HX

Insulation and Residual Current Monitoring

SUNGROW

1. Introduction

This document provides instructions for the PV string inverter SG250HX insulation monitoring and residual current monitoring. It primarily covers standard requirements, electrical principles, system requirements etc. This document aims to help customers understand the equipment functions.

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2. Insulation Monitoring

The PV system's array insulation resistance monitoring function serves to reduce the risk of electric shock or fire caused by DC-side ground faults.

For non-isolated inverters, DC-side ground faults form a loop between the fault point and electrical grid, directly leading to a fault current. In this situation, the inverter is prohibited to connect to the grid.

Non-isolated inverters, connected in series to non-grounded or functional PV groups, should possess an insulation resistance monitoring function. Before the inverter connect to the grid, the insulation resistance value must be checked. When the insulation resistance value is lower than the threshold value required by the relevant standards, an alarm shall be promptly issued and the inverter should not be connected to the power grid.

The threshold must be set according to local standards.

According to section 4.8.2.1 in IEC62109-2, the minimum value set for the insulation resistance threshold may not be lower than $R=V_{MAX} PV/30mA$.

The SG250HX is complying with the IEC62109-2. The inverter has a built-in insulation resistance detection module, as shown below.

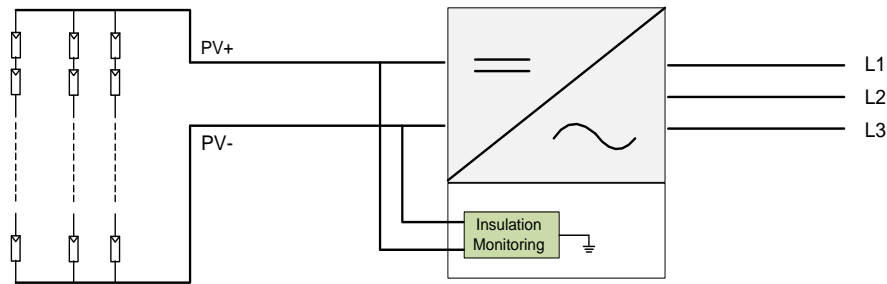


Fig.1. Inverter Insulation Resistance Monitoring

The process from inverter power-on to grid connection is divided into four stages: initial standby, standby, startup, and operation. In the "startup" stage, the insulation resistance is checked against the default threshold protection point. When the resistance from the positive and negative pole to the ground is exceeding the threshold value, the inverter is allowed to be connected to the grid as normal. If the first measurement finds that the resistance is less than the threshold value, then the inverter will wait for 10 minutes and will measure it again. If the resistance is still less than the threshold value, then the inverter will wait for another 10 minutes and will measure it again. If the resistance is still less than the threshold value even after the third time measurement, then the device shall report a fault and connection to the grid will be stopped.

3. Residual Current Monitoring

For non-isolated inverters, residual current can affect personal safety and may cause fires. Therefore, detection and protection are extremely important. Based on the requirements in the relevant standards, residual current protection is divided into two protection methods: continuous residual current protection and sudden current change protection. When the residual current exceeds the preset threshold value, then the inverter shall disconnect within the timeframe specified by the relevant standards.

The threshold value must be set according to the local standards.

This value is set according to section 4.8.3.5 in IEC62109-2, which is the same as required in UL1741 CRD Sections 87-100, table 89.1 and 89.2.

Inverter Capacity	Continuous Residual Current Limit	Time to Disconnect from the Grid
Less than or equal to 30kVA	300mA	0.3s
Greater than 30kVA	10mA/KVA	0.3s

Sudden Current Change	Time to Disconnect the Inverter from the Grid
30mA	0.3s
60mA	0.15s
150mA	0.04s

With reference to the relevant standard requirements, the design of the residual current detection circuit is shown below. The Residual Current Monitoring Unit (RCMU) samples the sum of the three-phase output currents. After wave filtering, amplification, and other stages, the result is sent to the DSP control unit.

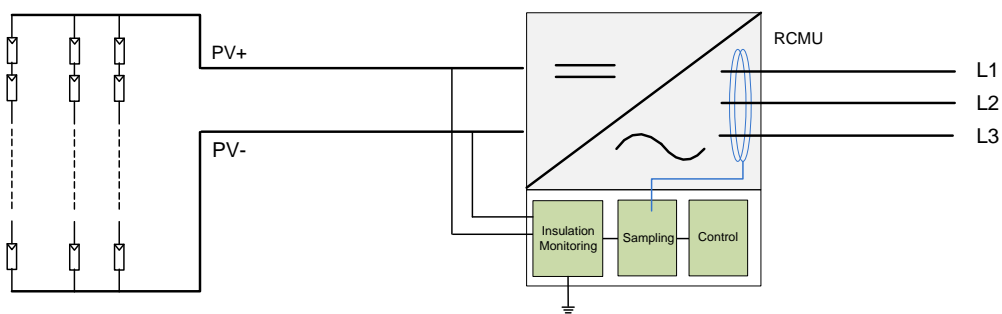


Fig.2. Residual Current Detection

During the operation, the inverter relays are switched on to connect the inverter to the grid and feeds power to it. The RCMU keeps monitoring the residual current to see if it exceeds the default protection threshold value specified in the relevant standards. Once the continuous residual current exceeds the preset threshold, the inverter will disconnect from the grid and report a residual current fault.

If the sudden current change is detected that exceeds a threshold value during the operation, the inverter will also be disconnected from the grid. This protection must be implemented more quickly according to the magnitude of the fluctuation, with different requirements for fluctuations greater than 30mA, 60mA, and 150mA respectively.