



Project Number: Design Qualification Test Report	Tracking Code: 643196_Report_Rev_1
Requested by: Catie Eichhorn	Date: 12/17/2015
Part #: PSS-20-02-T-S/HPM-20-01-T-S-VS	
Part description: PSS/HPM	Tech: Kason He
Test Start:9/16/2015	Test Completed: 10/26/2015



(Actual part not depicted)

DESIGN QUALIFICATION TEST REPORT

PSS/HPM

PSS-20-02-T-S/HPM-20-01-T-S-VS

Tracking Code: 643196_Report_Rev_1

Part #: PSS-20-02-T-S/HPM-20-01-T-S-VS

Part description: PSS/HPM

REVISION HISTORY

DATE	REV.NUM.	DESCRIPTION	ENG
12/17/2015	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.

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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) Samtec Test PCBs used: PCB-107079-TST/PCB-107080-TST/PCB-107081-TST/PCB-107082-TST

FLOWCHARTS**Gas Tight**Group 1

PSS-20-02-T-S
 HPM-20-01-T-S-VS
 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 ForceGroup 1

PSS-20-02-T-S
 HPM-20-01-T-S-VS
 8 Contacts Minimum
 Signal Without Thermals

Step	Description
1.	Contact Gaps
2.	Normal Force ⁽¹⁾ Expected Force at Max Deflection = 181 g Deflection = 0.0045 "

Group 2

PSS-20-02-T-S
 HPM-20-01-T-S-VS
 8 Contacts Minimum
 Signal With Thermals

Step	Description
1.	Contact Gaps
2.	Thermal Age ⁽²⁾
3.	Contact Gaps
4.	Normal Force ⁽¹⁾ Expected Force at Max Deflection = 181 g Deflection = 0.0045 "

(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

PSS-20-02-T-S

HPM-20-01-T-S-VS

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

PSS-20-02-T-S
HPM-20-01-T-S-VS
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⁾
9.	LLCR ⁽²⁾ Max Delta = 15 mOhm
10.	Humidity ⁽¹⁾
11.	LLCR ⁽²⁾ Max Delta = 15 mOhm
12.	Mating/Unmating Force ⁽³⁾

Group 2

PSS-10-02-T-S
HPM-10-01-T-S-VS
8 Assemblies

Step	Description
1.	Contact Gaps
2.	Mating/Unmating Force ⁽³⁾
3.	Cycles Quantity = 25 Cycles
4.	Mating/Unmating Force ⁽³⁾

Group 3

PSS-02-02-T-S
HPM-02-01-T-S-VS
8 Assemblies

Step	Description
1.	Contact Gaps
2.	Mating/Unmating Force ⁽³⁾
3.	Cycles Quantity = 25 Cycles
4.	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 = 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
PSS-20-02-T-S
HPM-20-01-T-S-VS
2 Assemblies

Group 2
PSS-20-02-T-S

2 Assemblies

Group 3
HPM-20-01-T-S-VS
2 Assemblies

Group 4
PSS-20-02-T-S
HPM-20-01-T-S-VS
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⁾
						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 = 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
PSS-20-02-T-S
HPM-20-01-T-S-VS
1 Pins Powered
Signal

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

Group 2
PSS-20-02-T-S
HPM-20-01-T-S-VS
2 Pins Powered
Signal

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

Group 3
PSS-20-02-T-S
HPM-20-01-T-S-VS
3 Pins Powered
Signal

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

Group 4
PSS-20-02-T-S
HPM-20-01-T-S-VS
4 Pins Powered
Signal

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

Group 5
PSS-20-02-T-S
HPM-20-01-T-S-VS
20 Pins Powered
Signal

Step	Description
1.	CCC ⁽¹⁾ Rows=1 Number of Positions = 20

(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

PSS-20-02-T-S
 HPM-20-01-T-S-VS
 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

PSS-20-02-T-S
 HPM-20-01-T-S-VS
 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 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 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.

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 TC², computer controlled test stand with a deflection measurement system accuracy of 5 μm (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 TC² software in order to acquire and record the test data.
- 14) The permanent set of each contact shall be measured within the TC² 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.

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. 65° C
 - c. 75° C
 - d. 95° 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

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. $\leq +5.0$ 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 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-----11.0 A per contact with 1 contacts (1x1) powered
- CCC for a 30°C Temperature Rise-----10.6 A per contact with 2 contacts (1x2) powered
- CCC for a 30°C Temperature Rise-----9.7 A per contact with 3 contacts (1x3) powered
- CCC for a 30°C Temperature Rise-----8.8 A per contact with 4 contacts (1x4) powered
- CCC for a 30°C Temperature Rise-----7.5 A per contact with 20 contacts (1x20) powered

Mating/Unmating Forces

Thermal Aging Group

- **Initial**
 - **Mating**
 - **Min**-----26.29 Lbs
 - **Max**----- 31.44 Lbs
 - **Unmating**
 - **Min**-----25.17 Lbs
 - **Max**----- 27.08 Lbs
- **After Thermal**
 - **Mating**
 - **Min**-----24.20 Lbs
 - **Max**-----25.85 Lbs
 - **Unmating**
 - **Min**-----20.48 Lbs
 - **Max**-----21.81 Lbs

Mating-Unmating Durability Group (PSS-20-02-T-S/HPM-20-01-T-S-VS)

- **Initial**
 - **Mating**
 - **Min**-----28.41 Lbs
 - **Max**-----33.50 Lbs
 - **Unmating**
 - **Min**-----24.36 Lbs
 - **Max**----- 26.72 Lbs
- **After 25 Cycles**
 - **Mating**
 - **Min**-----33.96 Lbs
 - **Max**-----37.01 Lbs
 - **Unmating**
 - **Min**-----25.00 Lbs
 - **Max**----- 27.15 Lbs
- **Humidity**
 - **Mating**
 - **Min**-----22.40 Lbs
 - **Max**-----27.90 Lbs
 - **Unmating**
 - **Min**-----17.77 Lbs
 - **Max**----- 21.49 Lbs

RESULTS Continued**Mating-Unmating Basic (PSS-02-02-T-S/HPM-02-01-T-S-VS)**

- **Initial**
 - **Mating**
 - **Min**----- 2.49 Lbs
 - **Max**----- 4.60 Lbs
 - **Unmating**
 - **Min**----- 2.37 Lbs
 - **Max**----- 3.62 Lbs
- **After 25 Cycles**
 - **Mating**
 - **Min**----- 3.79 Lbs
 - **Max**----- 5.48 Lbs
 - **Unmating**
 - **Min**----- 3.04 Lbs
 - **Max**----- 3.85 Lbs

Mating-Unmating Basic (PSS-10-02-T-S/HPM-10-01-T-S-VS)

- **Initial**
 - **Mating**
 - **Min**-----17.31 Lbs
 - **Max**-----19.56 Lbs
 - **Unmating**
 - **Min**-----13.89 Lbs
 - **Max**----- 15.38 Lbs
- **After 25 Cycles**
 - **Mating**
 - **Min**-----19.39 Lbs
 - **Max**-----21.63 Lbs
 - **Unmating**
 - **Min**-----13.59 Lbs
 - **Max**-----15.93 Lbs

Normal Force at 0.0068 inch deflection

- **Initial**
 - **Min**-----578.90 gf **Set** --- 0.0000 inch
 - **Max**-----653.50 gf **Set** --- 0.0008 inch
- **Thermal**
 - **Min**-----483.30 gf **Set** --- 0.0004 inch
 - **Max**-----665.20 gf **Set** --- 0.0014 inch

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

- **Initial**
 - Mated-----10000 Meg Ω ----- Passed
 - Unmated ----- 10000 Meg Ω ----- Passed
- **Thermal Shock**
 - Mated----- 10000 Meg Ω ----- Passed
 - Unmated ----- 10000 Meg Ω ----- Passed
- **Humidity**
 - Mated-----10000 Meg Ω ----- Passed
 - Unmated -----10000 Meg Ω ----- Passed

Dielectric Withstanding Voltage minimums, DWV

- **Minimums**
 - Breakdown Voltage----- 2000 VAC
 - Test Voltage----- 1875 VAC
 - Working Voltage ----- 625 VAC

Pin to Pin

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

RESULTS Continued**LLCR Thermal Aging Group (128 LLCR test points)**

- **Initial**-----2.11 mOhms Max
- **Thermal**
 - **<= +5.0 mOhms** ----- 128 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 Gas Tight Group (128 LLCR test points)

- **Initial**-----2.12 mOhms Max
- **Thermal**
 - **<= +5.0 mOhms** ----- 128 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 Mating/Unmating Durability Group (128 LLCR test points)

- **Initial**-----2.23 mOhms Max
- **Durability, 25 Cycles**
 - **<= +5.0 mOhms** ----- 128 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**
- **Thermal Shock**
 - **<= +5.0 mOhms** ----- 128 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** ----- 128 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 Group (128 LLCR test points)**

- **Initial**-----2.09 mOhms Max
- **Shock & Vibration**
 - **<= +5.0 mOhms** ----- 128 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**

Mechanical Shock & Random Vibration:

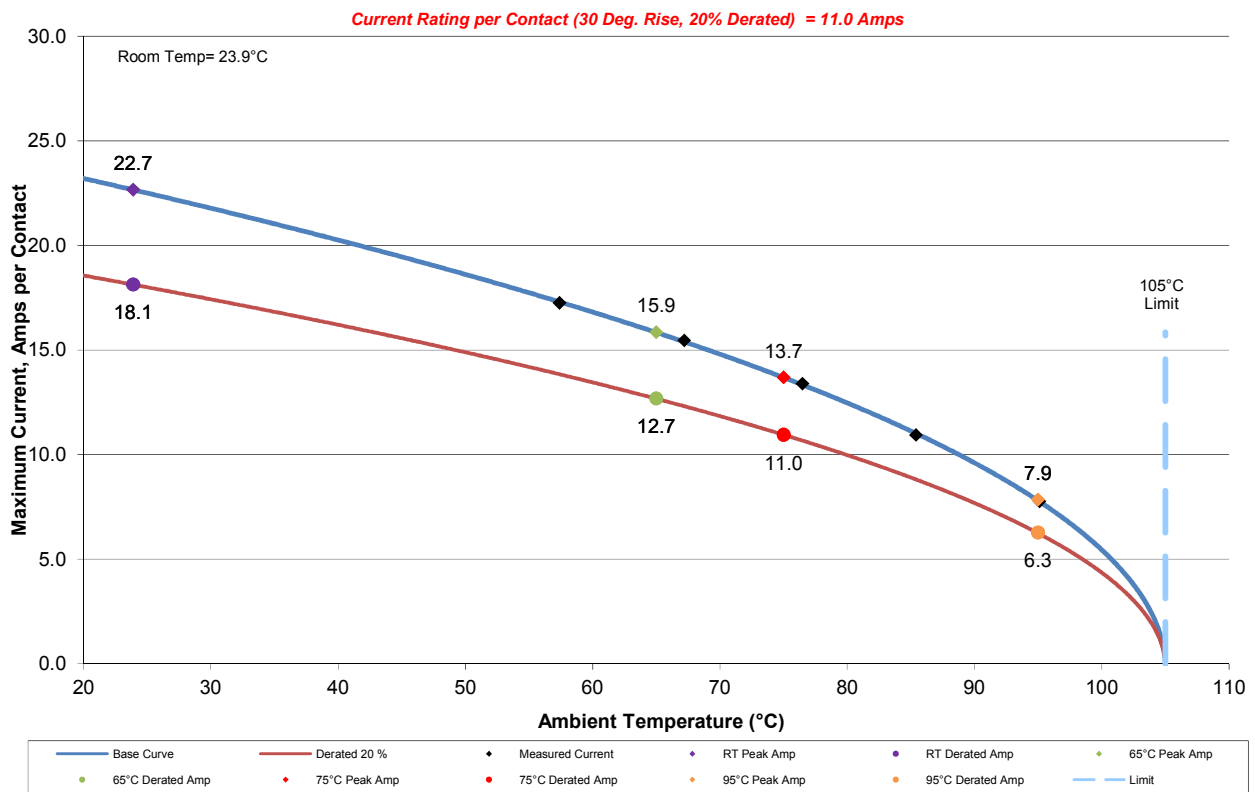
- **Shock**
 - **No Damage**----- **Pass**
 - **50 Nanoseconds**----- **Pass**
- **Vibration**
 - **No Damage**----- **Pass**
 - **50 Nanoseconds**----- **Pass**

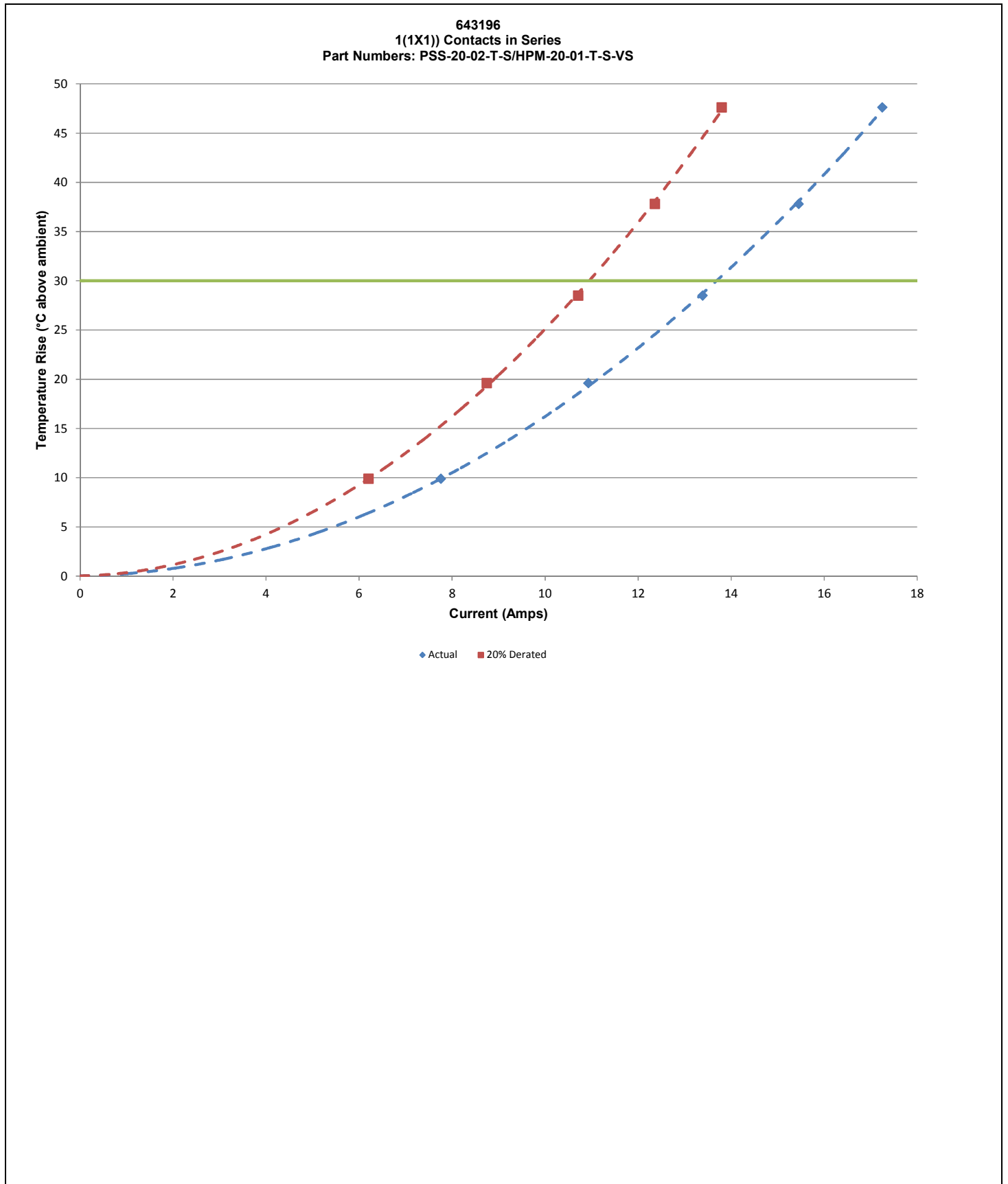
DATA SUMMARIES

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 1 adjacent conductors/contacts powered

643196
1(1X1) Contacts in Series
Part Numbers: PSS-20-02-T-S/HPM-20-01-T-S-VS



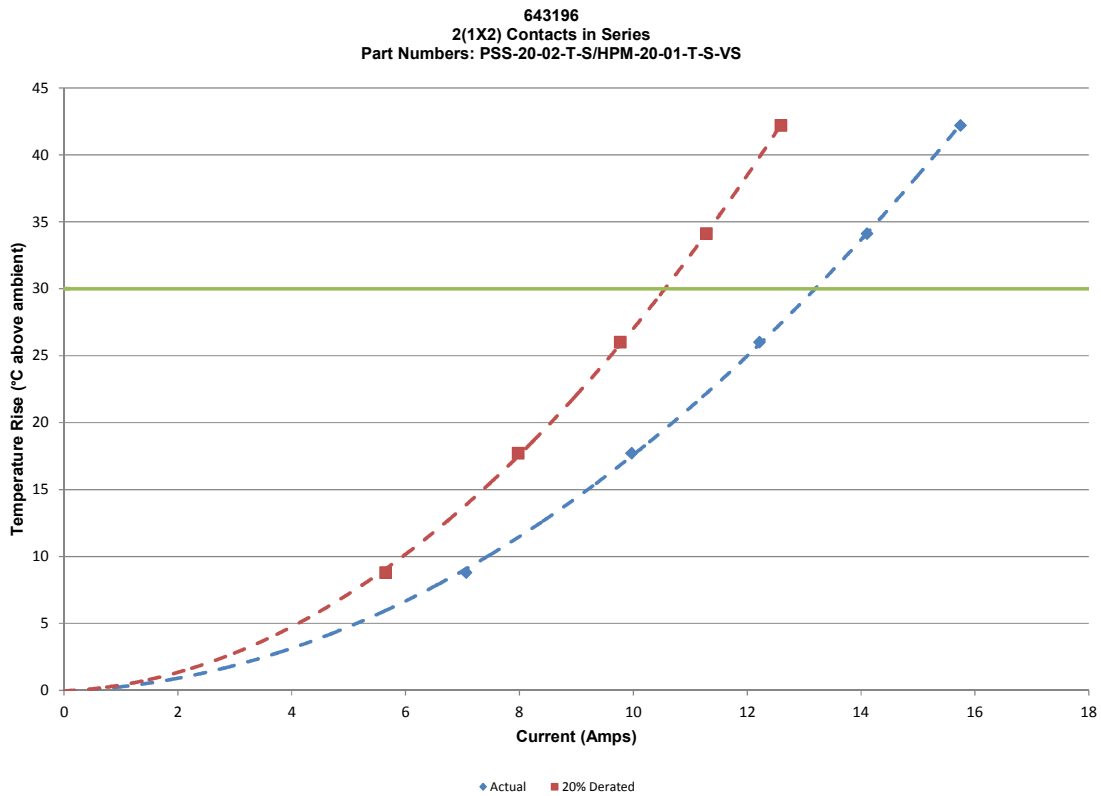
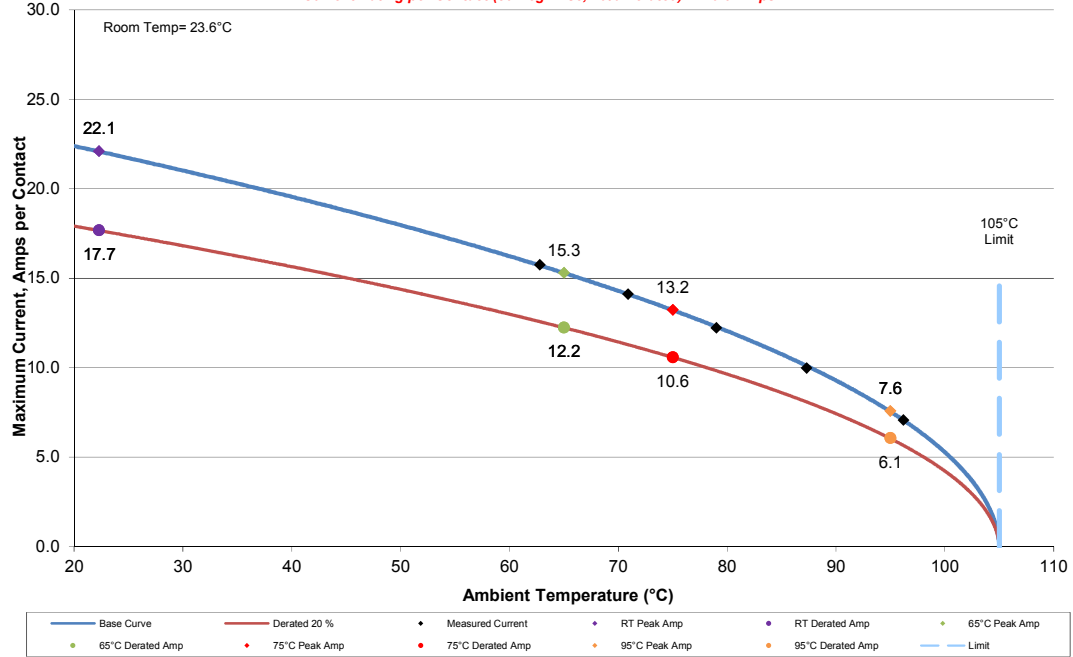


DATA SUMMARIES Continued

b. Linear configuration with 2 adjacent conductors/contacts powered

643196
2(1X2) Contacts in Series
Part Numbers: PSS-20-02-T-S/HPM-20-01-T-S-VS

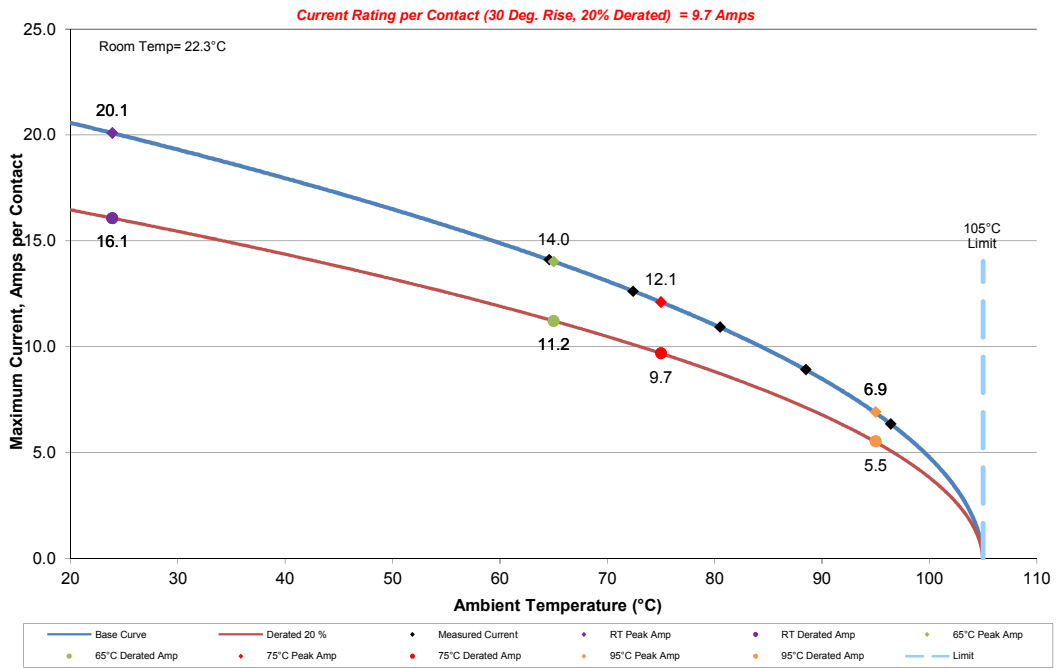
Current Rating per Contact (30 Deg. Rise, 20% Derated) = 10.6 Amps



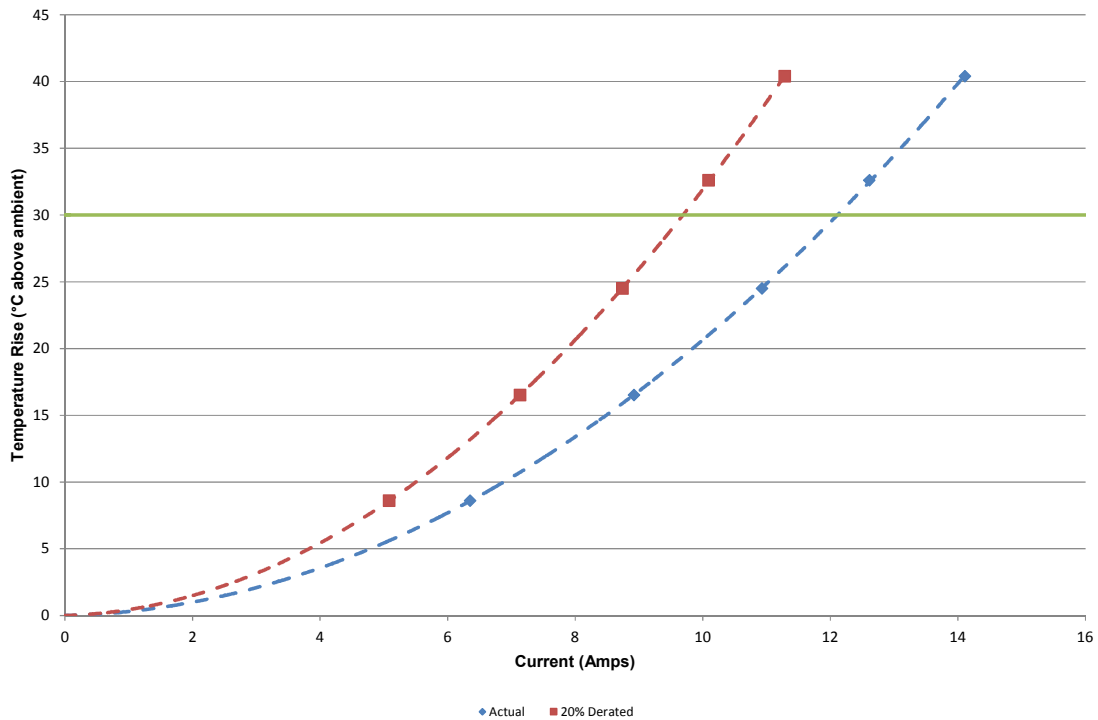
DATA SUMMARIES Continued

c. Linear configuration with 3 adjacent conductors/contacts powered

643196
3(1X3) Contacts in Series
Part Numbers: PSS-20-02-T-S/HPM-20-01-T-S-VS



643196
3(1X3) Contacts in Series
Part Numbers: PSS-20-02-T-S/HPM-20-01-VS

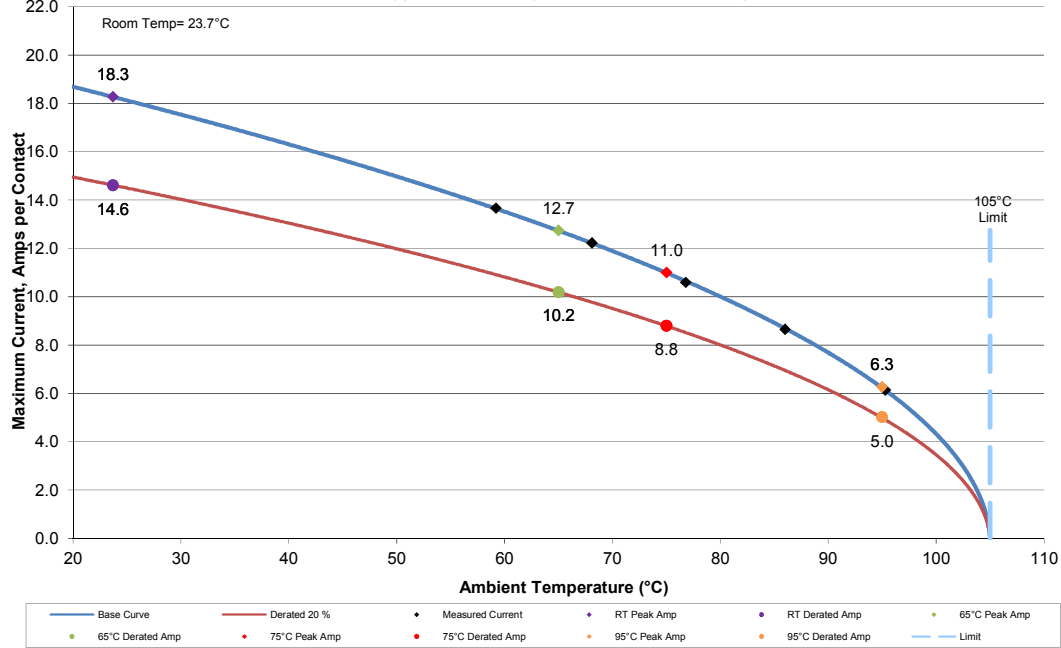


DATA SUMMARIES Continued

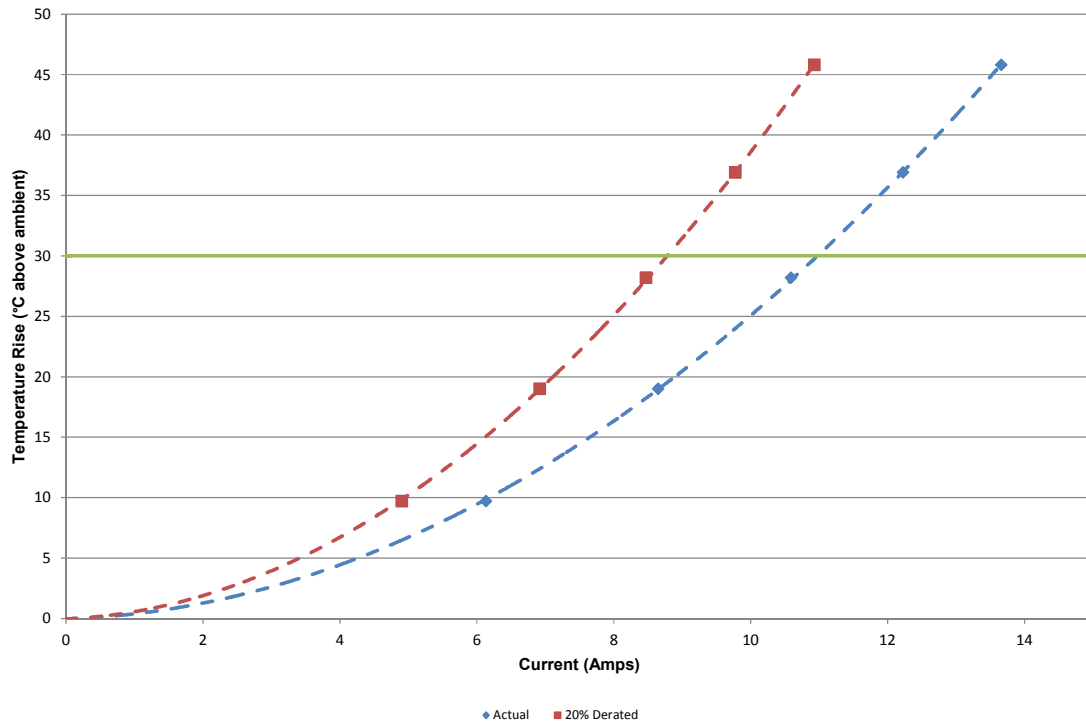
d. Linear configuration with 4 adjacent conductors/contacts powered

643196
4(1X4) Contacts in Series
Part Numbers: PSS-20-02-T-S/HPM-20-01-T-S-VS

Current Rating per Contact (30 Deg. Rise, 20% Derated) = 8.8 Amps



643196
4(1X4) Contacts in Series
Part Numbers: PSS-20-02-T-S/HPM-20-01-T-S-VS

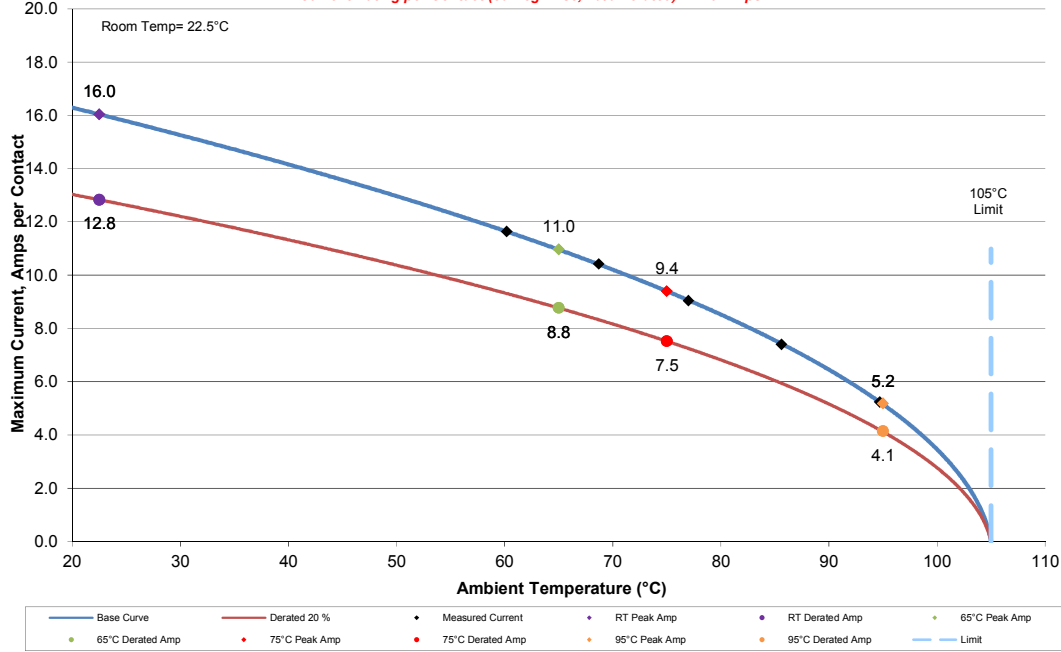


DATA SUMMARIES Continued

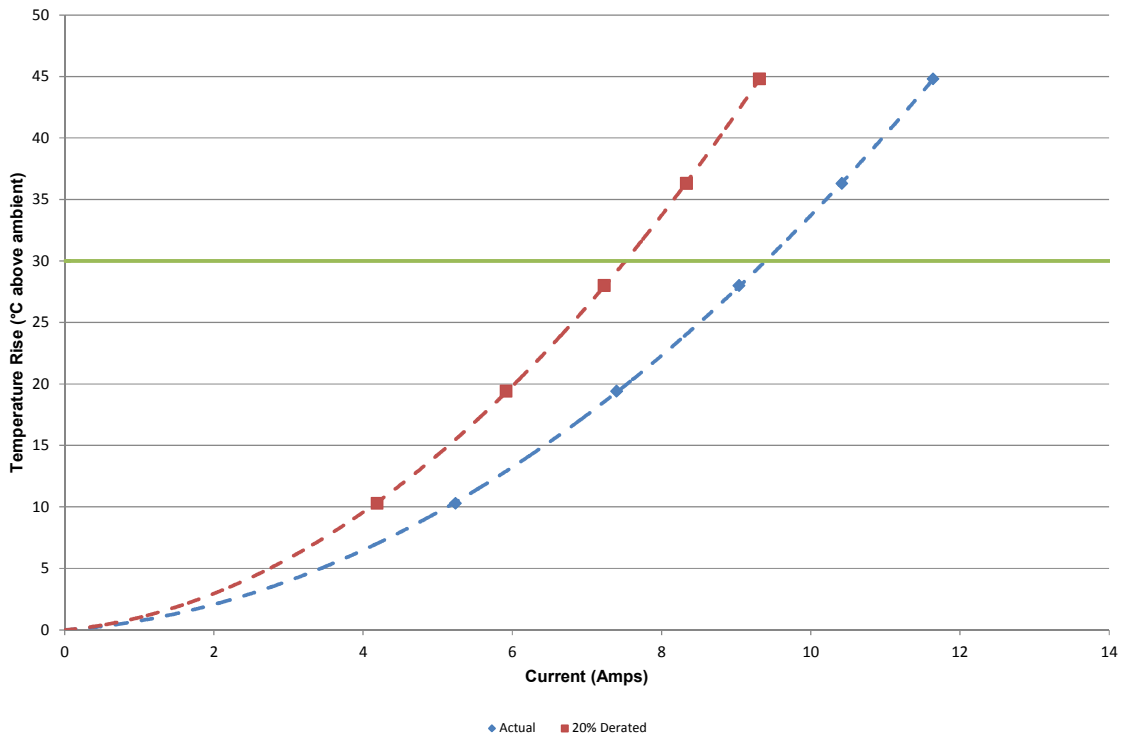
e. Linear configuration with all adjacent conductors/contacts powered

643196
20(1X20) Contacts in Series
Part Numbers: PSS-20-02-T-S/HPM-20-01-T-S-VS

Current Rating per Contact (30 Deg. Rise, 20% Derated) = 7.5 Amps



643196
20(1X20) Contacts in Series
Part Numbers: PSS-20-02-T-S/HPM-20-01-T-S-VS



DATA SUMMARIES Continued

MATING-UNMATING FORCE:**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	116.94	26.29	111.96	25.17	107.64	24.20	91.10	20.48
Maximum	139.85	31.44	120.45	27.08	114.98	25.85	97.01	21.81
Average	128.45	28.88	116.95	26.29	111.77	25.13	93.34	20.99
St Dev	6.97	1.57	3.20	0.72	2.67	0.60	2.19	0.49
Count	8	8	8	8	8	8	8	8

Mating-Unmating Durability Group (PSS-20-02-T-S/HPM-20-01-T-S-VS)

	Initial				After 25 Cycles			
	Mating		Unmating		Mating		Unmating	
	Newton's	Force (Lbs)	Newton's	Force (Lbs)	Newton's	Force (Lbs)	Newton's	Force (Lbs)
Minimum	126.37	28.41	108.35	24.36	151.05	33.96	111.20	25.00
Maximum	149.01	33.50	118.85	26.72	164.62	37.01	120.76	27.15
Average	137.70	30.96	114.58	25.76	156.16	35.11	114.70	25.79
St Dev	7.20	1.62	3.26	0.73	3.88	0.87	2.80	0.63
Count	8	8	8	8	8	8	8	8

	After Humidity			
	Mating		Unmating	
	Newton's	Force (Lbs)	Newton's	Force (Lbs)
Minimum	99.64	22.40	79.04	17.77
Maximum	124.10	27.90	95.59	21.49
Average	115.39	25.94	89.98	20.23
St Dev	7.68	1.73	4.87	1.10
Count	8	8	8	8

SUMMARIES Continued

MATING-UNMATING FORCE:**Mating-Unmating Basic (PSS-02-02-T-S/HPM-02-01-T-S-VS)**

	Initial				After 25 Cycles			
	Mating		Unmating		Mating		Unmating	
	Newton's	Force (Lbs)	Newton's	Force (Lbs)	Newton's	Force (Lbs)	Newton's	Force (Lbs)
Minimum	11.08	2.49	10.54	2.37	16.86	3.79	13.52	3.04
Maximum	20.46	4.60	16.10	3.62	24.38	5.48	17.12	3.85
Average	14.54	3.27	12.80	2.88	19.84	4.46	14.62	3.29
St Dev	3.34	0.75	1.99	0.45	2.28	0.51	1.24	0.28
Count	8	8	8	8	8	8	8	8

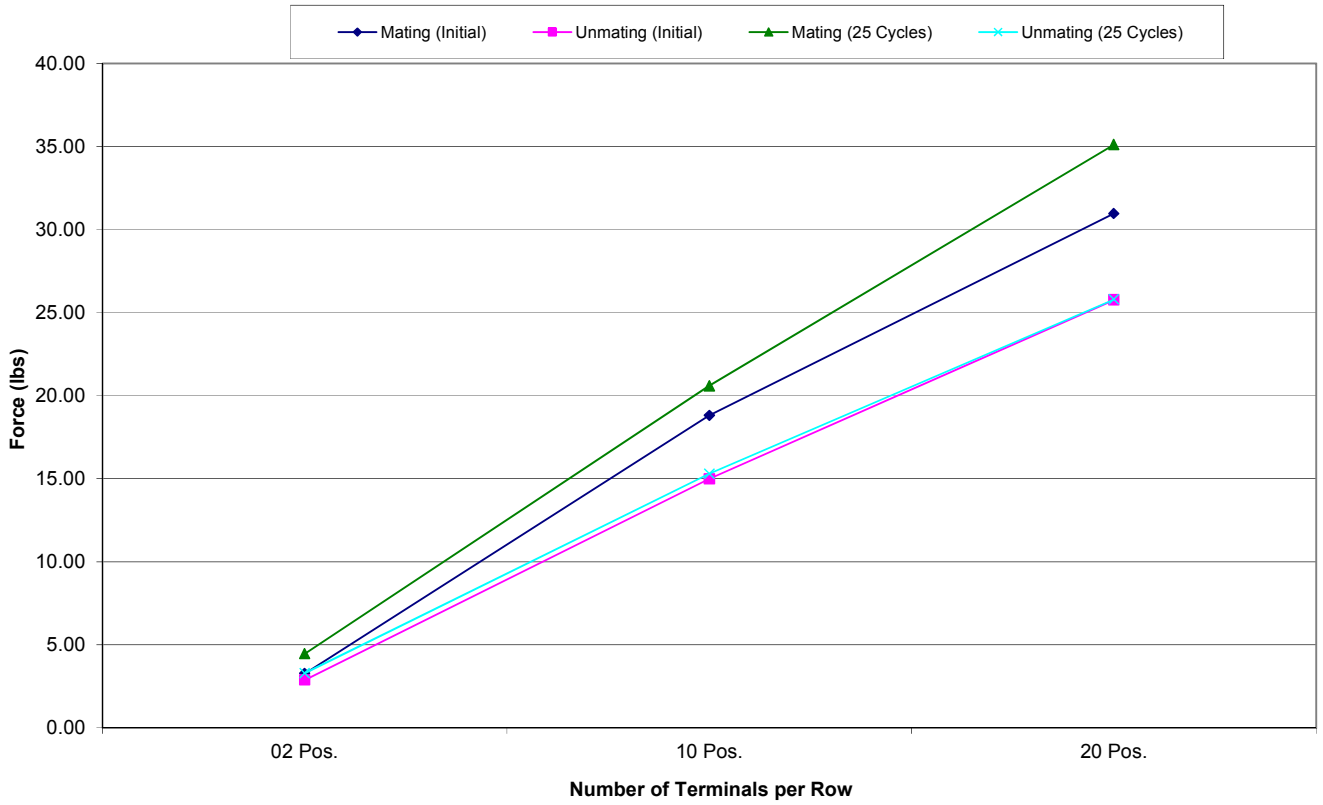
Mating-Unmating Basic (PSS-10-02-T-S/HPM-10-01-T-S-VS)

	Initial				After 25 Cycles			
	Mating		Unmating		Mating		Unmating	
	Newton's	Force (Lbs)	Newton's	Force (Lbs)	Newton's	Force (Lbs)	Newton's	Force (Lbs)
Minimum	76.99	17.31	61.78	13.89	86.25	19.39	60.45	13.59
Maximum	87.00	19.56	68.41	15.38	96.21	21.63	70.86	15.93
Average	83.66	18.81	66.70	15.00	91.58	20.59	68.06	15.30
St Dev	3.14	0.71	2.28	0.51	4.09	0.92	3.66	0.82
Count	8	8	8	8	8	8	8	8

DATA SUMMARIES Continued

Mating\Unmating Force Comparison

Mating/Unmating Data for 02, 10 and 20 Position PSS/HPM



DATA SUMMARIES Continued

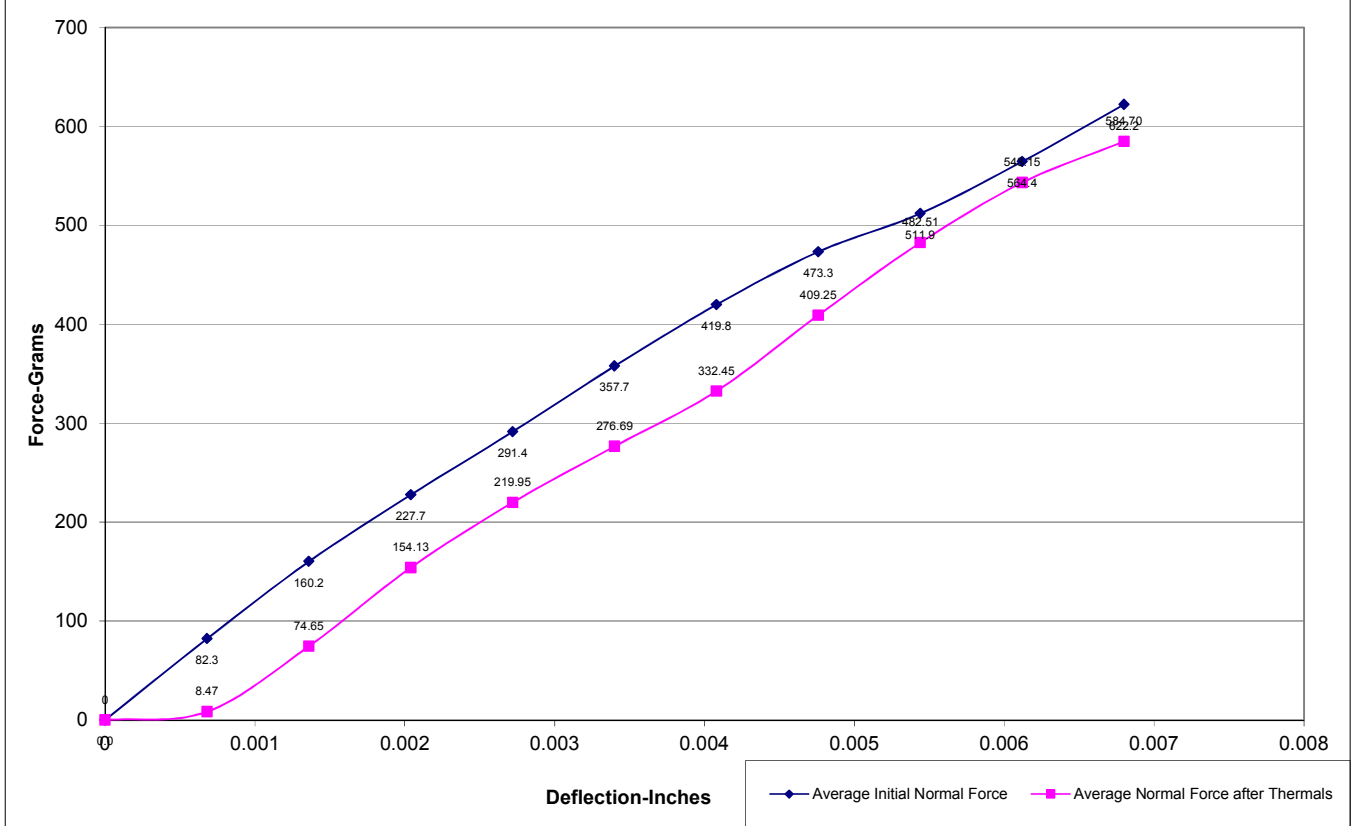
NORMAL FORCE (FOR CONTACTS TESTED OUTSIDE THE HOUSING):

- 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										
	0.0007	0.0014	0.0020	0.0027	0.0034	0.0041	0.0048	0.0054	0.0061	0.0068	SET
Averages	82.30	160.22	227.70	291.39	357.68	419.80	473.28	511.91	564.40	622.18	0.0003
Min	74.40	136.10	195.40	255.30	324.90	381.20	424.00	458.30	504.10	578.90	0.0000
Max	95.70	173.40	249.50	319.60	386.60	460.60	520.50	549.30	588.60	653.50	0.0008
St. Dev	7.841	9.436	13.546	17.368	17.831	27.435	36.138	30.366	26.283	21.142	0.0002
Count	12	12	12	12	12	12	12	12	12	12	12

After Thermals	Deflections in inches Forces in Grams										
	0.0007	0.0014	0.0020	0.0027	0.0034	0.0041	0.0048	0.0054	0.0061	0.0068	SET
Averages	8.47	74.65	154.13	219.95	276.69	332.45	409.25	482.51	543.15	584.70	0.0007
Min	-0.50	11.50	108.80	175.80	242.10	294.60	338.00	385.10	458.80	483.30	0.0004
Max	35.20	131.80	197.90	261.50	305.40	384.40	481.60	562.40	610.80	665.20	0.0014
St. Dev	13.250	35.896	28.851	27.199	21.823	31.743	44.583	56.560	57.148	57.112	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):**

Minimum	Pin to Pin		
	Mated	Unmated	Unmated
	PSS/HPM	PSS	HPM
Initial	10000	10000	10000
Thermal	10000	10000	10000
Humidity	10000	10000	10000

DIELECTRIC WITHSTANDING VOLTAGE (DWV):

Voltage Rating Summary	
Minimum	PSS/HPM
Break Down Voltage	2500
Test Voltage	1875
Working Voltage	625

Pin to Pin	
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 128 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	9/15/2015	9/30/2015		
Room Temp (Deg C)	24	23		
Rel Humidity (%)	51	53		
Technician	Kason He	Kason He		
mOhm values	Actual Initial	Delta Thermal	Delta	Delta
Pin Type 1: Signal				
Average	1.87	0.03		
St. Dev.	0.10	0.04		
Min	1.60	0.00		
Max	2.11	0.37		
Summary Count	128	128		
Total Count	128	128		

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
Thermal	128	0	0	0	0	0

DATA SUMMARIES Continued**LLCR Mating/Unmating Durability Group**

- 1). A total of 128 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	9/18/2015	9/22/2015	9/30/2015	10/23/2015
Room Temp (Deg C)	23	23	23	23
Rel Humidity (%)	51	51	53	57
Technician	Kason He	Kason He	Kason He	Kason He
mOhm values	Actual Initial	Delta 25 Cycles	Delta Therm Shck	Delta Humidity
Pin Type 1: Signal				
Average	1.87	0.13	0.26	0.37
St. Dev.	0.12	0.10	0.23	0.30
Min	1.38	0.00	0.00	0.00
Max	2.23	0.56	1.37	1.44
Summary Count	128	128	128	128
Total Count	128	128	128	128

LLCR Delta Count by Category						
mOhms	Stable	Minor	Acceptable	Marginal	Unstable	Open
	≤ 5	>5 & ≤ 10	>10 & ≤ 15	>15 & ≤ 50	>50 & ≤ 1000	>1000
25 Cycles	128	0	0	0	0	0
Therm Shck	128	0	0	0	0	0
Humidity	128	0	0	0	0	0

DATA SUMMARIES Continued

LLCR Gas Tight Group

- 1) A total of 128 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	9/16/2015	9/18/2015		
Room Temp (Deg C)	24	23		
Rel Humidity (%)	52	51		
Technician	Kason He	Kason He		
mOhm values	Actual	Delta	Delta	Delta
	Initial	Acid Vapor		
Pin Type 1: Signal				
Average	1.90	0.04		
St. Dev.	0.09	0.05		
Min	1.71	0.00		
Max	2.12	0.27		
Summary Count	128	128		
Total Count	128	128		

LLCR Delta Count by Category						
	Stable	Minor	Acceptable	Marginal	Unstable	Open
mOhms	≤ 5	>5 & ≤ 10	>10 & ≤ 15	>15 & ≤ 50	>50 & ≤ 1000	>1000
Acid Vapor	128	0	0	0	0	0

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

- 1) A total of 128 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	10/23/2015	10/26/2015		
Room Temp (Deg C)	23	22		
Rel Humidity (%)	40	40		
Technician	Tony Wagoner	Tony Wagoner		
mOhm values	Actual Initial	Delta Shock-Vib	Delta	Delta
Pin Type 1: Signal				
Average	1.84	0.03		
St. Dev.	0.11	0.02		
Min	1.45	0.00		
Max	2.09	0.11		
Summary Count	128	128		
Total Count	128	128		

LLCR Delta Count by Category						
	Stable	Minor	Acceptable	Marginal	Unstable	Open
mOhms	≤ 5	>5 & ≤ 10	>10 & ≤ 15	>15 & ≤ 50	>50 & ≤ 1000	>1000
Shock-Vib	128	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: 4/24/2015, Next Cal: 4/23/2016**Equipment #:** HZ-OV-01**Description:** Oven**Manufacturer:** Huida**Model:** CS101-1E**Serial #:** CS101-1E-B**Accuracy:** Last Cal: 12/11/2014, Next Cal: 12/10/2015**Equipment #:** HZ-THC-01**Description:** Humidity transmitter**Manufacturer:** Thermtron**Model:** SM-8-8200**Serial #:** 38846**Accuracy:** Last Cal: 2/26/2015, Next Cal: 2/25/2016**Equipment #:** HZ-HPM-01**Description:** NA9636H**Manufacturer:** Ainuo**Model:** 6031A**Serial #:** 089601091**Accuracy:** Last Cal: 3/5/2015, Next Cal: 3/4/2016**Equipment #:** HZ-MO-05**Description:** Micro-ohmmeter**Manufacturer:** Keithley**Model:** 3706**Serial #:** 1285188**Accuracy:** Last Cal: 11/13/2014, Next Cal: 11/12/2015**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: 06/25/2015, Next Cal: 06/24/2016

Equipment #: HZ-MO-01**Description:** Multimeter /Data Acquisition System**Manufacturer:** Keithley**Model:** 2700**Serial #:** 1199807**Accuracy:** See Manual

... Last Cal: 07/01/2015, Next Cal: 06/30/2016

EQUIPMENT AND CALIBRATION SCHEDULES Continued**Equipment #:** HZ-PS-01**Description:** 120 Amp Power Supply**Manufacturer:** Agilent**Model:** 6031A PS**Serial #:** MY41000982**Accuracy:** See Manual

... Last Cal: 07/01/2015, Next Cal: 06/30/2016

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

... Last Cal: 08/21/2015, Next Cal: 08/21/2016

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

... Last Cal: 04/22/2015, Next Cal: 04/22/2016

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

... Last Cal: 07/18/2015, Next Cal: 07/18/2016

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

... Last Cal: 10/31/2014, Next Cal: 10/31/2015

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

... Last Cal: 05/15/2015, Next Cal: 05/15/2016