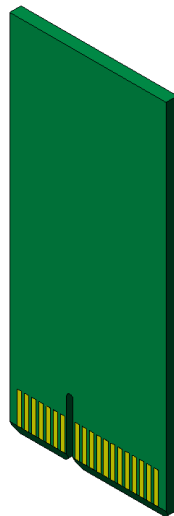
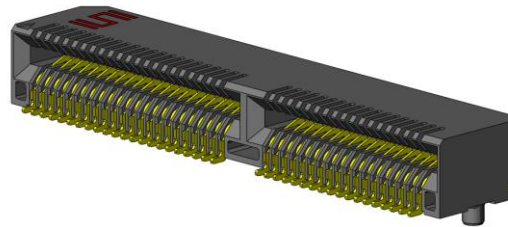




|                                                  |                                    |
|--------------------------------------------------|------------------------------------|
| Project Number: Design Qualification Test Report | Tracking Code: 245434_Report_Rev_1 |
| Requested by: Catie Eichhorn                     | Date: 06/20/2019                   |
| Part #: MEC8-140-02-L-D-RA1/Edge card            | Tech: Peter Chen                   |
| Part description: MEC8/Card                      | Qty to test: 25                    |
| Test Start: 08/13/2013                           | Test Completed: 08/27/2013         |



## DESIGN QUALIFICATION TEST REPORT

**MEC8/Card**  
**MEC8-140-02-L-D-RA1/Edge card**

|                                    |                                       |
|------------------------------------|---------------------------------------|
| Tracking Code: 245434_Report_Rev_1 | Part #: MEC8-140-02-L-D-RA1/Edge card |
| Part description: MEC8/Card        |                                       |

### REVISION HISTORY

| DATA       | REV.NUM. | DESCRIPTION   | ENG |
|------------|----------|---------------|-----|
| 09/02/2013 | 1        | Initial Issue | PC  |

## CERTIFICATION

All instruments and measuring equipment were calibrated to National Institute for Standards and Technology (NIST) traceable standards according to ISO 10012-1 and ANSI/NCSL 2540-1, as applicable.

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## SCOPE

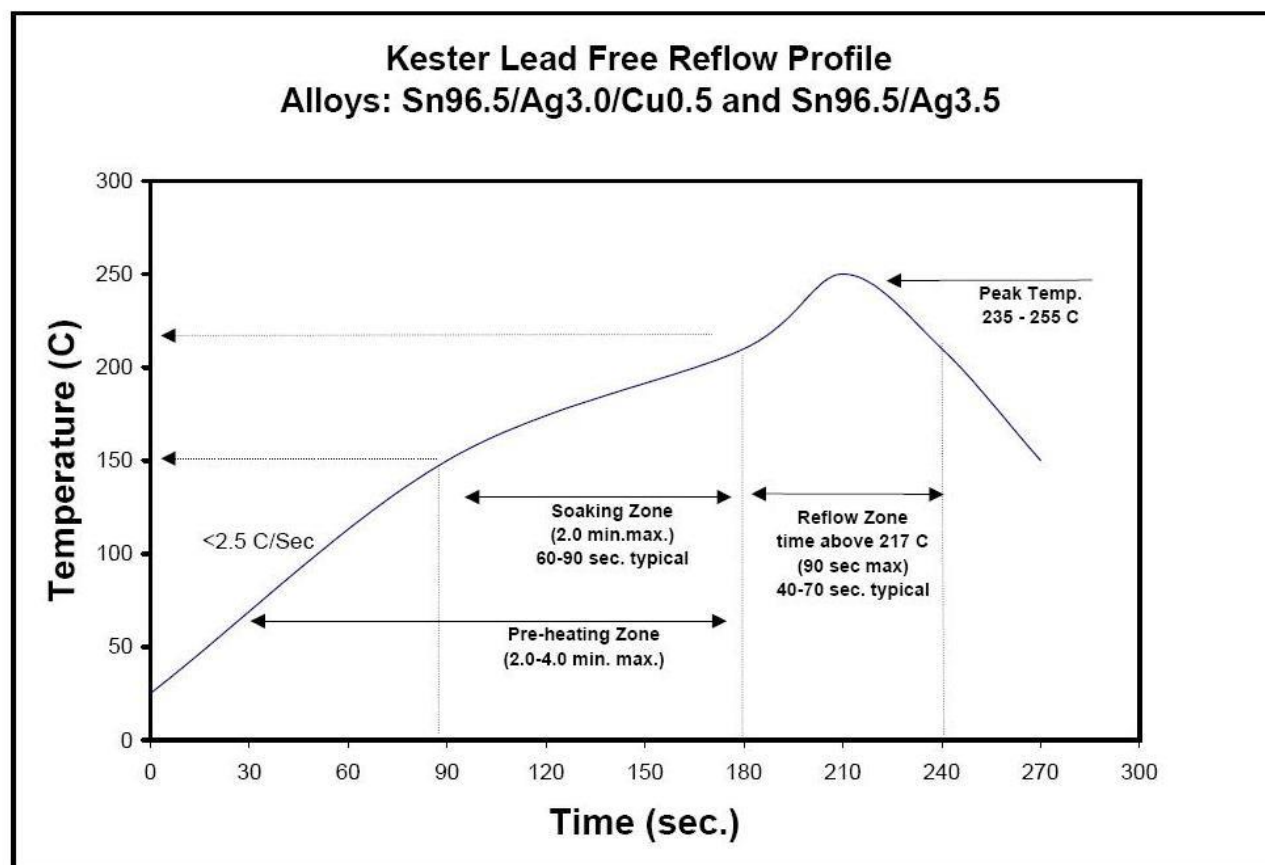
To perform the following tests: Design Qualification test. Please see test plan.

## APPLICABLE DOCUMENTS

Standards: EIA Publication 364

## TEST SAMPLES AND PREPARATION

- 1) All materials were manufactured in accordance with the applicable product specification.
- 2) All test samples were identified and encoded to maintain traceability throughout the test sequences.
- 3) After soldering, the parts to be used for LLCr testing were cleaned according to TLWI-0001.
- 4) Either an automated cleaning procedure or an ultrasonic cleaning procedure may be used.
- 5) The automated procedure is used with aqueous compatible soldering materials.
- 6) Parts not intended for testing LLCr are visually inspected and cleaned if necessary.
- 7) Any additional preparation will be noted in the individual test sequences.
- 8) Solder Information: Lead Free
- 9) Re-Flow Time/Temp: See accompanying profile.
- 10) Samtec Test PCBs used: PCB-104308-TST-01

**TYPICAL OVEN PROFILE (Soldering Parts to Test Boards)**

**FLOWCHARTS****Current Carrying Capacity - Double Row**

| TEST STEP | GROUP B1<br>3 Mated Assemblies<br>2 Contacts Powered | GROUP B2<br>3 Mated Assemblies<br>4 Contacts Powered | GROUP B3<br>3 Mated Assemblies<br>6 Contacts Powered | GROUP B4<br>3 Mated Assemblies<br>8 Contacts Powered | GROUP B5<br>3 Mated Assemblies<br>All Contacts Powered |
|-----------|------------------------------------------------------|------------------------------------------------------|------------------------------------------------------|------------------------------------------------------|--------------------------------------------------------|
| 01        | CCC                                                  | CCC                                                  | CCC                                                  | CCC                                                  | CCC                                                    |

(TIN PLATING) - Tabulate calculated current at RT, 65°C, 75°C and 95°C  
after derating 20% and based on 105°C

(GOLD PLATING) - Tabulate calculated current at RT, 85°C, 95°C and 115°C  
after derating 20% and based on 125°C

CCC, Temp rise = EIA-364-70

**Mechanical Shock / Vibration / LLCR**

| TEST STEP | GROUP 1<br>8 Assemblies (.056"<br>Edge Card) | GROUP 2<br>8 Assemblies (.068"<br>Edge Card) |
|-----------|----------------------------------------------|----------------------------------------------|
| 01        | LLCR-1                                       | LLCR-1                                       |
| 02        | Shock                                        | Shock                                        |
| 03        | Vibration                                    | Vibration                                    |
| 04        | LLCR-2                                       | LLCR-2                                       |

Mechanical Shock = EIA 364-27 Half Sine,

100 g's, 6 milliSeconds (Condition "C") each axis

Vibration = EIA 364-28, Random Vibration

7.56 g RMS, Condition VB --- 2 hours/axis

LLCR = EIA-364-23, LLCR

20 mV Max, 100 mA Max

Use Keithley 580 or 3706 in 4 wire dry circuit mode

**Shock / Vibration / nanoSecond Event Detection**

| TEST STEP | GROUP A1<br>60 Points (0.056"<br>Edge Card) |
|-----------|---------------------------------------------|
| 01        | Event Detection,<br>Shock                   |
| 02        | Event Detection,<br>Vibration               |

Mechanical Shock = EIA 364-27 Half Sine,

100 g's, 6 milliSeconds (Condition "C") each axis

Vibration = EIA 364-28, Random Vibration

7.56 g RMS, Condition VB --- 2 hours/axis

Event detection requirement during Shock / Vibration is 50 nanoseconds minimum

**ATTRIBUTE DEFINITIONS**

The following is a brief, simplified description of attributes.

**MECHANICAL SHOCK (Specified Pulse):**

- 1) Reference document: EIA-364-27, *Mechanical Shock Test Procedure for Electrical Connectors*
- 2) Test Condition C
- 3) Peak Value: 100 G
- 4) Duration: 6 Milliseconds
- 5) Wave Form: Half Sine
- 6) Velocity: 12.3 ft/s
- 7) Number of Shocks: 3 Shocks / Direction, 3 Axis (18 Total)

**VIBRATION:**

- 1) Reference document: EIA-364-28, *Vibration Test Procedure for Electrical Connectors*
- 2) Test Condition V, Letter B
- 3) Power Spectral Density: 0.04 G<sup>2</sup> / Hz
- 4) G 'RMS': 7.56
- 5) Frequency: 50 to 2000 Hz
- 6) Duration: 2.0 Hours per axis (3 axis total)

**NANOSECOND-EVENT DETECTION:**

- 1) Reference document: EIA-364-87, *Nanosecond-Event Detection for Electrical Connectors*
- 2) Prior to test, the samples were characterized to assure the low nanosecond event being monitored will trigger the detector.
- 3) After characterization it was determined the test samples could be monitored for 50 nanosecond events

**ATTRIBUTE DEFINITIONS Continued**

The following is a brief, simplified description of attributes.

**TEMPERATURE RISE (Current Carrying Capacity, CCC):**

- 1) EIA-364-70, *Temperature Rise versus Current Test Procedure for Electrical Connectors and Sockets*.
- 2) When current passes through a contact, the temperature of the contact increases as a result of  $I^2R$  (resistive) heating.
- 3) The number of contacts being investigated plays a significant part in power dissipation and therefore temperature rise.
- 4) The size of the temperature probe can affect the measured temperature.
- 5) Copper traces on PC boards will contribute to temperature rise:
  - a. Self heating (resistive)
  - b. Reduction in heat sink capacity affecting the heated contacts
- 6) A de-rating curve, usually 20%, is calculated.
- 7) Calculated de-rated currents at three temperature points are reported:
  - a. Ambient
  - b. 80° C
  - c. 95° C
  - d. 115° C
- 8) Typically, neighboring contacts (in close proximity to maximize heat build up) are energized.
- 9) The thermocouple (or temperature measuring probe) will be positioned at a location to sense the maximum temperature in the vicinity of the heat generation area.
- 10) A computer program, *TR 803.exe*, ensures accurate stability for data acquisition.
- 11) Hook-up wire cross section is larger than the cross section of any connector leads/PC board traces, jumpers, etc.
- 12) Hook-up wire length is longer than the minimum specified in the referencing standard.

**LLCR:**

- 1) EIA-364-23, *Low Level Contact Resistance Test Procedure for Electrical Connectors and Sockets*.
- 2) A computer program, *LLCR 221.exe*, ensures repeatability for data acquisition.
- 3) The following guidelines are used to categorize the changes in LLCR as a result from stressing
  - a.  $\leq +5.0$  mOhms:----- Stable
  - b.  $+5.1$  to  $+10.0$  mOhms:----- Minor
  - c.  $+10.1$  to  $+15.0$  mOhms:----- Acceptable
  - d.  $+15.1$  to  $+50.0$  mOhms:----- Marginal
  - e.  $+50.1$  to  $+2000$  mOhms:----- Unstable
  - f.  $>+2000$  mOhms:----- Open Failure

**RESULTS****Temperature Rise, CCC at a 20% de-rating**

- CCC for a 30°C Temperature Rise-----2.4 A per contact with 2 adjacent contacts powered
- CCC for a 30°C Temperature Rise-----1.8 A per contact with 4 adjacent contacts powered
- CCC for a 30°C Temperature Rise-----1.4 A per contact with 6 adjacent contacts powered
- CCC for a 30°C Temperature Rise-----1.3 A per contact with 8 adjacent contacts powered
- CCC for a 30°C Temperature Rise-----0.7 A per contact with all adjacent contacts powered

**LLCR Shock & Vibration Group (192 LLCR test points)****Card thickness-0.056"**

- Initial ----- 17.19 mOhms Max
- Shock & Vibration
  - <= +5.0 mOhms ----- 190 Points ----- Stable
  - +5.1 to +10.0 mOhms ----- 2 Points ----- Minor
  - +10.1 to +15.0 mOhms ----- 0 Points ----- Acceptable
  - +15.1 to +50.0 mOhms ----- 0 Points ----- Marginal
  - +50.1 to +2000 mOhms ----- 0 Points ----- Unstable
  - >+2000 mOhms ----- 0 Points ----- Open Failure

**Card thickness-0.068"**

- Initial ----- 16.39 mOhms Max
- Shock & Vibration
  - <= +5.0 mOhms ----- 191 Points ----- Stable
  - +5.1 to +10.0 mOhms ----- 1 Points ----- Minor
  - +10.1 to +15.0 mOhms ----- 0 Points ----- Acceptable
  - +15.1 to +50.0 mOhms ----- 0 Points ----- Marginal
  - +50.1 to +2000 mOhms ----- 0 Points ----- Unstable
  - >+2000 mOhms ----- 0 Points ----- Open Failure

**Mechanical Shock & Random Vibration:****Card thickness-0.056"**

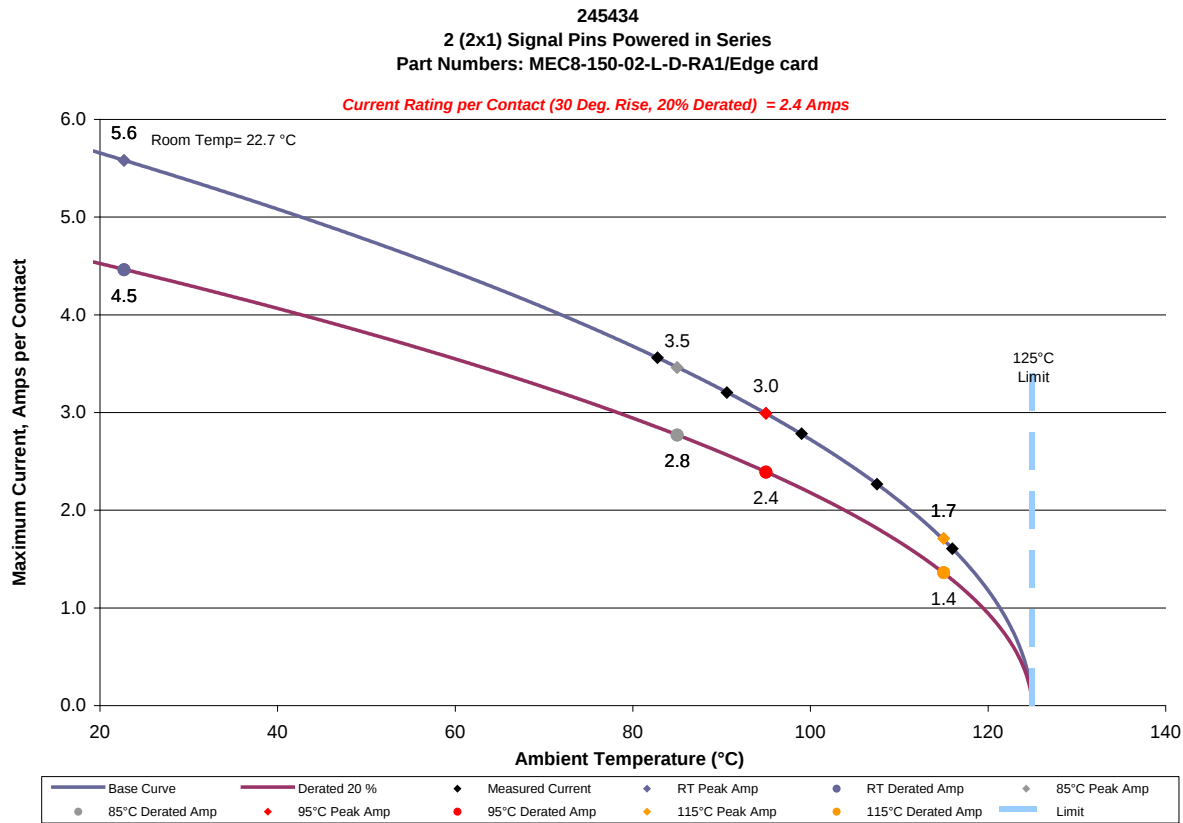
- Shock
  - No Damage----- Pass
  - 50 Nanoseconds----- Pass
- Vibration
  - No Damage----- Pass
  - 50 Nanoseconds----- Pass

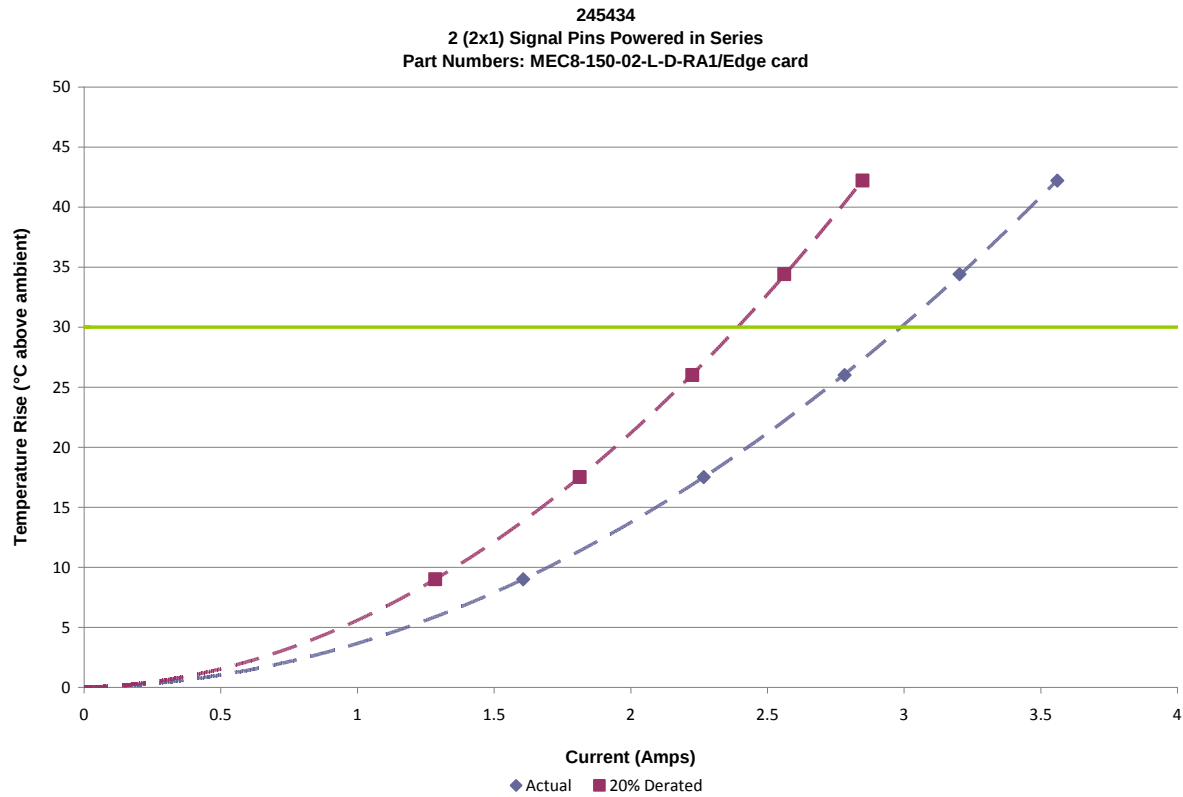
## DATA SUMMARIES

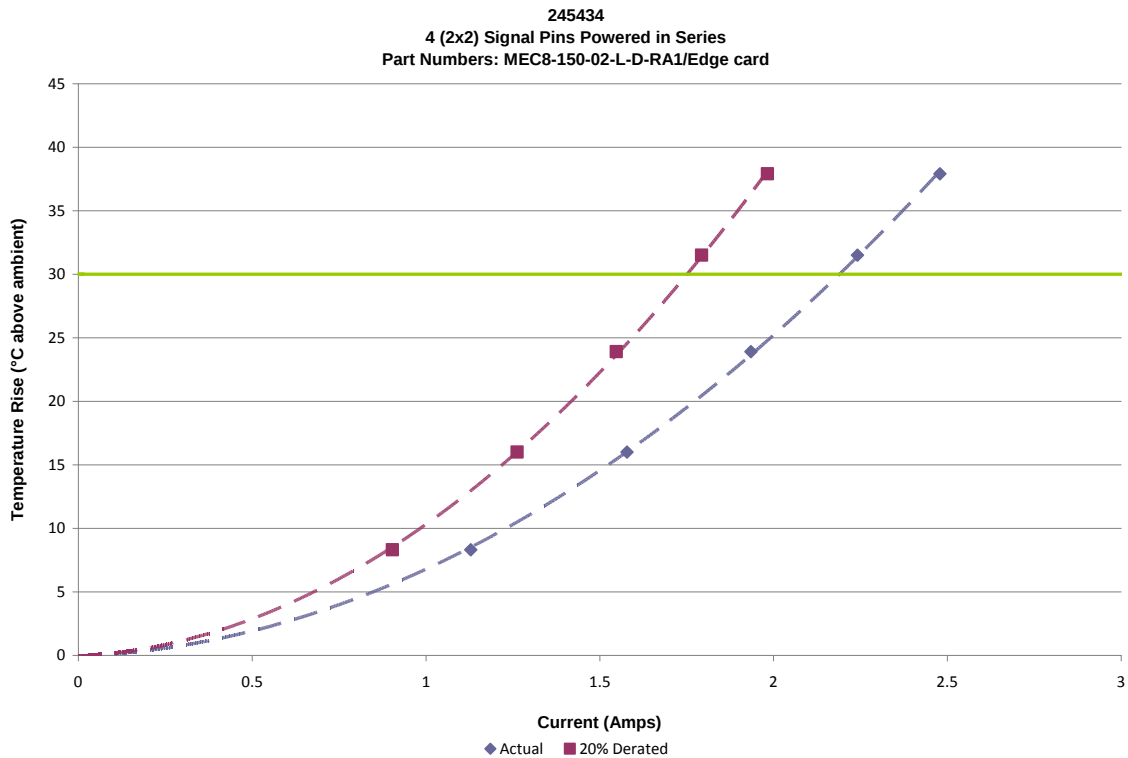
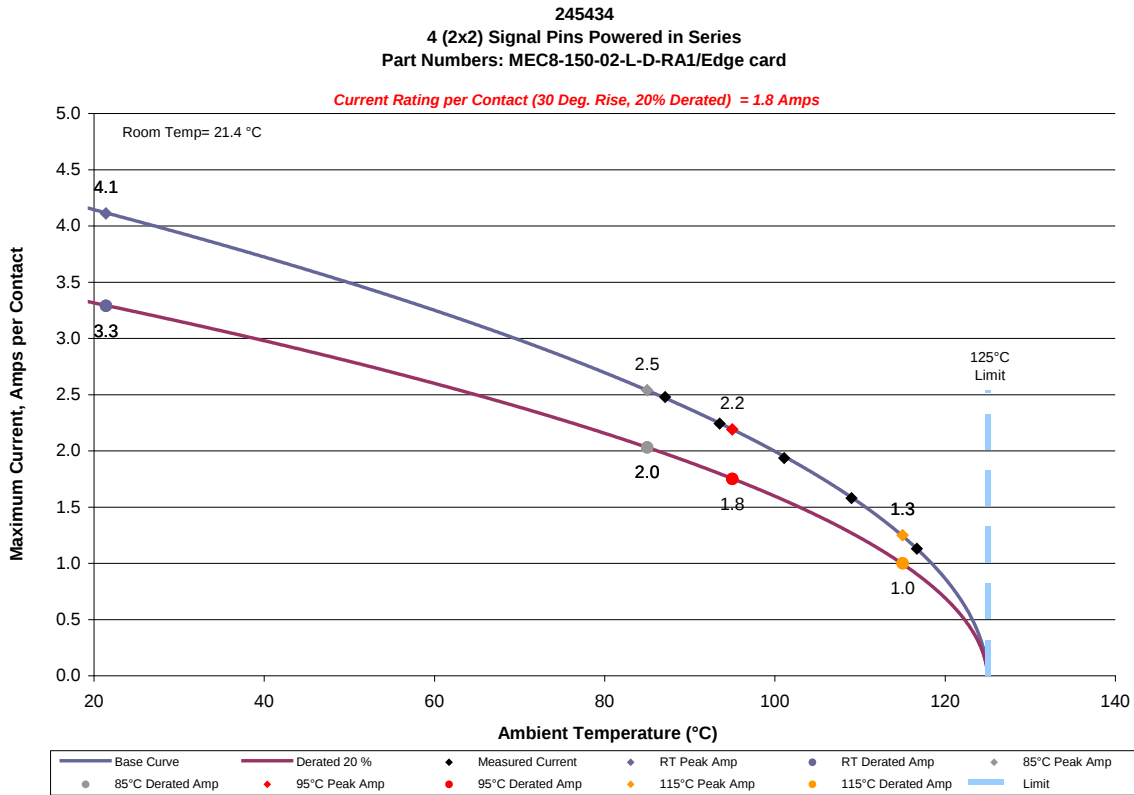
### TEMPERATURE RISE (Current Carrying Capacity, CCC):

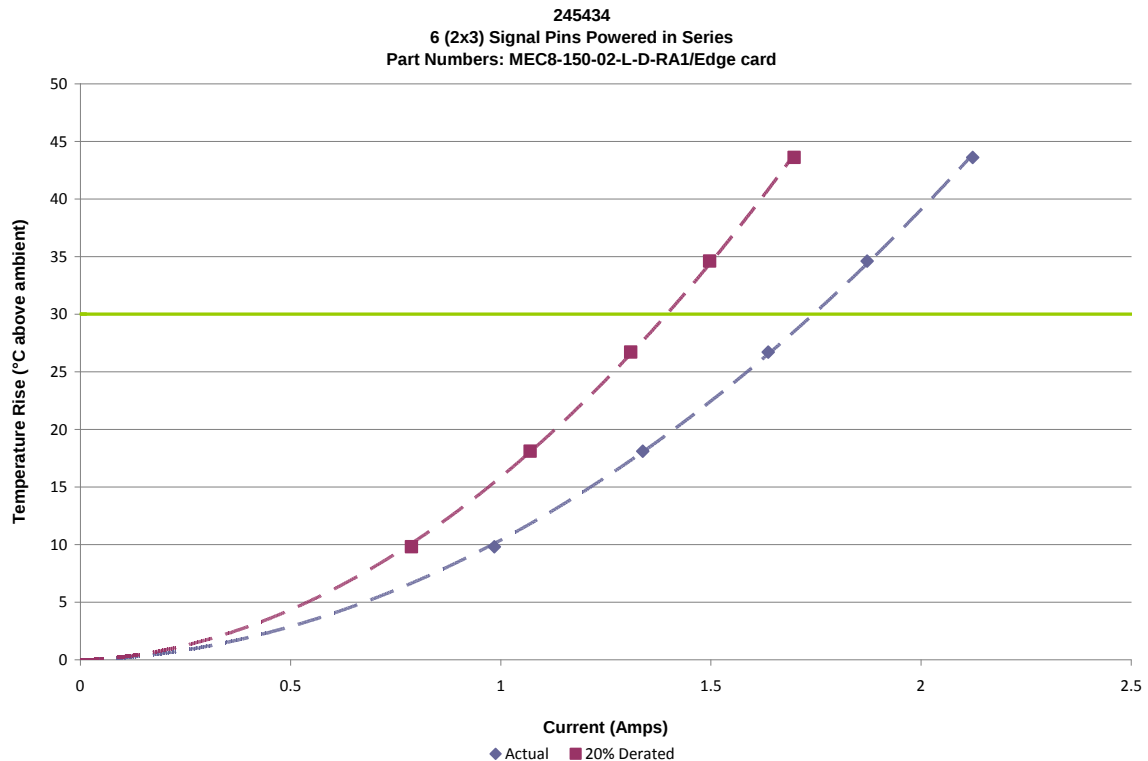
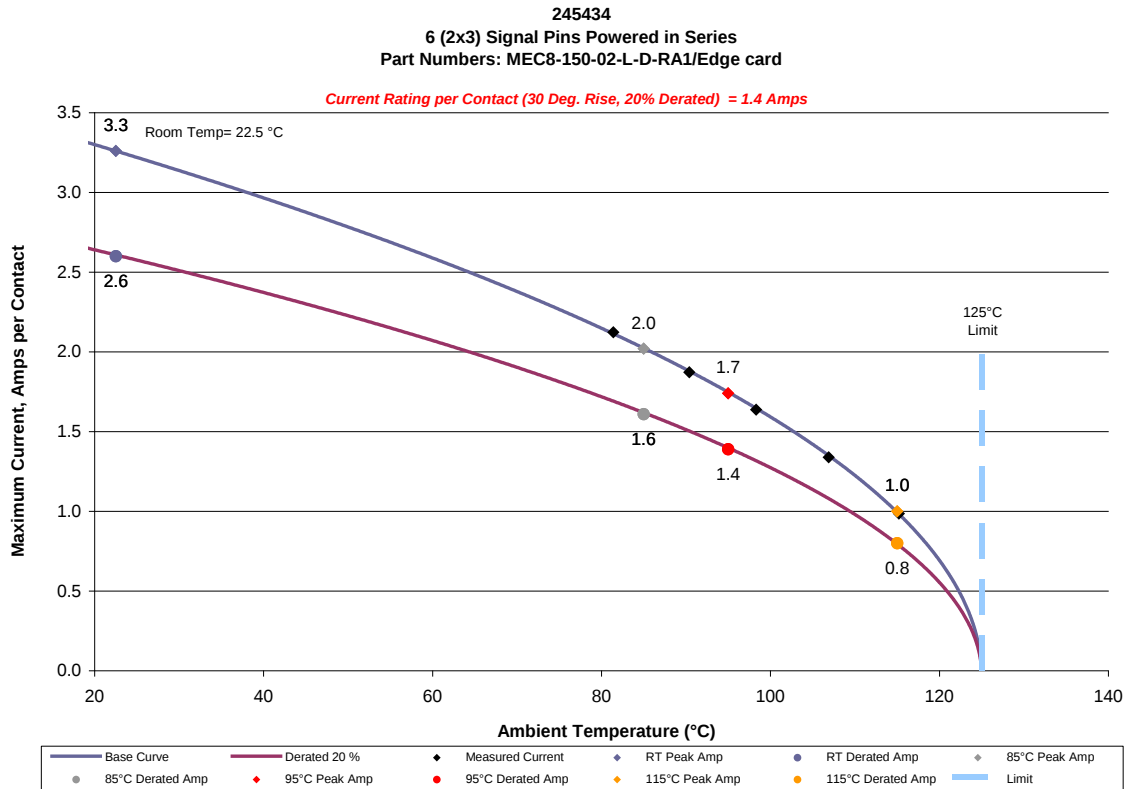
- 1) High quality thermocouples whose temperature slopes track one another were used for temperature monitoring.
- 2) The thermocouples were placed at a location to sense the maximum temperature generated during testing.
- 3) Temperature readings recorded are those for which three successive readings, 15 minutes apart, differ less than 1° C (computer controlled data acquisition).
- 4) Adjacent contacts were powered:

#### a. Linear configuration with 2 adjacent conductors/contacts powered



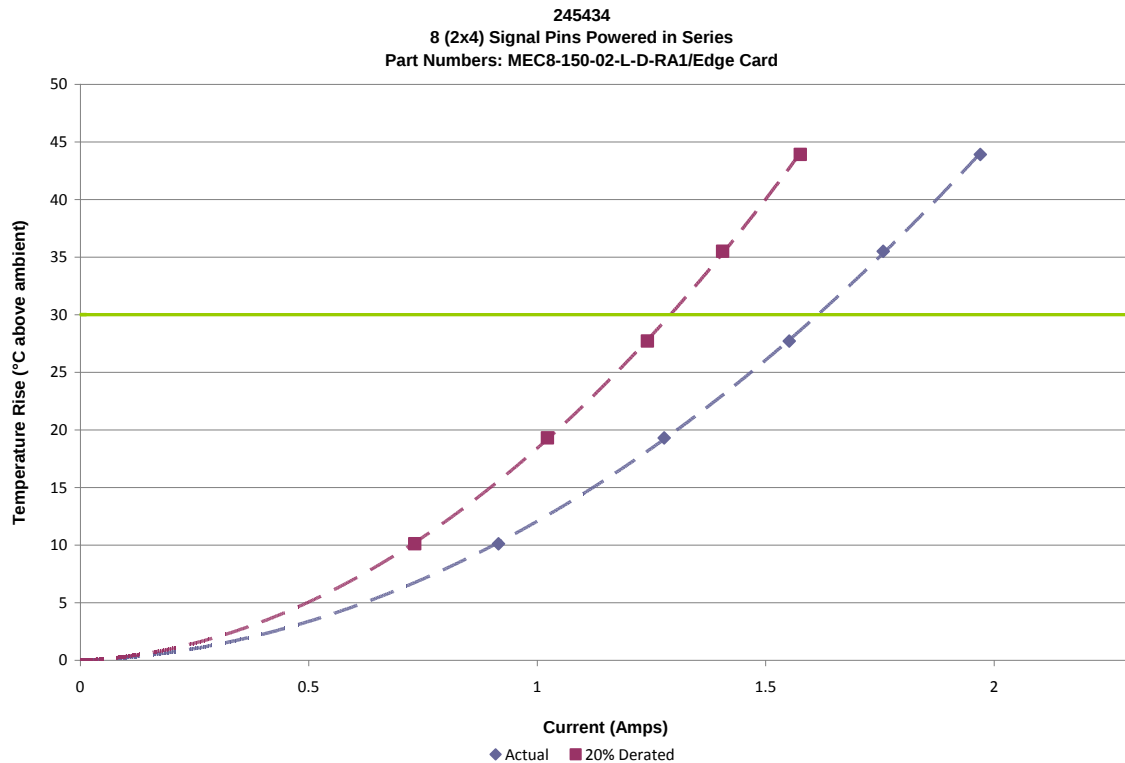
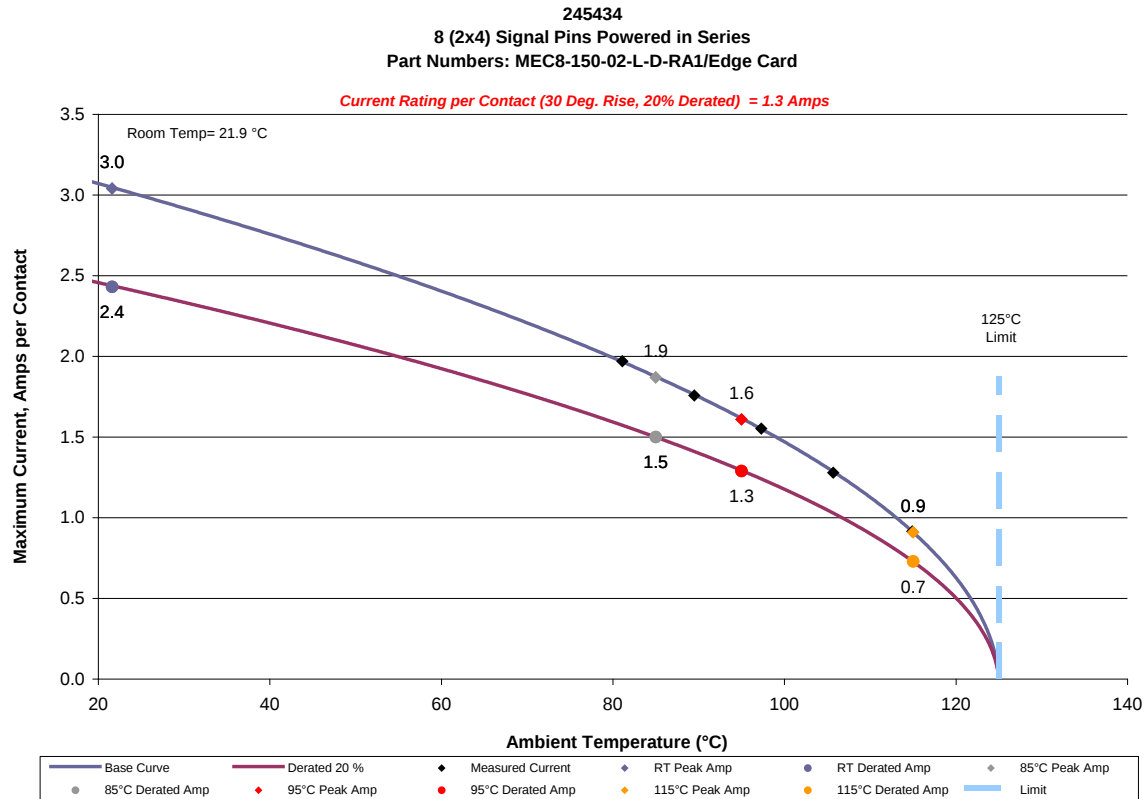
**DATA SUMMARIES Continued**

**DATA SUMMARIES Continued****b. Linear configuration with 4 adjacent conductors/contacts powered**

**DATA SUMMARIES Continued****c. Linear configuration with 6 adjacent conductors/contacts powered**

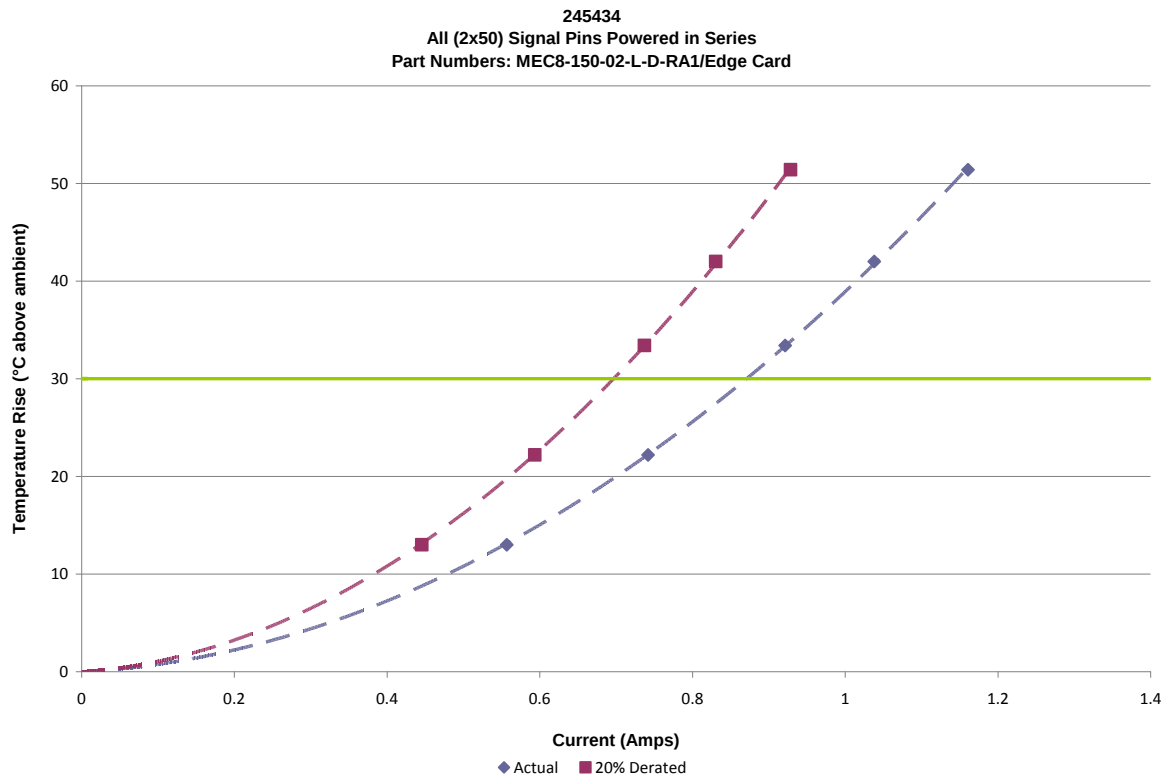
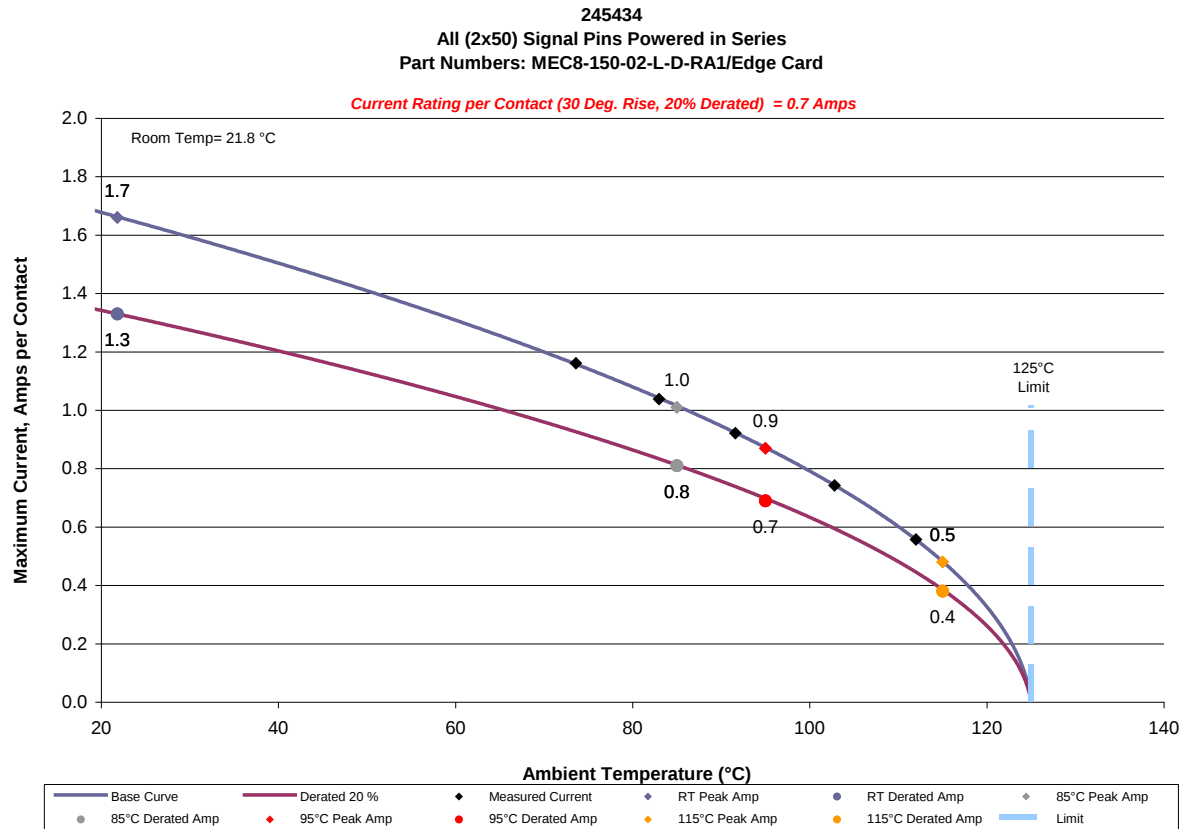
**DATA SUMMARIES Continued**

d. Linear configuration with 8 adjacent conductors/contacts powered



**DATA SUMMARIES Continued**

e. Linear configuration with all adjacent conductors/contacts powered



**DATA SUMMARIES Continued****LLCR Shock & Vibration Group**

- 1) A total of 192 points were measured.
- 2) EIA-364-23, *Low Level Contact Resistance Test Procedure for Electrical Connectors and Sockets*.
- 3) A computer program, *LLCR 221.exe*, ensures repeatability for data acquisition.
- 4) The following guidelines are used to categorize the changes in LLCR as a result from stressing.
  - a.  $\leq +5.0$  mOhms:-----Stable
  - b.  $+5.1$  to  $+10.0$  mOhms:-----Minor
  - c.  $+10.1$  to  $+15.0$  mOhms:-----Acceptable
  - d.  $+15.1$  to  $+50.0$  mOhms:-----Marginal
  - e.  $+50.1$  to  $+2000$  mOhms -----Unstable
  - f.  $>+2000$  mOhms:-----Open Failure

**Card thickness-0.056"**

| <b>LLCR Measurement Summaries by Pin Type</b> |                       |                        |              |              |
|-----------------------------------------------|-----------------------|------------------------|--------------|--------------|
| Date                                          | 8/23/2013             | 8/27/2013              |              |              |
| Room Temp (Deg C)                             | 22                    | 22                     |              |              |
| Rel Humidity (%)                              | 45                    | 42                     |              |              |
| Technician                                    | Craig Ryan            | Craig Ryan             |              |              |
| mOhm values                                   | <b>Actual Initial</b> | <b>Delta Shock-Vib</b> | <b>Delta</b> | <b>Delta</b> |
| <b>Pin Type 1: Row 1</b>                      |                       |                        |              |              |
| Average                                       | 12.25                 | 1.08                   |              |              |
| St. Dev.                                      | 0.83                  | 1.25                   |              |              |
| Min                                           | 10.66                 | 0.07                   |              |              |
| Max                                           | 15.25                 | 9.93                   |              |              |
| Summary Count                                 | 64                    | 64                     |              |              |
| Total Count                                   | 64                    | 64                     |              |              |
| <b>Pin Type 2: Row 2</b>                      |                       |                        |              |              |
| Average                                       | 15.18                 | 0.65                   |              |              |
| St. Dev.                                      | 0.61                  | 0.86                   |              |              |
| Min                                           | 13.85                 | 0.00                   |              |              |
| Max                                           | 17.19                 | 6.95                   |              |              |
| Summary Count                                 | 128                   | 128                    |              |              |
| Total Count                                   | 128                   | 128                    |              |              |

| <b>LLCR Delta Count by Category</b> |               |                          |                           |                           |                             |             |
|-------------------------------------|---------------|--------------------------|---------------------------|---------------------------|-----------------------------|-------------|
|                                     | <b>Stable</b> | <b>Minor</b>             | <b>Acceptable</b>         | <b>Marginal</b>           | <b>Unstable</b>             | <b>Open</b> |
| mOhms                               | $\leq 5$      | $>5 \text{ \& } \leq 10$ | $>10 \text{ \& } \leq 15$ | $>15 \text{ \& } \leq 50$ | $>50 \text{ \& } \leq 1000$ | $>1000$     |
| <b>Shock-Vib</b>                    | 190           | 2                        | 0                         | 0                         | 0                           | 0           |

**DATA SUMMARIES Continued****Card thickness-0.068"**

| <b>LLCR Measurement Summaries by Pin Type</b> |                |                  |              |              |
|-----------------------------------------------|----------------|------------------|--------------|--------------|
| Date                                          | 8/23/2013      | 8/26/2013        |              |              |
| Room Temp (Deg C)                             | 22             | 22               |              |              |
| Rel Humidity (%)                              | 42             | 45               |              |              |
| Technician                                    | Craig Ryan     | Craig Ryan       |              |              |
| <b>mOhm values</b>                            | <b>Actual</b>  | <b>Delta</b>     | <b>Delta</b> | <b>Delta</b> |
|                                               | <b>Initial</b> | <b>Shock-Vib</b> |              |              |
| <b>Pin Type 1: Row 1</b>                      |                |                  |              |              |
| Average                                       | 11.66          | 0.73             |              |              |
| St. Dev.                                      | 0.54           | 0.98             |              |              |
| Min                                           | 10.80          | 0.01             |              |              |
| Max                                           | 14.06          | 7.49             |              |              |
| Summary Count                                 | 64             | 64               |              |              |
| Total Count                                   | 64             | 64               |              |              |
| <b>Pin Type 2: Row 2</b>                      |                |                  |              |              |
| Average                                       | 15.05          | 0.50             |              |              |
| St. Dev.                                      | 0.55           | 0.54             |              |              |
| Min                                           | 13.99          | 0.01             |              |              |
| Max                                           | 16.39          | 3.49             |              |              |
| Summary Count                                 | 128            | 128              |              |              |
| Total Count                                   | 128            | 128              |              |              |

| <b>LLCR Delta Count by Category</b> |               |                            |                             |                             |                               |                 |
|-------------------------------------|---------------|----------------------------|-----------------------------|-----------------------------|-------------------------------|-----------------|
|                                     | <b>Stable</b> | <b>Minor</b>               | <b>Acceptable</b>           | <b>Marginal</b>             | <b>Unstable</b>               | <b>Open</b>     |
| <b>mOhms</b>                        | <b>&lt;=5</b> | <b>&gt;5 &amp; &lt;=10</b> | <b>&gt;10 &amp; &lt;=15</b> | <b>&gt;15 &amp; &lt;=50</b> | <b>&gt;50 &amp; &lt;=1000</b> | <b>&gt;1000</b> |
| <b>Shock-Vib</b>                    | <b>191</b>    | <b>1</b>                   | <b>0</b>                    | <b>0</b>                    | <b>0</b>                      | <b>0</b>        |

**Nanosecond Event Detection:**

| <b>Shock and Vibration Event Detection Summary</b> |                           |
|----------------------------------------------------|---------------------------|
| Contacts tested                                    | 60                        |
| Test Condition                                     | C, 100g's, 6ms, Half-Sine |
| Shock Events                                       | 0                         |
| Test Condition                                     | V-B, 7.56 rms g           |
| Vibration Events                                   | 0                         |
| <b>Total Events</b>                                | <b>0</b>                  |

**EQUIPMENT AND CALIBRATION SCHEDULES****Equipment #:** HZ-MO-01**Description:** Micro-ohmmeter**Manufacturer:** Keithley**Model:** 2700**Serial #:** 1199807**Accuracy:** Last Cal: 04/28/2013, Next Cal: 04/28/2014**Equipment #:** HZ-PS-01**Description:** Power Supply**Manufacturer:** Agilent**Model:** 6031A**Serial #:** MY41000982**Accuracy:** Last Cal: 04/28/2013, Next Cal: 04/28/2014**Equipment #:** SVC-01**Description:** Shock & Vibration Table**Manufacturer:** Data Physics**Model:** LE-DSA-10-20K**Serial #:** 10037**Accuracy:** See Manual

... Last Cal: 11/31/2012, Next Cal: 11/31/2013

**Equipment #:** ACLM-01**Description:** Accelerometer**Manufacturer:** PCB Piezotronics**Model:** 352C03**Serial #:** 115819**Accuracy:** See Manual

... Last Cal: 07/09/2013, Next Cal: 07/09/2014

**Equipment #:** ED-03**Description:** Event Detector**Manufacturer:** Analysis Tech**Model:** 32EHD**Serial #:** 1100604**Accuracy:** See Manual

... Last Cal: 06/04/2013, Next Cal: 06/04/2014

**Equipment #:** MO-04**Description:** Multimeter /Data Acquisition System**Manufacturer:** Keithley**Model:** 2700**Serial #:** 0798688**Accuracy:** See Manual

... Last Cal: 04/30/2013, Next Cal: 04/30/2014