

SEMI PV95-0820

TEST METHOD FOR METAL WRAP THROUGH SOLAR CELL VIA RESISTANCE

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1 Purpose

1.1 The purpose of this Document is to standardize a fast and accurate test method for determining metallized vias resistance of metal wrap through (MWT) solar cells. The vias are a must and key design for MWT cells. The metallization within vias plays an important role for the performance of MWT solar cells because the generated current collected by the front fingers will be transferred through the vias to the rear side of the cells. If vias metallization is not fully optimized, there will be poor contact between the front finger and the rear pad. This kind of contacts increases the series resistance which results in the decrease of the fill factor and finally bad electrical performance on cell. It is necessary to setup the standardization of vias' testing method.

2 Scope

2.1 This Standard defines the testing method to determine the resistance of metallized-vias in MWT solar cells.

NOTICE: SEMI Standards and Safety Guidelines do not purport to address all safety issues associated with their use. It is the responsibility of the users of the Documents to establish appropriate safety and health practices, and determine the applicability of regulatory or other limitations prior to use.

3 Referenced Standards and Documents

3.1 ISO Standards¹

ISO 14644-1:2015 — Cleanrooms and Associated Controlled Environments – Part 1: Classification of Air Cleanliness by Particle Concentration

NOTICE: Unless otherwise indicated, all documents cited shall be the latest published versions.

4 Summary of Test Method

4.1 The four points test method has been used here to evaluate the metallized vias resistance of MWT solar cells by calculating the ohm's law (see Figure 1).

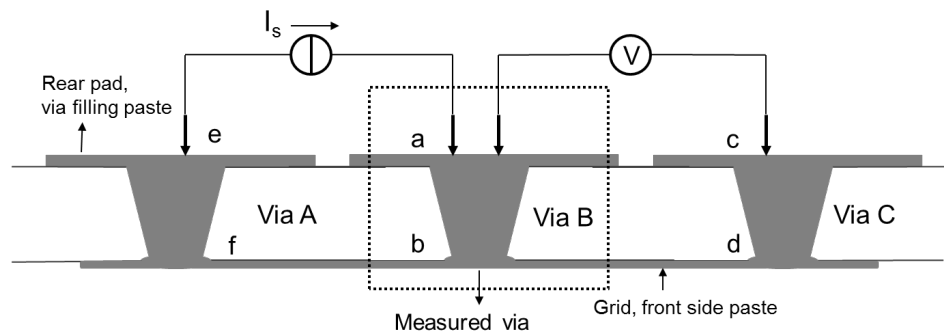


Figure 1
Test Principle

¹ International Organization for Standardization, ISO Central Secretariat, BIBC II, Chemin de Blandonnet 8, CP 401, 1214 Vernier, Geneva, Switzerland; Telephone: +41.22.749.01.11, <http://www.iso.org>

4.1.1 Via B in the dashed box is the measured hole, Via A and Via C are adjacent to Via B. The letters b, d, and f indicate the fronts of these three holes, which Via B, Via C and Via A are connected through grid lines of the cell.

4.1.2 Letters a, c, and e are the isolated back contacts of holes by Via B, Via C and Via A.

4.1.3 Place one probe of the current source on the rear contact (a) of Via B and place the other one on the rear contact (e) of Via A.

4.1.4 Place one probe of the voltmeter on the rear contact (a) of Via B and place the other one on the rear contact (c) of the adjacent Via C.

4.1.5 According to ohm's law, the equivalent resistance of the measured Via B can be calculated.

4.2 The equivalent circuit of the test (see Figure 2).

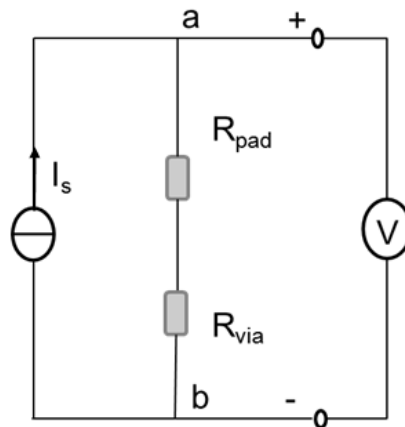


Figure 2
Equivalent Circuit of the Test

4.2.1 The bulk resistivity of silicon is much higher than the resistivity of metal, so the bulk resistance of silicon can be ignored. Figure 2 is the equivalent circuit of the test. From the circuit, we can derive

$$R_{measured} = R_{via} + R_{pad} \quad (1)$$

where:

R_{via} = resistance of the measured via, and

R_{pad} = electrode resistance.

4.2.2 In MWT solar cells, to form the current path from the frontage to the back surface, each via should be filled with metal paste. However, some vias cannot be completely filled in actual production due to factors such as the vacuum degree, the properties of pastes, operating parameters of the screen printing, etc. This phenomenon can cause a sharp increase of the value of R_{via} . Since R_{pad} can be seen as a constant, the value of $R_{measured}$ can indirectly represent the quality of the vias.

5 Apparatus

5.1 *Current Source* — Used to test current values across the resistor of measured via, minimum range required is 10A, accuracy is greater than 0.5%.

5.2 *Voltmeter* — Used to test voltage values in the resistor of measured via, required millivolt voltage meter, the minimum range is 50 mV, high precision class is 0.1%, more than 1 k Ω internal resistance.

5.3 *Four Points Probe* — As a contact probe, the probe tip diameter is required to be less than 0.5 mm.