



Project Number: Design Qualification Test Report	Tracking Code: 1576078_Report_Rev_1
Requested by: Dick Jones	Date: 1/25/2019
Part #: FCDP-040-01-L-RA/FEDP-16-06.0-LU-XX-1	
Part description: FCDP/FEDP	Tech: Dustin Pritchard
Test Start: 7/11/2018	Test Completed: 8/30/2018



DESIGN QUALIFICATION TEST REPORT
FCDP/FEDP
FCDP-040-01-L-RA/FEDP-16-06.0-LU-XX-1

Tracking Code: 1576078 Report Rev 1	Part #: FCDP-040-01-L-RA/FEDP-16-06.0-LU-XX-1
Part description: FCDP/FEDP	

REVISION HISTORY

DATA	REV.NUM.	DESCRIPTION	ENG
1/25/2019	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 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) Samtec Test PCBs used: PCB-108638-TST/PCB-108639-TST/ PCB-108842-TST

FLOWCHARTS**Gas Tight**Group 1

FCDP-040-01-L-RA

FEDP-16-06.0-LU-XX-1

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

Thermal AgingGroup 1

FCDP-040-01-L-RA

FEDP-16-06.0-LU-XX-1

8 Assemblies

Step Description

1. Contact Gaps
2. Mating/Unmating Force (2)
3. LLCR (1)
4. Thermal Age (3)
5. LLCR (1)
Max Delta = 15 mOhm
6. Mating/Unmating Force (2)
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

FCDP-040-01-L-RA

FEDP-16-06.0-LU-XX-1

8 Assemblies

Step	Description
1.	Contact Gaps
2.	LLCR (2)
3.	Mating/Unmating Force (3)
4.	Cycles Quantity = 25 Cycles
5.	Mating/Unmating Force (3)
6.	Contact Gaps
7.	LLCR (2) Max Delta = 15 mOhm
8.	Thermal Shock (4) - Non Standard
9.	LLCR (2) Max Delta = 15 mOhm
10.	Humidity (1)
11.	LLCR (2) Max Delta = 15 mOhm
12.	Mating/Unmating Force (3)

(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 = Other

Exposure Time at Temperature Extremes = 1/2 Hour

Method A, Test Condition = I (-25°C to +85°C)

Test Duration = A-3 (100 Cycles)

EIA-364-32

FLOWCHARTS Continued

IR/DWV**Pin-to-Pin**

<u>Group 1</u>		<u>Group 2</u>		<u>Group 3</u>		<u>Group 4</u>	
FCDP-040-01-L-RA FEDP-16-06.0-LU-XX-1 2 Assemblies		FCDP-040-01-L-RA 2 Assemblies		FEDP-16-06.0-LU-XX-1 2 Assemblies		FCDP-040-01-L-RA FEDP-16-06.0-LU-XX-1 2 Assemblies	
Step	Description	Step	Description	Step	Description	Step	Description
1.	DWV Breakdown (2)	1.	DWV Breakdown (2)	1.	DWV Breakdown (2)	1.	IR (4)
						2.	DWV at Test Voltage (1)
						3.	Thermal Shock (5) - Non Standard
						4.	IR (4)
						5.	DWV at Test Voltage (1)
						6.	Humidity (3)
						7.	IR (4)
						8.	DWV at Test Voltage (1)

Row-to-Row

<u>Group 5</u>		<u>Group 6</u>		<u>Group 7</u>		<u>Group 8</u>	
FCDP-040-01-L-RA FEDP-16-06.0-LU-XX-1 2 Assemblies		FCDP-040-01-L-RA 2 Assemblies		FEDP-16-06.0-LU-XX-1 2 Assemblies		FCDP-040-01-L-RA FEDP-16-06.0-LU-XX-1 2 Assemblies	
Step	Description	Step	Description	Step	Description	Step	Description
1.	DWV Breakdown (2)	1.	DWV Breakdown (2)	1.	DWV Breakdown (2)	1.	IR (4)
						2.	DWV at Test Voltage (1)
						3.	Thermal Shock (5) - Non Standard
						4.	IR (4)
						5.	DWV at Test Voltage (1)
						6.	Humidity (3)
						7.	IR (4)
						8.	DWV at Test Voltage (1)

Pin-to-Ground

<u>Group 9</u>		<u>Group 10</u>		<u>Group 11</u>		<u>Group 12</u>	
FCDP-040-01-L-RA FEDP-16-06.0-LU-XX-1 2 Assemblies		FCDP-040-01-L-RA 2 Assemblies		FEDP-16-06.0-LU-XX-1 2 Assemblies		FCDP-040-01-L-RA FEDP-16-06.0-LU-XX-1 2 Assemblies	
Step	Description	Step	Description	Step	Description	Step	Description
1.	DWV Breakdown (2)	1.	DWV Breakdown (2)	1.	DWV Breakdown (2)	1.	IR (4)
						2.	DWV at Test Voltage (1)
						3.	Thermal Shock (5) - Non Standard
						4.	IR (4)
						5.	DWV at Test Voltage (1)
						6.	Humidity (3)
						7.	IR (4)
						8.	DWV at Test Voltage (1)

- (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 = Other
Exposure Time at Temperature Extremes = 1/2 Hour
Method A, Test Condition = I (-25°C to +85°C)
Test Duration = A-3 (100 Cycles)
EIA-364-32

FLOWCHARTS Continued**Current Carrying Capacity**Group 1

FCDP-040-01-L-RA
FEDP-16-12.0-LU-LU-1
2 Pins Powered
Signal

Step	Description
1.	CCC ⁽²⁾ Rows = 2 Number of Positions = 1

Group 2

FCDP-040-01-L-RA
FEDP-16-12.0-LU-LU-1
4 Pins Powered
Signal

Step	Description
1.	CCC ⁽²⁾ Rows = 2 Number of Positions = 2

Group 3

FCDP-040-01-L-RA
FEDP-16-12.0-LU-LU-1
6 Pins Powered
Signal

Step	Description
1.	CCC ⁽²⁾ Rows = 2 Number of Positions = 3

Group 4

FCDP-040-01-L-RA
FEDP-16-12.0-LU-LU-1
8 Pins Powered
Signal

Step	Description
1.	CCC ⁽²⁾ Rows = 2 Number of Positions = 4

Group 5

FCDP-040-01-L-RA
FEDP-16-12.0-LU-LU-1
32 Pins Powered
Signal

Step	Description
1.	CCC ⁽²⁾ Rows = 2 Number of Positions = 16

Group 6

FCDP-040-01-L-RA
FEDP-16-12.0-LU-LU-1
1 Pins Powered
Ground

Step	Description
1.	CCC ⁽²⁾ Rows = 1 Number of Positions = 1

Group 7

FCDP-040-01-L-RA
FEDP-16-12.0-LU-LU-1
All Power

Step	Description
1.	CCC - All Power ⁽¹⁾

(1) CCC - All Power = 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

(2) 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

FCDP-040-01-L-RA

FEDP-16-XX.X-LU-XX-1

8 Assemblies

Step	Description
1.	LLCR (1)
2.	Mechanical Shock (2)
3.	Random Vibration (3)
4.	LLCR (1) 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 DetectionGroup 1

FCDP-040-01-L-RA

FEDP-16-XX.X-LU-XX-1

60 Points

Step	Description
1.	Nanosecond Event Detection (Mechanical Shock) (1)
2.	Nanosecond Event Detection (Random Vibration) (2)

(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:

- 1) EIA-364-17, *Temperature Life with or without Electrical Load Test Procedure for Electrical Connectors*.
- 2) Test Condition 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.

THERMAL SHOCK:

- 1) EIA-364-32, *Thermal Shock (Temperature Cycling) Test Procedure for Electrical Connectors*.
- 2) Test Condition: -25°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.

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 G² / 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

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

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

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. $\leq +5.0$ 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
- 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° 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 1000 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

Signal pin

- CCC for a 30°C Temperature Rise-----1.3 A per contact with 2 contacts (2x1) powered
- CCC for a 30°C Temperature Rise-----1.0 A per contact with 4 contacts (2x2) powered
- CCC for a 30°C Temperature Rise-----0.9 A per contact with 6 contacts (2x3) powered
- CCC for a 30°C Temperature Rise-----0.7 A per contact with 8 contacts (2x4) powered
- CCC for a 30°C Temperature Rise-----0.5 A per contact with 32 contacts (2x16) powered

Ground pin

- CCC for a 30°C Temperature Rise-----11.5 A per contact with 1 contacts (1x1) powered

Signal & Ground pin

- CCC for a 30°C Temperature Rise-----10.2 A per contact with 1 contacts (1x1) powered.
Signals being powered at ½ rated current.

Mating – Unmating Forces

Thermal aging Group

- Initial
 - Mating
 - Min ----- 7.46 lbs
 - Max ----- 8.48 lbs
 - Unmating
 - Min ----- 3.39 lbs
 - Max ----- 4.82 lbs
- After Thermal
 - Mating
 - Min ----- 4.34 lbs
 - Max ----- 6.74 lbs
 - Unmating
 - Min ----- 2.52 lbs
 - Max ----- 3.58 lbs

Mating/Unmating Durability Group

- Initial
 - Mating
 - Min ----- 5.64 lbs
 - Max ----- 8.47 lbs
 - Unmating
 - Min ----- 2.52 lbs
 - Max ----- 4.24 lbs
- After 25 Cycles
 - Mating
 - Min ----- 6.28 lbs
 - Max ----- 10.13 lbs
 - Unmating
 - Min ----- 3.22 lbs
 - Max ----- 4.74 lbs
- Humidity
 - Mating
 - Min ----- 4.94 lbs
 - Max ----- 6.52 lbs
 - Unmating
 - Min ----- 2.38 lbs
 - Max ----- 3.59 lbs

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

- **Initial**
 - Mated-----45000 Meg Ω ----- Passed
 - Unmated -----45000 Meg Ω ----- Passed
- **Thermal Shock**
 - Mated-----45000 Meg Ω ----- Passed
 - Unmated -----45000 Meg Ω ----- Passed
- **Humidity**
 - Mated-----1230 Meg Ω ----- Passed
 - Unmated -----5600 Meg Ω ----- Passed

Row to Row

- **Initial**
 - Mated-----45000 Meg Ω ----- Passed
 - Unmated -----45000 Meg Ω ----- Passed
- **Thermal Shock**
 - Mated-----45000 Meg Ω ----- Passed
 - Unmated -----45000 Meg Ω ----- Passed
- **Humidity**
 - Mated-----45000 Meg Ω ----- Passed
 - Unmated -----45000 Meg Ω ----- Passed

Pin to Ground

- **Initial**
 - Mated-----45000 Meg Ω ----- Passed
 - Unmated -----45000 Meg Ω ----- Passed
- **Thermal Shock**
 - Mated-----45000 Meg Ω ----- Passed
 - Unmated -----45000 Meg Ω ----- Passed
- **Humidity**
 - Mated-----19900 Meg Ω ----- Passed
 - Unmated -----23300 Meg Ω ----- Passed

Dielectric Withstanding Voltage minimums, DWV

- **Minimums**
 - Breakdown Voltage-----576 VAC
 - Test Voltage-----435 VAC
 - Working Voltage-----140 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

Pin to Ground

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

RESULTS Continued**LLCR Gas Tight (160 signal and 32 ground LLCR test points)****Signal Pin**

- **Initial** ----- 167.46 mOhms Max
- **Gas-Tight**
 - **<= +5.0 mOhms** ----- 157 Points ----- Stable
 - **+5.1 to +10.0 mOhms** ----- 2 Points ----- Minor
 - **+10.1 to +15.0 mOhms** ----- 1 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

Ground Pin

- **Initial** ----- 38.52 mOhms Max
- **Thermal Aging**
 - **<= +5.0 mOhms** ----- 32 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 +2000 mOhms** ----- 0 Points ----- Unstable
 - **>+2000 mOhms** ----- 0 Points ----- Open Failure

LLCR Thermal Aging (160 signal and 32 ground LLCR test points)**Signal Pin**

- **Initial** ----- 177.06 mOhms Max
- **Thermal Aging**
 - **<= +5.0 mOhms** ----- 160 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 +2000 mOhms** ----- 0 Points ----- Unstable
 - **>+2000 mOhms** ----- 0 Points ----- Open Failure

Ground Pin

- **Initial** ----- 36.72 mOhms Max
- **Thermal Aging**
 - **<= +5.0 mOhms** ----- 32 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 +2000 mOhms** ----- 0 Points ----- Unstable
 - **>+2000 mOhms** ----- 0 Points ----- Open Failure

RESULTS Continued**LLCR Durability (160 signal and 32 ground LLCR test points)****Signal Pin**

- **Initial** ----- 180.53 mOhms Max
- **Durability, 25 Cycles**
 - **<= +5.0 mOhms** ----- 159 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
- **Thermal**
 - **<= +5.0 mOhms** ----- 159 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
- **Humidity**
 - **<= +5.0 mOhms** ----- 155 Points ----- Stable
 - **+5.1 to +10.0 mOhms** ----- 4 Points ----- Minor
 - **+10.1 to +15.0 mOhms** ----- 1 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

Ground Pin

- **Initial** ----- 37.13 mOhms Max
- **Durability, 25 Cycles**
 - **<= +5.0 mOhms** ----- 31 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
- **Thermal**
 - **<= +5.0 mOhms** ----- 32 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 +2000 mOhms** ----- 0 Points ----- Unstable
 - **>+2000 mOhms** ----- 0 Points ----- Open Failure
- **Humidity**
 - **<= +5.0 mOhms** ----- 32 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 +2000 mOhms** ----- 0 Points ----- Unstable
 - **>+2000 mOhms** ----- 0 Points ----- Open Failure

RESULTS Continued**LLCR Shock & Vibration (160 signal and 32 ground LLCR test points)****Signal Pin**

- **Initial**-----313.31 mOhms Max
- **Shock &Vibration**
 - **<= +5.0 mOhms**----- 146 Points----- Stable
 - **+5.1 to +10.0 mOhms**----- 12 Points----- Minor
 - **+10.1 to +15.0 mOhms**-----2 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

Ground Pin

- **Initial**----- 49.70 mOhms Max
- **Shock &Vibration**
 - **<= +5.0 mOhms**----- 30 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

Mechanical Shock & Random Vibration:

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

DATA SUMMARIES

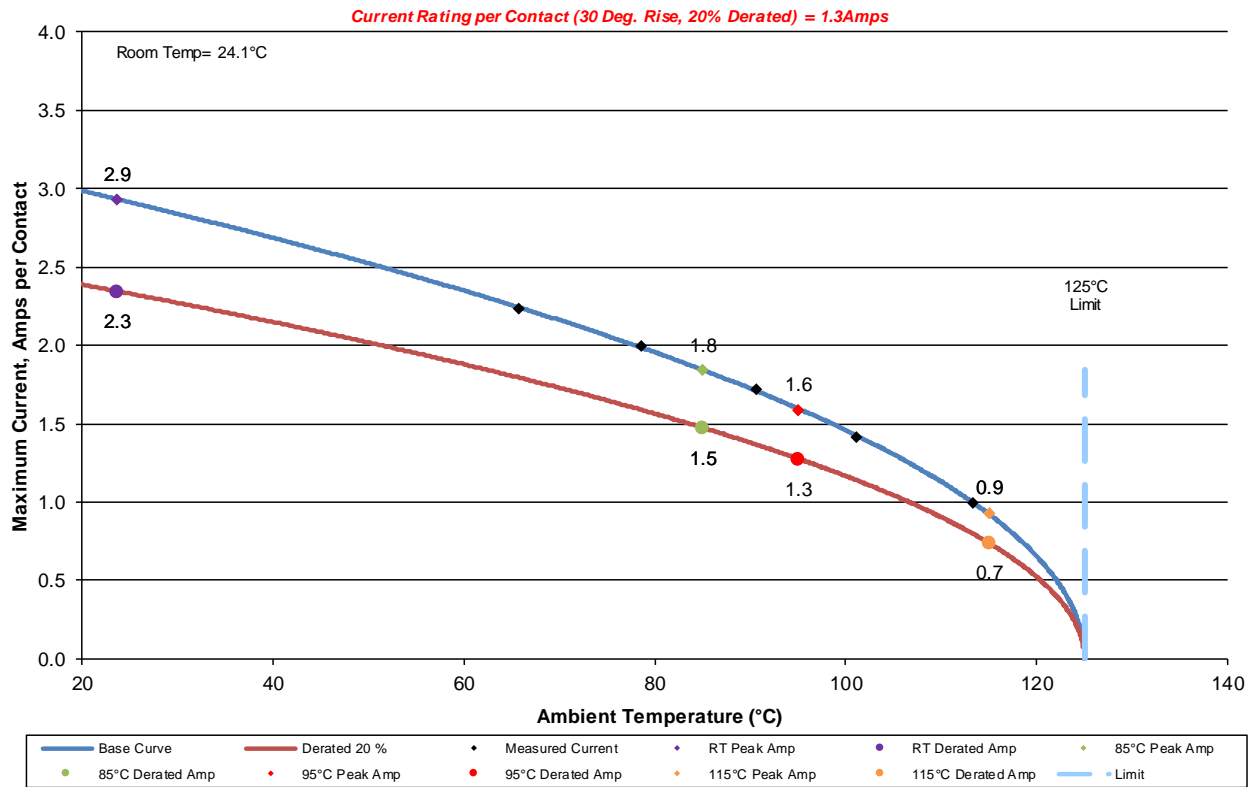
TEMPERATURE RISE (Current Carrying Capacity, CCC):

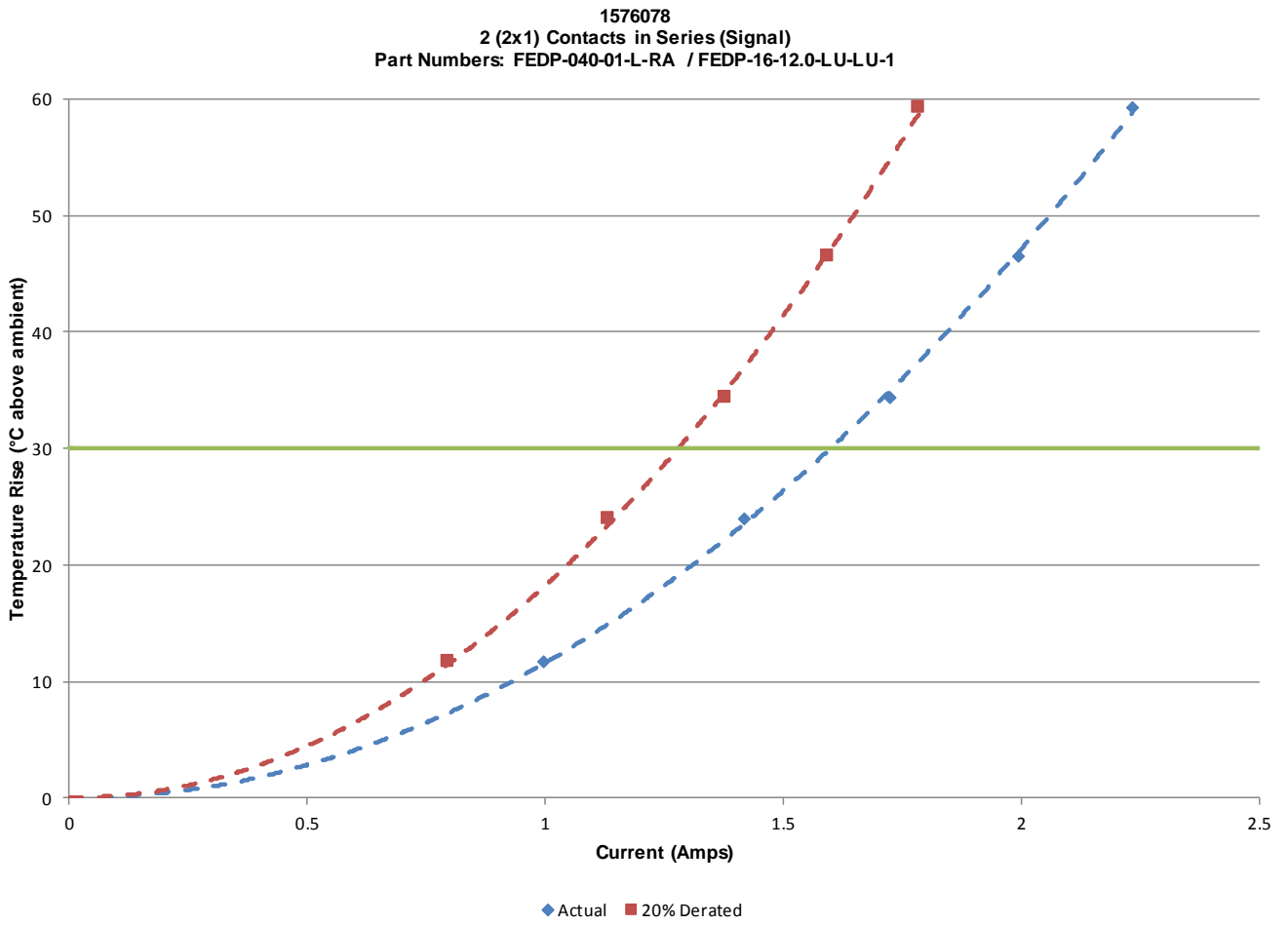
- 1) High quality thermocouples whose temperature slopes track one another were used for temperature monitoring.
- 2) The thermocouples were placed at a location to sense the maximum temperature generated during testing.
- 3) Temperature readings recorded are those for which three successive readings,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

Signal pin

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

1576078
2 (2x1) Contacts in Series Signal (Cable)
Part Numbers: FCDP-040-01-L-RA/FEDP-16-12.0-LU-LU-1



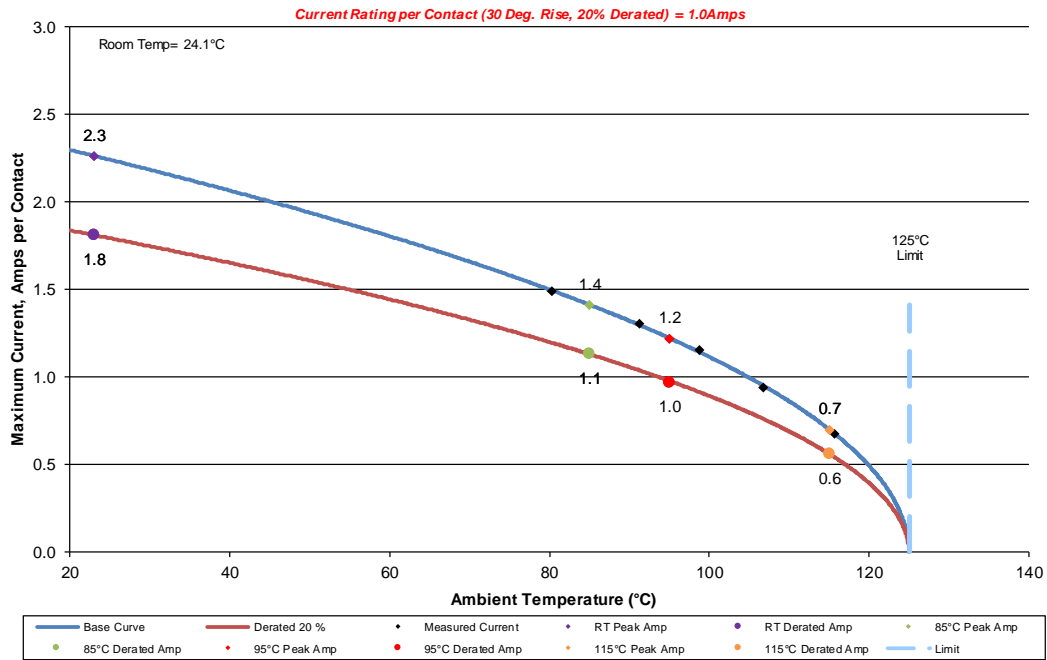


DATA SUMMARIES Continued

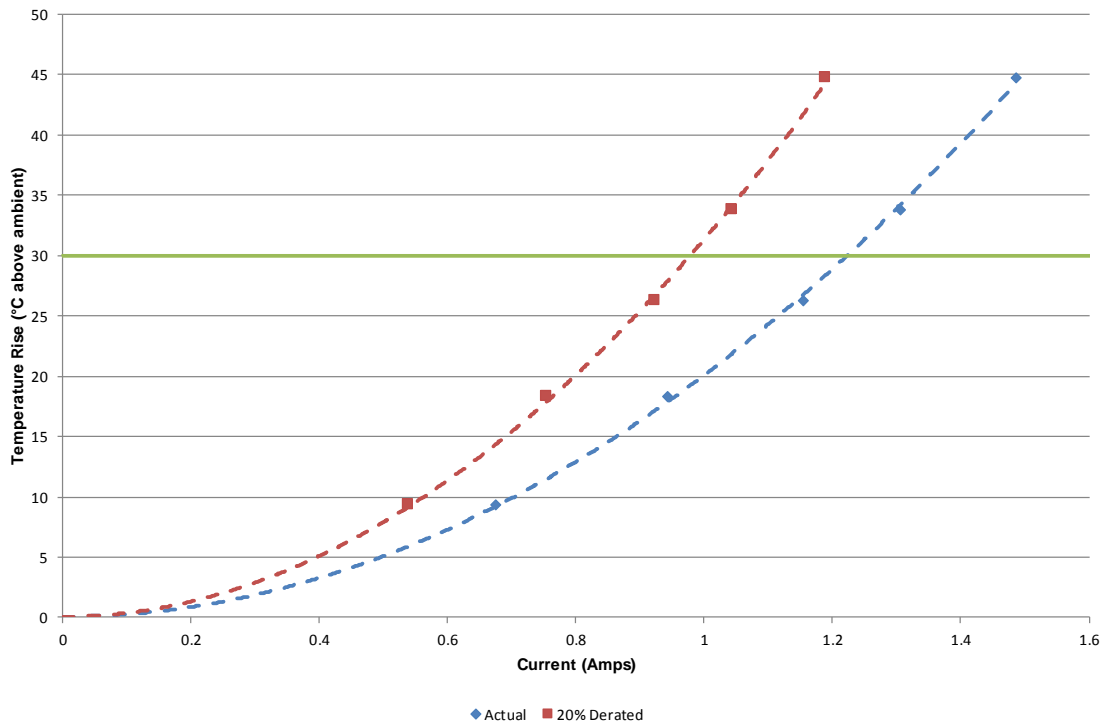
Signal pin

b. Linear configuration with 4 adjacent conductors/contacts powered

1576078
 4 (2x2) Contacts in Series Signal (Cable)
 Part Numbers: FCDP-040-01-L-RA/FEDP-16-12.0-LU-LU-1



1576078
 4 (2x2) Contacts in Series (Signal)
 Part Numbers: FEDP-040-01-L-RA / FEDP-16-12.0-LU-LU-1



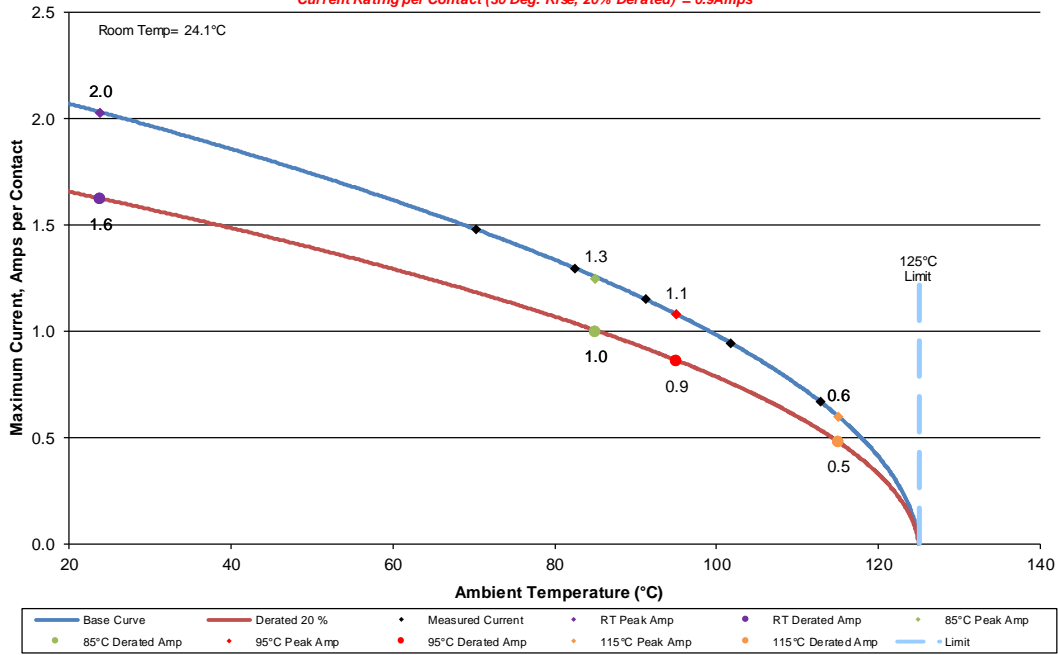
DATA SUMMARIES Continued

Signal pin

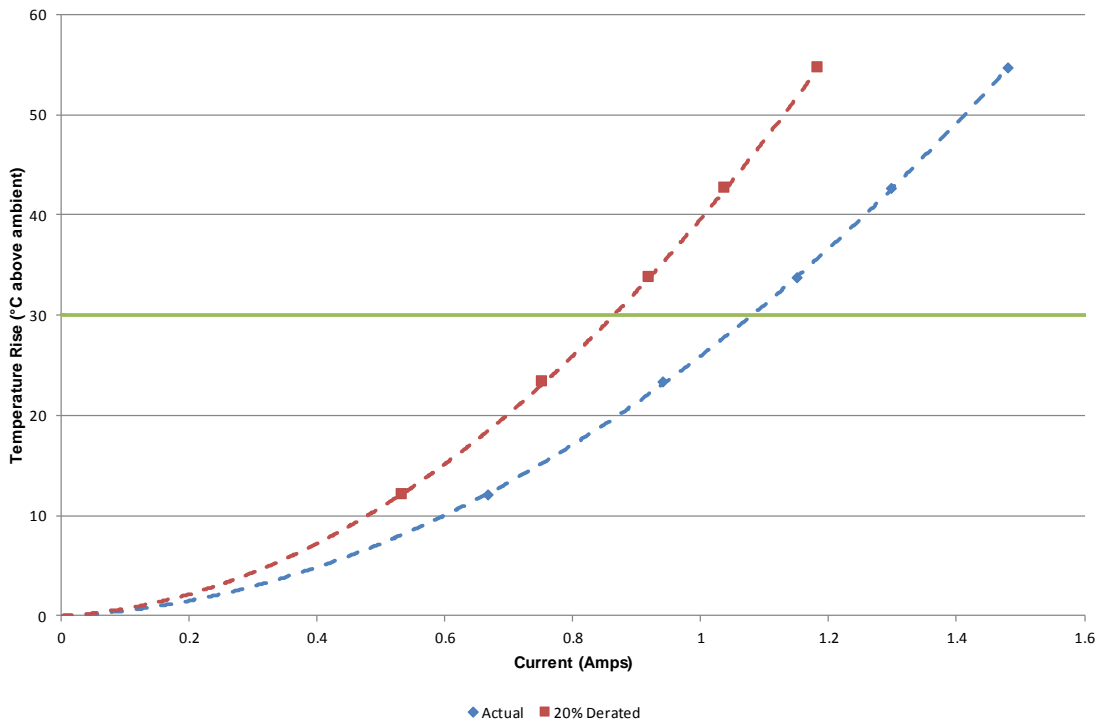
c. Linear configuration with 6 adjacent conductors/contacts powered

1576078
 6 (2x3) Contacts in Series Signal (Cable)
 Part Numbers: FCDP-040-01-L-RA/FEDP-16-12.0-LU-LU-1

Current Rating per Contact (30 Deg. Rise, 20% Derated) = 0.9Amps



1576078
 6 (2x3) Contacts in Series (Signal)
 Part Numbers: FEDP-040-01-L-RA / FEDP-16-12.0-LU-LU-1

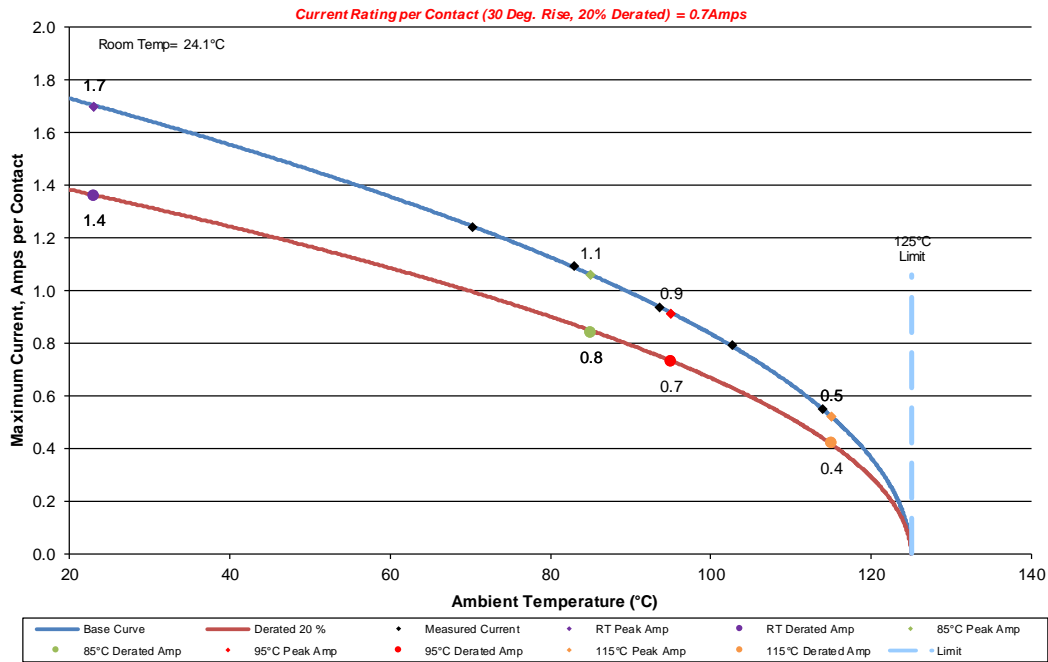


DATA SUMMARIES Continued

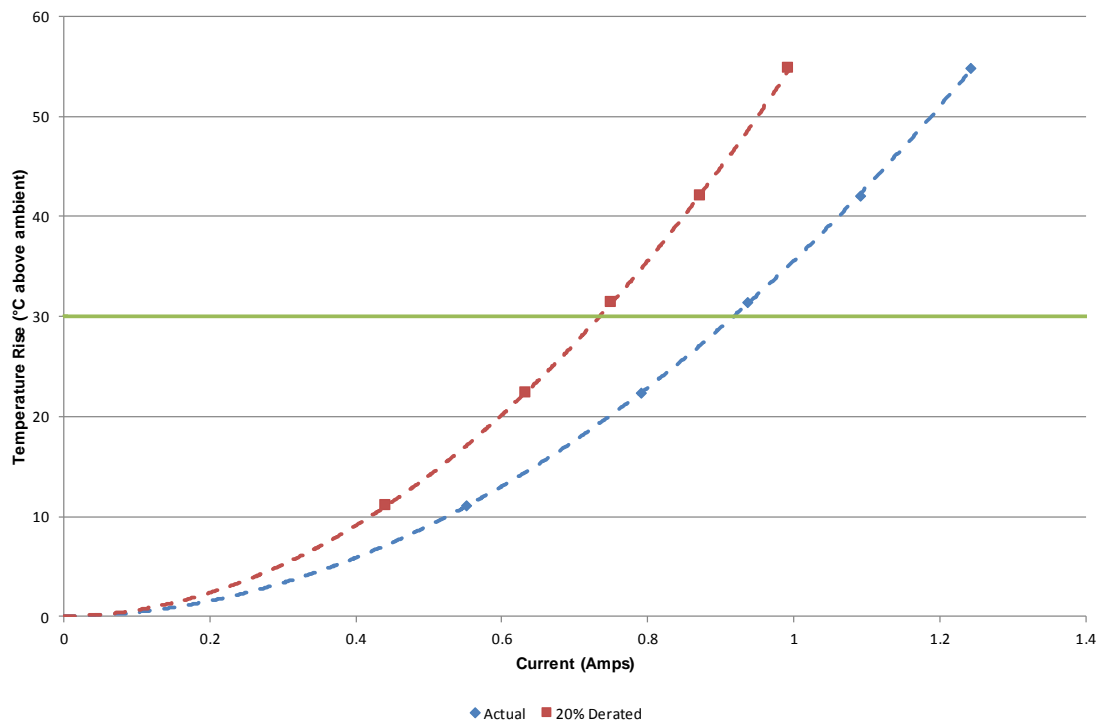
Signal pin

d. Linear configuration with 8 adjacent conductors/contacts powered

1576078
 8 (2x4) Contacts in Series Signal (Cable)
 Part Numbers: FCDP-040-01-L-RA/FEDP-16-12.0-LU-LU-1



1576078
 8 (2x4) Contacts in Series (Signal)
 Part Numbers: FEDP-040-01-L-RA / FEDP-16-12.0-LU-LU-1

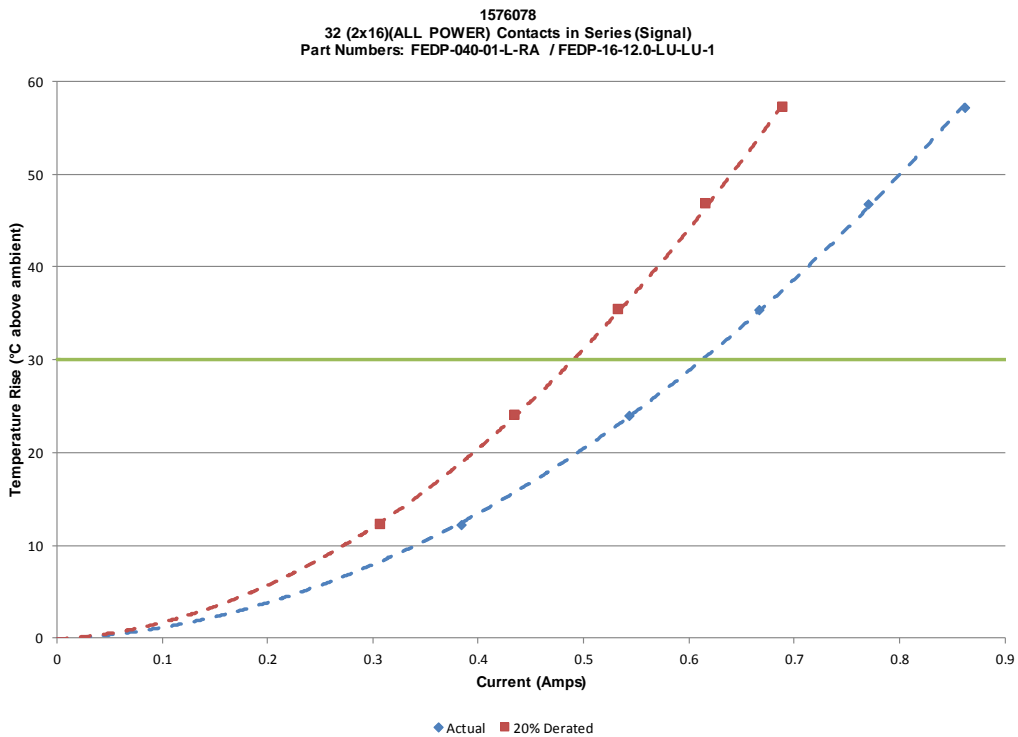
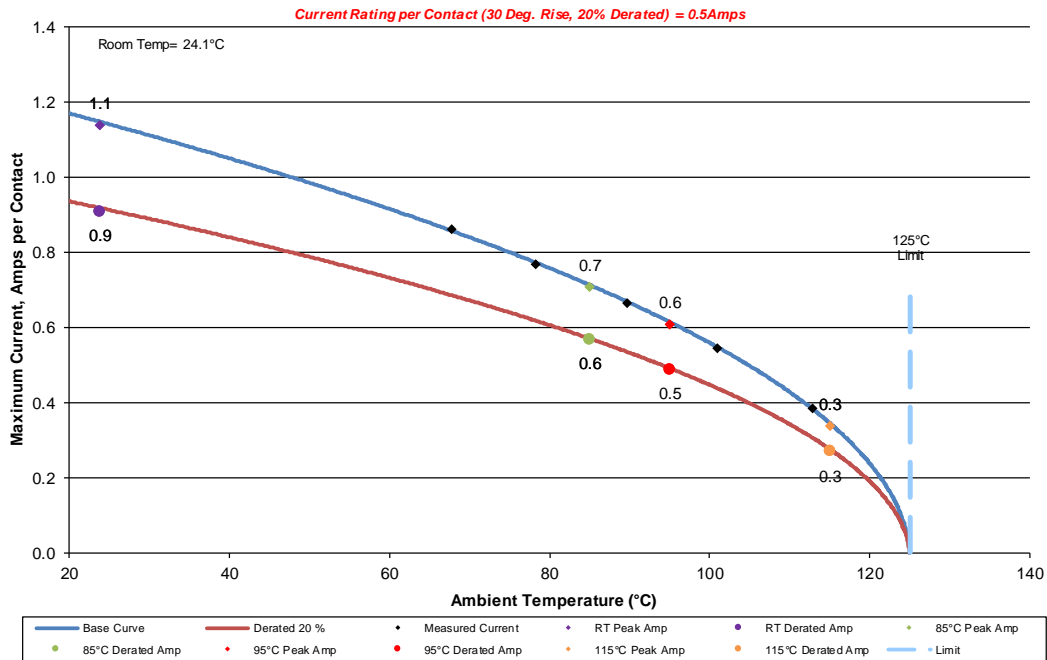


DATA SUMMARIES Continued

Signal pin

e. Linear configuration with 32 adjacent conductors/contacts powered

1576078
 32 (2x16)(ALL POWER) Contacts in Series Signal (Cable)
 Part Numbers: FCDP-040-01-L-RA/FEDP-16-12.0-LU-LU-1

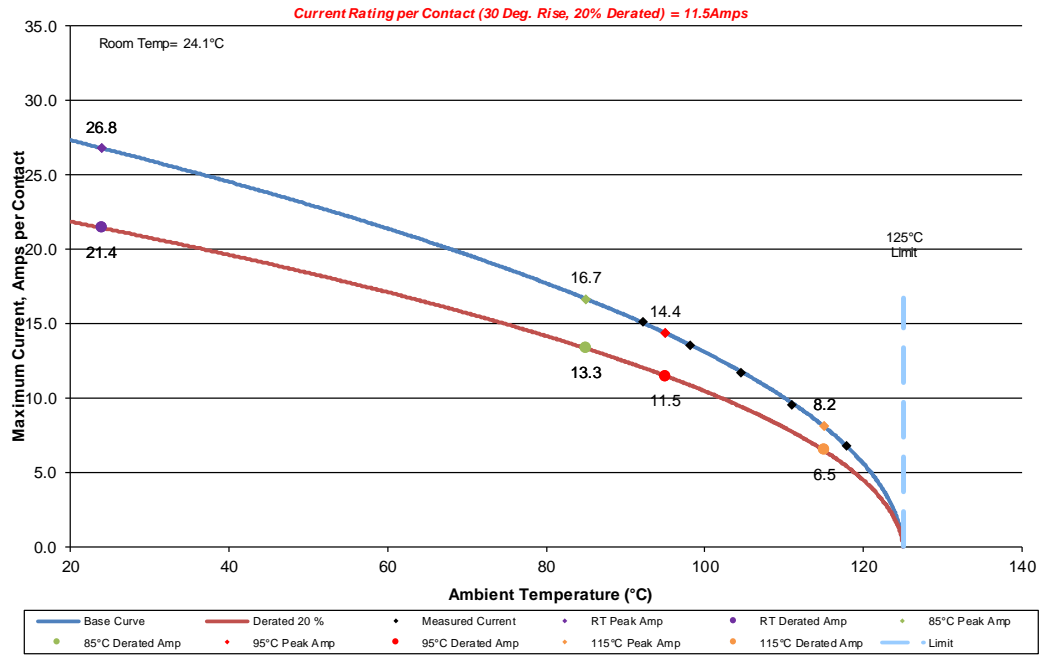


DATA SUMMARIES Continued

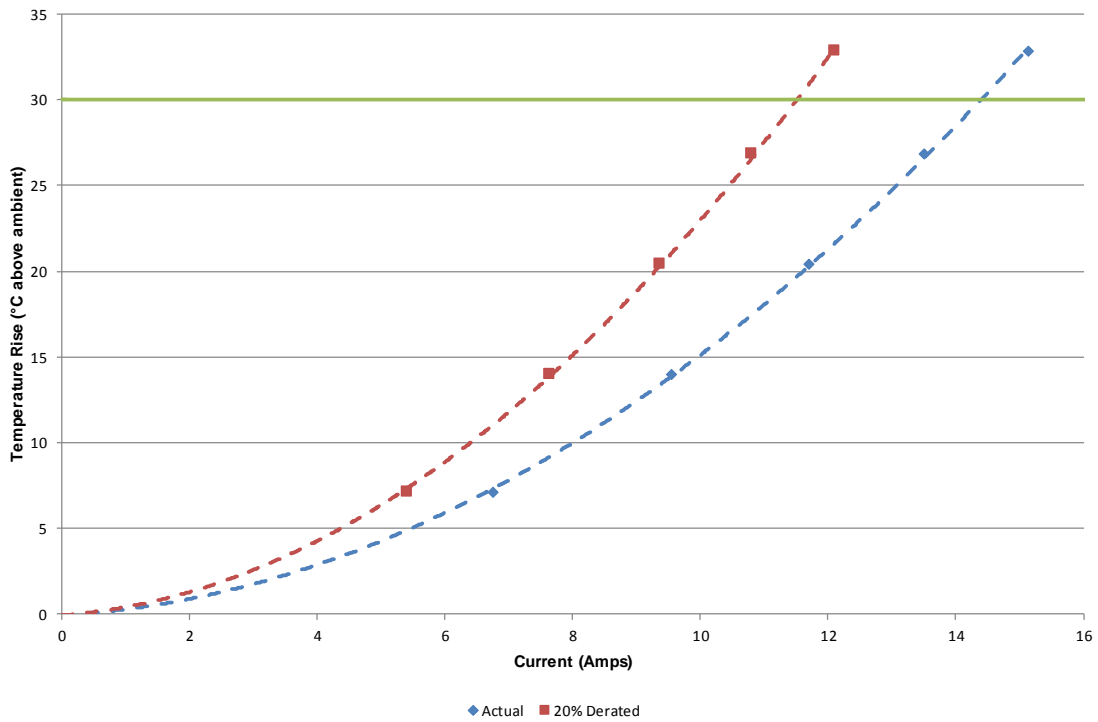
Ground Pin

f. Linear configuration with 1 conductors/contacts powered

1576078
 1 (1x1) (ALL POWER) Contacts in Series Ground (Contact Interface)
 Part Numbers: FCDP-040-01-L-RA/FEDP-16-12.0-LU-LU-1



1576078
 1 (1x1) (ALL POWER) Contacts in Series Ground (Contact Interface)
 Part Numbers: FEDP-040-01-L-RA / FEDP-16-12.0-LU-LU-1

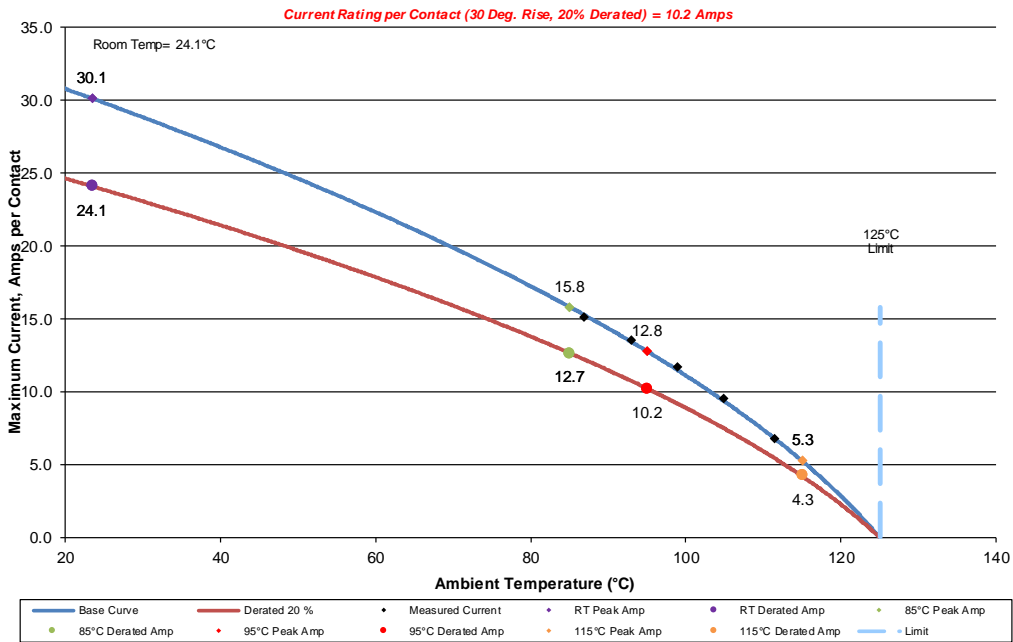


DATA SUMMARIES Continued

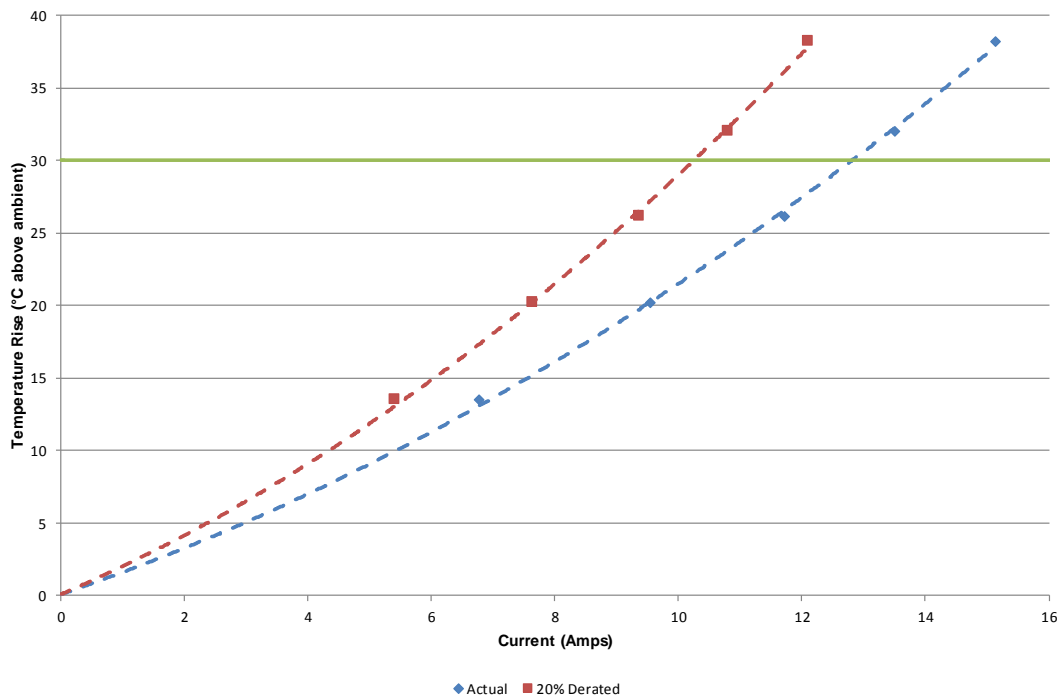
Signal & Ground Pin

g. Linear configuration with 1 conductors contact in Series (Ground)(Signals Powered @ 1/2 Rated Current /contacts powered

1576078
 1 (1x1) (ALL POWER) Contacts in Series (Signals powered @ 1/2 rated current - .35A) (Contact Interface)
 Part Numbers: FCDP-040-01-L-RA/FEDP-16-12.0-LU-LU-1



1576078
 1 (1x1) (ALL POWER) Contacts in Series (Signals powered @ 1/2 rated current - .35A) (Contact Interface)
 Part Numbers: FEDP-040-01-L-RA / FEDP-16-12.0-LU-LU-1



DATA SUMMARIES Continued

**MATING/UNMATING:
Thermal Aging Group**

	Initial				After Thermals			
	Mating		Unmating		Mating		Unmating	
	Newton's	Force (Lbs)	Newton's	Force (Lbs)	Newton's	Force (Lbs)	Newton's	Force (Lbs)
Minimum	33.18	7.46	15.08	3.39	19.30	4.34	11.21	2.52
Maximum	37.72	8.48	21.44	4.82	29.98	6.74	15.92	3.58
Average	34.72	7.81	18.27	4.11	23.82	5.36	13.69	3.08
St Dev	1.39	0.31	2.02	0.46	3.26	0.73	1.58	0.35
Count	8	8	8	8	8	8	8	8

Mating/Unmating Durability Group

	Initial				25 Cycles			
	Mating		Unmating		Mating		Unmating	
	Newton's	Force (Lbs)	Newton's	Force (Lbs)	Newton's	Force (Lbs)	Newton's	Force (Lbs)
Minimum	25.09	5.64	11.21	2.52	27.93	6.28	14.32	3.22
Maximum	37.67	8.47	18.86	4.24	45.06	10.13	21.08	4.74
Average	31.74	7.14	15.21	3.42	37.16	8.36	17.19	3.86
St Dev	4.01	0.90	2.44	0.55	6.01	1.35	2.13	0.48
Count	8	8	8	8	8	8	8	8

	After Humidity			
	Mating		Unmating	
	Newton's	Force (Lbs)	Newton's	Force (Lbs)
Minimum	21.97	4.94	10.59	2.38
Maximum	29.00	6.52	15.97	3.59
Average	25.45	5.72	13.31	2.99
St Dev	2.32	0.52	1.68	0.38
Count	8	8	8	8

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

		Pin to Pin		
		Mated	Unmated	Unmated
Minimum		FCDP/FEDP	FCDP	FEDP
Initial		45000	45000	Not Tested
Thermal		45000	45000	Not Tested
Humidity		1230	5600	Not Tested

		Row to Row		
		Mated	Unmated	Unmated
Minimum		FCDP/FEDP	FCDP	FEDP
Initial		45000	45000	Not Tested
Thermal		45000	45000	Not Tested
Humidity		45000	45000	Not Tested

		Pin to Ground		
		Mated	Unmated	Unmated
Minimum		FCDP/FEDP	FCDP	FEDP
Initial		45000	45000	Not Tested
Thermal		45000	45000	Not Tested
Humidity		19900	23300	Not Tested

DIELECTRIC WITHSTANDING VOLTAGE (DWV):

Voltage Rating Summary	
Minimum	FCDP/FEDP
Break Down Voltage	576
Test Voltage	435
Working Voltage	140

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

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

DATA SUMMARIES Continued**LLCR Durability:**

- 1) A total of 160 signal and 32 ground 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

LLCR Measurement Summaries by Pin Type				
Date	7/19/2018	7/25/2018	8/9/2018	8/27/2018
Room Temp (Deg C)	23	23	23	23
Rel Humidity (%)	39	43	45	43
Technician	Dustin Pritchard	Dustin Pritchard	Dustin Pritchard	Dustin Pritchard
mOhm values	Actual Initial	Delta 25 Cycles	Delta Therm Shck	Delta Humidity
Pin Type 1: Signal				
Average	173.22	0.85	1.33	1.30
St. Dev.	2.06	0.89	0.97	1.66
Min	168.73	0.00	0.04	0.00
Max	180.53	6.00	5.05	13.93
Summary Count	160	160	160	160
Total Count	160	160	160	160
Pin Type 2: Ground				
Average	34.59	0.79	0.67	0.81
St. Dev.	2.78	1.19	0.57	0.81
Min	22.27	0.01	0.09	0.01
Max	37.13	6.48	2.70	3.16
Summary Count	32	32	32	32
Total Count	32	32	32	32

LLCR Delta Count by Category						
	Stable	Minor	Acceptable	Marginal	Unstable	Open
mOhms	≤ 5	>5 & ≤ 10	>10 & ≤ 15	>15 & ≤ 50	>50 & ≤ 1000	>1000
25 Cycles	190	2	0	0	0	0
Therm Shck	191	1	0	0	0	0
Humidity	187	4	1	0	0	0

DATA SUMMARIES Continued**LLCR Thermal Aging:**

- 1) A total of 160 signal and 32 ground 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

LLCR Measurement Summaries by Pin Type				
Date	7/19/2018	7/30/2018		
Room Temp (Deg C)	23	23		
Rel Humidity (%)	40	43		
Technician	Dustin Pritchard	Dustin Pritchard		
mOhm values	Actual Initial	Delta Thermal	Delta	Delta
Pin Type 1: Signal				
Average	170.32	0.72		
St. Dev.	4.74	0.48		
Min	159.59	0.00		
Max	177.06	3.30		
Summary Count	160	160		
Total Count	160	160		
Pin Type 2: Ground				
Average	34.66	0.54		
St. Dev.	1.90	0.52		
Min	29.86	0.01		
Max	36.72	2.55		
Summary Count	32	32		
Total Count	32	32		

LLCR Delta Count by Category						
	Stable	Minor	Acceptable	Marginal	Unstable	Open
mOhms	≤ 5	>5 & ≤ 10	>10 & ≤ 15	>15 & ≤ 50	>50 & ≤ 1000	>1000
Thermal	192	0	0	0	0	0

DATA SUMMARIES Continued**LLCR Gas Tight:**

- 1) A total of 160 signal and 32 ground 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

LLCR Measurement Summaries by Pin Type				
Date	7/11/2018	7/19/2018		
Room Temp (Deg C)	24	23		
Rel Humidity (%)	44	40		
Technician	Dustin Pritchard	Dustin Pritchard		
mOhm values	Actual Initial	Delta Acid Vapor	Delta	Delta
Pin Type 1: Signal				
Average	160.15	0.78		
St. Dev.	4.60	1.32		
Min	147.40	0.01		
Max	167.46	14.65		
Summary Count	160	160		
Total Count	160	160		
Pin Type 2: Ground				
Average	34.72	0.69		
St. Dev.	1.99	0.64		
Min	29.17	0.01		
Max	38.52	2.46		
Summary Count	32	32		
Total Count	32	32		

LLCR Delta Count by Category						
	Stable	Minor	Acceptable	Marginal	Unstable	Open
mOhms	≤ 5	>5 & ≤ 10	>10 & ≤ 15	>15 & ≤ 50	>50 & ≤ 1000	>1000
Acid Vapor	189	2	1	0	0	0

DATA SUMMARIES Continued

LLCR Shock &Vibration:

- 1). A total of 160 signal and 32 ground points were measured.
- 2). EIA-364-23, *Low Level Contact Resistance Test Procedure for Electrical Connectors and Sockets.*
- 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

LLCR Measurement Summaries by Pin Type				
Date	7/25/2018	8/30/2018		
Room Temp (Deg C)	23	23		
Rel Humidity (%)	43	44		
Technician	Dustin Pritchard	Dustin Pritchard		
mOhm values	Actual Initial	Delta Shock-Vib	Delta	Delta
Pin Type 1: Signal				
Average	302.42	2.15		
St. Dev.	5.54	2.09		
Min	274.54	0.06		
Max	313.31	11.41		
Summary Count	160	160		
Total Count	160	160		
Pin Type 2: Ground				
Average	41.04	1.43		
St. Dev.	2.80	1.46		
Min	35.02	0.08		
Max	49.70	6.80		
Summary Count	32	32		
Total Count	32	32		

LLCR Delta Count by Category						
	Stable	Minor	Acceptable	Marginal	Unstable	Open
mOhms	≤ 5	$>5 \ \& \ \leq 10$	$>10 \ \& \ \leq 15$	$>15 \ \& \ \leq 50$	$>50 \ \& \ \leq 1000$	>1000
Shock-Vib	175	15	2	0	0	0

Nanosecond Event Detection:

Shock and Vibration Event Detection Summary	
Contacts tested	32
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 #:** TCT-04**Description:** Dillon Quantrol TC21 25-1000 mm/min series test stand**Manufacturer:** Dillon Quantrol**Model:** TC2 I series test stand**Serial #:** 04-1041-04**Accuracy:** Speed Accuracy: +/- 5% of indicated speed; Speed Accuracy: +/- 5% of indicated speed;

... Last Cal: 05/29/2018, Next Cal: 05/29/2019

Equipment #: MO-11**Description:** Switch/Multimeter**Manufacturer:** Keithley**Model:** 3706**Serial #:** 120169**Accuracy:** See Manual

... Last Cal: 09/11/2018, Next Cal: 09/11/2019

Equipment #: THC-05**Description:** Temperature/Humidity Chamber (Chamber Room)**Manufacturer:** ThermoTron**Model:** SM-8-3800**Serial #:** 05 23 00 02**Accuracy:** See Manual

... Last Cal: 11/14/2017, Next Cal: 11/14/2018

Equipment #: TSC-01**Description:** Vertical Thermal Shock Chamber**Manufacturer:** Cincinnati Sub Zero**Model:** VTS-3-6-6-SC/AC**Serial #:** 10-VT14993**Accuracy:** See Manual

... Last Cal: 06/30/2018, Next Cal: 06/30/2019

Equipment #: HPT-01**Description:** Hipot Safety Tester**Manufacturer:** Vitrek**Model:** V73**Serial #:** 019808**Accuracy:**

... Last Cal: 05/15/2018, Next Cal: 05/15/2019

Equipment #: PS-02**Description:** Power Supply**Manufacturer:** Hewlett-Packard**Model:** 6033A**Serial #:** N/A**Accuracy:** See Manual

... Last Cal: NOT CALIBRATED

EQUIPMENT AND CALIBRATION SCHEDULES**Equipment #:** SVC-01**Description:** Shock & Vibration Table**Manufacturer:** Data Physics**Model:** LE-DSA-10-20K**Serial #:** 10037**Accuracy:** See Manual

... Last Cal: 04/22/2018, Next Cal: 04/22/2019

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

... Last Cal: 07/18/2018, Next Cal: 07/18/2019

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

... Last Cal: 10/31/2018, Next Cal: 10/31/2019

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

... Last Cal: 09/11/2018, Next Cal: 09/11/2019