

SEMI FH2-0323

TEST METHOD OF SHEET RESISTANCE FOR WOVEN ELECTRONIC TEXTILES

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1 Purpose

1.1 Development of soft-dry sensing electrodes and motion sensors is one of the main topics of recent smart textile research, because personal health care is a growing global interest. Where the sensing electrodes are an important configuration for the circuit layout and signal processing, and woven electronic textiles are applied to the sensing electrodes for transmitting the signal.

1.2 In this Standard, van der Pauw method is applied to measure the anisotropic sheet resistance of woven electronic textiles.

1.3 The sheet resistance measurement is important for ensuring the sensing electrode quality in incoming quality control and out-going quality control, and improves the productivity and efficiency.

2 Scope

2.1 This Standard is a test method of sheet resistance for the electrodes of woven electronic textiles.

2.2 The woven structure to be measured in this Standard consists of two sets of yarns that are the warp and the weft, respectively. The warp is along vertical direction, and the weft is along horizontal direction. The woven material is applied to the electrodes of woven electronic textiles.

2.3 This measurement method is applicable to conductive woven fabrics in which both the warp and weft contain conductive yarn, and the conductive yarns in both directions are in electrical contact at the intersection.

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 Limitations

3.1 The measurement range of sheet resistance is limited to $\leq 1 \Omega/\text{sq}$.

4 Referenced Standards and Documents

4.1 *ISO® Standards*¹

ISO 139 — Textiles – Standard atmospheres for conditioning and testing

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

5 Terminology

5.1 None.

6 Apparatus

6.1 *Multimeter*

6.1.1 Voltmeter resolution: $\leq 0.001 \text{ mV}$.

¹ International Organization for Standardization, ISO Central Secretariat, Chemin de Blandonnet 8, CP 401-1214 Vernier, Geneva, Switzerland; Telephone: +41.22.749.01.11, Fax: +41.22.733.34.30, <http://www.iso.org>. ISO trademark is owned by International Organization for Standardization.

6.2 Current Source

6.2.1 Accuracy of current source: $\leq 0.02\%$.

6.3 Testing Chamber

6.3.1 The relative humidity and temperature can be controlled under the conditions $65 \pm 4\%$ RH, $20 \pm 2^\circ\text{C}$ or $50 \pm 5\%$ RH, $23 \pm 2^\circ\text{C}$.

6.4 *Insulation Flat* — The material should be mica, rubber mat, vinyl chloride sheet, or acrylic board.

7 Test Specimens

7.1 The material of test specimens is woven fabrics in which both the warp and weft contain conductive yarn.

7.2 The shape of specimen is square with the size $100 \pm 5\text{ mm} \times 100 \pm 5\text{ mm}$.

7.3 The specimens consist of interlacement of warp and weft, and the structure is flat.

8 Summary of Test Method

8.1 Van der Pauw method is used in determining the sheet resistance.

8.2 Applying current through the adjacent two pads, and measure voltage by the other two pads using the multimeter.

8.3 The sheet resistance is calculated by the resistance of vertical direction and horizontal direction according to van der Pauw method.

9 Procedure

9.1 The calibration of multimeter and the current source shall be repeated periodically based on the manufacturer's recommendations or the lab rules and regulations.

9.2 Prepare the test specimens in a suitable testing chamber or a conditioning room at a predetermined relative humidity and temperature.

9.3 The measurement shall be performed under the conditions of $65 \pm 4\%$ RH and $20 \pm 2^\circ\text{C}$, or $50 \pm 5\%$ RH and $23 \pm 2^\circ\text{C}$ which is followed by ISO 139, or other settings (such as the test conditions comply with the using conditions of end-products). The temperature and humidity shall be consistent during measurements.

9.4 Before the measurement, the test specimens are stabilized under the conditions of the measurement conditions.

NOTE 1: 24 hours is recommended for stabilization time.

9.5 The redundant charges of specimens shall be removed.

9.6 Check the size and shape of specimen square with the size $100 \pm 5\text{ mm} \times 100 \pm 5\text{ mm}$.

9.7 The antistatic mat is grounded and is placed on the flat workbench. The surface should be larger than the specimen.

9.8 Place the insulation flat on the anti-static mat, and put the test specimen on the insulation flat.

9.9 Four test pads shall be placed on the four edges of the specimen.

9.9.1 The test pads size shall be from $4 \pm 1\text{ mm} \times 4 \pm 1\text{ mm}$.

9.9.2 The materials of test pads shall be copper or other conductive substances.

9.10 Applying proper pressure on the test pads to ensure the stabilization of the measurement result, and when additional pressure is applied, the test results are not affected.

9.11 The multimeter and current source are calibrated.

9.12 The multimeter and the current source of the measurement system shall be warmed up at least 30 minutes before the measurement.

NOTE 2: It is recommended to wear the anti-static bracelet or the insulating gloves.

9.13 Fix the specimen and make it flat and not stretched.