Project Number: Design Qualification Test Report	Tracking Code: 1822945_Report_Rev_1
Requested by: Roy Luo	Date: 12/16/2019
Part #: T1XS-10-28-GF-06.0-A/S1SS-10-28-GF-06.00-L	
Part description: T1XS/S1SS	Tech: Kason He
Test Start: 12/29/2018	Test Completed: 1/22/2019

DESIGN QUALIFICATION TEST REPORT

T1XS/S1SS
T1XS-10-28-GF-06.0-A/S1SS-10-28-GF-06.00-L

REVISION HISTORY

DATA	REV.NUM.	DESCRIPTION	ENG
12/16/2019	**1**	**Initial Issue**	**KH**

CERTIFICATION

All instruments and measuring equipment were calibrated to National Institute for Standards and Technology (NIST) traceable standards according to IS0 10012-l and ANSI/NCSL 2540-1, as applicable.

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-103219-TST

FLOWCHARTS

Gas Tight

Group 1
T1SS-10-28-GF-06.0
S1SS-10-28-GF-06.00-L
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 Aging

Group 1
T1SS-10-28-GF-06.0
S1SS-10-28-GF-06.00-L
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
T1SS-10-28-GF-06.0
S1SS-10-28-GF-06.00-L
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.	Cycles Quantity = 25 Cycles
7.	Mating/Unmating Force (3)
8.	Cycles Quantity = 25 Cycles
9.	Mating/Unmating Force (3)
10.	Cycles Quantity = 25 Cycles
11.	Mating/Unmating Force (3)
12.	Contact Gaps
13.	LLCR (2) Max Delta = 15 mOhm
14.	Thermal Shock (4)
15.	LLCR (2) Max Delta = 15 mOhm
16.	Humidity (1)
17.	LLCR (2) Max Delta = 15 mOhm
18.	Mating/Unmating Force (3)

Group 2
T1SS-02-28-GF-06.0
S1SS-02-28-GF-06.00-L
8 Assemblies

Step	Description
1.	Contact Gaps
2.	Mating/Unmating Force (3)
3.	Cycles Quantity = 25 Cycles
4.	Mating/Unmating Force (3)
5.	Cycles Quantity = 25 Cycles
6.	Mating/Unmating Force (3)
7.	Cycles Quantity = 25 Cycles
8.	Mating/Unmating Force (3)
9.	Cycles Quantity = 25 Cycles
10.	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 (-55°C to +125°C)
Test Duration = A-3 (100 Cycles)

FLOWCHARTS Continued

IR/DWV

Pin-to-Pin

Group 1 T1SS-10-28-GF-06.0 S1SS-10-28-GF-06.00-L 2 Assemblies		Group 2 T1SS-10-28-GF-06.0 S1SS-10-28-GF-06.00-L 2 Assemblies		Group 3 T1SS-10-28-GF-06.0 S1SS-10-28-GF-06.00-L 2 Assemblies		Group 4 T1SS-10-28-GF-06.0 S1SS-10-28-GF-06.00-L 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
T1SS-10-28-GF-12.0
S1SS-10-28-GF-12.00-L
1 Pins Powered
Power

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

Group 2
T1SS-10-28-GF-12.0
S1SS-10-28-GF-12.00-L
2 Pins Powered
Power

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

Group 3
T1SS-10-28-GF-12.0
S1SS-10-28-GF-12.00-L
3 Pins Powered
Power

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

Group 4
T1SS-10-28-GF-12.0
S1SS-10-28-GF-12.00-L
4 Pins Powered
Power

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

Group 5
T1SS-10-28-GF-12.0
S1SS-10-28-GF-12.00-L
10 Pins Powered
Power

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
T1PS-10-28-GF-12.0-A
S1SS-10-28-GF-12.00-L
8 Assemblies
0.033" PANEL THICKNESS

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 Detection

Group 1
T1PS-10-28-GF-12.0-A
S1SS-10-28-GF-12.00-L
60 Points
0.033" PANEL THICKNESS

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)

FLOWCHARTS Continued

Cable Pull

Note: Pull on T1PS cable to test panel mount latching system.

0.033" PANEL THICKNESS

Group 1		Group 2	
T1PS-10-28-GF-12.0-A		T1PS-10-28-GF-12.0-A	
S1SS-10-28-GF-06.00-L		S1SS-10-28-GF-06.00-L	
5 Assemblies		5 Assemblies	
0 Degrees		90 Degrees	
Step	**Description**	**Step**	**Description**
1.	Cable Pull (1)	1.	Cable Pull (1)

0.090" PANEL THICKNESS

Group 3		Group 4	
T1PS-10-28-GF-12.0-A		T1PS-10-28-GF-12.0-A	
S1SS-10-28-GF-06.00-L		S1SS-10-28-GF-06.00-L	
5 Assemblies		5 Assemblies	
0 Degrees		90 Degrees	
Step	**Description**	**Step**	**Description**
1.	Cable Pull (1)	1.	Cable Pull (1)

(1) Cable Pull = EIA-364-38
Measure and Record Force Required to Failure
Failure = Discontinuity >1 microsecond at 10 ohms

FLOWCHARTS Continued

Cable Flex

Note: Flex T1PS cable to test panel mount latching system.

0.033" PANEL THICKNESS

Group 1

T1PS-10-28-GF-12.0-A

S1SS-10-28-GF-06.00-L

8 Assemblies

Flat Cable

Step	Description
1.	IR (3)
2.	DWV at Test Voltage (2)
3.	Cable Flex (1)
4.	Visual Inspection
5.	IR (3)
6.	DWV at Test Voltage (2)

0.090" PANEL THICKNESS

Group 2

T1PS-10-28-GF-12.0-A

S1SS-10-28-GF-06.00-L

8 Assemblies

Flat Cable

Step	Description
1.	IR (3)
2.	DWV at Test Voltage (2)
3.	Cable Flex (1)
4.	Visual Inspection
5.	IR (3)
6.	DWV at Test Voltage (2)

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(1) Cable Flex = EIA-364-41
- Circular Jacket Cable - to be tested 90° each direction (180° total)
- Flat Cable - to be tested 70° each direction (140° total)
- Monitor continuity during flex testing
- Failure = Discontinuity >1 microsecond at 10 ohms

(2) 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

(3) IR = EIA-364-21
- Test Condition = 500 Vdc, 2 Minutes Max

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 I: -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.

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 G
3) Peak Value: 100 G
4) Duration: 6 Milliseconds
5) Wave Form: Sawtooth
6) Velocity: 12.3 ft/s
7) Number of Shocks: 3 Shocks / Direction, 3 Axis (18 Total)

VIBRATION:

1) Reference document: EIA-364-28, *Vibration Test Procedure for Electrical Connectors*
2) Test Condition V, Letter B
3) Power Spectral Density: 0.04 G^2 / 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

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. <= +5.0 mOhms: ----------Stable
    b. +5.1 to +10.0 mOhms:----------Minor
    c. +10.1 to +15.0 mOhms: ----------Acceptable
    d. +15.1 to +50.0 mOhms: ----------Marginal
    e. +50.1 to +1000 mOhms: ----------Unstable
    f. >+1000 mOhms:----------Open Failure

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. <= +5.0 mOhms:----------Stable
    b. +5.1 to +10.0 mOhms:----------Minor
    c. +10.1 to +15.0 mOhms: ----------Acceptable
    d. +15.1 to +50.0 mOhms: ----------Marginal
    e. +50.1 to +1000 mOhms:----------Unstable
    f. >+1000 mOhms:----------Open Failure
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^{o} 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

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^{o} C
    c. 95^{o} C
    d. 115^{o} 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

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).

ATTRIBUTE DEFINITIONS Continued

The following is a brief, simplified description of attributes

CABLE PULL:

1) Secure cable near center and pull on connector
    a. At 0°, in-line with cable
    b. At 90°, in-line with cable

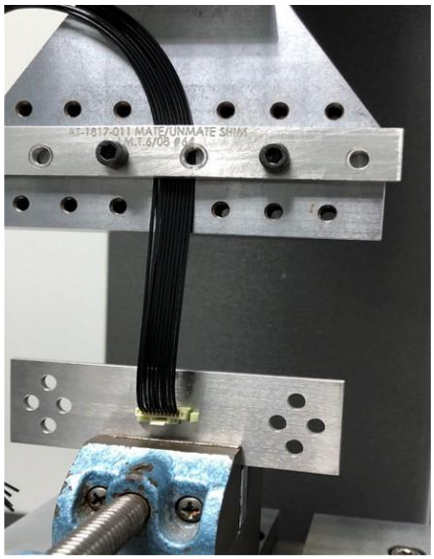


Fig. 1
90° Connector pull, notice the electrical continuity hook-up wires.

CABLE DURABILITY:

1) Oscillate and monitor electrical continuity for open circuit indication.
    a. ± 90° Flex Mode, bend up to 100 cycles. load on cable end.

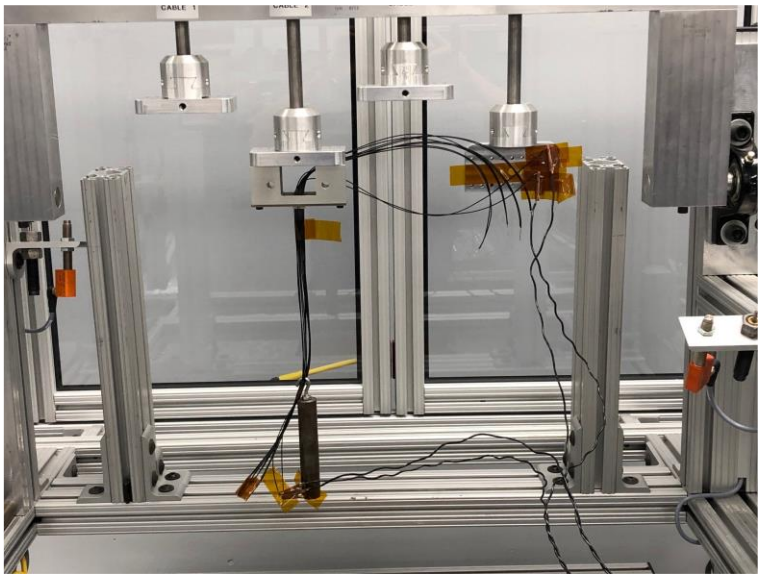


Fig. 2
(Setup picture)

RESULTS

Temperature Rise, CCC at a 20% de-rating

- **CCC for a 30°C Temperature Rise----------2.7 A per contact with 1 contacts (1x1) powered**
- **CCC for a 30°C Temperature Rise----------2.1 A per contact with 2 contacts (1x2) powered**
- **CCC for a 30°C Temperature Rise----------1.7 A per contact with 3 contacts (1x3) powered**
- **CCC for a 30°C Temperature Rise----------1.7 A per contact with 4 contacts (1x4) powered**
- **CCC for a 30°C Temperature Rise----------1.4 A per contact with 10 contacts (1x10) powered**

Mating – Unmating Forces

Thermal Aging Group

- **Initial**
  - **Mating**
    - **Min ---------- 1.59 lbs**
    - **Max---------- 2.45 lbs**
  - **Unmating**
    - **Min ---------- 0.73 lbs**
    - **Max---------- 1.09 lbs**
- **After 25 Cycles**
  - **Mating**
    - **Min ---------- 0.95 lbs**
    - **Max---------- 1.67 lbs**
  - **Unmating**
    - **Min ---------- 0.56 lbs**
    - **Max---------- 0.95 lbs**

RESULTS Continued

Mating – Unmating Forces

Mating/Unmating Durability Group

T1SS-10-28-GF-06.0/S1SS-10-28-GF-06.00-L

- **Initial**
  - **Mating**
    - **Min ---------- 1.40 lbs**
    - **Max---------- 2.50 lbs**
  - **Unmating**
    - **Min ---------- 0.79 lbs**
    - **Max---------- 1.14 lbs**
- **After 25 Cycles**
  - **Mating**
    - **Min ---------- 1.26 lbs**
    - **Max---------- 2.64 lbs**
  - **Unmating**
    - **Min ---------- 0.85 lbs**
    - **Max---------- 1.24 lbs**
- **After 50 Cycles**
  - **Mating**
    - **Min ---------- 1.26 lbs**
    - **Max---------- 2.83 lbs**
  - **Unmating**
    - **Min ---------- 0.86 lbs**
    - **Max---------- 1.31 lbs**
- **After 75 Cycles**
  - **Mating**
    - **Min ---------- 1.29 lbs**
    - **Max---------- 2.90 lbs**
  - **Unmating**
    - **Min ---------- 0.88 lbs**
    - **Max---------- 1.43 lbs**
- **After 100 Cycles**
  - **Mating**
    - **Min ---------- 1.33 lbs**
    - **Max---------- 2.88 lbs**
  - **Unmating**
    - **Min ---------- 0.92 lbs**
    - **Max---------- 1.52 lbs**
- **After Humidity**
  - **Mating**
    - **Min ---------- 1.32 lbs**
    - **Max---------- 2.12 lbs**
  - **Unmating**
    - **Min ---------- 0.76 lbs**
    - **Max---------- 1.09 lbs**

RESULTS Continued

Mating/Unmating Basic

T1SS-02-28-GF-06.0/S1SS-02-28-GF-06.00-L

- **Initial**
  - **Mating**
    - **Min ---------- 0.44 lbs**
    - **Max---------- 0.59 lbs**
  - **Unmating**
    - **Min ---------- 0.12 lbs**
    - **Max---------- 0.21 lbs**
- **After 25 Cycles**
  - **Mating**
    - **Min ---------- 0.32 lbs**
    - **Max---------- 0.41 lbs**
  - **Unmating**
    - **Min ---------- 0.16 lbs**
    - **Max---------- 0.22 lbs**
- **After 50 Cycles**
  - **Mating**
    - **Min ---------- 0.25 lbs**
    - **Max---------- 0.35 lbs**
  - **Unmating**
    - **Min ---------- 0.13 lbs**
    - **Max---------- 0.26 lbs**
- **After 75 Cycles**
  - **Mating**
    - **Min ---------- 0.25 lbs**
    - **Max---------- 0.36 lbs**
  - **Unmating**
    - **Min ---------- 0.16 lbs**
    - **Max---------- 0.28 lbs**
- **After 100 Cycles**
  - **Mating**
    - **Min ---------- 0.25 lbs**
    - **Max---------- 0.42 lbs**
  - **Unmating**
    - **Min ---------- 0.17 lbs**
    - **Max---------- 0.29 lbs**

Cable Pull force

0.033” PANEL THICKNESS

- **Group 1 0° Pull**
  - **Min---------- 2.71 lbs**
  - **Max ---------- 3.28 lbs**
- **Group 2 90° Pull**
  - **Min---------- 3.52 lbs**
  - **Max ---------- 3.89 lbs**

0.090” PANEL THICKNESS

- **Group 3 0° Pull**
  - **Min---------- 2.75 lbs**
  - **Max ---------- 3.46 lbs**
- **Group 4 90° Pull**
  - **Min---------- 4.54 lbs**
  - **Max ---------- 5.27 lbs**

RESULTS Continued

Insulation Resistance minimums, IR

- **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 ---------- 40000 Meg Ω ---------- Passed**
  - **Unmated ---------- 41000 Meg Ω ---------- Passed**

Dielectric Withstanding Voltage minimums, DWV

- **Minimums**
  - **Breakdown Voltage ---------- 920 VAC**
  - **Test Voltage ---------- 690 VAC**
  - **Working Voltage ---------- 230 VAC**
- **Initial DWV ---------- Passed**
- **Thermal DWV ---------- Passed**
- **Humidity DWV ---------- Passed**

Cable Flex:

0.033" PANEL THICKNESS

Insulation Resistance minimums, IR

- **Initial**
  - **Mated ---------- 45000 Meg Ω ---------- Passed**
- **After 500 flex cycles**
  - **Mated ---------- 45000 Meg Ω ---------- Passed**

Dielectric Withstanding Voltage minimums, DWV

- **Test Voltage ---------- 690 VAC**

- **Initial DWV ---------- Passed**
- **After 500 Flex cycles DWV ---------- Passed**

0.090" PANEL THICKNESS

Insulation Resistance minimums, IR

- **Initial**
  - **Mated ---------- 45000 Meg Ω ---------- Passed**
- **After 500 flex cycles**
  - **Mated ---------- 45000 Meg Ω ---------- Passed**

Dielectric Withstanding Voltage minimums, DWV

- **Test Voltage ---------- 690 VAC**

- **Initial DWV ---------- Passed**
- **After 500 Flex cycles DWV ---------- Passed**

RESULTS Continued

LLCR Gas Tight (80 LLCR test points)

- **Initial ---------- 77.97 mOhms Max**
- **Gas-Tight**
  - **<= +5.0 mOhms ---------- 79 Points ---------- Stable**
  - **+5.1 to +10.0 mOhms ---------- 1 Points ---------- Minor**
  - **+10.1 to +15.0 mOhms ---------- 0 Points ---------- Acceptable**
  - **+15.1 to +50.0 mOhms ---------- 0 Points ---------- Marginal**
  - **+50.1 to +1000 mOhms ---------- 0 Points ---------- Unstable**
  - **>+1000 mOhms ---------- 0 Points ---------- Open Failure**

LLCR Thermal Aging (80 LLCR test points)

- **Initial ---------- 76.77 mOhms Max**
- **Thermal Aging**
  - **<= +5.0 mOhms ---------- 76 Points ---------- Stable**
  - **+5.1 to +10.0 mOhms ---------- 2 Points ---------- Minor**
  - **+10.1 to +15.0 mOhms ---------- 2 Points ---------- Acceptable**
  - **+15.1 to +50.0 mOhms ---------- 0 Points ---------- Marginal**
  - **+50.1 to +1000 mOhms ---------- 0 Points ---------- Unstable**
  - **>+1000 mOhms ---------- 0 Points ---------- Open Failure**

LLCR Durability (80 LLCR test points)

- **Initial ---------- 76.30 mOhms Max**
- **Durability, 100 Cycles**
  - **<= +5.0 mOhms ---------- 80 Points ---------- Stable**
  - **+5.1 to +10.0 mOhms ---------- 0 Points ---------- Minor**
  - **+10.1 to +15.0 mOhms ---------- 0 Points ---------- Acceptable**
  - **+15.1 to +50.0 mOhms ---------- 0 Points ---------- Marginal**
  - **+50.1 to +1000 mOhms ---------- 0 Points ---------- Unstable**
  - **>+1000 mOhms ---------- 0 Points ---------- Open Failure**
- **Thermal**
  - **<= +5.0 mOhms ---------- 57 Points ---------- Stable**
  - **+5.1 to +10.0 mOhms ---------- 18 Points ---------- Minor**
  - **+10.1 to +15.0 mOhms ---------- 5 Points ---------- Acceptable**
  - **+15.1 to +50.0 mOhms ---------- 0 Points ---------- Marginal**
  - **+50.1 to +1000 mOhms ---------- 0 Points ---------- Unstable**
  - **>+1000 mOhms ---------- 0 Points ---------- Open Failure**
- **Humidity**
  - **<= +5.0 mOhms ---------- 43 Points ---------- Stable**
  - **+5.1 to +10.0 mOhms ---------- 33 Points ---------- Minor**
  - **+10.1 to +15.0 mOhms ---------- 4 Points ---------- Acceptable**
  - **+15.1 to +50.0 mOhms ---------- 0 Points ---------- Marginal**
  - **+50.1 to +1000 mOhms ---------- 0 Points ---------- Unstable**
  - **>+1000 mOhms ---------- 0 Points ---------- Open Failure**

RESULTS Continued

LLCR Shock & Vibration (80 LLCR test points)

- **Initial ---------- 137.41 mOhms Max**
- **Shock &Vibration**
  - **<= +5.0 mOhms ---------- 79 Points ---------- Stable**
  - **+5.1 to +10.0 mOhms ---------- 1 Points ---------- Minor**
  - **+10.1 to +15.0 mOhms ---------- 0 Points ---------- Acceptable**
  - **+15.1 to +50.0 mOhms ---------- 0 Points ---------- Marginal**
  - **+50.1 to +1000 mOhms ---------- 0 Points ---------- Unstable**
  - **>+1000 mOhms ---------- 0 Points ---------- Open Failure**

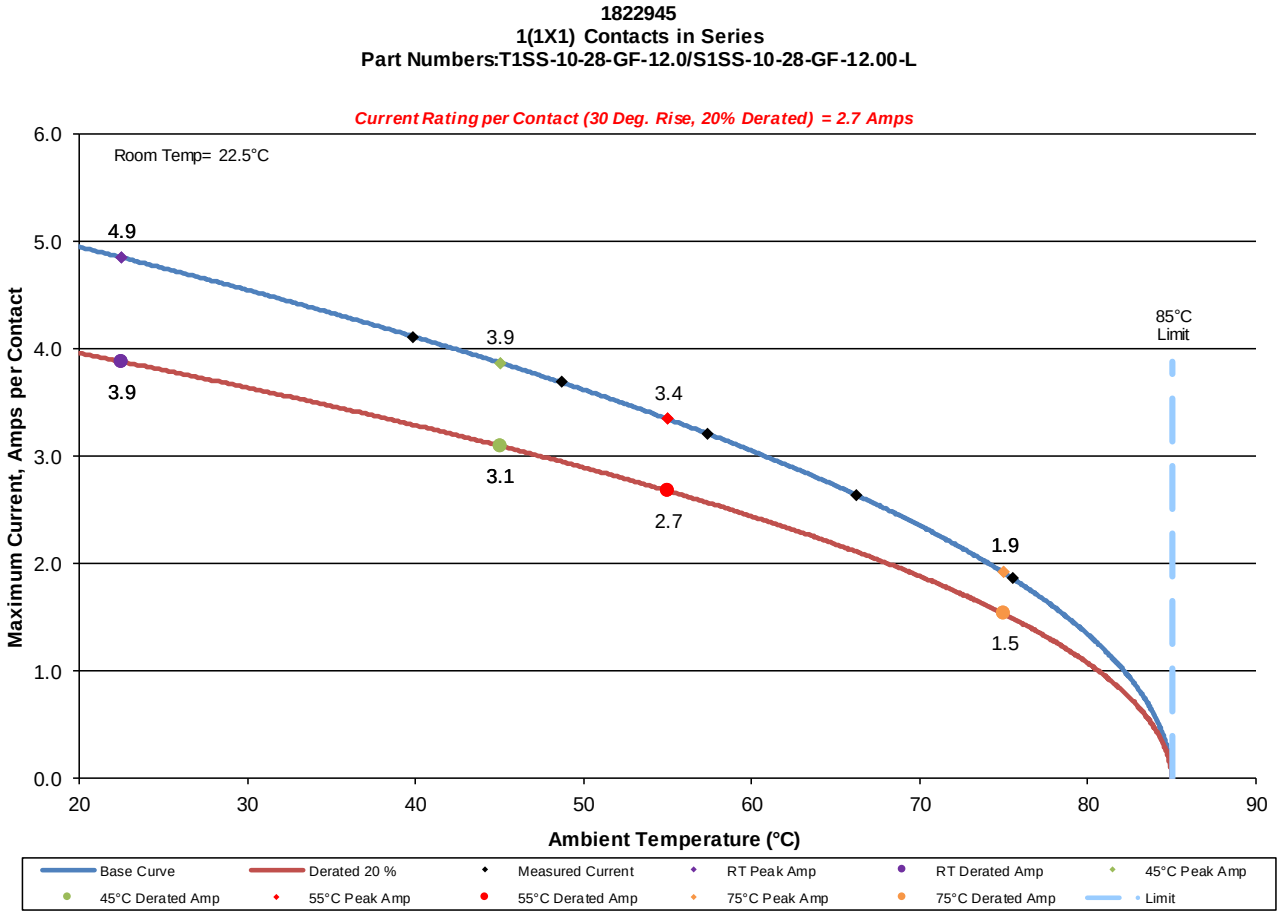
Mechanical Shock & Random Vibration:

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

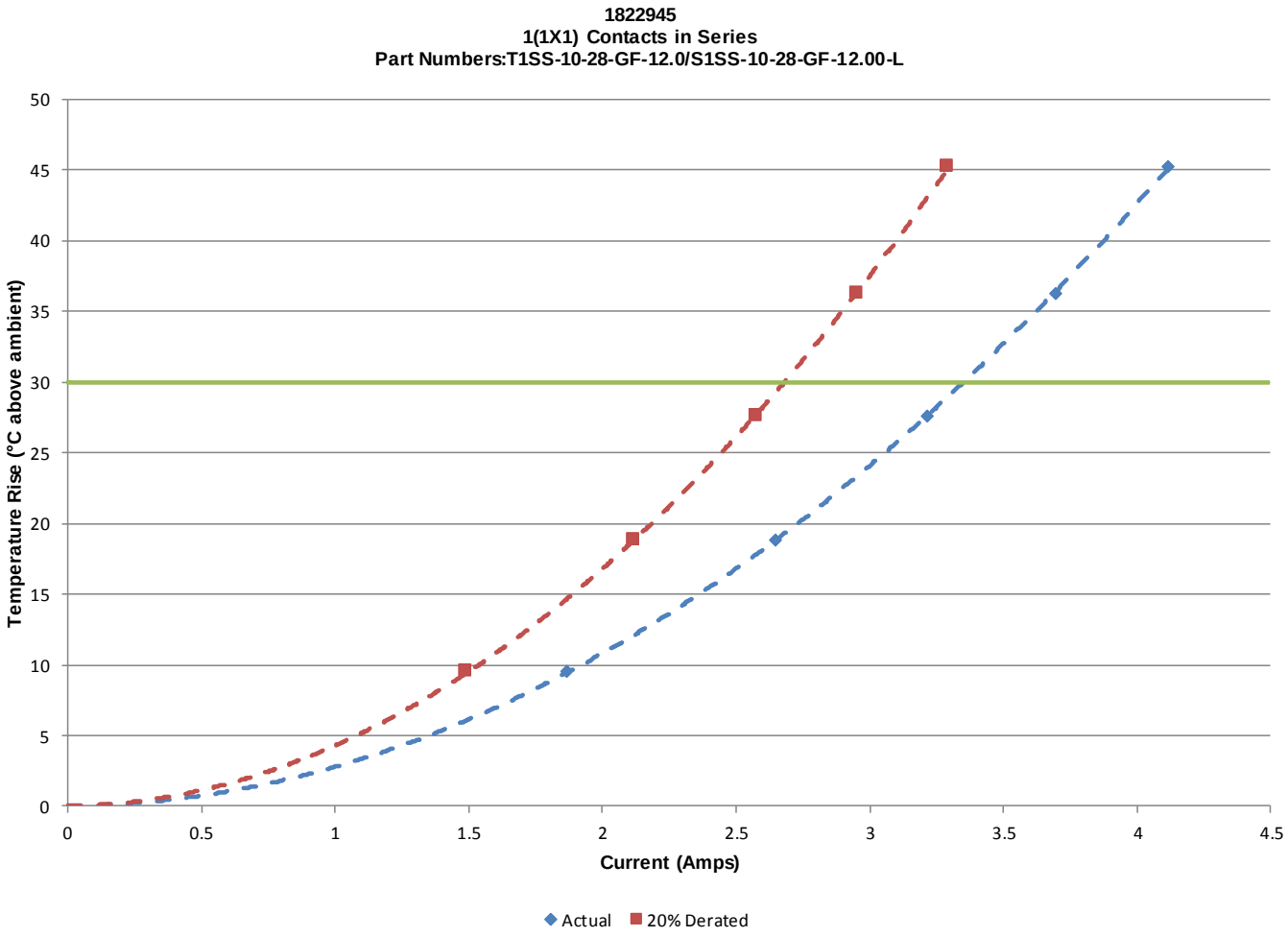
DATA SUMMARIES

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

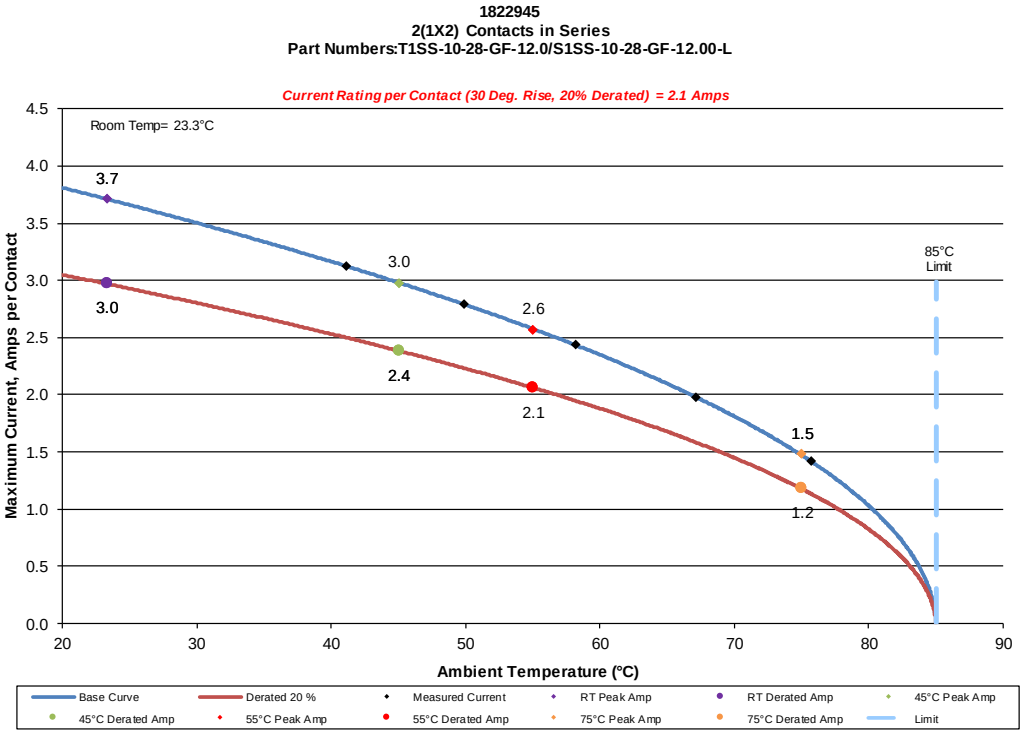


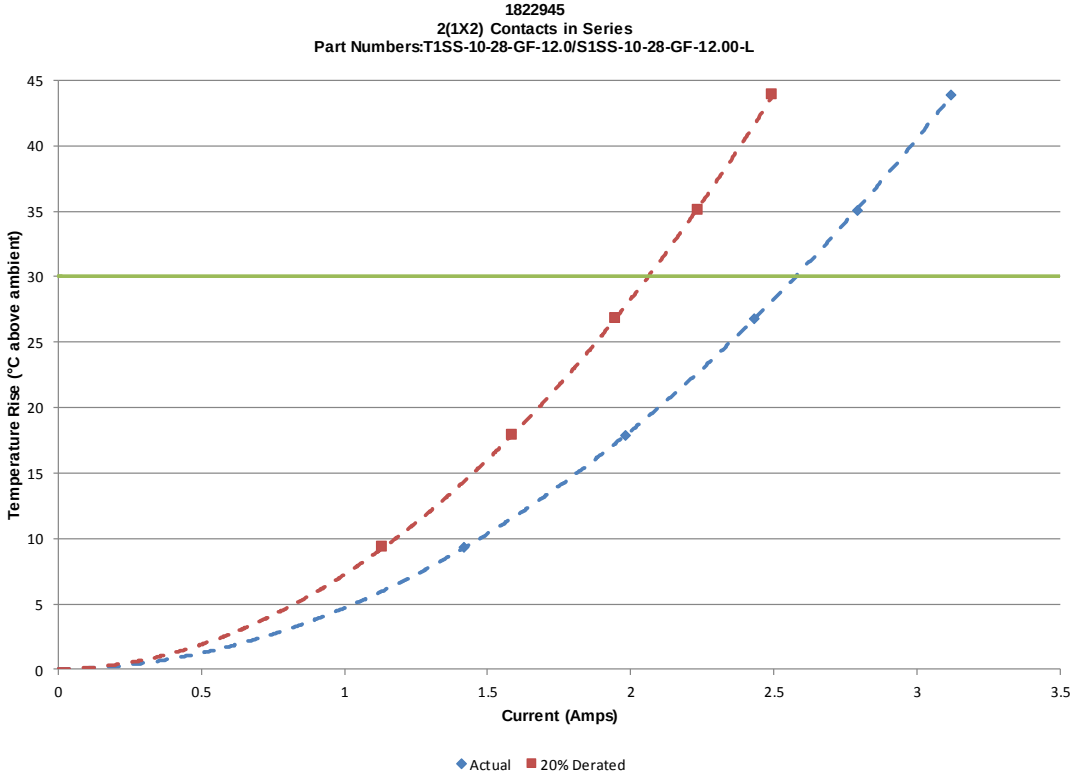
DATA SUMMARIES Continued



DATA SUMMARIES Continued

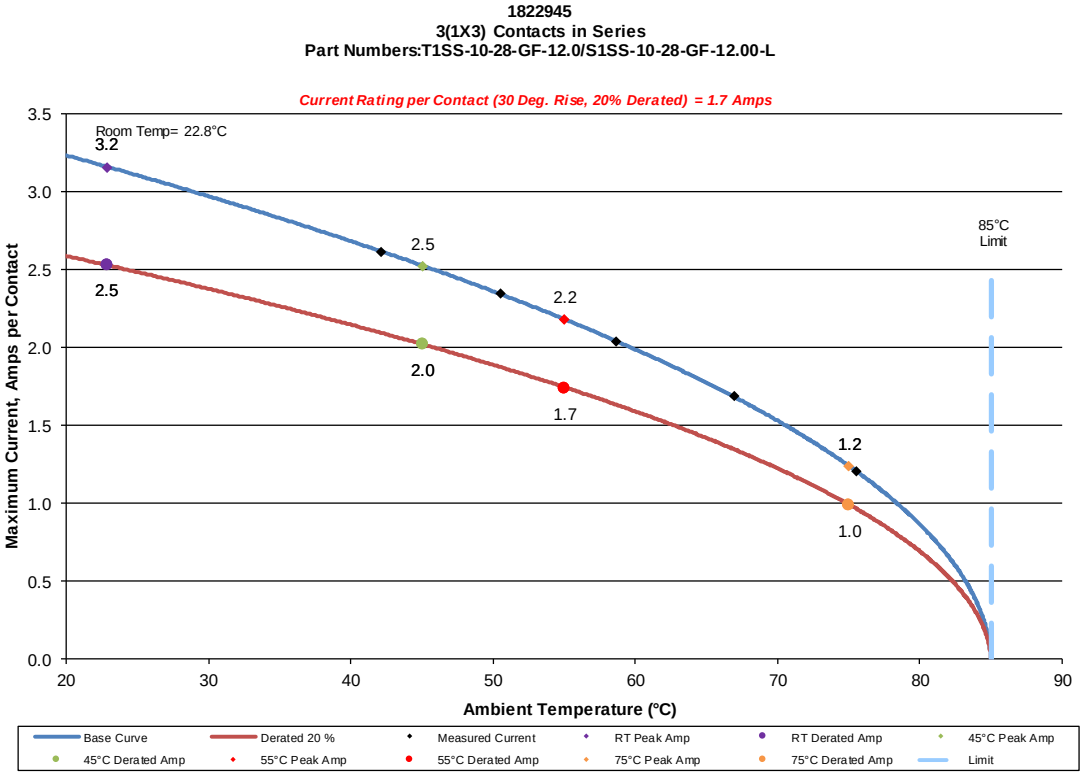
b. Linear configuration with 2 adjacent conductors/contacts powered

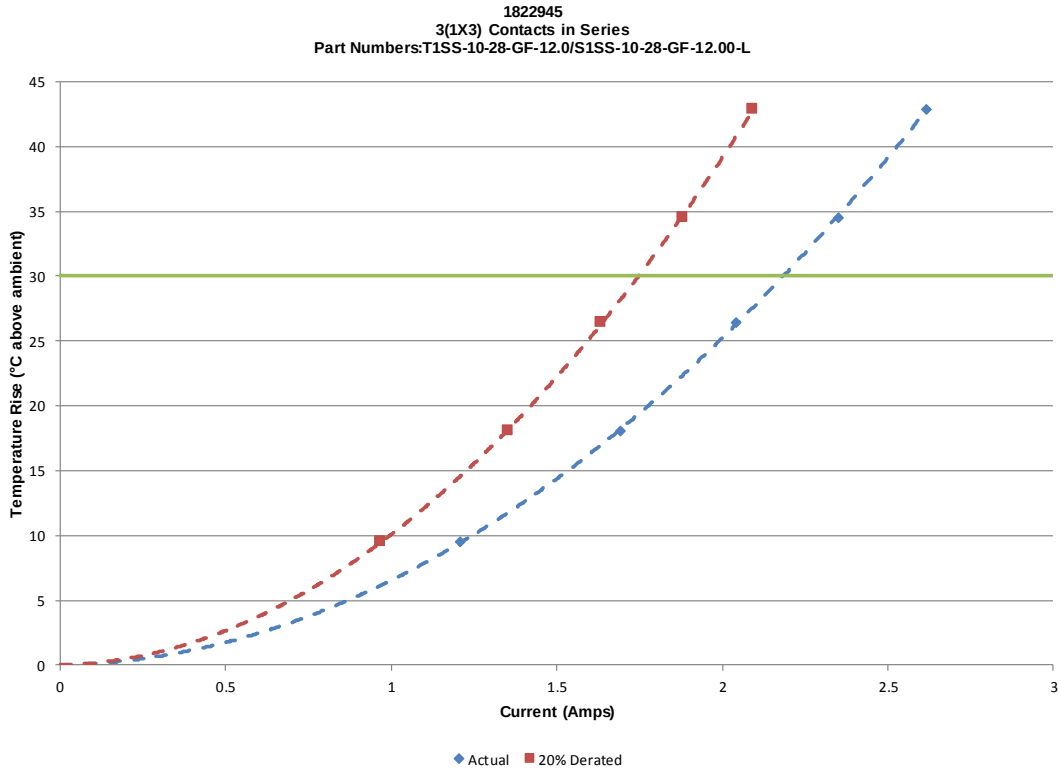




DATA SUMMARIES Continued

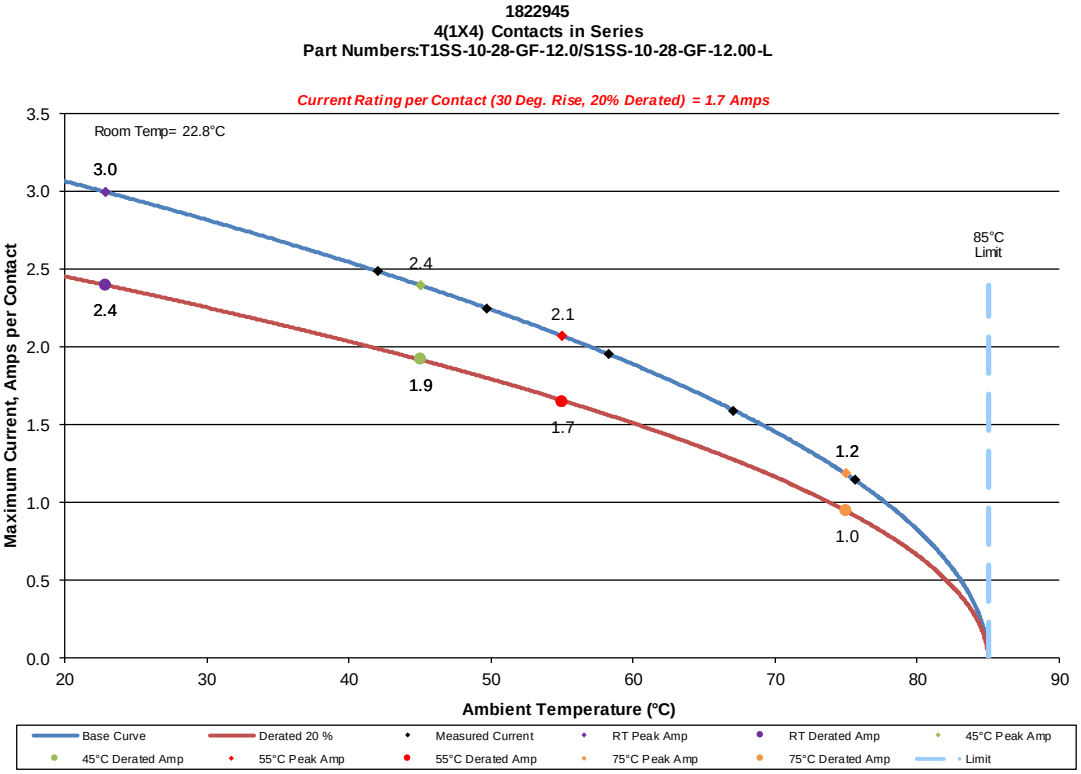
c. Linear configuration with 3 adjacent conductors/contacts powered

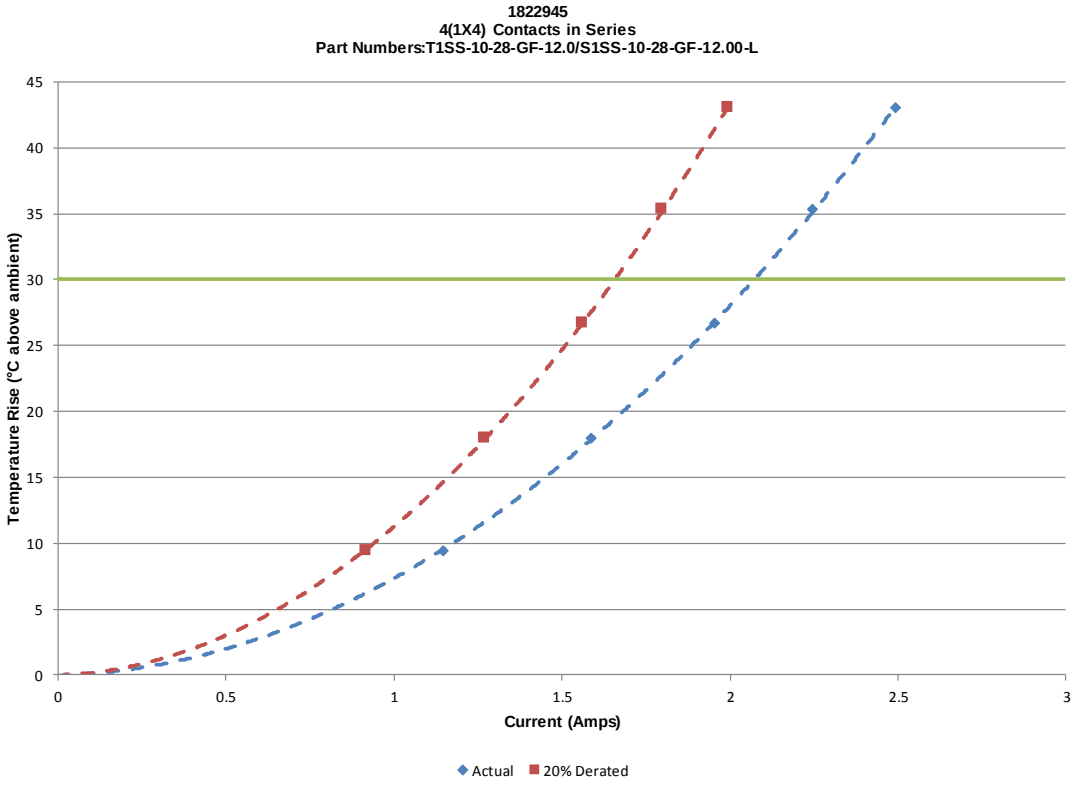




DATA SUMMARIES Continued

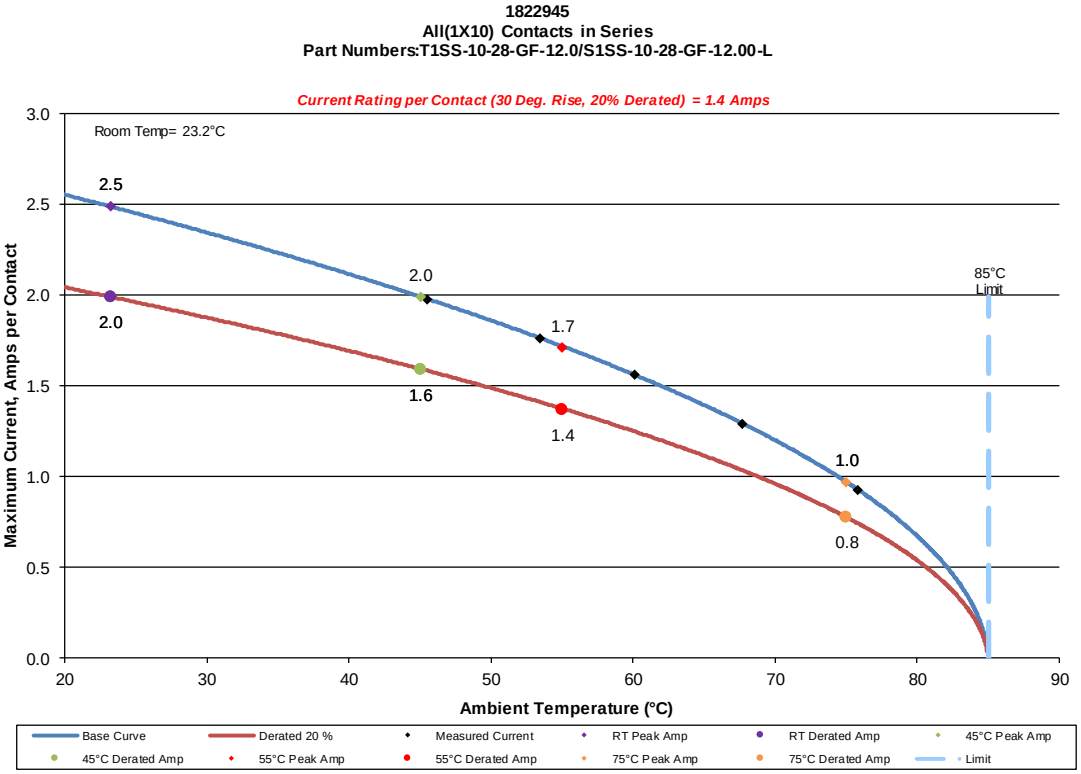
d. Linear configuration with 4 adjacent conductors/contacts powered

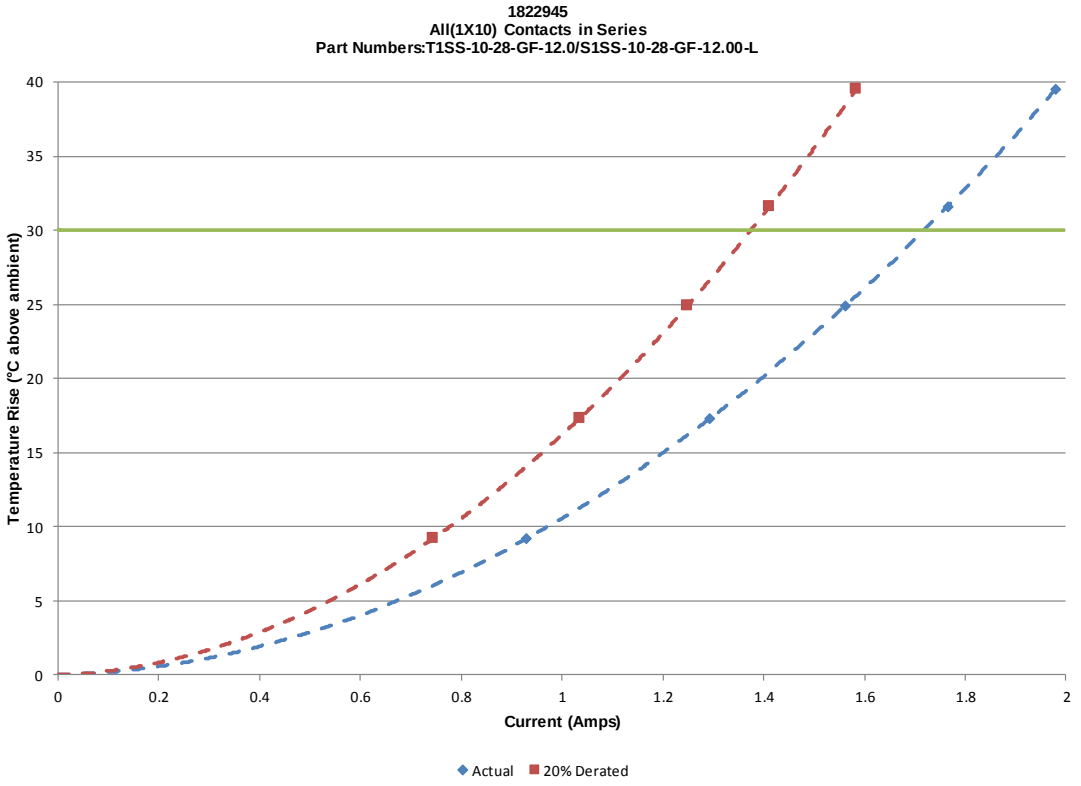




DATA SUMMARIES Continued

e. Linear configuration with 10 adjacent conductors/contacts powered





DATA SUMMARIES Continued

MATING/UNMATING:

Thermal Aging Group

	Initial				After Thermals			
	Mating		**Unmating**		**Mating**		**Unmating**	
	Newtons	Force (Lbs)	Newtons	Force (Lbs)	Newtons	Force (Lbs)	Newtons	Force (Lbs)
Minimum	7.07	1.59	3.25	0.73	4.23	0.95	2.49	0.56
Maximum	10.90	2.45	4.85	1.09	7.43	1.67	4.23	0.95
Average	8.65	**1.95**	4.09	**0.92**	5.90	**1.33**	3.56	**0.80**
St Dev	1.29	0.29	0.56	0.13	1.06	0.24	0.50	0.11
Count	8	8	8	8	8	8	8	8

Mating/Unmating Durability Group

T1SS-10-28-GF-06.0/S1SS-10-28-GF-06.00-L

	Initial				After 25 Cycles			
	Mating		**Unmating**		**Mating**		**Unmating**	
	Newtons	Force (Lbs)	Newtons	Force (Lbs)	Newtons	Force (Lbs)	Newtons	Force (Lbs)
Minimum	6.23	1.40	3.51	0.79	5.60	1.26	3.78	0.85
Maximum	11.12	2.50	5.07	1.14	11.74	2.64	5.52	1.24
Average	8.60	**1.93**	4.48	**1.01**	7.98	**1.79**	4.78	**1.07**
St Dev	1.64	0.37	0.58	0.13	1.97	0.44	0.63	0.14
Count	8	8	8	8	8	8	8	8
	After 50 Cycles				After 75 Cycles			
	Mating		**Unmating**		**Mating**		**Unmating**	
	Newtons	Force (Lbs)	Newtons	Force (Lbs)	Newtons	Force (Lbs)	Newtons	Force (Lbs)
Minimum	5.60	1.26	3.83	0.86	5.74	1.29	3.91	0.88
Maximum	12.59	2.83	5.83	1.31	12.90	2.90	6.36	1.43
Average	8.37	**1.88**	4.97	**1.12**	8.76	**1.97**	5.28	**1.19**
St Dev	2.27	0.51	0.74	0.17	2.38	0.54	0.92	0.21
Count	8	8	8	8	8	8	8	8
	After 100 Cycles				After Humidity			
	Mating		**Unmating**		**Mating**		**Unmating**	
	Newtons	Force (Lbs)	Newtons	Force (Lbs)	Newtons	Force (Lbs)	Newtons	Force (Lbs)
Minimum	5.92	1.33	4.09	0.92	5.87	1.32	3.38	0.76
Maximum	12.81	2.88	6.76	1.52	9.43	2.12	4.85	1.09
Average	9.10	**2.05**	5.65	**1.27**	7.04	**1.58**	3.88	**0.87**
St Dev	2.37	0.53	1.01	0.23	1.15	0.26	0.49	0.11
Count	8	8	8	8	8	8	8	8

DATA SUMMARIES Continued

Mating/Unmating Basic

T1SS-02-28-GF-06.0/S1SS-02-28-GF-06.00-L

	Initial				After 25 Cycles			
	Mating		**Unmating**		**Mating**		**Unmating**	
	Newtons	Force (Lbs)	Newtons	Force (Lbs)	Newtons	Force (Lbs)	Newtons	Force (Lbs)
Minimum	1.96	0.44	0.53	0.12	1.42	0.32	0.71	0.16
Maximum	2.62	0.59	0.93	0.21	1.82	0.41	0.98	0.22
Average	2.14	**0.48**	0.76	**0.17**	1.58	**0.36**	0.84	**0.19**
St Dev	0.21	0.05	0.14	0.03	0.14	0.03	0.09	0.02
Count	8	8	8	8	8	8	8	8

	After 50 Cycles				After 75 Cycles			
	Mating		**Unmating**		**Mating**		**Unmating**	
	Newtons	Force (Lbs)	Newtons	Force (Lbs)	Newtons	Force (Lbs)	Newtons	Force (Lbs)
Minimum	1.11	0.25	0.58	0.13	1.11	0.25	0.71	0.16
Maximum	1.56	0.35	1.16	0.26	1.60	0.36	1.25	0.28
Average	1.44	**0.32**	0.88	**0.20**	1.43	**0.32**	1.00	**0.22**
St Dev	0.15	0.03	0.18	0.04	0.18	0.04	0.20	0.05
Count	8	8	8	8	8	8	8	8

	After 100 Cycles			
	Mating		**Unmating**	
	Newtons	Force (Lbs)	Newtons	Force (Lbs)
Minimum	1.11	0.25	0.76	0.17
Maximum	1.87	0.42	1.29	0.29
Average	1.52	**0.34**	1.03	**0.23**
St Dev	0.27	0.06	0.22	0.05
Count	8	8	8	8

DATA SUMMARIES Continued

Cable Pull Force:

0.033" PANEL THICKNESS

Group 1 0° Pull

	Force (lbs)
Minimum	**2.71**
Maximum	3.28
Average	3.01

Group 2 90° Pull

	Force (lbs)
Minimum	**3.52**
Maximum	3.89
Average	3.72

0.090" PANEL THICKNESS

Group 3 0° Pull

	Force (lbs)
Minimum	**2.75**
Maximum	3.46
Average	3.16

Group 4 90° Pull

	Force (lbs)
Minimum	**4.54**
Maximum	5.27
Average	5.00

DATA SUMMARIES Continued

INSULATION RESISTANCE (IR):

	Pin to Pin		
	Mated	Unmated	Unmated
Minimum	**T1SS/S1SS**	**T1SS**	**S1SS**
Initial	45000	45000	45000
Thermal	45000	45000	45000
Humidity	40000	45000	41000

DIELECTRIC WITHSTANDING VOLTAGE (DWV):

Voltage Rating Summary	
Minimum	**T1SS/S1SS**
Break Down Voltage	920
Test Voltage	690
Working Voltage	230

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

DATA SUMMARIES Continued

Cable Flex:

0.033" PANEL THICKNESS

Insulation Resistance minimums, IR

Pin to Ground	
Mated	
Minimum	
Initial	45000
After 500 Flex Cycles	45000

Dielectric Withstanding Voltage minimums, DWV

Voltage Rating Summary	
Minimum	**T1SS/S1SS**
Break Down Voltage	920
Test Voltage	690
Working Voltage	230

Pin to Ground	
Initial Test Voltage	Passed
After 500 Flex Cycles Test Voltage	Passed

0.090" PANEL THICKNESS

Insulation Resistance minimums, IR

Pin to Ground	
Mated	
Minimum	
Initial	45000
After 500 Flex Cycles	45000

Dielectric Withstanding Voltage minimums, DWV

Voltage Rating Summary	
Minimum	**T1SS/S1SS**
Break Down Voltage	920
Test Voltage	690
Working Voltage	230

Pin to Ground	
Initial Test Voltage	Passed
After 500 Flex Cycles Test Voltage	Passed

DATA SUMMARIES Continued

LLCR Durability:

1) A total of 80 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. <= +5.0 mOhms: ----------Stable
   b. +5.1 to +10.0 mOhms: ----------Minor
   c. +10.1 to +15.0 mOhms:----------Acceptable
   d. +15.1 to +50.0 mOhms:----------Marginal
   e. +50.1 to +1000 mOhms----------Unstable
   f. >+1000 mOhms:----------Open Failure

LLCR Measurement Summaries by Pin Type				
Date	12/29/2018	1/3/2019	1/8/2019	1/22/2019
Room Temp (Deg C)	22	22	22	22
Rel Humidity (%)	52	52	52	52
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	74.43	0.59	3.29	4.90
St. Dev.	0.81	0.50	3.31	3.14
Min	72.59	0.01	0.01	0.42
Max	76.30	2.26	14.01	11.29
Summary Count	80	80	80	80
Total Count	80	80	80	80

LLCR Delta Count by Category						
	Stable	**Minor**	**Acceptable**	**Marginal**	**Unstable**	**Open**
mOhms	**<=5**	**>5 & <=10**	**>10 & <=15**	**>15 & <=50**	**>50 & <=1000**	**>1000**
100 Cycles	**80**	**0**	**0**	**0**	**0**	**0**
Therm Shck	**57**	**18**	**5**	**0**	**0**	**0**
Humidity	**43**	**33**	**4**	**0**	**0**	**0**

DATA SUMMARIES Continued

LLCR Thermal Aging:

1) A total of 80 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. <= +5.0 mOhms: ----------Stable
   b. +5.1 to +10.0 mOhms:----------Minor
   c. +10.1 to +15.0 mOhms: ----------Acceptable
   d. +15.1 to +50.0 mOhms: ----------Marginal
   e. +50.1 to +1000 mOhms: ----------Unstable
   f. >+1000 mOhms:----------Open Failure

LLCR Measurement Summaries by Pin Type				
Date	12/29/2018	1/14/2019		
Room Temp (Deg C)	22	23		
Rel Humidity (%)	52	52		
Technician	Kason He	Kason He		
mOhm values	**Actual Initial**	**Delta Thermal**	**Delta**	**Delta**
	Pin Type 1: Signal			
Average	74.11	2.17		
St. Dev.	0.90	2.19		
Min	71.82	0.23		
Max	76.77	13.70		
Summary Count	80	80		
Total Count	80	80		

LLCR Delta Count by Category						
	Stable	**Minor**	**Acceptable**	**Marginal**	**Unstable**	**Open**
mOhms	**<=5**	**>5 & <=10**	**>10 & <=15**	**>15 & <=50**	**>50 & <=1000**	**>1000**
Thermal	**76**	**2**	**2**	**0**	**0**	**0**

DATA SUMMARIES Continued

LLCR Gas Tight:

1) A total of 80 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. <= +5.0 mOhms: ----------Stable
   b. +5.1 to +10.0 mOhms: ----------Minor
   c. +10.1 to +15.0 mOhms:----------Acceptable
   d. +15.1 to +50.0 mOhms:----------Marginal
   e. +50.1 to +1000 mOhms: ----------Unstable
   f. >+1000 mOhms:----------Open Failure

LLCR Measurement Summaries by Pin Type				
Date	1/16/2019	1/17/2019		
Room Temp (Deg C)	22	22		
Rel Humidity (%)	52	52		
Technician	Kason He	Kason He		
mOhm values	**Actual Initial**	**Delta Acid Vapor**	**Delta**	**Delta**
	Pin Type 1: Signal			
Average	75.57	0.93		
St. Dev.	0.95	1.10		
Min	73.83	0.03		
Max	77.97	6.62		
Summary Count	80	80		
Total Count	80	80		

LLCR Delta Count by Category						
	Stable	**Minor**	**Acceptable**	**Marginal**	**Unstable**	**Open**
mOhms	**<=5**	**>5 & <=10**	**>10 & <=15**	**>15 & <=50**	**>50 & <=1000**	**>1000**
Acid Vapor	**79**	**1**	**0**	**0**	**0**	**0**

DATA SUMMARIES Continued

LLCR Shock &Vibration:

1). A total of 80 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. <= +5.0 mOhms: ----------Stable
   b. +5.1 to +10.0 mOhms: ----------Minor
   c. +10.1 to +15.0 mOhms: ----------Acceptable
   d. +15.1 to +50.0 mOhms: ----------Marginal
   e. +50.1 to +1000 mOhms ----------Unstable
   f. >+1000 mOhms: ----------Open Failure

	LLCR Measurement Summaries by Pin Type			
Date	2/6/2019	4/9/2019		
Room Temp (Deg C)	23	22		
Rel Humidity (%)	45	43		
Technician	Aaron McKim	Aaron McKim		
mOhm values	**Actual Initial**	**Delta Shock-Vib**	**Delta**	**Delta**
	Pin Type 1: Signal			
Average	135.04	1.42		
St. Dev.	1.32	1.18		
Min	129.95	0.01		
Max	137.41	5.32		
Summary Count	80	80		
Total Count	80	80		

LLCR Delta Count by Category						
	Stable	**Minor**	**Acceptable**	**Marginal**	**Unstable**	**Open**
mOhms	**<=5**	**>5 & <=10**	**>10 & <=15**	**>15 & <=50**	**>50 & <=1000**	**>1000**
Shock-Vib	**79**	**1**	**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: 4/25/2019, Next Cal: 4/24/2020

Equipment #: HZ-OV-01
Description: Oven
Manufacturer: Huida
Model: CS101-1E
Serial #: CS101-1E-B
Accuracy: Last Cal: 12/11/2018, Next Cal: 12/10/2020

Equipment #: HZ-THC-01
Description: Humidity transmitter
Manufacturer: Thermtron
Model: SM-8-8200
Serial #: 38846
Accuracy: Last Cal: 2/27/2019, Next Cal: 2/26/2020

Equipment #: DG-HPT-01
Description: Hipot Safety Tester
Manufacturer: Vitrek
Model: V73
Serial #: 025866
Accuracy:
… Last Cal: 04/11/2019, Next Cal: 04/10/2020

Equipment #: HZ-MO-05
Description: Micro-ohmmeter
Manufacturer: Keithley
Model: 3706
Serial #: 1285188
Accuracy: Last Cal: 11/13/2019, Next Cal: 11/12/2020

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: 06/26/2019, Next Cal: 06/25/2020

EQUIPMENT AND CALIBRATION SCHEDULES

Equipment #: HPT-01
Description: Hipot Safety Tester
Manufacturer: Vitrek
Model: V73
Serial #: 019808
Accuracy:
… Last Cal: 05/15/2019, Next Cal: 05/15/2020

Equipment #: SVC-01
Description: Shock & Vibration Table
Manufacturer: Data Physics
Model: LE-DSA-10-20K
Serial #: 10037
Accuracy: See Manual
… Last Cal: 04/22/2019, Next Cal: 04/22/2020

Equipment #: ACLM-01
Description: Accelerometer
Manufacturer: PCB Piezotronics
Model: 352C03
Serial #: 115819
Accuracy: See Manual
… Last Cal: 07/18/2019, Next Cal: 07/18/2020

Equipment #: ED-03
Description: Event Detector
Manufacturer: Analysis Tech
Model: 32EHD
Serial #: 1100604
Accuracy: See Manual
… Last Cal: 10/31/2019, Next Cal: 10/31/2020

Equipment #: MO-11
Description: Switch/Multimeter
Manufacturer: Keithley
Model: 3706
Serial #: 120169
Accuracy: See Manual
… Last Cal: 09/11/2019, Next Cal: 09/11/2020