



Project Number: Design Qualification Test Report	Tracking Code: 277524_Report_Rev_1
Requested by: Catie Eichhorn	Date: 12/23/2013
Part #: MPPT-10-01-01-L-RA-SD/MPPT-10-01-01-L-RA-SD	
Part description: MPPT/MPPT	Tech: Kason He
Test Start: 10/17/2013	Test Completed: 11/26/2013



DESIGN QUALIFICATION TEST REPORT

MPPT/MPPT

MPPT-10-01-01-L-RA-SD/MPPT-10-01-01-L-RA-SD

REVISION HISTORY

DATA	REV.NUM.	DESCRIPTION	ENG
12/23/2013	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.

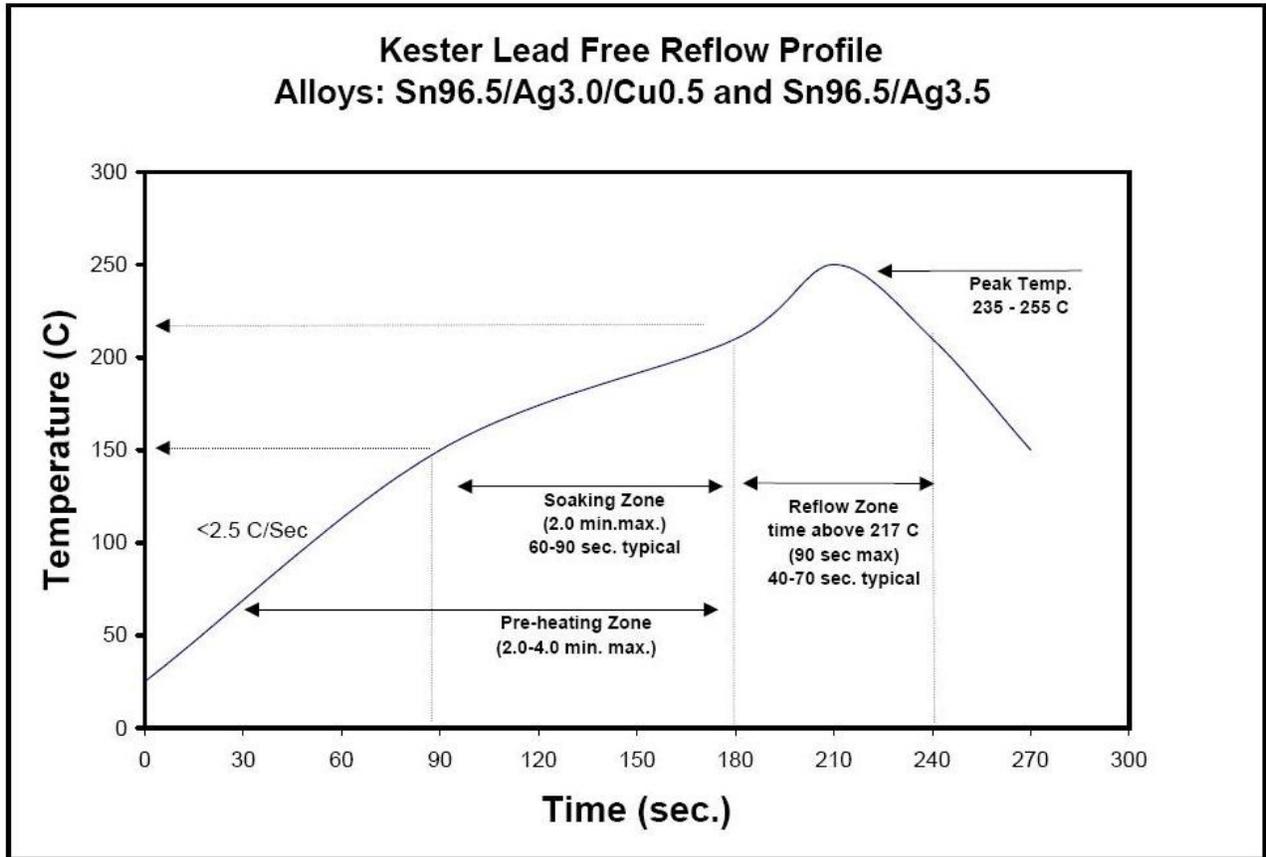
APPLICABLE DOCUMENTS

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) Re-Flow Time/Temp: See accompanying profile.
- 10) Samtec Test PCBs used: PCB-105908-TST\PCB-105909-TST\PCB-105910-TST

TYPICAL OVEN PROFILE (Soldering Parts to Test Boards)



FLOWCHARTS**Gas Tight**Group 1

MPPT-10-01-01-L-RA-SD
 MPPT-10-01-01-L-RA-SD
 8 Assemblies

Step Description

1. LLCR ⁽²⁾
Max Delta = 15 mOhm
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

MPPT-10-01-01-L-RA-SD

 8 Contacts Minimum
 Signal Without Thermals

Step Description

1. Contact Gaps
2. Normal Force ⁽¹⁾
Deflection = 0.10 "
Expected Force at Max Deflection = 400 g

Group 2

MPPT-10-01-01-L-RA-SD
 MPPT-10-01-01-L-RA-SD
 8 Contacts Minimum
 Signal With Thermals

Step Description

1. Contact Gaps
2. Thermal Age ⁽²⁾
3. Contact Gaps
4. Normal Force ⁽¹⁾
Deflection = 0.10 "
Expected Force at Max Deflection = 400 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**

MPPT-10-01-01-L-RA-SD

MPPT-10-01-01-L-RA-SD

8 Assemblies

Step	Description
1.	Contact Gaps
2.	LLCR ⁽¹⁾ Max Delta = 15 mOhm
3.	Thermal Age ⁽²⁾
4.	LLCR ⁽¹⁾ Max Delta = 15 mOhm
5.	Contact Gaps

(1) LLCR = EIA-364-23

Open Circuit Voltage = 20 mV Max

Test Current = 100 mA Max

(2) Thermal Age = EIA-364-17

Test Condition = 4 (105°C)

Time Condition = B (250 Hours)

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

MPPT-10-01-01-L-RA-SD

MPPT-10-01-01-L-RA-SD

8 Assemblies

Step	Description
1.	Contact Gaps
2.	LLCR ⁽²⁾ Max Delta = 15 mOhm
3.	Cycles Quantity = 100 Cycles
4.	Contact Gaps
5.	LLCR ⁽²⁾ Max Delta = 15 mOhm
6.	Thermal Shock ⁽³⁾
7.	LLCR ⁽²⁾ Max Delta = 15 mOhm
8.	Humidity ⁽¹⁾
9.	LLCR ⁽²⁾ Max Delta = 15 mOhm

- (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) 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**

<u>Group 1</u>		<u>Group 2</u>		<u>Group 3</u>		<u>Group 4</u>	
MPPT-10-01-01-L-RA-SD		MPPT-10-01-01-L-RA-SD		MPPT-10-01-01-L-RA-SD		MPPT-10-01-01-L-RA-SD	
MPPT-10-01-01-L-RA-SD						MPPT-10-01-01-L-RA-SD	
2 Assemblies		2 Assemblies		2 Assemblies		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

MPPT-10-01-01-L-RA-SD
 MPPT-10-01-01-L-RA-SD
 1 Pins Powered
 Signal

Step Description

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

Group 2

MPPT-10-01-01-L-RA-SD
 MPPT-10-01-01-L-RA-SD
 2 Pins Powered
 Signal

Step Description

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

Group 3

MPPT-10-01-01-L-RA-SD
 MPPT-10-01-01-L-RA-SD
 3 Pins Powered
 Signal

Step Description

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

Group 4

MPPT-10-01-01-L-RA-SD
 MPPT-10-01-01-L-RA-SD
 4 Pins Powered
 Signal

Step Description

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

Group 5

MPPT-10-01-01-L-RA-SD
 MPPT-10-01-01-L-RA-SD
 10 Pins Powered
 Signal

Step Description

- | Step | Description |
|------|--|
| 1. | CCC ⁽¹⁾
Rows = 1
Number of Positions = 10 |

(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

MPPT-10-01-01-L-RA-SD

MPPT-10-01-01-L-RA-SD

8 Assemblies

Step Description

1. LLCR ⁽¹⁾
Max Delta = 15 mOhm
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

MPPT-10-01-01-L-RA-SD

MPPT-10-01-01-L-RA-SD

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.

TEMPERATURE RISE (Current Carrying Capacity, CCC):

- 1) EIA-364-70, *Temperature Rise versus Current Test Procedure for Electrical Connectors and Sockets*.
- 2) When current passes through a contact, the temperature of the contact increases as a result of I^2R (resistive) heating.
- 3) The number of contacts being investigated plays a significant part in power dissipation and therefore temperature rise.
- 4) The size of the temperature probe can affect the measured temperature.
- 5) Copper traces on PC boards will contribute to temperature rise:
 - a. Self heating (resistive)
 - b. Reduction in heat sink capacity affecting the heated contacts
- 6) A de-rating curve, usually 20%, is calculated.
- 7) Calculated de-rated currents at three temperature points are reported:
 - a. Ambient
 - b. 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.

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

NORMAL FORCE (FOR CONTACTS TESTED IN THE HOUSING):

- 1) Reference document: EIA-364-04, *Normal Force Test Procedure for Electrical Connectors*.
- 2) The contacts shall be tested in the connector housing.
- 3) If necessary, a "window" shall be made in the connector body to allow a probe to engage and deflect the contact at the same attitude and distance (plus 0.05 mm [0.002"]) as would occur in actual use.
- 4) The connector housing shall be placed in a holding fixture that does not interfere with or otherwise influence the contact force or deflection.
- 5) 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 5.0 µm (0.0002").
- 6) The nominal deflection rate shall be 5 mm (0.2")/minute.
- 7) Unless otherwise noted a minimum of five contacts shall be tested.
- 8) The force/deflection characteristic to load and unload each contact shall be repeated five times.
- 9) The system shall utilize the TC² software in order to acquire and record the test data.
- 10) The permanent set of each contact shall be measured within the TC² software.
- 11) 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.

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-----35.5 A per contact with 1 adjacent contacts powered
- CCC for a 30°C Temperature Rise-----29.6 A per contact with 2 adjacent contacts powered
- CCC for a 30°C Temperature Rise-----27.6 A per contact with 3 adjacent contacts powered
- CCC for a 30°C Temperature Rise-----24.4 A per contact with 4 adjacent contacts powered
- CCC for a 30°C Temperature Rise-----20.2 A per contact with all adjacent contacts powered

Normal Force at 0.0091 inch deflection

- **Initial**
 - Min----- 398.10 gf Set ---- 0.0001 in
 - Max ----- 474.50 gf Set ---- 0.0006 in
- **Thermal**
 - Min----- 287.90 gf Set ---- 0.0024 in
 - Max ----- 335.80 gf Set ---- 0.0033 in

Insulation Resistance minimums, IR

- **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----- 2057 VAC
 - Test Voltage ----- 1543 VAC
 - Working Voltage -----510 VAC
- **Initial DWV -----Passed**
- **Thermal DWV-----Passed**
- **Humidity DWV-----Passed**

Notes: The samples for IR/DWV test were not soldered to a PCB.

RESULTS Continued**LLCR Thermal Aging Group (64 LLCR test points)**

- **Initial** -----0.58 mOhms Max
- **Thermal**
 - **<= +5.0 mOhms** -----64 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 (64 LLCR test points)

- **Initial** -----0.54 mOhms Max
- **Gas-Tight**
 - **<= +5.0 mOhms** -----64 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 (64 LLCR test points)

- **Initial** -----0.51 mOhms Max
- **Durability, 100 Cycles**
 - **<= +5.0 mOhms** -----64 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** -----64 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** -----64 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 (64 LLCR test points)**

- **Initial** -----0.63 mOhms Max
- **Shock & Vibration**
 - **<= +5.0 mOhms** -----64 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

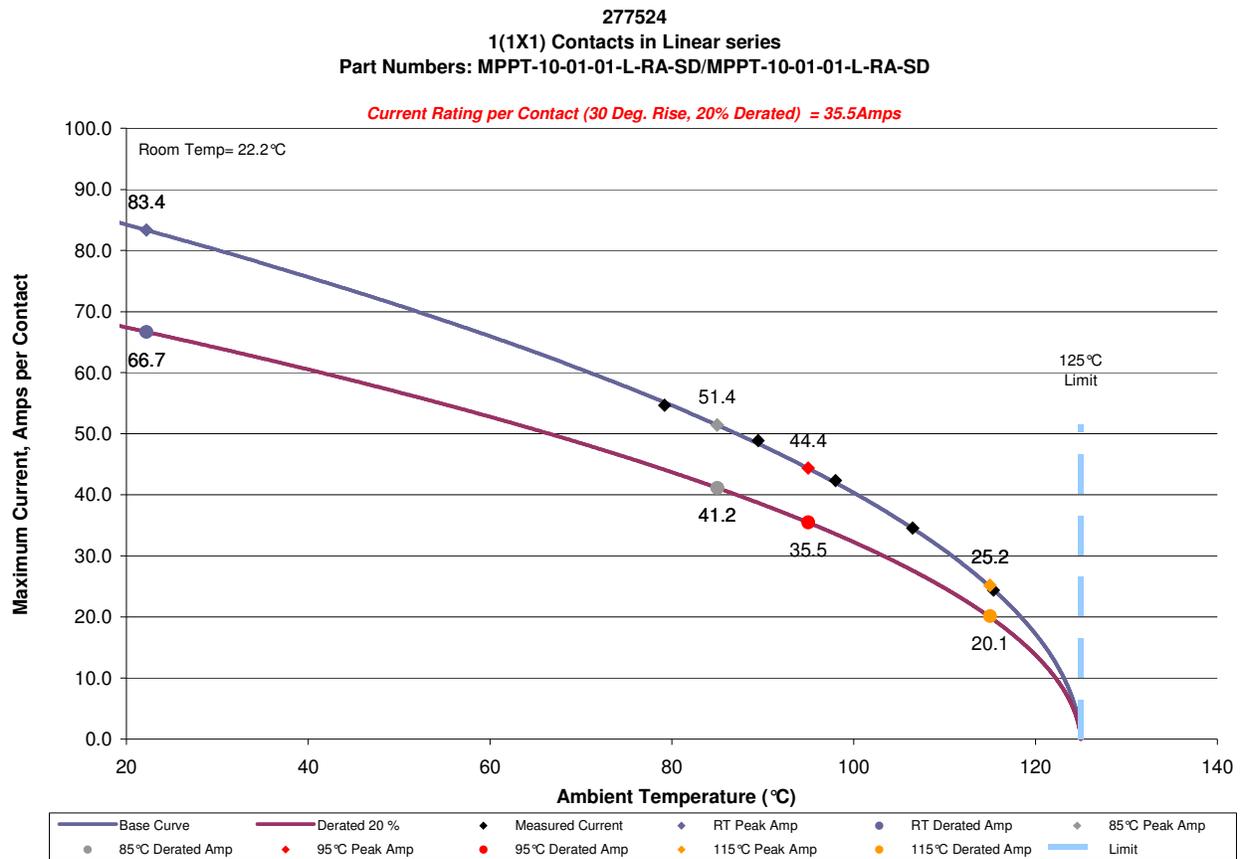
Mechanical Shock & Random Vibration:

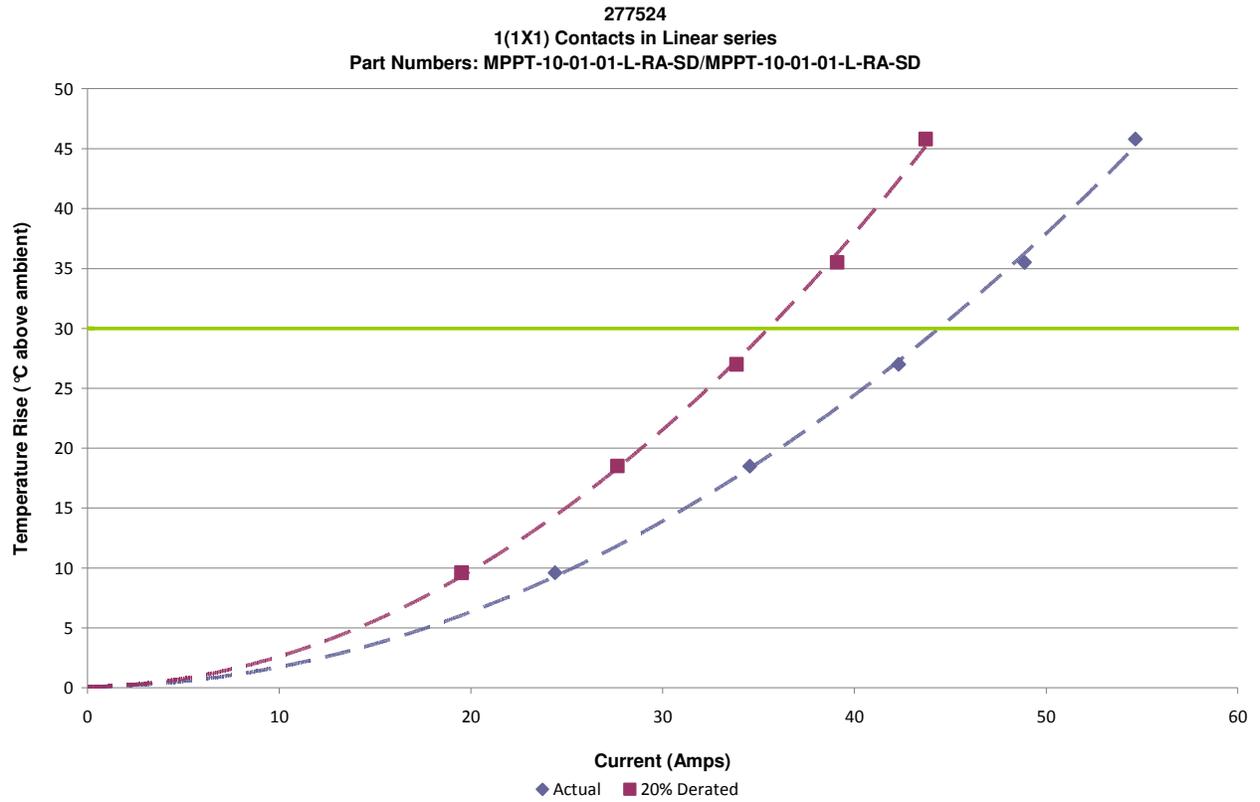
- **Shock**
 - **No Damage**----- Pass
 - **50 Nanoseconds**----- Pass
- **Vibration**
 - **No Damage**----- Pass
 - **50 Nanoseconds**----- Pass

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



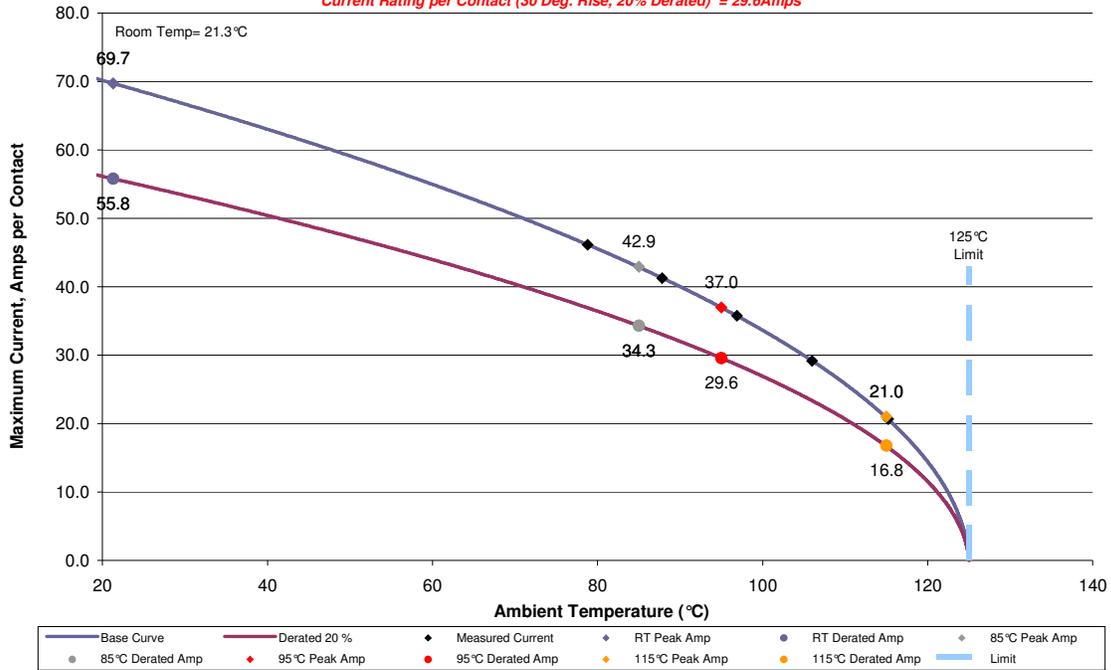


DATA SUMMARIES Continued

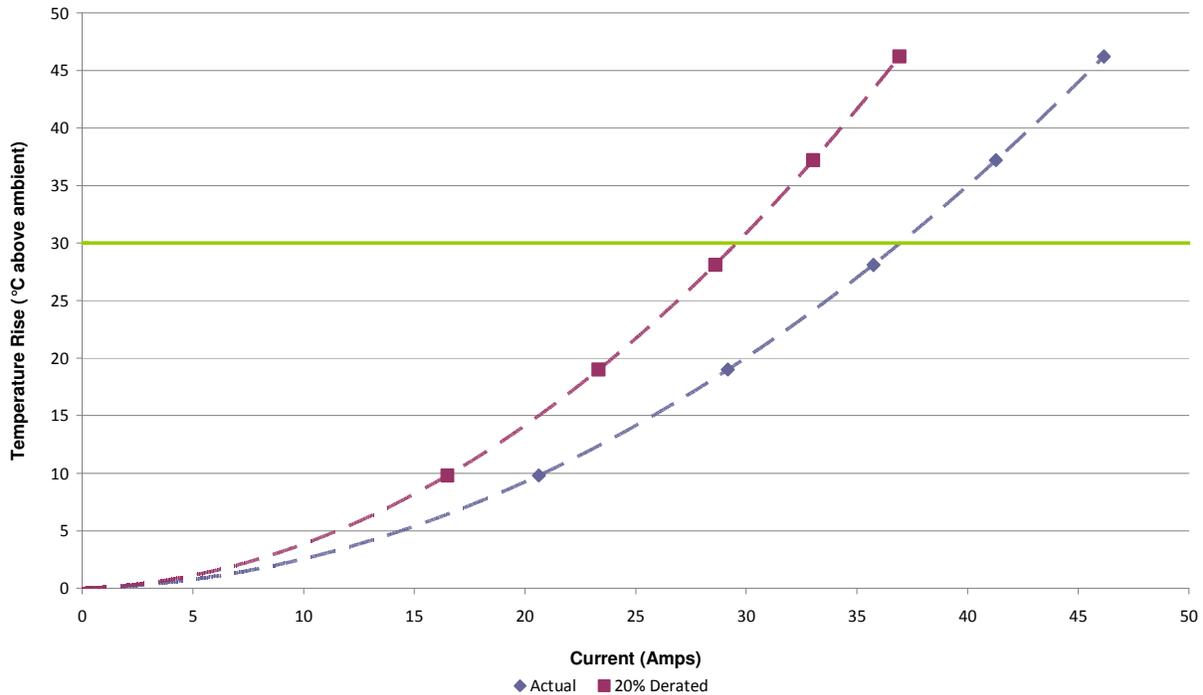
b. Linear configuration with 2 adjacent conductors/contacts powered

277524
 2(1X2) Contacts in Linear series
 Part Numbers: MPPT-10-01-01-L-RA-SD/MPPT-10-01-01-L-RA-SD

Current Rating per Contact (30 Deg. Rise, 20% Derated) = 29.6Amps

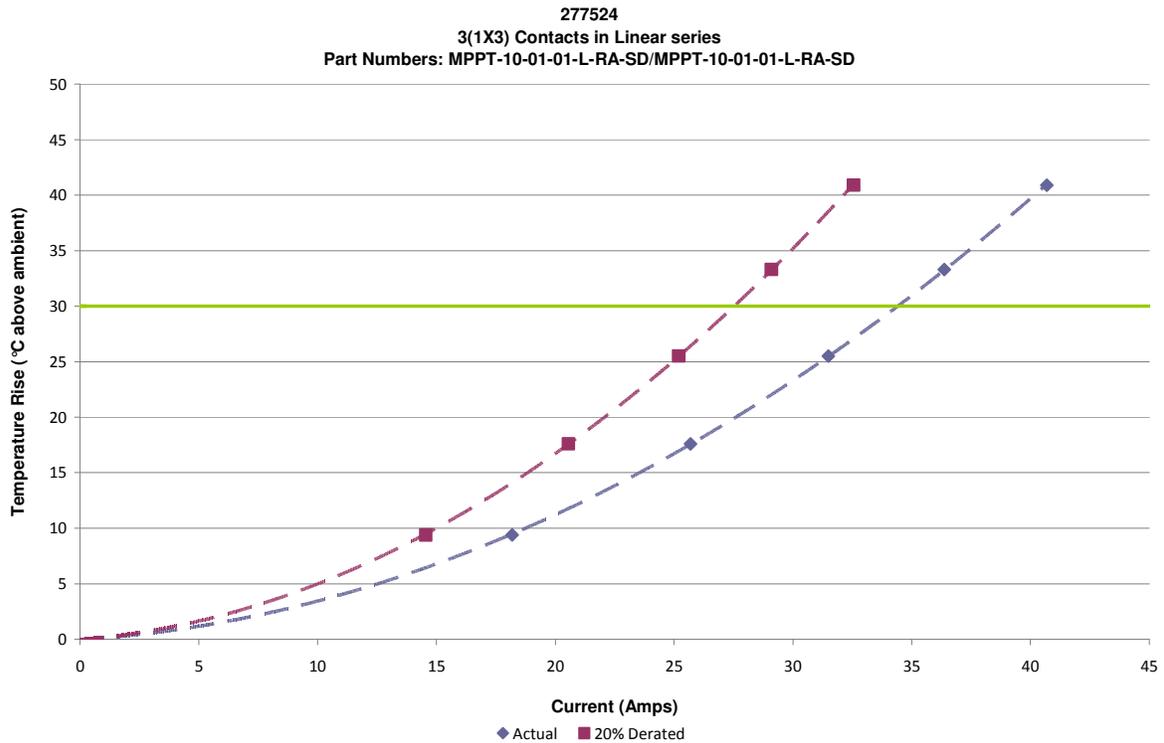
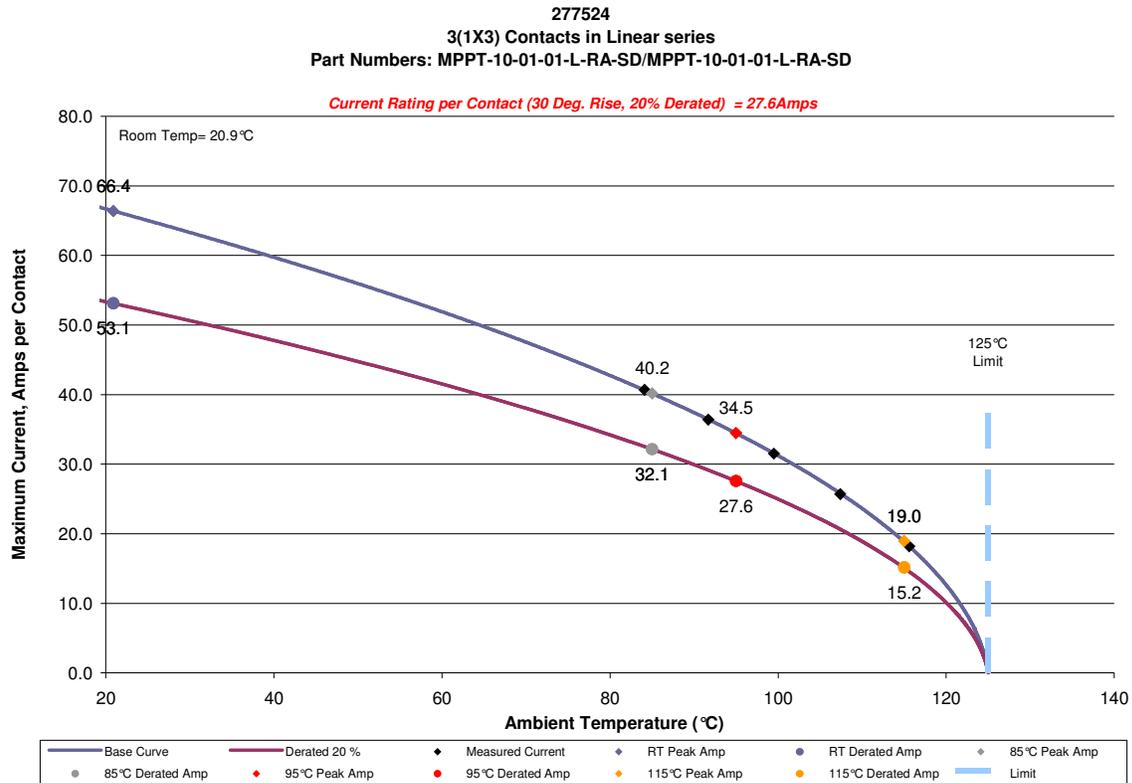


277524
 2(1X2) Contacts in Linear series
 Part Numbers: MPPT-10-01-01-L-RA-SD/MPPT-10-01-01-L-RA-SD



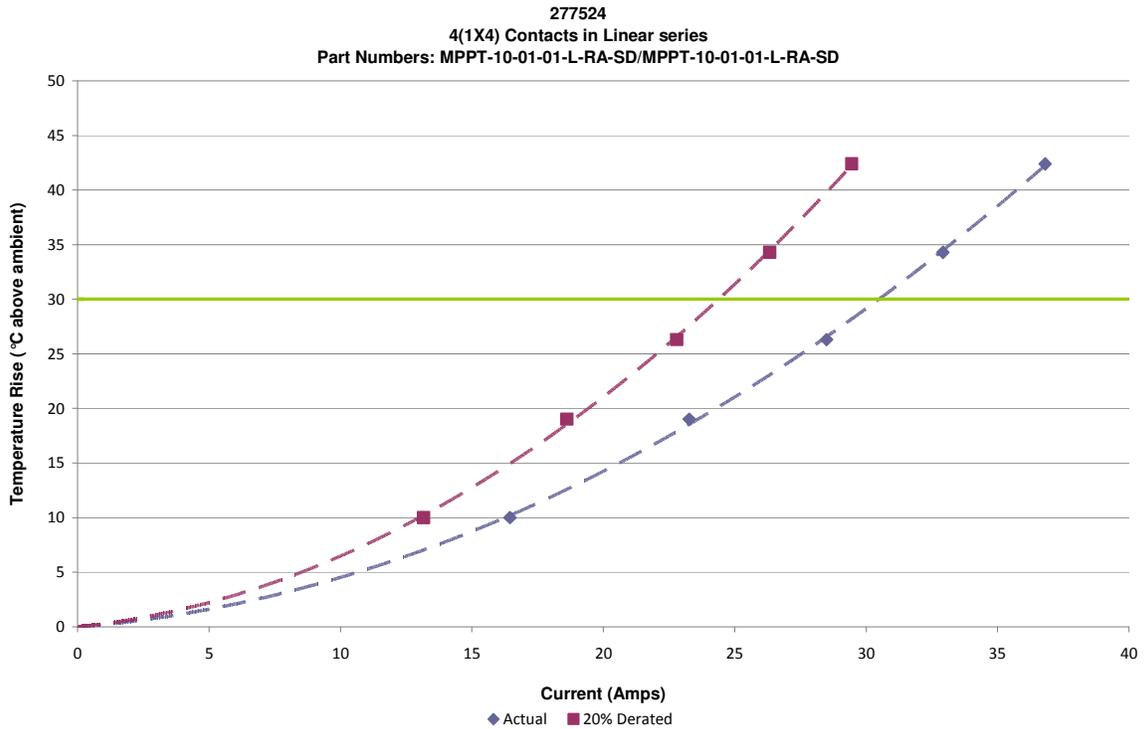
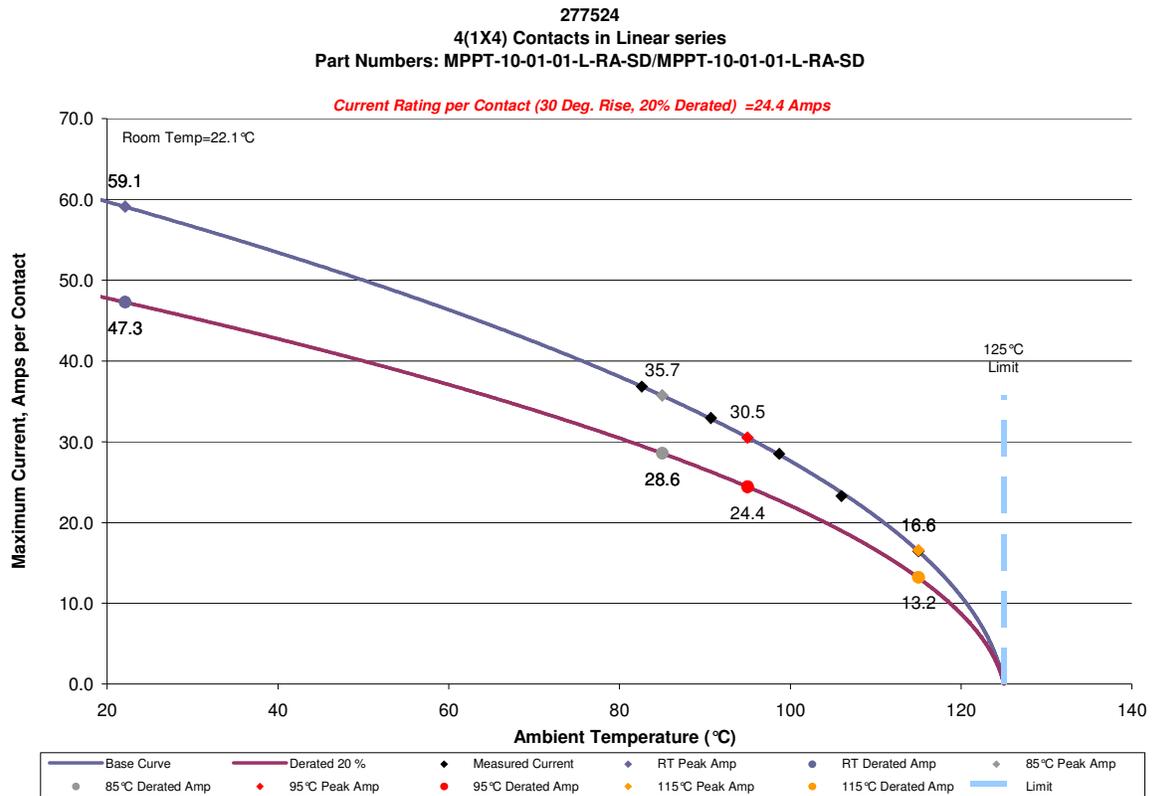
DATA SUMMARIES Continued

c. Linear configuration with 3 adjacent conductors/contacts powered



DATA SUMMARIES Continued

d. Linear configuration with 4 adjacent conductors/contacts powered

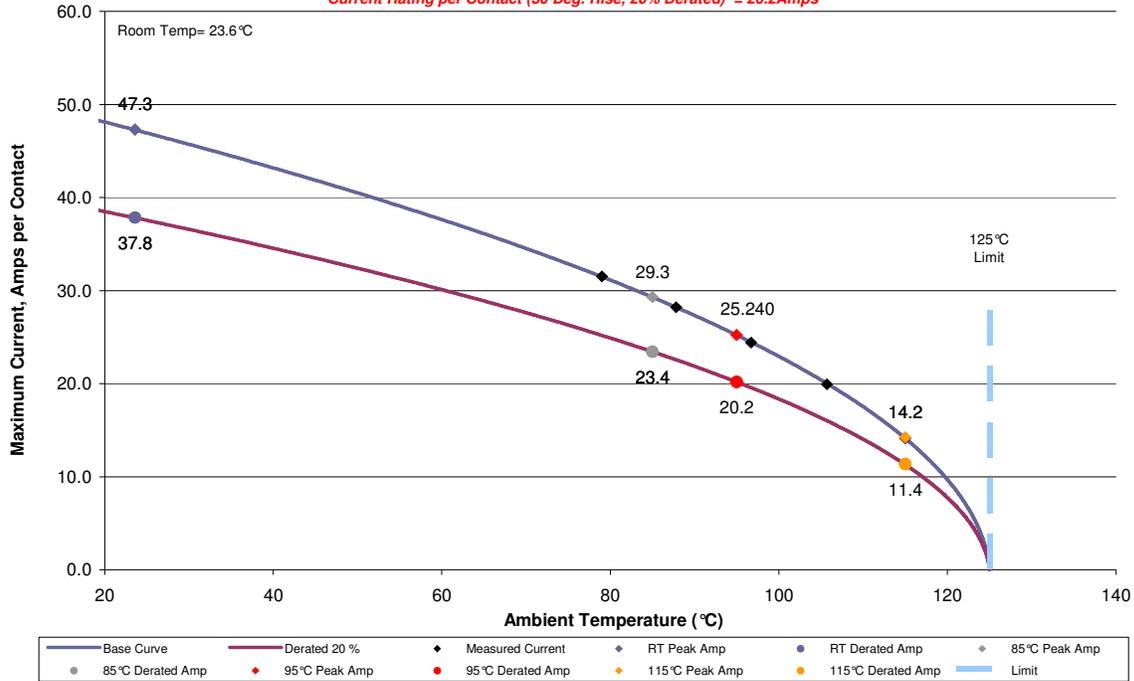


DATA SUMMARIES Continued

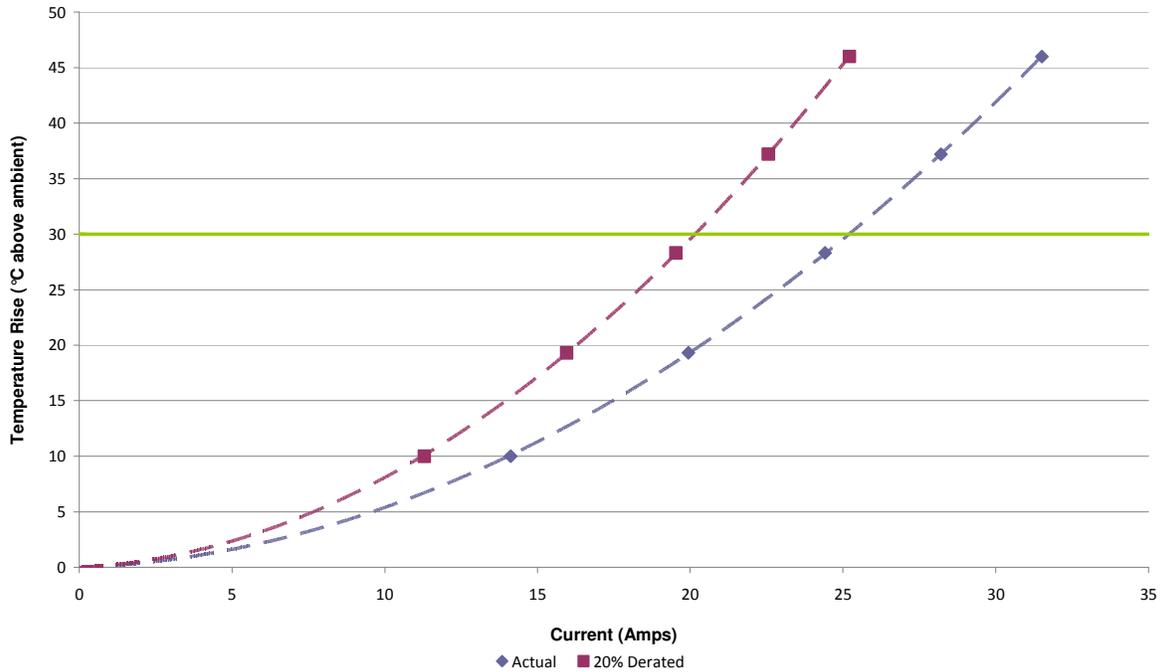
e. Linear configuration with all adjacent conductors/contacts powered

277524
 10(All) Contacts in Linear series
 Part Numbers: MPPT-10-01-01-L-RA-SD/MPPT-10-01-01-L-RA-SD

Current Rating per Contact (30 Deg. Rise, 20% Derated) = 20.2Amps



277524
 10(All) Contacts in Linear series
 Part Numbers: MPPT-10-01-01-L-RA-SD/MPPT-10-01-01-L-RA-SD



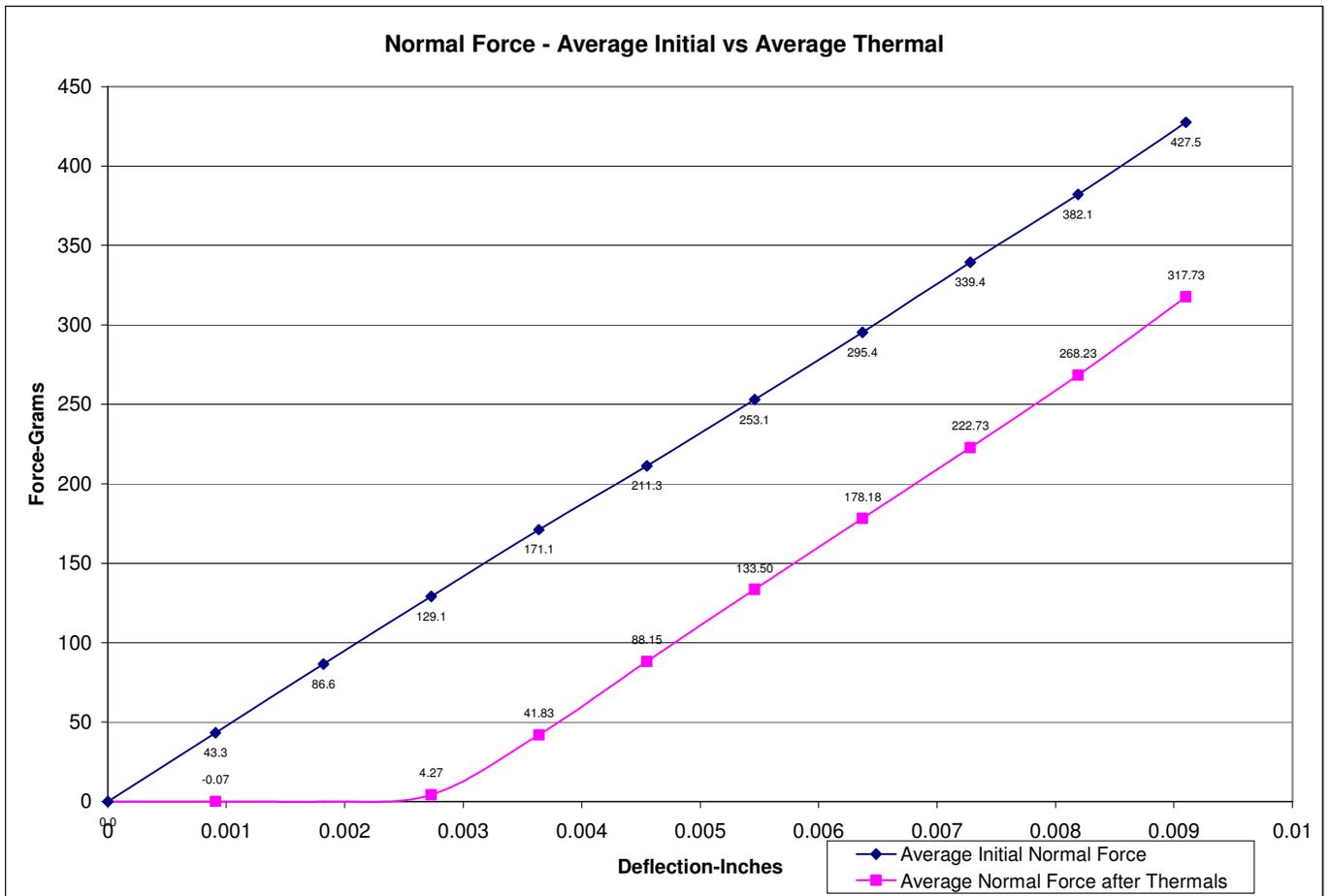
DATA SUMMARIES Continued

NORMAL FORCE (FOR CONTACTS TESTED IN THE HOUSING):

- 1) Calibrated force gauges are used along with computer controlled positioning equipment.
- 2) For Normal force 8-10 measurements are taken and the averages reported.

Initial	Deflections in inches Forces in Grams										
	<u>0.0009</u>	<u>0.0018</u>	<u>0.0027</u>	<u>0.0036</u>	<u>0.0046</u>	<u>0.0055</u>	<u>0.0064</u>	<u>0.0073</u>	<u>0.0082</u>	<u>0.0091</u>	<i>SET</i>
Averages	43.26	86.64	129.08	171.05	211.29	253.06	295.36	339.40	382.06	427.46	0.0003
Min	34.00	74.00	113.70	152.00	194.10	234.50	272.70	312.10	356.00	398.10	0.0001
Max	52.00	95.80	143.60	191.70	239.20	285.60	330.10	376.30	424.70	474.50	0.0006
St. Dev	5.792	6.119	7.969	9.986	12.685	15.302	17.860	20.924	22.145	26.742	0.0001
Count	12	12	12	12	12	12	12	12	12	12	12

After Thermals	Deflections in inches Forces in Grams										
	<u>0.0009</u>	<u>0.0018</u>	<u>0.0027</u>	<u>0.0036</u>	<u>0.0046</u>	<u>0.0055</u>	<u>0.0064</u>	<u>0.0073</u>	<u>0.0082</u>	<u>0.0091</u>	<i>SET</i>
Averages	-0.07	-0.08	4.27	41.83	88.15	133.50	178.18	222.73	268.23	317.73	0.0028
Min	-0.40	-0.40	-0.40	5.60	65.10	108.40	157.90	202.00	240.90	287.90	0.0024
Max	0.10	0.00	25.60	66.60	108.20	148.90	199.70	241.30	283.90	335.80	0.0033
St. Dev	0.172	0.134	7.879	18.134	13.278	12.594	13.660	14.607	14.589	14.822	0.0003
Count	12	12	12	12	12	12	12	12	12	12	12



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

	Pin to Pin		
	Mated	Unmated	Unmated
Minimum	MPPT/MPPT	MPPT	MPPT
Initial	10000	10000	10000
Thermal	10000	10000	10000
Humidity	10000	10000	10000

DIELECTRIC WITHSTANDING VOLTAGE (DWV):

Voltage Rating Summary	
Minimum	MPPT/MPPT
Break Down Voltage	2057
Test Voltage	1543
Working Voltage	510

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 64 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	10/18/2013	10/29/2013		
Room Temp (Deg C)	22	22		
Rel Humidity (%)	56	53		
Technician	Kason He	Kason He		
mOhm values	Actual Initial	Delta Thermal	Delta	Delta
Pin Type 1: Signal				
Average	0.36	0.03		
St. Dev.	0.06	0.02		
Min	0.29	0.00		
Max	0.58	0.14		
Summary Count	64	64		
Total Count	64	64		

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	64	0	0	0	0	0

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

- 1). A total of 64 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	10/17/2013	10/23/2013	10/30/2013	11/11/2013
Room Temp (Deg C)	21	22	22	22
Rel Humidity (%)	54	54	51	56
Technician	Kason He	Kason He	Kason He	Kason He
mOhm values	Actual Initial	Delta 100 Cycles	Delta Therm Shck	Delta Humidity
Pin Type 1: Signal				
Average	0.36	0.02	0.03	0.03
St. Dev.	0.06	0.03	0.03	0.03
Min	0.28	0.00	0.00	0.00
Max	0.51	0.16	0.14	0.15
Summary Count	64	64	64	64
Total Count	64	64	64	64

LLCR Delta Count by Category						
mOhms	Stable	Minor	Acceptable	Marginal	Unstable	Open
	≤ 5	$>5 \ \& \ \leq 10$	$>10 \ \& \ \leq 15$	$>15 \ \& \ \leq 50$	$>50 \ \& \ \leq 1000$	>1000
100 Cycles	64	0	0	0	0	0
Therm Shck	64	0	0	0	0	0
Humidity	64	0	0	0	0	0

DATA SUMMARIES Continued**LLCR Gas Tight Group**

- 1) A total of 64 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	10/16/2013	11/1/2013		
Room Temp (Deg C)	20	22		
Rel Humidity (%)	55	50		
Technician	Kason He	Kason He		
mOhm values	Actual	Delta	Delta	Delta
	Initial	Acid Vapor		
Pin Type 1: Signal				
Average	0.35	0.02		
St. Dev.	0.06	0.01		
Min	0.29	0.00		
Max	0.54	0.07		
Summary Count	64	64		
Total Count	64	64		

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
Acid Vapor	64	0	0	0	0	0

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

- 1) A total of 64 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	11/11/2013	11/26/2013		
Room Temp (Deg C)	21	22		
Rel Humidity (%)	32	36		
Technician	Aaron McKim	Tony Wagoner		
mOhm values	Actual	Delta	Delta	Delta
	Initial	Shock-Vib		
Pin Type 1: Signal				
Average	0.35	0.02		
St. Dev.	0.07	0.02		
Min	0.27	0.00		
Max	0.63	0.07		
Summary Count	64	64		
Total Count	64	64		

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	64	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: 4/26/2013, Next Cal: 4/25/2014**Equipment #:** HZ-OV-01**Description:** Oven**Manufacturer:** Huida**Model:** CS101-1E**Serial #:** CS101-1E-B**Accuracy:** Last Cal: 12/13/2012, Next Cal: 12/12/2013**Equipment #:** HZ-THC-01**Description:** Humidity transmitter**Manufacturer:** Thermtron**Model:** SM-8-8200**Serial #:** 38846**Accuracy:** Last Cal: 2/28/2013, Next Cal: 2/27/2014**Equipment #:** HZ-HPM-01**Description:** NA9636H**Manufacturer:** Ainuo**Model:** 6031A**Serial #:** 089601091**Accuracy:** Last Cal: 3/7/2013, Next Cal: 3/6/2014**Equipment #:** HZ-MO-05**Description:** Micro-ohmmeter**Manufacturer:** Keithley**Model:** 3706**Serial #:** 1285188**Accuracy:** Last Cal: 11/15/2012, Next Cal: 11/14/2013**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: 06/27/2013, Next Cal: 06/26/2014

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

... Last Cal: 07/02/2013, Next Cal: 07/01/2014

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

... Last Cal: 07/02/2013, Next Cal: 07/01/2014

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

... Last Cal: 08/21/2013, Next Cal: 08/21/2014

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

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

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

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

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

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