

Chroma Systems Solutions, Inc.

Wet Insulation Test using Chroma Hipot Tester

19053 Hipot Tester AC/DC/IR/SCAN

Keywords: Wet insulation testing, 19053 hipot tester, solar photovoltaic modules

Title:

Wet Insulation Test using Chroma Hipot Tester

Product Family: **19050 Series Hipot Tester AC/DC/IR/SCAN**

Abstract

This application note discusses wet insulation testing on solar photovoltaic modules.

What is Wet Insulation Testing?

Based on standard test methods, wet insulation testing of photovoltaic modules consists of performing resistance measurement on the insulation of a panel immersed in a liquid solution bath, as shown in Figure 1.

In this application, the panel is immersed in a solution (such as saline) for a given period of time, allowing water to penetrate the insulation barrier. The non-corrosive liquid solution is able to fully cover all exposed areas of the solar panel, which upon testing, allows a hipot tester to fully detect pin holes or other defects that exist within the insulation barrier of the panel. If the insulation performs as expected, measurement readings on the meter will indicate very high insulation resistance results.

However, if there are punctures, pin holes, or other defects on the insulation barrier of the solar panel, a weakness will be detected during testing. When this occurs, the solution has penetrate the insulation barrier, resulting in a very low resistance measurement, or even a direct short for failure.

Why Do We Need To Perform A Wet Insulation Resistance Test?

Wet insulation testing must be conducted per IEC 61730-1-2 1st Ed. and UL1703 3rd Ed. standards, which outline the specific requirements for wet insulation tests conducted on a solar module. In order to comply with the standard, wet insulation resistance tests shall be conducted by immersing the panel into a liquid solution (water or saline) for approximately 2 minutes.

A hipot tester like Chroma's 19053 model can be utilized to make measurements between the shorted output interconnect terminals of the solar module and the solution, which is usually connected to a metal rod or water tank. The applied test voltage should be 500VDC and the minimum resistance to be

detected by the tester shall not be less than 400MΩ. With this method setup, the hipot tester will pick up any excessive leakage current through the panel covered by the non-corrosive solution.

Solar panels are to be fully immersed in a non-corrosive liquid solution as a fully-assembled module in order to detect any manufacture defect of the insulation barrier. They can be made with the following materials: tempered glass, top quality EVA encapsulating material, high-quality solar cells, top-quality americium fluoride film, a reliable connecting junction box, mechanic conductor joints, and silicon sealing cement. Figure 1 illustrates the connection when performing a wet insulation test per IEC61730 and UL1703 standards.

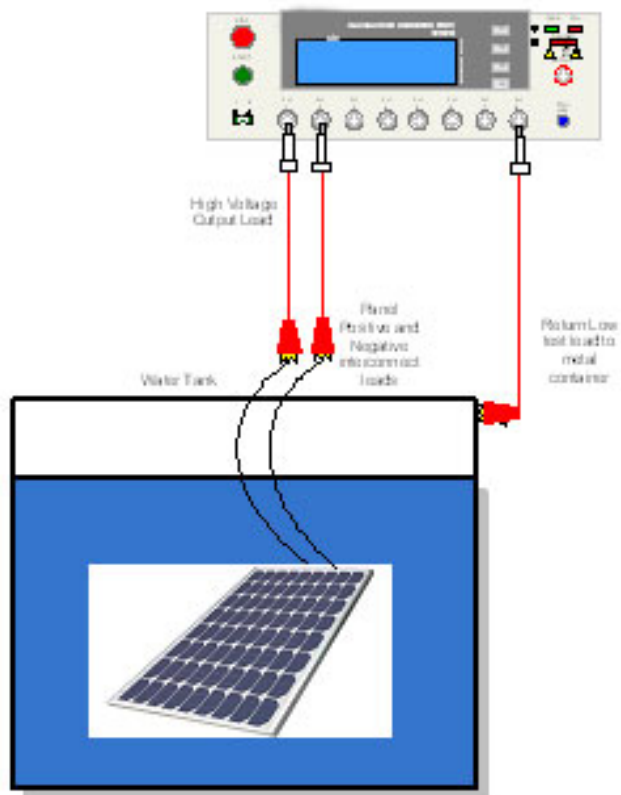


Figure 1: Wet insulation resistance test using Chroma’s 19035 Hipot Tester.

The test setup shown in Figure 1 illustrates Chroma’s 19035 set up as follows:

Channel 1 high voltage lead connected to the positive interconnect lead

Channel 2 high voltage lead connected to the negative interconnect lead of the panel

Channel 8 is connected to the tank and is utilized as a return path to the measurement circuit

In this example, both Channel 1 and Channel 2 are set to “H” (high) to apply high voltage to both interconnect leads of the panel.

The leakage current path will be monitored through the liquid solution to the return low test lead (Channel 8) connected to the tank.

This configuration of the 19035 allows users full flexibility to change polarity of the output terminals and solution. It also allows for switching without needing operator intervention.

This can be accomplished by setting any of the channels to high or setting the return path measurement to low.

The following are the specific test requirements per UL1703 and IEC 61730:

- There shall not be dielectric breakdown or surface tracking as a result of the applied DC voltage.
- For a module with an area 0.1 m^2 or less, the insulation resistance shall not be less than $400\text{M}\Omega$.
- For a module with an area larger than 0.1 m^2 , the measured insulation resistance times the area of the module shall not be less than $40\text{M}\Omega \text{ m}^2$.
- Wet Insulation Resistance Test (IR) – Panel must be immersed in a solution for 2 minutes. Measurement is between shorted output terminals of module and the solution. Test Voltage is 500VDC with minimum resistance of $400\text{M}\Omega$.
- The laminate portion of the module or panel is to be immersed in a non-corrosive liquid agent (surfactant) solution. Terminal boxes and pigtail-leads or other connectors are to be maintained above the solution level and are to be thoroughly wetted by pouring the solution over these areas. Un-insulated terminations are not to be wetted.
- After two minutes of immersion in the solution, the insulation resistance between the shorted output terminals of the module or panel and the solution is to be measured, in both polarities, with an instrument having a voltage of 500 VDC.

19053 Hipot Tester AC/DC/IR/SCAN



Dielectric Strength

19051, 19052 & 19053

AC Output Voltage:	Range:	0.05 to 5kV AC, in 1V steps
	Regulation:	\pm (1% of setting +5V)
	Frequency:	50/60Hz selectable
Voltage Display:	Accuracy:	\pm (1% of reading +5V)
	Resolution:	1V steps
AC Current Display:	Total & Real current	
	Range:	0.001mA to 30mA AC, in 1 μ A steps
	Accuracy:	\pm (1% of reading + 5 counts) (Total)
	Accuracy:	\pm (5% of reading + 20 counts) (Real)

19052 & 19053

DC Output Voltage:	Range:	0.05 to 6kV DC, in 1V steps
Voltage Display:	Accuracy:	\pm (1% of reading +5V)
	Resolution:	1V steps
DC Current Display:	Range:	0.0001mA to 10mA DC
	3 Ranges:	0.0001mA – 0.3mA; 0.31mA-3mA; 3.1mA-10mA
	Accuracy:	\pm (1% of reading + 5 counts)

Note: AC set over 75 VA, DC set over 22.5 VA the maximum operating time is 60 seconds, the same as rest time. If the period is 1/2 duty (TUV ON), for full rating output, the line input range is +10%, -0%.

Insulation Resistance

19052 & 19053

Insulation Resistance:	Voltage:	50 - 1000V DC in 1V steps
	Accuracy:	\pm (1.5% of reading + 5V)
	Range:	0.1M Ω - 50G Ω (voltage dependent)
	Accuracy:	1M Ω - 1G Ω , \pm (5% + 10counts) \geq 500V
		1G Ω - 10G Ω , \pm (10% + 10counts) \geq 500V
		10G Ω - 50G Ω , \pm (15% + 10counts) \geq 500V
		0.1M Ω - 1G Ω , \pm (10% + 10counts) < 500V

Credits and Reference:

- IEC 61730-1-2 1st Ed.
- UL1703 3rd Ed.
- <http://www.solarbuzz.com>
- http://en.wikipedia.org/wiki/Solar_panel