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EIA STANDARD

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LOW LEVEL CONTACT RESISTANCE TEST PROCEDURE FOR ELECTRICAL CONNECTORS AND SOCKETS

EIA/ECA-364-23C

(Revision of EIA-364-23B)

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(From Standards Proposal No. 5105 formulated under the cognizance of the CE-2.0 National Connectors Standards Committee.

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TEST PROCEDURE No. 23C

LOW LEVEL CONTACT RESISTANCE TEST PROCEDURE
FOR
ELECTRICAL CONNECTORS AND SOCKETS

(From EIA Standards Proposal No. 5105, formulated under the cognizance EIA CE-2.0 Committee on National Connector Standards, and previously published in EIA-364-23B.)

1 Introduction

1.1. Scope

This test procedure may apply to any type or combination of current carrying members such as pin and socket contacts, relay contacts, wire and crimp connectors, or printed circuit board and contact.

1.2. Object

The object of this test procedure is to detail a standard method to measure the electrical resistance of two current carrying members in mutual contact. This test procedure specifies test voltages that will not disturb insulating films on the contacting surface nor cause asperity melting. This procedure addresses the effect of thermal EMF's, a source of measurement error.

2 Test resources

2.1. Equipment

Low level contact resistance measurements may be made using a discrete power source, ammeter and micro-voltmeter or an integrated micro-ohmmeter.

2.1.1. Integrated micro-ohmmeter

Four wire resistance meter that regulates test current, limits open circuit (source) voltage to 20 millivolts maximum, corrects for thermal EMF's, measures voltage drop, such as a Keithley Micro-Ohmmeter model 580, HP 4338B or equivalent, may be used. These meters generally display the measured resistance directly in ohms.

2.1.2. Discrete Equipment

2.1.2.1. Power source

Power supply or circuit capable of regulating either alternating or direct current within 5% of desired value, and limiting the open circuit (source) voltage to 20 millivolts maximum.

2.1.2.2. Ammeter or current shunt

Capable of measuring either alternating or direct current within an accuracy of 2%.

2.1.2.3. Micro-voltmeter

Capable of measuring either alternating or direct current voltage within an accuracy of 2%

2.1.2.4. Low Level Circuit

Low level circuit delivering 100 milliamperes at 20 millivolts open circuit potential.

2.2. Fixture

The test specimen shall be mated or fixtured as in normal service, or as specified in the referencing document. Fixturing of specimens shall not disturb the natural normal force of the mating contacts.

3 Test specimen

3.1 The test specimen shall be wired as specified in the referencing document. Connections may be made by use of clips, by soldering to a printed circuit board and/or wires. Subsequent measurements should be made at the same point to reduce variability due to path length changes. Soldering the sample to a printed circuit board or to wires fixes the measurement point.

3.2 Voltage probes for crimp contacts shall be placed on the conductors a distance of 152.4 millimeters ± 3.0 millimeters (6.00 inch ± 0.12 inch) from each other, with the mated contacts in the center of that distance unless otherwise specified in the referencing document.

4 Test procedure

Measure and record the contact resistance of the specimen under test with a test current of 100 milliamperes maximum and 20 millivolts open circuit (source) voltage maximum. One of the following options shall be used to correct for thermal EMF's.

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4.1. Option 1, integrated micro-ohmmeter

Use an 4 wire micro-ohmmeter. The micro-ohmmeter shall employ a method to correct for thermal EMF. Such methods include; alternating current, pulsed direct current or current reversal. Integrated meters generally measure the actual test current and the voltage drop across the specimen. The measured resistance is then internally calculated and displayed.

4.2. Option 2, current reversal (direct current)

Apply direct current through the specimen. Measure the current and record it as I_f. Measure the voltage drop across the specimen and record it as V_f. Reverse the direction of current through the specimen. Do not reverse the voltage leads. Measure the current and record it as I_r. Measure the voltage drop across the specimen and record it as V_r.

Calculate the contact resistance with the following equation:

$$R = \frac{|V_f - V_r|}{|I_f| + |I_r|} \qquad (1)$$

NOTE — The sign of the voltage readings shall be carried into the equation to obtain a proper result.

4.3. Option 3, offset compensation

Apply direct current through the specimen. Measure the current and record it as I. Measure the voltage drop across the specimen and record it as V_1.

Remove the current from the specimen. Measure the voltage drop across the specimen as V_2. Calculate the contact resistance with the following equation:

$$R = \frac{|V_1| - |V_2|}{|I|} \qquad (2)$$

4.4. Option 4, alternating current

Apply alternating current through the specimen. Measure the current and record it as I. Measure the voltage drop across the specimen using a true RMS voltmeter and record it as V.

Calculate the contact resistance with the following equation:

$$R = \frac{|V|}{|I|} \qquad (3)$$

5 Details to be specified

The following details shall be specified in the referencing document:

5.1 Test specimen preparation or conditioning

5.2 Test specimen mating conditions or fixturing

5.3 Placement of test leads on specimen (see 3.2)

5.4 Test current and voltage other than 100 milliamperes maximum and 20 millivolts open circuit (source) voltage maximum

5.5 Number of specimens to be tested

6 Test documentation

Documentation shall contain the details specified in clause 5, with any exceptions, and the following:

6.1 Title of test

6.2 Specimen description

6.3 Test specimen preparation or conditioning

6.4 Test specimen mating conditions or fixturing

6.5 Test equipment used, and date of last and next calibration

6.6 Test current and voltage other than 100 milliamperes maximum and 20 millivolts open circuit (source) voltage maximum

6.7 Values and observations

6.8 Name of operator and date of test

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EIA Document Improvement Proposal

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