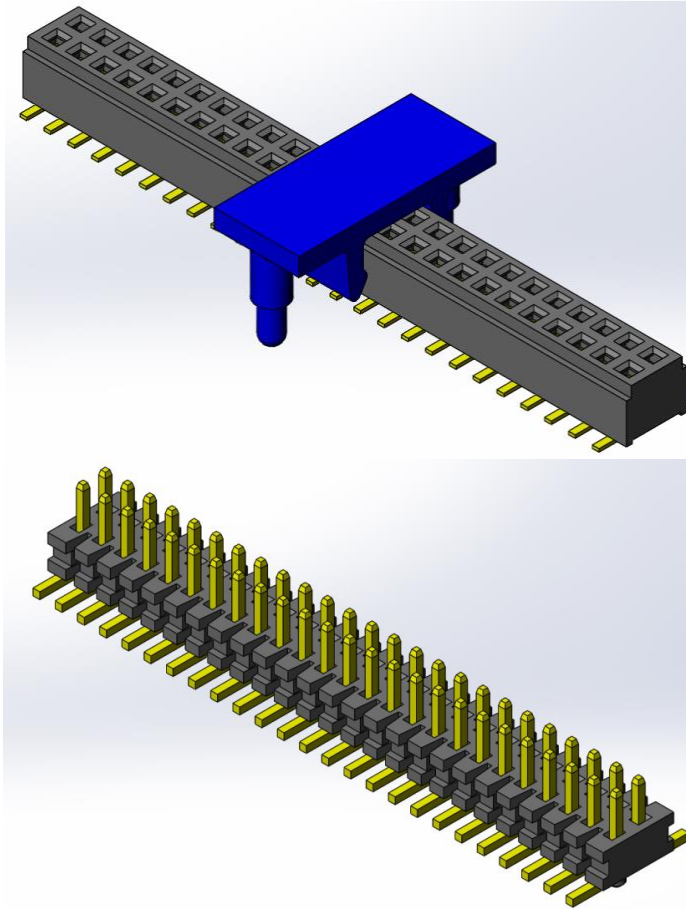




Project Number: Design Qualification Test Report	Tracking Code: 2579670_Report_Rev_1
Requested by: Mark Shireman	Date: 4/27/2022
Part #: CLM-125-02-L-D-PA/FTMH-125-03-L-DV-A	
Part description: CLM/FTMH	Tech: Kason He
Test Start: 12/2/2020	Test Completed: 1/26/2021



## DESIGN QUALIFICATION TEST REPORT

CLM/FTMH  
CLM-125-02-L-D-PA /FTMH-125-03-L-DV-A

Tracking Code: 2579670_Report_Rev_1	Part #: CLM-125-02-L-D-PA/FTMH-125-03-L-DV-A
Part description: CLM/FTMH	

## REVISION HISTORY

DATA	REV.NUM.	DESCRIPTION	ENG
4/27/2022	1	Initial Issue	KH

## 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.

All contents contained herein are the property of Samtec. No portion of this report, in part or in full shall be reproduced without prior written approval of Samtec.

## 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 and DWV/IR 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 and DWV/IR 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) Samtec Test PCBs used: PCB-111173-TST/PCB-111174-TST/PCB-111175-TST

## FLOWCHARTS

### Gas Tight

#### Group 1

CLM-125-02-L-D-PA

FTMH-125-03-L-DV-A

8 Assemblies

Step	Description
------	-------------

- |    |                     |
|----|---------------------|
| 1. | LLCR (2)            |
| 2. | Gas Tight (1)       |
| 3. | LLCR (2)            |
|    | Max Delta = 15 mOhm |

---

(1) Gas Tight = EIA-364-36

(2) LLCR = EIA-364-23

Open Circuit Voltage = 20 mV Max

Test Current = 100 mA Max

### Normal Force

#### Group 1

CLM-125-02-L-D-PA

FTMH-125-03-L-DV-A

8 Contacts Minimum

Signal Without Thermals

Step	Description
------	-------------

- |    |   |
|----|---|
| 1. | Contact Gaps                            |
| 2. | Normal Force (1)                        |
|    | Deflection = 0.002 "                    |
|    | Expected Force at Max Deflection = 80 g |

#### Group 2

CLM-125-02-L-D-PA

FTMH-125-03-L-DV-A

8 Contacts Minimum

Signal With Thermals

Step	Description
------	-------------

- |    |   |
|----|---|
| 1. | Contact Gaps                            |
| 2. | Thermal Age (2)                         |
| 3. | Contact Gaps                            |
| 4. | Normal Force (1)                        |
|    | Deflection = 0.002 "                    |
|    | Expected Force at Max Deflection = 80 g |

---

(1) Normal Force = EIA-364-04

(2) Thermal Age = EIA-364-17

Test Condition = 4 (105°C)

Time Condition = B (250 Hours)

**FLOWCHARTS Continued****Thermal Aging**Group 1

CLM-125-02-L-D-PA

FTMH-125-03-L-DV-A

8 Assemblies

Step	Description
1.	Contact Gaps
2.	Mating/Unmating Force <sup>(2)</sup>
3.	LLCR <sup>(1)</sup>
4.	Thermal Age <sup>(3)</sup>
5.	LLCR <sup>(1)</sup> Max Delta = 15 mOhm
6.	Mating/Unmating Force <sup>(2)</sup>
7.	Contact Gaps

---

(1) LLCR = EIA-364-23

Open Circuit Voltage = 20 mV Max

Test Current = 100 mA Max

(2) Mating/Unmating Force = EIA-364-13

(3) Thermal Age = EIA-364-17

Test Condition = 4 (105°C)

Time Condition = B (250 Hours)

**FLOWCHARTS Continued****Mating/Unmating/Durability**Group 1

CLM-125-02-L-D-PA

FTMH-125-03-L-DV-A

8 Assemblies

Step	Description
1.	Contact Gaps
2.	LLCR <sup>(2)</sup>
3.	Mating/Unmating Force <sup>(3)</sup>
4.	Cycles Quantity = 25 Cycles
5.	Mating/Unmating Force <sup>(3)</sup>
6.	Cycles Quantity = 25 Cycles
7.	Mating/Unmating Force <sup>(3)</sup>
8.	Cycles Quantity = 25 Cycles
9.	Mating/Unmating Force <sup>(3)</sup>
10.	Cycles Quantity = 25 Cycles
11.	Mating/Unmating Force <sup>(3)</sup>
12.	Contact Gaps
13.	LLCR <sup>(2)</sup> Max Delta = 15 mOhm
14.	Thermal Shock <sup>(4)</sup>
15.	LLCR <sup>(2)</sup> Max Delta = 15 mOhm
16.	Humidity <sup>(1)</sup>
17.	LLCR <sup>(2)</sup> Max Delta = 15 mOhm
18.	Mating/Unmating Force <sup>(3)</sup>

(1) Humidity = EIA-364-31

Test Condition = B (240 Hours)

Test Method = III (+25°C to +65°C @ 90% RH to 98% RH)

Test Exceptions: ambient pre-condition and delete steps 7a and 7b

(2) LLCR = EIA-364-23

Open Circuit Voltage = 20 mV Max

Test Current = 100 mA Max

(3) Mating/Unmating Force = EIA-364-13

(4) Thermal Shock = EIA-364-32

Exposure Time at Temperature Extremes = 1/2 Hour

Method A, Test Condition = I (-55°C to +85°C)

Test Duration = A-3 (100 Cycles)

**FLOWCHARTS Continued****IR/DWV****Pin-to-Pin**Group 1

CLM-125-02-L-D-PA  
FTMH-125-03-L-DV-A  
2 Assemblies

Group 2

CLM-125-02-L-D-PA  
  
2 Assemblies

Group 3

FTMH-125-03-L-DV-A  
2 Assemblies

Group 4

CLM-125-02-L-D-PA  
FTMH-125-03-L-DV-A  
2 Assemblies

Step	Description
1.	DWV Breakdown (2)

Step	Description
1.	DWV Breakdown (2)

Step	Description
1.	DWV Breakdown (2)

Step	Description
1.	IR (4)
2.	DWV at Test Voltage <sub>(1)</sub>
3.	Thermal Shock (5)
4.	IR (4)
5.	DWV at Test Voltage <sub>(1)</sub>
6.	Humidity (3)
7.	IR (4)
8.	DWV at Test Voltage <sub>(1)</sub>

**Row-to-Row**Group 5

CLM-125-02-L-D-PA  
FTMH-125-03-L-DV-A  
2 Assemblies

Group 6

CLM-125-02-L-D-PA  
  
2 Assemblies

Group 7

FTMH-125-03-L-DV-A  
2 Assemblies

Group 8

CLM-125-02-L-D-PA  
FTMH-125-03-L-DV-A  
2 Assemblies

Step	Description
1.	DWV Breakdown (2)

Step	Description
1.	DWV Breakdown (2)

Step	Description
1.	DWV Breakdown (2)

Step	Description
1.	IR (4)
2.	DWV at Test Voltage <sub>(1)</sub>
3.	Thermal Shock (5)
4.	IR (4)
5.	DWV at Test Voltage <sub>(1)</sub>
6.	Humidity (3)
7.	IR (4)
8.	DWV at Test Voltage <sub>(1)</sub>

- (1) DWV at Test Voltage = EIA-364-20  
Test Condition = 1 (Sea Level)  
DWV test voltage is equal to 75% of the lowest breakdown voltage  
Test voltage applied for 60 seconds
- (2) DWV Breakdown = EIA-364-20  
Test Condition = 1 (Sea Level)  
DWV test voltage is equal to 75% of the lowest breakdown voltage  
Test voltage applied for 60 seconds
- (3) Humidity = EIA-364-31  
Test Condition = B (240 Hours)  
Test Method = III (+25°C to +65°C @ 90% RH to 98% RH)  
Test Exceptions: ambient pre-condition and delete steps 7a and 7b
- (4) IR = EIA-364-21  
Test Condition = 500 Vdc, 2 Minutes Max
- (5) Thermal Shock = EIA-364-32  
Exposure Time at Temperature Extremes = 1/2 Hour  
Method A, Test Condition = I (-55°C to +85°C)  
Test Duration = A-3 (100 Cycles)

**FLOWCHARTS Continued****Current Carrying Capacity**Group 1

CLM-150-02-L-D-PA  
FTMH-150-03-L-DV-A  
2 Pins Powered  
Signal

Step	Description
1.	CCC <sup>(1)</sup> Rows = 2 Number of Positions = 1

Group 2

CLM-150-02-L-D-PA  
FTMH-150-03-L-DV-A  
4 Pins Powered  
Signal

Step	Description
1.	CCC <sup>(1)</sup> Rows = 2 Number of Positions = 2

Group 3

CLM-150-02-L-D-PA  
FTMH-150-03-L-DV-A  
6 Pins Powered  
Signal

Step	Description
1.	CCC <sup>(1)</sup> Rows = 2 Number of Positions = 3

Group 4

CLM-150-02-L-D-PA  
FTMH-150-03-L-DV-A  
8 Pins Powered  
Signal

Step	Description
1.	CCC <sup>(1)</sup> Rows = 2 Number of Positions = 4

Group 5

CLM-150-02-L-D-PA  
FTMH-150-03-L-DV-A  
100 Pins Powered  
Signal

Step	Description
1.	CCC <sup>(1)</sup> Rows = 2 Number of Positions = 50

(1) CCC = EIA-364-70

Method 2, Temperature Rise Versus Current Curve

(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



**FLOWCHARTS Continued****Mechanical Shock/Random Vibration/LLCR**Group 1

CLM-125-02-L-D-PA

FTMH-125-03-L-DV-A

8 Assemblies

**Step Description**

1. LLCR <sup>(1)</sup>
2. Mechanical Shock <sup>(2)</sup>
3. Random Vibration <sup>(3)</sup>
4. LLCR <sup>(1)</sup>  
Max Delta = 15 mOhm

---

**(1) LLCR = EIA-364-23**

Open Circuit Voltage = 20 mV Max

Test Current = 100 mA Max

**(2) Mechanical Shock = EIA-364-27**

Test Condition = C (100 G Peak, 6 milliseconds, Half Sine)

Number of Shocks = 3 Per Direction, Per Axis, 18 Total

**(3) Random Vibration = EIA-364-28**

Condition = VB (7.56 gRMS Average, 2 Hours/Axis)

**Mechanical Shock/Random Vibration/Event Detection**Group 1

CLM-125-02-L-D-PA

FTMH-125-03-L-DV-A

60 Points

**Step Description**

1. Nanosecond Event Detection  
(Mechanical Shock) <sup>(1)</sup>
2. Nanosecond Event Detection  
(Random Vibration) <sup>(2)</sup>

---

**(1) Nanosecond Event Detection (Mechanical Shock)**

Use EIA-364-87 for Nanosecond Event Detection:

Test Condition = F (50 nanoseconds at 10 ohms)

Use EIA-364-27 for Mechanical Shock:

Test Condition = C (100 G Peak, 6 milliseconds, Half Sine)

Number of Shocks = 3 Per Direction, Per Axis, 18 Total

**(2) Nanosecond Event Detection (Random Vibration)**

Use EIA-364-87 for Nanosecond Event Detection:

Test Condition = F (50 nanoseconds at 10 ohms)

Use EIA-364-28 for Random Vibration:

Condition = VB (7.56 gRMS Average, 2 Hours/Axis)

## ATTRIBUTE DEFINITIONS

The following is a brief, simplified description of attributes.

### THERMAL SHOCK:

- 1) EIA-364-32, *Thermal Shock (Temperature Cycling) Test Procedure for Electrical Connectors*.
- 2) Test Condition 1: -55°C to +85°C
- 3) Test Time: ½ hour dwell at each temperature extreme
- 4) Number of Cycles: 100
- 5) All test samples are pre-conditioned at ambient.
- 6) All test samples are exposed to environmental stressing in the mated condition.

### THERMAL:

- 1) EIA-364-17, *Temperature Life with or without Electrical Load Test Procedure for Electrical Connectors*.
- 2) Test Condition 4 at 105° C
- 3) Test Time Condition B for 250 hours.
- 4) All test samples are pre-conditioned at ambient.
- 5) All test samples are exposed to environmental stressing in the mated condition.

### HUMIDITY:

- 1) Reference document: EIA-364-31, *Humidity Test Procedure for Electrical Connectors*.
- 2) Test Condition B, 240 Hours.
- 3) Method III, +25° C to + 65° C, 90% to 98% Relative Humidity excluding sub-cycles 7a and 7b.
- 4) All samples are pre-conditioned at ambient.
- 5) All test samples are exposed to environmental stressing in the mated condition.

### 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

### MATING/UNMATING:

- 1) Reference document: EIA-364-13, *Mating and Unmating Forces Test Procedure for Electrical Connectors*.
- 2) The full insertion position was to within 0.003" to 0.004" of the plug bottoming out in the receptacle to prevent damage to the system under test.
- 3) One of the mating parts is secured to a floating X-Y table to prevent damage during cycling.

**ATTRIBUTE DEFINITIONS Continued**

The following is a brief, simplified description of attributes.

**NORMAL FORCE (FOR CONTACTS TESTED OUTSIDE THE HOUSING):**

- 1) Reference document: EIA-364-04, *Normal Force Test Procedure for Electrical Connectors*.
- 2) The contacts shall be tested in the loose state, *not* inserted in connector housing.
- 3) The contacts shall be prepared to allow access to the spring member at the same attitude and deflection level as would occur in actual use.
- 4) In the event that portions of the contact prevent insertion of the test probe and/or deflection of the spring member under evaluation, said material shall be removed leaving the appropriate contact surfaces exposed.
- 5) In the case of multi-tine contacts, each tine shall be tested independently on separate samples as required.
- 6) The connector housing shall be simulated, if required, in order to provide an accurate representation of the actual contact system performance.
- 7) A holding fixture shall be fashioned to allow the contact to be properly deflected.
- 8) Said holding fixture shall be mounted on a floating, adjustable, X-Y table on the base of the Dillon TC<sup>2</sup>, computer controlled test stand with a deflection measurement system accuracy of 5  $\mu$ m (0.0002").
- 9) The probe shall be attached to a Dillon P/N 49761-0105, 5 N (1.1 Lb) load cell providing an accuracy of  $\pm$  0.2%.
- 10) The nominal deflection rate shall be 5 mm (0.2")/minute.
- 11) Unless otherwise noted a minimum of five contacts shall be tested.
- 12) The force/deflection characteristic to load and unload each contact shall be repeated five times.
- 13) The system shall utilize the TC<sup>2</sup> software in order to acquire and record the test data.
- 14) The permanent set of each contact shall be measured within the TC<sup>2</sup> software.
- 15) The acquired data shall be graphed with the deflection data on the X-axis and the force data on the Y-axis and a print out will be stored with the Tracking Code paperwork.

**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 +1000 mOhms: -----Unstable
  - f.  $>+1000$  mOhms: -----Open Failure

**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 four temperature points are reported:
  - a. Ambient
  - b. 85° 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.

**ATTRIBUTE DEFINITIONS Continued**

The following is a brief, simplified description of attributes.

**GAS TIGHT:**

To provide method for evaluating the ability of the contacting surfaces in preventing penetration of harsh vapors which might lead to oxide formation that may degrade the electrical performance of the contact system.

- 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.  $\leq +0.33$  mOhms: -----Stable
  - b.  $+0.33$  to  $+0.66$  mOhms: -----Minor
  - c.  $+0.67$  to  $+1.00$  mOhms: -----Acceptable
  - d.  $+1.01$  to  $+50.0$  mOhms: -----Marginal
  - e.  $+50.1$  to  $+1000$  mOhms: -----Unstable
  - f.  $>+1000$  mOhms: -----Open Failure
- 4) Procedure:
  - a. Reference document: EIA-364-36, *Test Procedure for Determination of Gas-Tight Characteristics for Electrical Connectors, Sockets and/or Contact Systems*.
  - b. Test Conditions:
    - i. Class II--- Mated pairs of contacts assembled to their plastic housings.
    - ii. Reagent grade Nitric Acid shall be used of sufficient volume to saturate the test chamber
    - iii. The ratio of the volume of the test chamber to the surface area of the acid shall be 10:1.
    - iv. The chamber shall be saturated with the vapor for at least 15 minutes before samples are added.
    - v. Exposure time, 55 to 65 minutes.
    - vi. The samples shall be no closer to the chamber walls than 1 inches and no closer to the surface of the acid than 3 inches.
    - vii. The samples shall be dried after exposure for a minimum of 1 hour.
    - viii. Drying temperature  $50^{\circ}\text{C}$
    - ix. The final LLCR shall be conducted within 1 hour after drying.

**ATTRIBUTE DEFINITIONS Continued**

The following is a brief, simplified description of attributes.

**INSULATION RESISTANCE (IR):**

To determine the resistance of insulation materials to leakage of current through or on the surface of these materials when a DC potential is applied.

- 1) PROCEDURE:
  - a. Reference document: EIA-364-21, *Insulation Resistance Test Procedure for Electrical Connectors*.
  - b. Test Conditions:
    - i. Between Adjacent Contacts or Signal-to-Ground
    - ii. Electrification Time 2.0 minutes
    - iii. Test Voltage (500 VDC) corresponds to calibration settings for measuring resistances.
- 2) MEASUREMENTS:
- 3) When the specified test voltage is applied (VDC), the insulation resistance shall not be less than 5000 megohms.

**DIELECTRIC WITHSTANDING VOLTAGE (DWV):**

To determine if the sockets can operate at its rated voltage and withstand momentary over potentials due to switching, surges, and other similar phenomenon. Separate samples are used to evaluate the effect of environmental stresses so not to influence the readings from arcing that occurs during the measurement process.

- 1) PROCEDURE:
  - a. Reference document: EIA-364-20, *Withstanding Voltage Test Procedure for Electrical Connectors*.
  - b. Test Conditions:
    - i. Between Adjacent Contacts or Signal-to-Ground
    - ii. Barometric Test Condition 1
    - iii. Rate of Application 500 V/Sec
    - iv. Test Voltage (VAC) until breakdown occurs
- 2) MEASUREMENTS/CALCULATIONS
  - a. The breakdown voltage shall be measured and recorded.
  - b. The dielectric withstanding voltage shall be recorded as 75% of the minimum breakdown voltage.
  - c. The working voltage shall be recorded as one-third (1/3) of the dielectric withstanding voltage (one-fourth of the breakdown voltage).

## RESULTS

### Temperature Rise, CCC at a 20% de-rating

- CCC for a 30°C Temperature Rise-----3.1 A per contact with 2 contacts (2x1) powered
- CCC for a 30°C Temperature Rise-----2.5 A per contact with 4 contacts (2x2) powered
- CCC for a 30°C Temperature Rise-----2.0 A per contact with 6 contacts (2x3) powered
- CCC for a 30°C Temperature Rise-----1.8 A per contact with 8 contacts (2x4) powered
- CCC for a 30°C Temperature Rise-----0.9 A per contact with 100 contacts (2x50) powered

### Mating – Unmating Forces

#### Thermal Aging Group

- Initial
  - Mating
    - Min ----- 5.43 Lbs
    - Max----- 8.12 Lbs
  - Unmating
    - Min ----- 3.15 Lbs
    - Max----- 6.51 Lbs
- After Thermal
  - Mating
    - Min ----- 4.90 Lbs
    - Max----- 7.10 Lbs
  - Unmating
    - Min ----- 3.64 Lbs
    - Max----- 6.34 Lbs

**RESULTS Continued****Mating – Unmating Forces****Mating-Unmating Durability Group**

- **Initial**
  - **Mating**
    - **Min** ----- 4.44 Lbs
    - **Max** ----- 7.92 Lbs
  - **Unmating**
    - **Min** ----- 3.23 Lbs
    - **Max** ----- 6.23 Lbs
- **After 25 Cycles**
  - **Mating**
    - **Min** ----- 5.20 Lbs
    - **Max** ----- 8.82 Lbs
  - **Unmating**
    - **Min** ----- 4.52 Lbs
    - **Max** ----- 8.20 Lbs
- **After 50 Cycles**
  - **Mating**
    - **Min** ----- 5.94 Lbs
    - **Max** ----- 10.12 Lbs
  - **Unmating**
    - **Min** ----- 5.58 Lbs
    - **Max** ----- 9.96 Lbs
- **After 75 Cycles**
  - **Mating**
    - **Min** ----- 6.74 Lbs
    - **Max** ----- 11.33 Lbs
  - **Unmating**
    - **Min** ----- 6.37 Lbs
    - **Max** ----- 10.83 Lbs
- **After 100 Cycles**
  - **Mating**
    - **Min** ----- 7.46 Lbs
    - **Max** ----- 11.87 Lbs
  - **Unmating**
    - **Min** ----- 6.86 Lbs
    - **Max** ----- 11.27 Lbs
- **Humidity**
  - **Mating**
    - **Min** ----- 5.40 Lbs
    - **Max** ----- 6.92 Lbs
  - **Unmating**
    - **Min** ----- 4.15 Lbs
    - **Max** ----- 5.63 Lbs



**RESULTS Continued****Normal Force at 0.0049-inch deflection**

- **Initial**
  - Min ----- 126.60 gf      Set ----- 0.0015 inch
  - Max ----- 151.50 gf      Set ----- 0.0033 inch
- **Thermal**
  - Min ----- 130.50 gf      Set ----- 0.0016 inch
  - Max ----- 156.20 gf      Set ----- 0.0025 inch

**Insulation Resistance minimums, IR****Pin to Pin**

- **Initial**
  - Mated ----- 45000 Meg  $\Omega$  ----- Passed
  - Unmated ----- 45000 Meg  $\Omega$  ----- Passed
- **Thermal Shock**
  - Mated ----- 45000 Meg  $\Omega$  ----- Passed
  - Unmated ----- 45000 Meg  $\Omega$  ----- Passed
- **Humidity**
  - Mated ----- 45000 Meg  $\Omega$  ----- Passed
  - Unmated ----- 45000 Meg  $\Omega$  ----- Passed

**Row to Row**

- **Initial**
  - Mated ----- 45000 Meg  $\Omega$  ----- Passed
  - Unmated ----- 45000 Meg  $\Omega$  ----- Passed
- **Thermal Shock**
  - Mated ----- 45000 Meg  $\Omega$  ----- Passed
  - Unmated ----- 45000 Meg  $\Omega$  ----- Passed
- **Humidity**
  - Mated ----- 45000 Meg  $\Omega$  ----- Passed
  - Unmated ----- 45000 Meg  $\Omega$  ----- Passed

**Dielectric Withstanding Voltage minimums, DWV**

- **Minimums**
  - Breakdown Voltage ----- 1092 VAC
  - Test Voltage ----- 820 VAC
  - Working Voltage ----- 270 VAC

**Pin to Pin**

- Initial DWV ----- Passed
- Thermal DWV ----- Passed
- Humidity DWV ----- Passed

**Row to Row**

- Initial DWV ----- Passed
- Thermal DWV ----- Passed
- Humidity DWV ----- Passed

**RESULTS Continued****LLCR Thermal Aging Group (192 LLCR test points)**

- Initial ----- 13.64 mOhms Max
- Thermal
  - <= +5.0 mOhms-----192 Points ----- Stable
  - +5.1 to +10.0 mOhms -----0 Points ----- Minor
  - +10.1 to +15.0 mOhms -----0 Points ----- Acceptable
  - +15.1 to +50.0 mOhms -----0 Points ----- Marginal
  - +50.1 to +1000 mOhms-----0 Points ----- Unstable
  - >+1000 mOhms-----0 Points ----- Open Failure

**LLCR Gas Tight Group (192 LLCR test points)**

- Initial ----- 11.02 mOhms Max
- Gas-Tight
  - <= +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 +1000 mOhms-----0 Points ----- Unstable
  - >+1000 mOhms-----0 Points ----- Open Failure

**LLCR Mating/Unmating Durability Group (192 LLCR test points)**

- Initial ----- 11.58 mOhms Max
- Durability, 100 Cycles
  - <= +5.0 mOhms-----192 Points ----- Stable
  - +5.1 to +10.0 mOhms -----0 Points ----- Minor
  - +10.1 to +15.0 mOhms -----0 Points ----- Acceptable
  - +15.1 to +50.0 mOhms -----0 Points ----- Marginal
  - +50.1 to +1000 mOhms-----0 Points ----- Unstable
  - >+1000 mOhms-----0 Points ----- Open Failure
- Thermal Shock
  - <= +5.0 mOhms-----192 Points ----- Stable
  - +5.1 to +10.0 mOhms -----0 Points ----- Minor
  - +10.1 to +15.0 mOhms -----0 Points ----- Acceptable
  - +15.1 to +50.0 mOhms -----0 Points ----- Marginal
  - +50.1 to +1000 mOhms-----0 Points ----- Unstable
  - >+1000 mOhms-----0 Points ----- Open Failure
- Humidity
  - <= +5.0 mOhms-----192 Points ----- Stable
  - +5.1 to +10.0 mOhms -----0 Points ----- Minor
  - +10.1 to +15.0 mOhms -----0 Points ----- Acceptable
  - +15.1 to +50.0 mOhms -----0 Points ----- Marginal
  - +50.1 to +1000 mOhms-----0 Points ----- Unstable
  - >+1000 mOhms-----0 Points ----- Open Failure

**RESULTS Continued**

**LLCR Shock & Vibration (192 LLCR test points)**

- Initial ----- 12.32 mOhms Max
- Shock &Vibration
  - <= +5.0 mOhms-----192 Points ----- Stable
  - +5.1 to +10.0 mOhms -----0 Points ----- Minor
  - +10.1 to +15.0 mOhms -----0 Points ----- Acceptable
  - +15.1 to +50.0 mOhms -----0 Points ----- Marginal
  - +50.1 to +1000 mOhms-----0 Points ----- Unstable
  - >+1000 mOhms -----0 Points ----- Open Failure

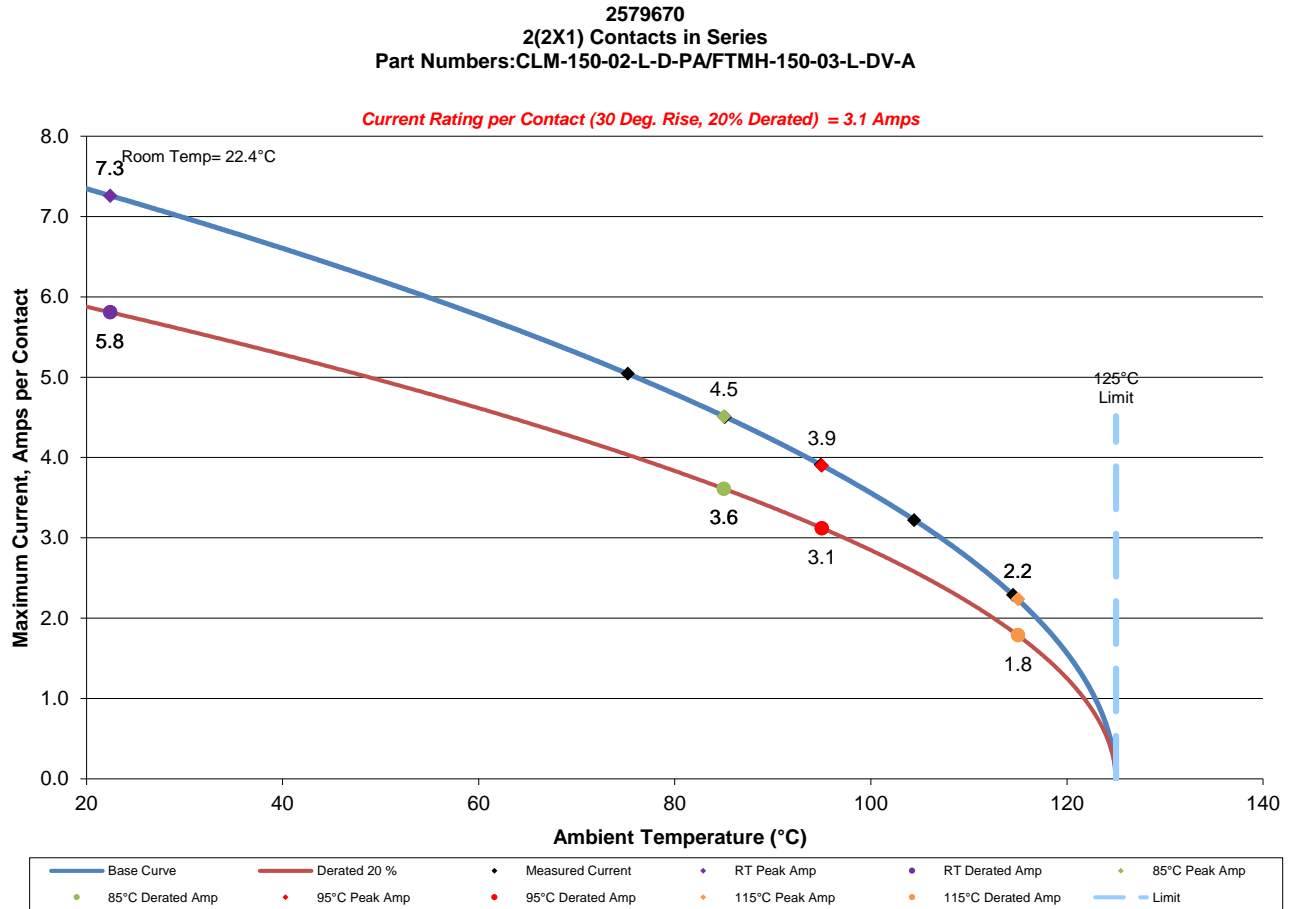
**Mechanical Shock & Random Vibration:**

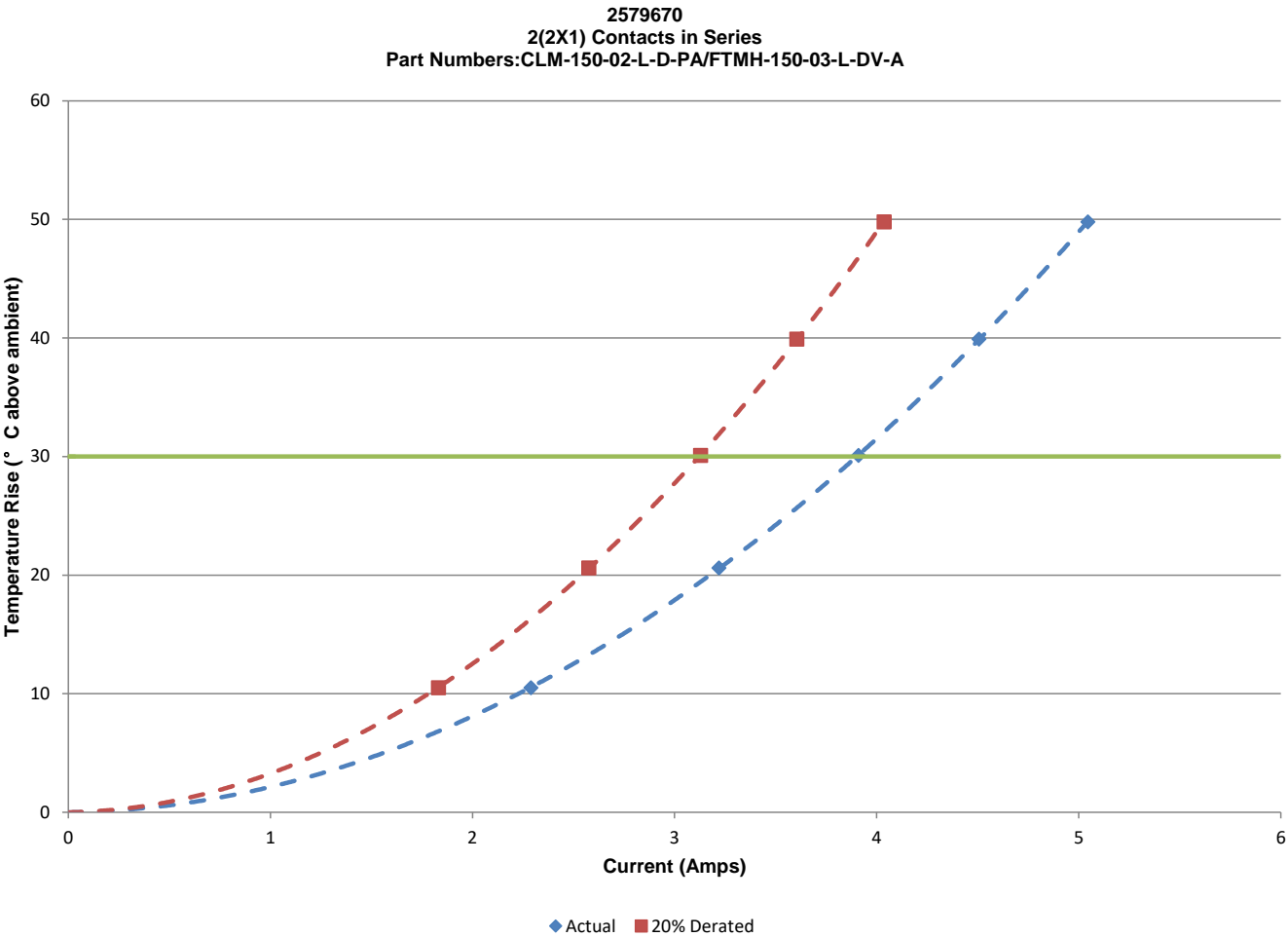
- Shock
  - No Damage----- Pass
  - 50 Nanoseconds ----- Pass
- Vibration
  - No Damage----- Pass
  - 50 Nanoseconds ----- Pass

## DATA SUMMARIES

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

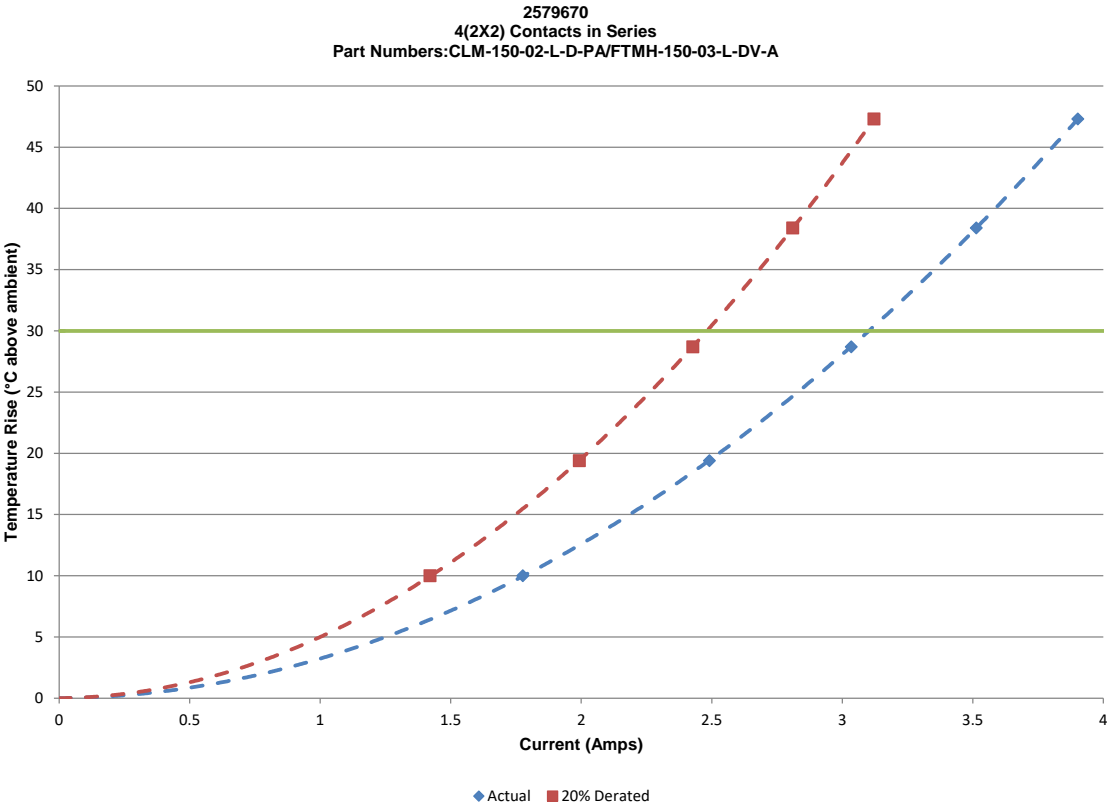
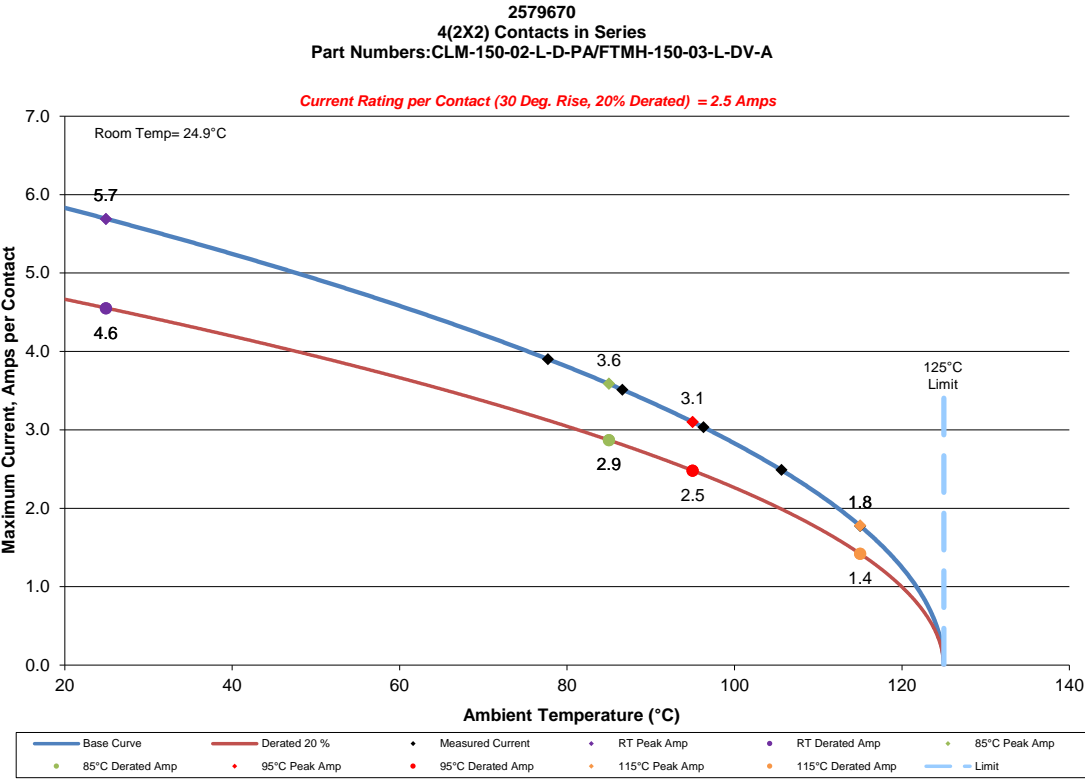
- 1) High quality thermocouples whose temperature slopes track one another were used for temperature monitoring.
- 2) The thermocouples were placed at a location to sense the maximum temperature generated during testing.
- 3) Temperature readings recorded are those for which three successive readings, 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





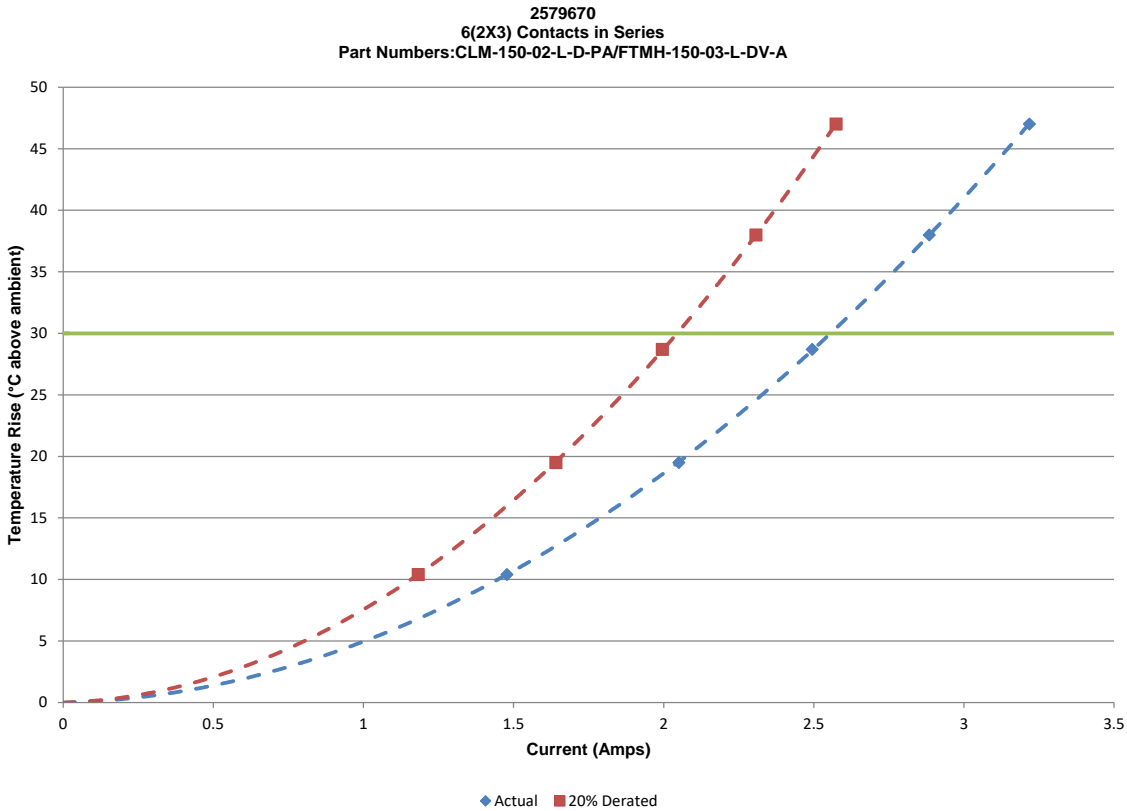
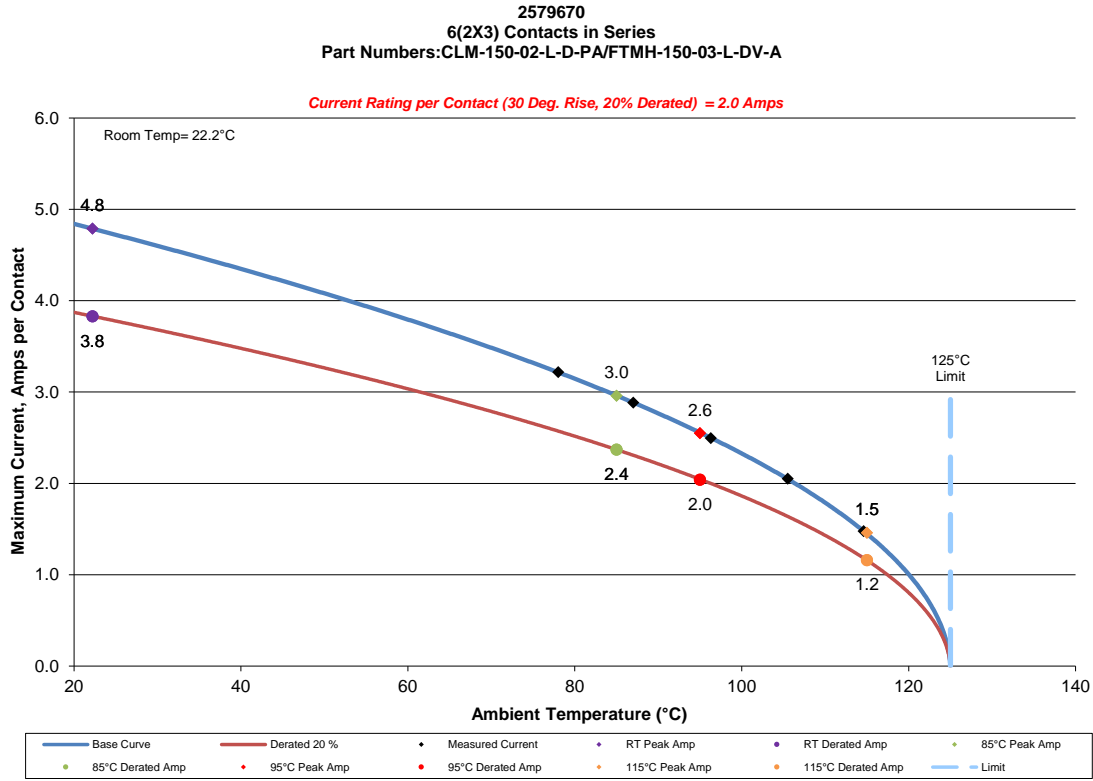
DATA SUMMARIES Continued

b. Linear configuration with 4 adjacent conductors/contacts powered



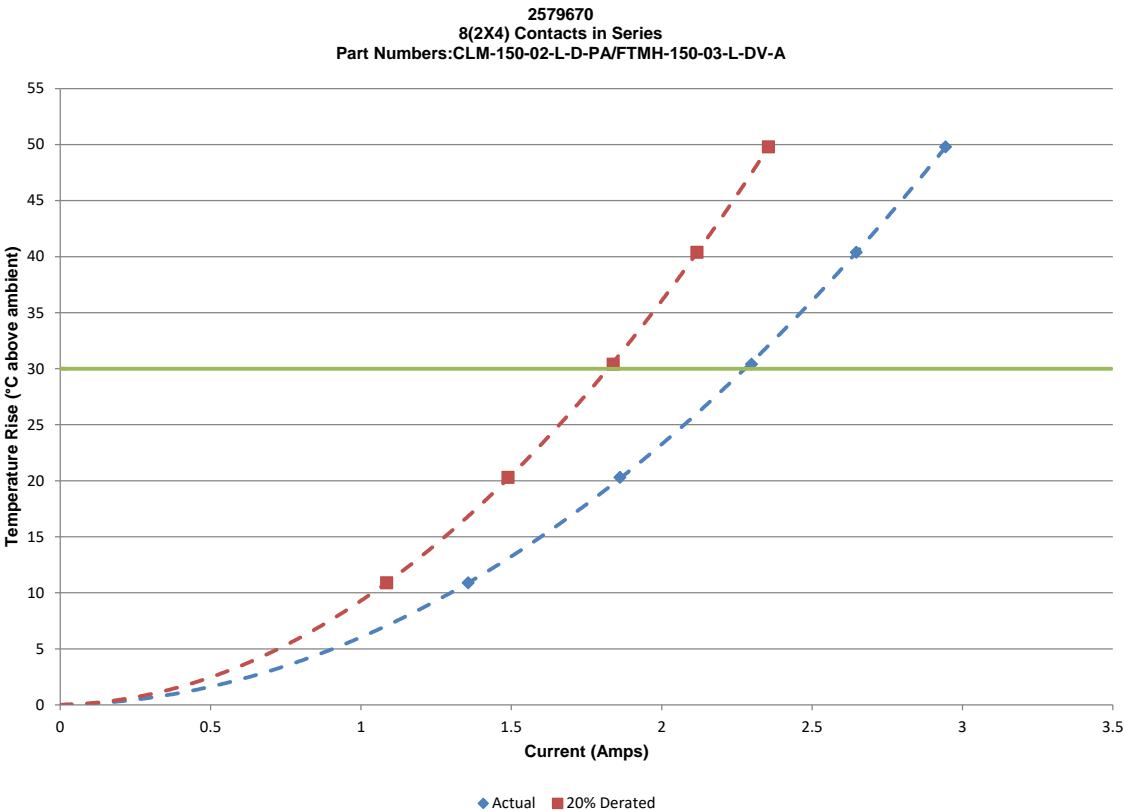
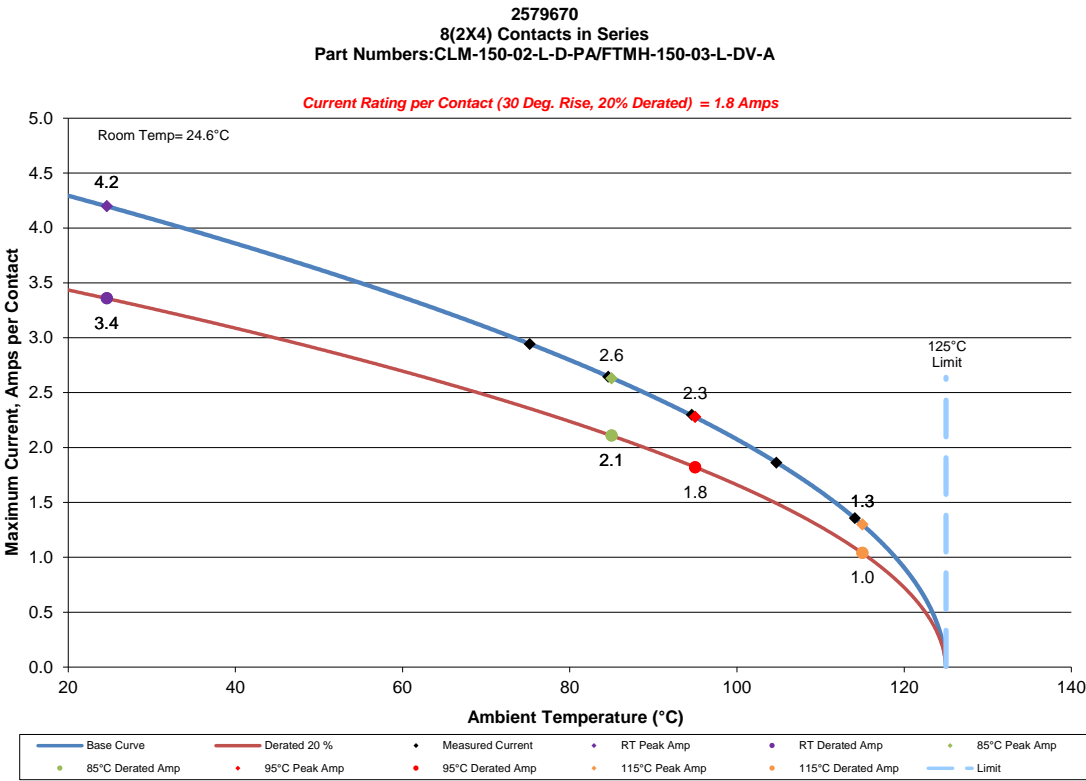
DATA SUMMARIES Continued

c. Linear configuration with 6 adjacent conductors/contacts powered



DATA SUMMARIES Continued

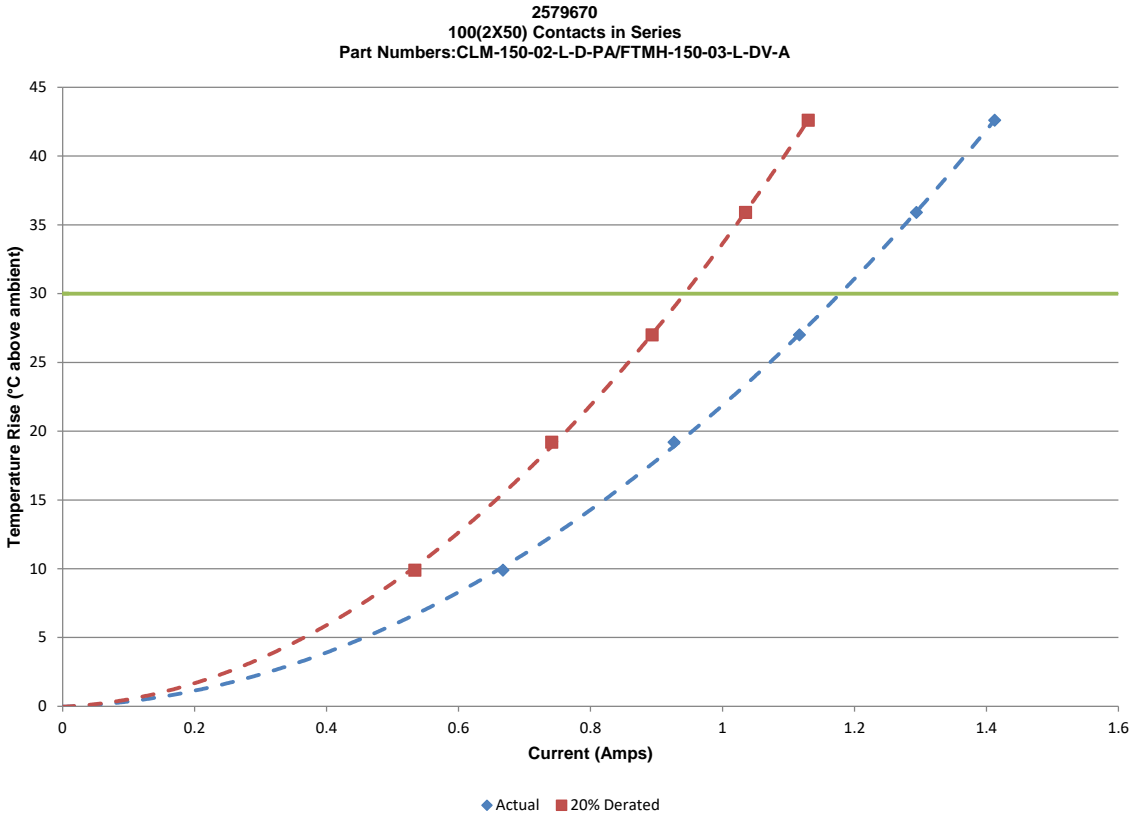
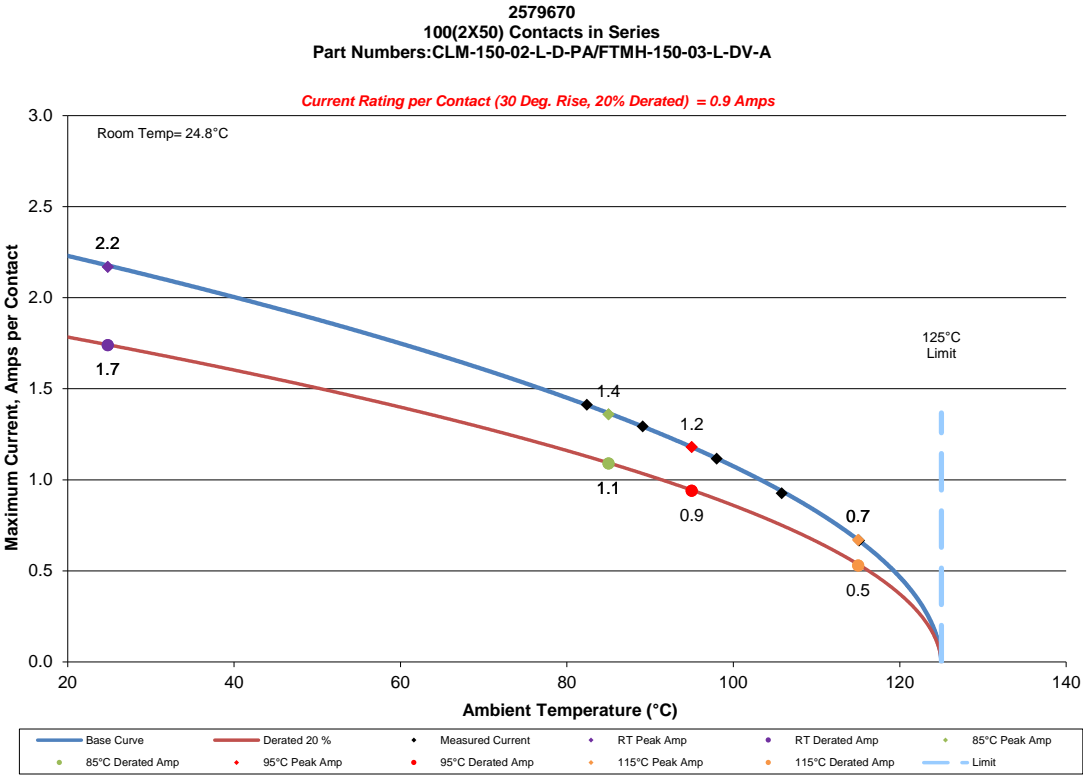
d. Linear configuration with 8 adjacent conductors/contacts powered





DATA SUMMARIES Continued

e. Linear configuration with all adjacent conductors/contacts powered



**DATA SUMMARIES Continued****MATING-UNMATING FORCE:****Thermal Aging Group**

	Initial				After Thermals			
	Mating		Unmating		Mating		Unmating	
	Newtons	Force (Lbs)	Newtons	Force (Lbs)	Newtons	Force (Lbs)	Newtons	Force (Lbs)
Minimum	24.15	5.43	14.01	3.15	21.80	4.90	16.19	3.64
Maximum	36.12	8.12	28.96	6.51	31.58	7.10	28.20	6.34
<b>Average</b>	28.98	<b>6.52</b>	20.66	<b>4.65</b>	26.20	<b>5.89</b>	21.88	<b>4.92</b>
St Dev	4.33	0.97	4.69	1.06	3.73	0.84	4.00	0.90
Count	8	8	8	8	8	8	8	8

**Mating-Unmating Durability Group**

	Initial				After 25 Cycles			
	Mating		Unmating		Mating		Unmating	
	Newtons	Force (Lbs)	Newtons	Force (Lbs)	Newtons	Force (Lbs)	Newtons	Force (Lbs)
Minimum	19.75	4.44	14.37	3.23	23.13	5.20	20.10	4.52
Maximum	35.23	7.92	27.71	6.23	39.23	8.82	36.47	8.20
<b>Average</b>	27.98	<b>6.29</b>	20.65	<b>4.64</b>	31.46	<b>7.07</b>	28.85	<b>6.49</b>
St Dev	4.80	1.08	3.85	0.87	4.92	1.11	5.09	1.15
Count	8	8	8	8	8	8	8	8

	After 50 Cycles				After 75 Cycles			
	Mating		Unmating		Mating		Unmating	
	Newtons	Force (Lbs)	Newtons	Force (Lbs)	Newtons	Force (Lbs)	Newtons	Force (Lbs)
Minimum	26.42	5.94	24.82	5.58	29.98	6.74	28.33	6.37
Maximum	45.01	10.12	44.30	9.96	50.40	11.33	48.17	10.83
<b>Average</b>	35.99	<b>8.09</b>	34.76	<b>7.82</b>	40.40	<b>9.08</b>	38.79	<b>8.72</b>
St Dev	5.53	1.24	6.08	1.37	6.17	1.39	6.27	1.41
Count	8	8	8	8	8	8	8	8

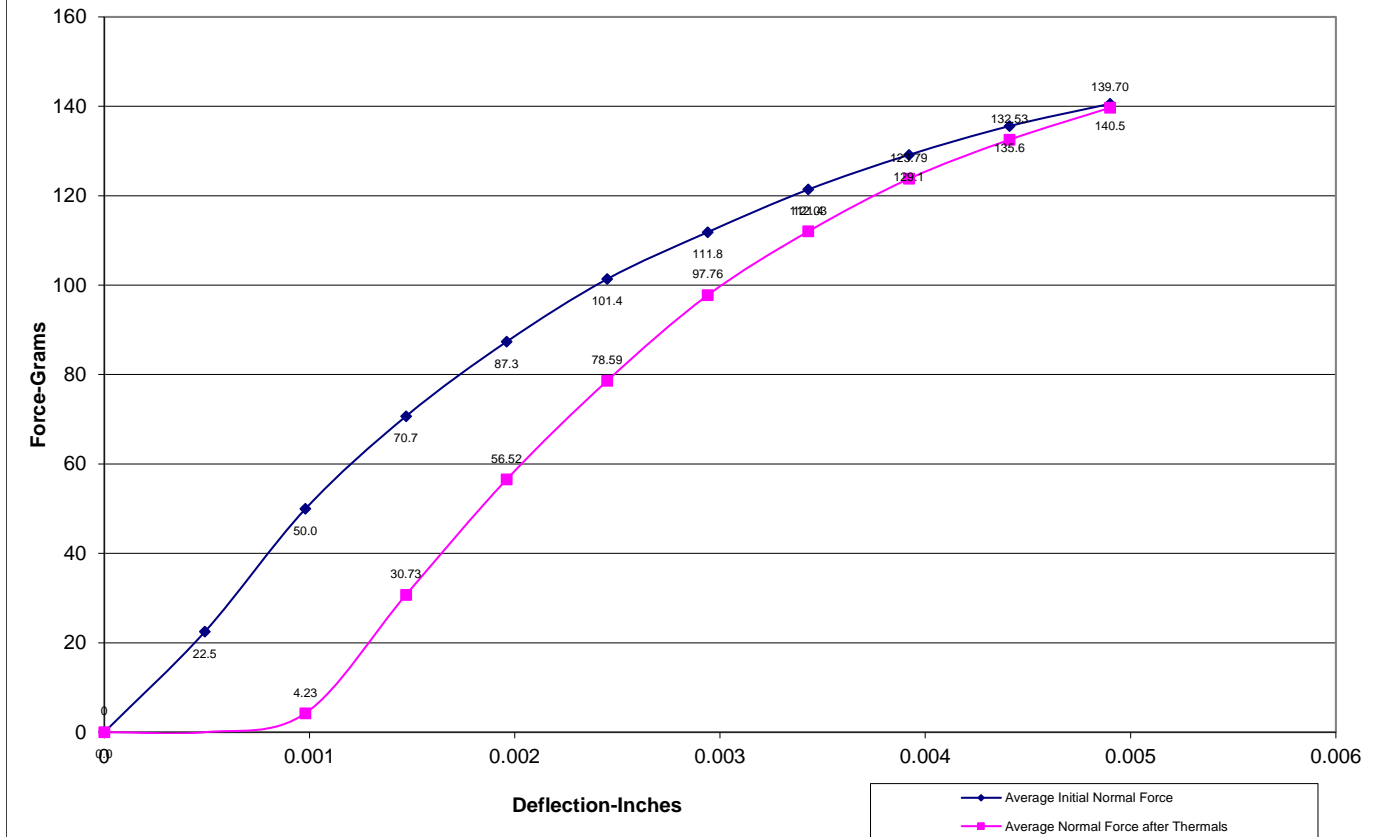
	After 100 Cycles				After Humidity			
	Mating		Unmating		Mating		Unmating	
	Newtons	Force (Lbs)	Newtons	Force (Lbs)	Newtons	Force (Lbs)	Newtons	Force (Lbs)
Minimum	33.18	7.46	30.51	6.86	24.02	5.40	18.46	4.15
Maximum	52.80	11.87	50.13	11.27	30.78	6.92	25.04	5.63
<b>Average</b>	43.73	<b>9.83</b>	41.49	<b>9.33</b>	27.53	<b>6.19</b>	22.47	<b>5.05</b>
St Dev	6.11	1.37	6.39	1.44	2.35	0.53	2.34	0.53
Count	8	8	8	8	8	8	8	8

**DATA SUMMARIES Continued****NORMAL FORCE (FOR CONTACTS TESTED OUTSIDE THE HOUSING):**

- 1) Calibrated force gauges are used along with computer-controlled positioning equipment.
- 2) Typically, 8-10 readings are taken, and the averages reported.

Initial	Deflections in inches Forces in Grams										
	0.0005	0.0010	0.0015	0.0020	0.0025	0.0029	0.0034	0.0039	0.0044	0.0049	SET
Averages	22.48	49.95	70.68	87.33	101.35	111.84	121.38	129.12	135.56	140.54	0.0022
Min	15.40	35.30	55.10	72.10	88.90	97.90	108.90	115.90	122.30	126.60	0.0015
Max	31.20	59.40	81.20	99.20	113.50	124.70	133.50	140.20	148.00	151.50	0.0033
St. Dev	3.931	7.801	9.093	9.296	8.953	9.293	9.101	8.679	8.665	8.206	0.0005
Count	12	12	12	12	12	12	12	12	12	12	12

After Thermal	Deflections in inches Forces in Grams										
	0.0005	0.0010	0.0015	0.0020	0.0025	0.0029	0.0034	0.0039	0.0044	0.0049	SET
Averages	-0.02	4.23	30.73	56.52	78.59	97.76	112.03	123.79	132.53	139.70	0.0021
Min	-0.40	-0.20	20.10	46.30	66.20	79.70	99.60	112.60	122.20	130.50	0.0016
Max	0.10	10.50	39.60	71.30	94.90	115.20	130.90	139.60	150.60	156.20	0.0025
St. Dev	0.164	4.208	7.473	9.187	10.457	11.172	9.524	8.188	7.799	7.756	0.0003
Count	12	12	12	12	12	12	12	12	12	12	12

**Normal Force - Average Initial vs Average Thermal**

**DATA SUMMARIES Continued****INSULATION RESISTANCE (IR):**

Pin to Pin			
	Mated	Unmated	Unmated
Minimum	CLM/FTMH	CLM	FTMH
Initial	45000	45000	45000
Thermal	45000	45000	45000
Humidity	45000	45000	45000

Row to Row			
	Mated	Unmated	Unmated
Minimum	CLM/FTMH	CLM	FTMH
Initial	45000	45000	45000
Thermal	45000	45000	45000
Humidity	45000	45000	45000

**DIELECTRIC WITHSTANDING VOLTAGE (DWV):**

Voltage Rating Summary	
Minimum	CLM/FTMH
Break Down Voltage	1092
Test Voltage	820
Working Voltage	270

Pin to Pin	
Initial Test Voltage	Passed
After Thermal Test Voltage	Passed
After Humidity Test Voltage	Passed

Row to Row	
Initial Test Voltage	Passed
After Thermal Test Voltage	Passed
After Humidity Test Voltage	Passed

**DATA SUMMARIES Continued****LLCR Thermal Aging 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  $+1000$  mOhms:-----Unstable
  - f.  $>+1000$  mOhms:-----Open Failure

<b>LLCR Measurement Summaries by Pin Type</b>				
Date	2020/12/7	2020/12/25		
Room Temp (Deg C)	22	20		
Rel Humidity (%)	50	50		
Technician	Kason He	Kason He		
mOhm values	<b>Actual Initial</b>	<b>Delta Thermal</b>	<b>Delta</b>	<b>Delta</b>
<b>Pin Type 1: Signal</b>				
Average	9.28	0.26		
St. Dev.	0.65	0.35		
Min	7.72	0.00		
Max	13.64	2.42		
Summary Count	192	192		
Total Count	192	192		

<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	$\leq 5$	$>5 \text{ \& } \leq 10$	$>10 \text{ \& } \leq 15$	$>15 \text{ \& } \leq 50$	$>50 \text{ \& } \leq 1000$	$>1000$
Thermal	192	0	0	0	0	0

**DATA SUMMARIES Continued****LLCR Mating/Unmating Durability 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  $+1000$  mOhms:-----Unstable
  - f.  $>+1000$  mOhms:-----Open Failure

<b>LLCR Measurement Summaries by Pin Type</b>				
Date	2020/12/4	2020/12/14	2020/12/25	2021/1/26
Room Temp (Deg C)	22	22	20	22
Rel Humidity (%)	50	50	50	50
Technician	Kason He	Kason He	Kason He	Kason He
mOhm values	<b>Actual Initial</b>	<b>Delta 100 Cycles</b>	<b>Delta Therm Shck</b>	<b>Delta Humidity</b>
<b>Pin Type 1: Signal</b>				
Average	9.42	0.73	0.94	0.76
St. Dev.	0.66	0.50	0.54	0.59
Min	7.53	0.01	0.01	0.01
Max	11.58	3.41	3.38	3.22
Summary Count	192	192	192	192
Total Count	192	192	192	192

<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>100 Cycles</b>	192	0	0	0	0	0
<b>Therm Shck</b>	192	0	0	0	0	0
<b>Humidity</b>	192	0	0	0	0	0

**DATA SUMMARIES Continued****LLCR Gas Tight 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  $+1000$  mOhms:-----Unstable
  - f.  $>+1000$  mOhms:-----Open Failure

<b>LLCR Measurement Summaries by Pin Type</b>				
Date	2021/1/27	2021/1/29		
Room Temp (Deg C)	22	22		
Rel Humidity (%)	57	52		
Technician	Kason He	Kason He		
mOhm values	<b>Actual</b>	<b>Delta</b>	<b>Delta</b>	<b>Delta</b>
	<b>Initial</b>	<b>Acid Vapor</b>		
<b>Pin Type 1: Signal</b>				
Average	9.44	0.52		
St. Dev.	0.65	0.72		
Min	7.47	0.00		
Max	11.02	7.31		
Summary Count	192	192		
Total Count	192	192		

<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>Acid Vapor</b>	191	1	0	0	0	0

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

- 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  $+1000$  mOhms:-----Unstable
  - f.  $>+1000$  mOhms:-----Open Failure

LLCR Measurement Summaries by Pin Type				
Date	2021/2/10	2021/2/23		
Room Temp (Deg C)	22	23		
Rel Humidity (%)	36	36		
Technician	Scott Rollefstad	Scott Rollefstad		
mOhm values	Actual	Delta		
	Initial	Shock-Vib		
Pin Type: Signal 1				
Average	10.06	0.57		
St. Dev.	0.87	0.59		
Min	6.8	0		
Max	12.32	3.16		
Summary Count	192	192		
Total Count	192	192		

LLCR Delta Count by Category						
	Stable	Minor	Acceptable	Marginal	Unstable	Open
mOhms	$\leq 5$	$>5 \text{ \& } \leq 10$	$>10 \text{ \& } \leq 15$	$>15 \text{ \& } \leq 50$	$>50 \text{ \& } \leq 1000$	$>1000$
Shock-Vib	192	0	0	0	0	0

**Nanosecond Event Detection:**

Shock and Vibration Event Detection Summary	
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
Total Events	0



**EQUIPMENT AND CALIBRATION SCHEDULES****Equipment #:** HZ-TCT-01**Description:** Normal force analyzer**Manufacturer:** Mecmesin Multitester**Model:** Mecmesin Multitester 2.5-i**Serial #:** 08-1049-04**Accuracy:** Last Cal: 3/25/2022, Next Cal: 3/24/2023**Equipment #:** HZ-OV-01**Description:** Oven**Manufacturer:** Huida**Model:** CS101-1E**Serial #:** CS101-1E-B**Accuracy:** Last Cal: 12/12/2021, Next Cal: 12/11/2022**Equipment #:** HZ-THC-01**Description:** Humidity transmitter**Manufacturer:** Thermtron**Model:** SM-8-8200**Serial #:** 38846**Accuracy:** Last Cal: 2/26/2022, Next Cal: 2/25/2023**Equipment #:** HZ-TSC-01**Description:** Vertical Thermal Shock Chamber**Manufacturer:** Cincinnatti Sub Zero**Model:** VTS-3-6-6-SC/AC**Serial #:** 10-VT14994**Accuracy:** See Manual

... Last Cal: 06/27/2021, Next Cal: 06/26/2022

**Equipment #:** HZ-MO-05**Description:** Micro-ohmmeter**Manufacturer:** Keithley**Model:** 3706**Serial #:** 1285188**Accuracy:** Last Cal: 11/14/2021, Next Cal: 11/13/2022**Equipment #:** DG-HPT-01**Description:** Hipot Safety Tester**Manufacturer:** Vitrek**Model:** V73**Serial #:** 025866**Accuracy:**

... Last Cal: 04/11/2022, Next Cal: 04/10/2023

**EQUIPMENT AND CALIBRATION SCHEDULES Continued****Equipment #:** HZ-MO-01**Description:** Micro-ohmmeter**Manufacturer:** Keithley**Model:** 2700**Serial #:** 1199807**Accuracy:** Last Cal: 03/27/2022, Next Cal: 03/26/2023**Equipment #:** HZ-PS-01**Description:** Power Supply**Manufacturer:** Agilent**Model:** 6031A**Serial #:** MY41000982**Accuracy:** Last Cal: 03/27/2022, Next Cal: 04/26/2023**Equipment #:** ACLM-01**Description:** Accelerometer**Manufacturer:** PCB Piezotronics**Model:** 352C03**Serial #:** 115819**Accuracy:** See Manual

... Last Cal: 07/18/2021, Next Cal: 07/18/2022

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

... Last Cal: 10/31/2021, Next Cal: 10/31/2022

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

... Last Cal: 09/11/2021, Next Cal: 09/11/2022