INTERNATIONAL

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Test Method for Determining the Electrical Resistivity of a Printed Conductive Material[1]

This standard is issued under the fixed designation F1896; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This test method covers the determination of the electrical resistivity of a conductive material as used in the manufacture of a membrane switch.

1.2 This test method is not suitable for measuring force sensitive conductive materials.

~~1.3The values stated in inch-pound units are to be regarded as the standard. The values given in parentheses are for information only.~~

1.3 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Terminology

2.1 *Definitions:*

2.1.1 *membrane switch*—a momentary switching device in which at least one contact is on, or made of, a flexible substrate.

2.1.2 *circuit/test pattern resistance*—electrical resistance as measured between two terminations of a circuit trace.

2.1.3 *square*—A geometric unit of a printed conductive circuit trace/pattern obtained by dividing the length (*L*) of the printed conductive circuit trace/pattern by its width (*W*).

2.1.4 *resistivity*—ohms per square per mil of a conductive material.

3. Significance and Use

3.1 Resistivity is useful to suppliers and manufacturers as follows:

3.1.1 when designing membrane switch interface circuitry,

3.1.2 when selecting the appropriate conductive material,

3.1.3 for conductive material quality verification, and

3.1.4 for conductive material cure optimization and quality control.

4. Interferences

4.1 The precision and bias of this test method are under investigation. The accuracy of the resistivity determination will be improved as the number of squares of the resistance test strip is increased. The accuracy of the resistivity determination will be improved as the width (*W*) of the circuitry test pattern is increased. Some conductive materials' resistivity are sensitive to temperature and the temperature of the test specimen should be noted and recorded.

5. Apparatus

~~4.1~~

5.1 *Resistance Measuring Device*, (that is, ohm meter) equipped with test leads and probes. The device should be capable of measuring resistances up to 100 MΩ with an accuracy of greater than 1.5 % of full scale reading. Test probes should have tips that are 25 to 250 % of the width (*W*) of the printed conductor test pattern.

~~4.2~~

5.2 *Test Surface*, to be flat, smooth, unyielding and larger than switch under test.

~~4.3~~

[1] This test method is under the jurisdiction of Committee F01 on Electronics , and is the direct responsibility of Subcommittee F01.18 on Membrane Switches.

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5.3 *Thickness Measuring Device*, capable of measuring to the nearest 0.00005 in. (1.25 µm).
~~4.4~~
5.4 *Dimensional Measuring Device*, capable of measuring to the nearest 0.001 in. (25 µm).

~~**5.**~~

6. Test Specimen

~~5.1A~~6.1 A resistance test strip of printed and cured conductive material with a minimum length (*L*) to width (*W*) ratio of 50:1 (equal to or greater than 50 squares). A pattern of membrane switch circuitry is sufficient if a straight measurable strip, with a minimum length (*L*) to width (*W*) ratio of 50:1 (equal to or greater than 50 squares), is available. The accuracy of the resistivity determination will be improved as the number of squares of the resistance test strip is increased.

~~**6.**~~

7. Procedure

~~6.1~~
7.1 *Pre-Test Setup*:
~~6~~7.1.1 Secure switch/test pattern (that is, printed and cured conductive material) on the test surface.
~~6~~7.1.2 Measure the geometry of the test pattern as follows:
~~6~~7.1.2.1 Measure the length (*L*) of the printed test pattern.
~~6~~7.1.2.2 Measure the width (W) of the printed test pattern.
~~6~~7.1.2.3 Divide the length (L) by the width (W) to calculate the number of squares of the printed test pattern. Should be ≥50 squares.

NOTE 1—Measuring the length (L) and width (W) of the actual printed pattern checks the accuracy of the actual number of squares printed versus the artwork.

~~6.2~~
7.2 *In-Process Test*:
~~6~~7.2.1 Using the resistance measuring device (that is, ohm meter), measure the resistance of the printed test pattern. Place probes at ends of measured length of the test pattern as shown in Fig. 1.
~~6~~7.2.2 Record resistance in ohms.
~~6~~7.2.3 Using the thickness measuring device, measure the thickness (*t*) of the printed test pattern in mils, measure in a minimum of three locations across the test pattern.
~~6~~7.2.4 Record average thickness (*t*) in mils (1 mil = 25 µm).
~~6.3~~
7.3 *Calculations*:
~~6~~7.3.1 Determine the number of squares of the printed test pattern by dividing the length (*L*) by the width (*W*). Record the number of squares.
~~6~~7.3.2 Determine the ohms per square by dividing the measured resistance (in ohms) by the number of squares. Record the ohms per square.

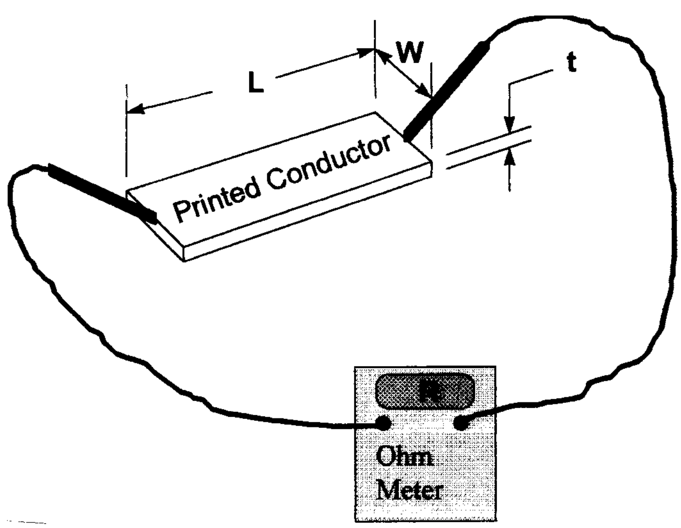

FIG. 1 Resistance Measurement Test Set-Up