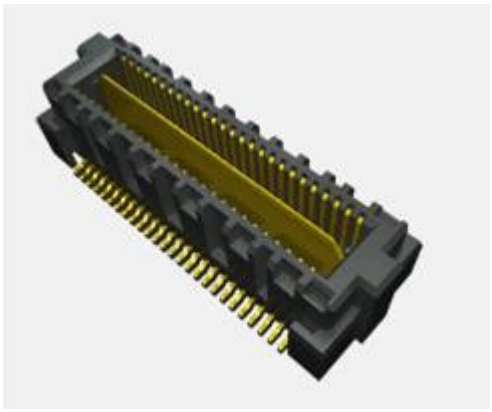
| | |
|---|---|
| Project Number: Design Qualification Test Report | Tracking Code: 262110_Report_Rev_1 |
| Requested by: Catie Eichhorn | Date: 11/22/2013 |
| Part #: QFS-052-04.25-L-D-A/QMS-052-05.75-L-D-A | |
| Part description: QFS/QMS | Tech: Kason He |
| Test Start: 08/16/2013 | Test Completed: 10/28/2013 |



**DESIGN QUALIFICATION TEST REPORT**

**QFS/QMS**
**QFS-052-04.25-L-D-A/QMS-052-05.75-L-D-A**

## REVISION HISTORY

| DATA | REV.NUM. | DESCRIPTION | ENG |
|---|---|---|---|
| **11/22/2013** | **1** | **Initial Issue** | **KH** |

## CERTIFICATION

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



## SCOPE

To perform the following tests: Design Qualification test. Please see test plan.

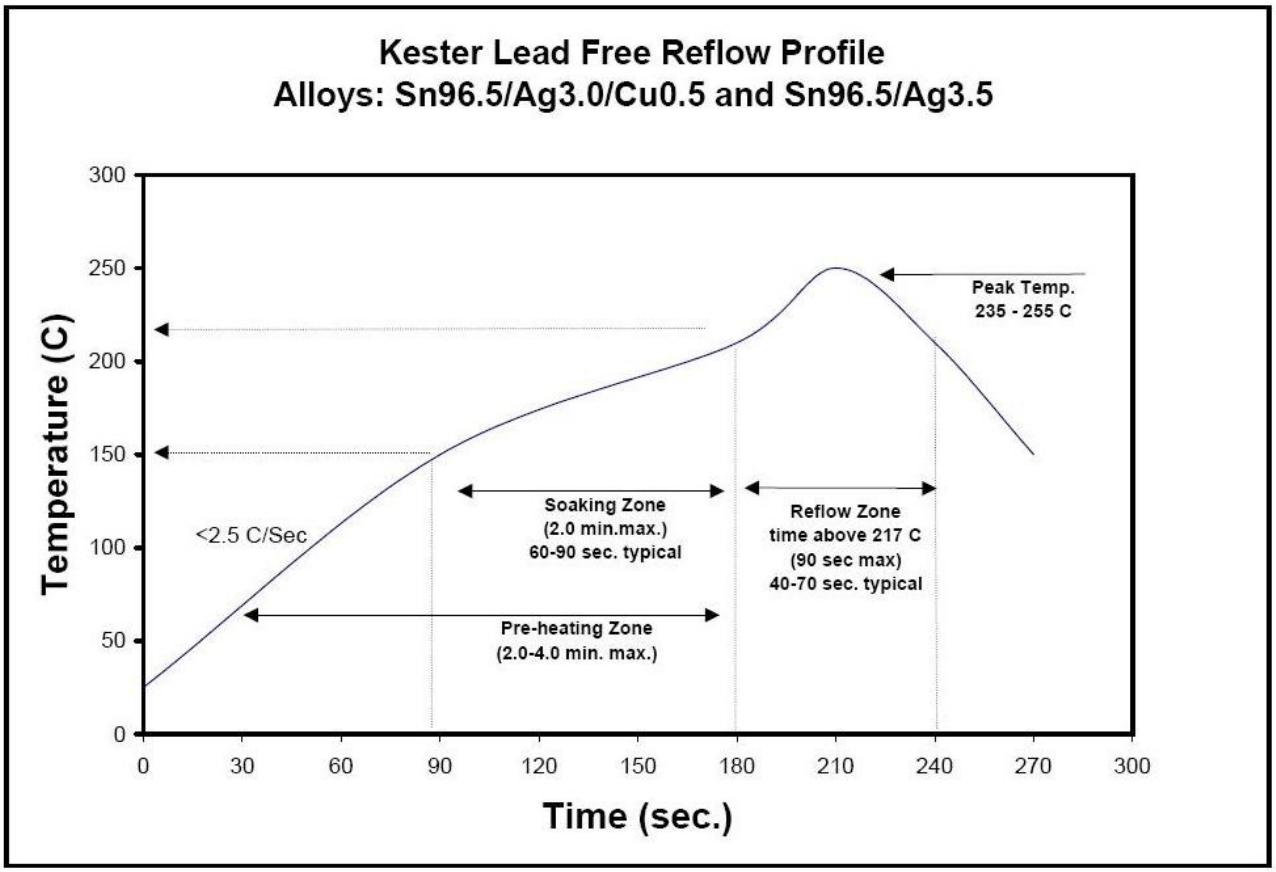
## APPLICABLE DOCUMENTS

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) Re-Flow Time/Temp: See accompanying profile.
10) Samtec Test PCBs used: PCB-105071-TST\PCB-105070-TST\PCB-105072-TST

**TYPICAL OVEN PROFILE (Soldering Parts to Test Boards)**



# FLOWCHARTS

## Gas Tight

Group 1
QFS-052-04.25-L-D-A
QMS-052-05.75-L-D-A
8 Assemblies

| Step | Description |
|---|---|
| 1. | LLCR (2)<br>Max Delta = 15 mOhm |
| 2. | Gas Tight (1) |
| 3. | LLCR (2)<br>Max Delta = 15 mOhm |

(1) Gas Tight = EIA-364-36

(2) LLCR = EIA-364-23
Open Circuit Voltage = 20 mV Max
Test Current = 100 mA Max

## Normal Force

Group 1
QFS-052-04.25-L-D-A
QMS-052-05.75-L-D-A
8 Contacts Minimum
Signal Without Thermals

| Step | Description |
|---|---|
| 1. | Contact Gaps |
| 2. | Normal Force (1)<br>Deflection = 0.0095 "<br>Expected Force at Max Deflection = 95 g |

Group 2
QFS-052-04.25-L-D-A
QMS-052-05.75-L-D-A
8 Contacts Minimum
Ground Without Thermals

| Step | Description |
|---|---|
| 1. | Contact Gaps |
| 2. | Normal Force (1)<br>Deflection = 0.003 "<br>Expected Force at Max Deflection = 100 g |

Group 3
QFS-052-04.25-L-D-A
QMS-052-05.75-L-D-A
8 Contacts Minimum
Signal With Thermals

| Step | Description |
|---|---|
| 1. | Contact Gaps |
| 2. | Thermal Age (2) |
| 3. | Contact Gaps |
| 4. | Normal Force (1)<br>Deflection = 0.0095 "<br>Expected Force at Max Deflection = 95 g |

Group 4
QFS-052-04.25-L-D-A
QMS-052-05.75-L-D-A
8 Contacts Minimum
Ground With Thermals

| Step | Description |
|---|---|
| 1. | Contact Gaps |
| 2. | Thermal Age (2) |
| 3. | Contact Gaps |
| 4. | Normal Force (1)<br>Deflection = 0.003 "<br>Expected Force at Max Deflection = 100 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
QFS-052-04.25-L-D-A
QMS-052-05.75-L-D-A
8 Assemblies

| Step | Description |
| --- | --- |
| 1. | Contact Gaps |
| 2. | Mating/Unmating Force (2) |
| 3. | LLCR (1)<br>Max Delta = 15 mOhm |
| 4. | Thermal Age (3) |
| 5. | LLCR (1)<br>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<br>QFS-052-04.25-L-D-A<br>QMS-052-05.75-L-D-A<br>8 Assemblies | | Group 2<br>QFS-026-04.25-L-D-A<br>QMS-026-05.75-L-D-A<br>8 Assemblies | | Group 3<br>QFS-078-04.25-L-D-A<br>QMS-078-05.75-L-D-A<br>8 Assemblies | | Group 4<br>QFS-104-04.25-L-D-A<br>QMS-104-05.75-L-D-A<br>8 Assemblies | |
|---|---|---|---|---|---|---|---|
| **Step** | **Description** | **Step** | **Description** | **Step** | **Description** | **Step** | **Description** |
| 1. | Contact Gaps | 1. | Contact Gaps | 1. | Contact Gaps | 1. | Contact Gaps |
| 2. | LLCR (2)<br>Max Delta = 15 mOhm | 2. | Mating/Unmating Force (3) | 2. | Mating/Unmating Force (3) | 2. | Mating/Unmating Force (3) |
| 3. | Mating/Unmating Force (3) | 3. | Cycles<br>Quantity = 25 Cycles | 3. | Cycles<br>Quantity = 25 Cycles | 3. | Cycles<br>Quantity = 25 Cycles |
| 4. | Cycles<br>Quantity = 25 Cycles | 4. | Mating/Unmating Force (3) | 4. | Mating/Unmating Force (3) | 4. | Mating/Unmating Force (3) |
| 5. | Mating/Unmating Force (3) | | | | | | |
| 6. | Contact Gaps | | | | | | |
| 7. | LLCR (2)<br>Max Delta = 15 mOhm | | | | | | |
| 8. | Thermal Shock (4) | | | | | | |
| 9. | LLCR (2)<br>Max Delta = 15 mOhm | | | | | | |
| 10. | Humidity (1) | | | | | | |
| 11. | LLCR (2)<br>Max Delta = 15 mOhm | | | | | | |
| 12. | Mating/Unmating Force (3) | | | | | | |

(1) Humidity = EIA-364-31
Test Condition = B (240 Hours)
Test Method = III (+25°C to +65°C @ 90% RH to 98% RH)
Test Exceptions: ambient pre-condition and delete steps 7a and 7b

(2) LLCR = EIA-364-23
Open Circuit Voltage = 20 mV Max
Test Current = 100 mA Max

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

(4) Thermal Shock = 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<br>QFS-052-04.25-L-D-A<br>QMS-052-05.75-L-D-A<br>2 Assemblies | | Group 2<br>QFS-052-04.25-L-D-A<br>2 Assemblies | | Group 3<br>QMS-052-05.75-L-D-A<br>2 Assemblies | | Group 4<br>QFS-052-04.25-L-D-A<br>QMS-052-05.75-L-D-A<br>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) |

***Row-to-Row***

| Group 5<br>QFS-052-04.25-L-D-A<br>QMS-052-05.75-L-D-A<br>2 Assemblies | | Group 6<br>QFS-052-04.25-L-D-A<br>2 Assemblies | | Group 7<br>QMS-052-05.75-L-D-A<br>2 Assemblies | | Group 8<br>QFS-052-04.25-L-D-A<br>QMS-052-05.75-L-D-A<br>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) |

# FLOWCHARTS Continued

***Pin-to-Ground***

| Group 9<br>QFS-052-04.25-L-D-A<br>QMS-052-05.75-L-D-A<br>2 Assemblies | | Group 10<br>QFS-052-04.25-L-D-A<br>2 Assemblies | | Group 11<br>QMS-052-05.75-L-D-A<br>2 Assemblies | | Group 12<br>QFS-052-04.25-L-D-A<br>QMS-052-05.75-L-D-A<br>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**
QFS-104-04.25-L-D-A
QMS-104-05.75-L-D-A
2 Pins Powered
Signal

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

**Group 2**
QFS-104-04.25-L-D-A
QMS-104-05.75-L-D-A
4 Pins Powered
Signal

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

**Group 3**
QFS-104-04.25-L-D-A
QMS-104-05.75-L-D-A
6 Pins Powered
Signal

| Step | Description |
|---|---|
| 1. | CCC (2)<br>Rows = 2<br>Number of Positions = 3 |

**Group 4**
QFS-104-04.25-L-D-A
QMS-104-05.75-L-D-A
8 Pins Powered
Signal

| Step | Description |
|---|---|
| 1. | CCC (2)<br>Rows = 2<br>Number of Positions = 4 |

**Group 5**
QFS-104-04.25-L-D-A
QMS-104-05.75-L-D-A
208 Pins Powered
Signal

| Step | Description |
|---|---|
| 1. | CCC (2)<br>Rows = 2<br>Number of Positions = 104 |

**Group 6**
QFS-104-04.25-L-D-A
QMS-104-05.75-L-D-A
1 Pins Powered
Ground

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

**Group 7**
QFS-104-04.25-L-D-A
QMS-104-05.75-L-D-A
2 Pins Powered
Ground

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

**Group 8**
QFS-104-04.25-L-D-A
QMS-104-05.75-L-D-A
3 Pins Powered
Ground

| Step | Description |
|---|---|
| 1. | CCC (2)<br>Rows = 1<br>Number of Positions = 3 |

**Group 9**
QFS-104-04.25-L-D-A
QMS-104-05.75-L-D-A
4 Pins Powered
Ground

| Step | Description |
|---|---|
| 1. | CCC (2)<br>Rows = 1<br>Number of Positions = 4 |

**Group 10**
QFS-104-04.25-L-D-A
QMS-104-05.75-L-D-A

All Power

*Note: Monitor grounds while powering all signal pins at half rated current from Group 5*

| Step | Description |
|---|---|
| 1. | CCC - All Power (1) |

---

(1) CCC - All Power = EIA-364-70
Method 2, Temperature Rise Versus Current Curve
(TIN PLATING) - Tabulate calculated current at RT, 65°C, 75°C and 95°C after derating 20% and based on 105°C
(GOLD PLATING) - Tabulate calculated current at RT, 85°C, 95°C and 115°C after derating 20% and based on 125°C

(2) CCC = EIA-364-70
Method 2, Temperature Rise Versus Current Curve
(TIN PLATING) - Tabulate calculated current at RT, 65°C, 75°C and 95°C after derating 20% and based on 105°C
(GOLD PLATING) - Tabulate calculated current at RT, 85°C, 95°C and 115°C after derating 20% and based on 125°C

## FLOWCHARTS Continued

## Mechanical Shock/Random Vibration/LLCR

Group 1
QFS-052-04.25-L-D-A
QMS-052-05.75-L-D-A
8 Assemblies

| Step | Description |
|---|---|
| 1. | LLCR (1)<br>Max Delta = 15 mOhm |
| 2. | Mechanical Shock (2) |
| 3. | Random Vibration (3) |
| 4. | LLCR (1)<br>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
QFS-052-04.25-L-D-A
QMS-052-05.75-L-D-A
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)

# FLOWCHARTS Continued

## Extended Life

| Group 1<br>QFS-052-06.25-S-D-A<br>QMS-052-09.75-S-D-A<br>8 Assemblies<br>100 Cycles | | Group 2<br>QFS-052-06.25-S-D-A<br>QMS-052-09.75-S-D-A<br>8 Assemblies<br>250 Cycles | | Group 3<br>QFS-052-06.25-S-D-A<br>QMS-052-09.75-S-D-A<br>8 Assemblies<br>500 Cycles | |
|---|---|---|---|---|---|
| **Step** | **Description** | **Step** | **Description** | **Step** | **Description** |
| 1. | Plating Thickness Verification (4) | 1. | Plating Thickness Verification (4) | 1. | Plating Thickness Verification (4) |
| 2. | LLCR (2)<br>Max Delta = 15 mOhm | 2. | LLCR (2)<br>Max Delta = 15 mOhm | 2. | LLCR (2)<br>Max Delta = 15 mOhm |
| 3. | Cycles<br>Quantity = 100 Cycles | 3. | Cycles<br>Quantity = 250 Cycles | 3. | Cycles<br>Quantity = 500 Cycles |
| 4. | LLCR (2)<br>Max Delta = 15 mOhm | 4. | LLCR (2)<br>Max Delta = 15 mOhm | 4. | LLCR (2)<br>Max Delta = 15 mOhm |
| 5. | Thermal Shock (5) | 5. | Thermal Shock (5) | 5. | Thermal Shock (5) |
| 6. | LLCR (2)<br>Max Delta = 15 mOhm | 6. | LLCR (2)<br>Max Delta = 15 mOhm | 6. | LLCR (2)<br>Max Delta = 15 mOhm |
| 7. | Humidity (1) | 7. | Humidity (1) | 7. | Humidity (1) |
| 8. | LLCR (2)<br>Max Delta = 15 mOhm | 8. | LLCR (2)<br>Max Delta = 15 mOhm | 8. | LLCR (2)<br>Max Delta = 15 mOhm |
| 9. | Photos (3) | 9. | Photos (3) | 9. | Photos (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) Photos
Attach 2-3 photos of contact area

(4) Plating Thickness Verification
Measure, verify, and document plating thickness on both male and female (one group only)
Plating thickness to be measured on loose pins used during assembly

(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)

## ATTRIBUTE DEFINITIONS

The following is a brief, simplified description of attributes.

### THERMAL SHOCK:

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

### THERMAL:

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

### HUMIDITY:

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

### MECHANICAL SHOCK (Specified Pulse):

1) Reference document: EIA-364-27, *Mechanical Shock Test Procedure for Electrical Connectors*
2) Test Condition C
3) Peak Value: 100 G
4) Duration: 6 Milliseconds
5) Wave Form: Half Sine
6) Velocity: 12.3 ft/s
7) Number of Shocks: 3 Shocks / Direction, 3 Axis (18 Total)

### VIBRATION:

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

### 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. $85^{o}$ 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.

### 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 +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. <= +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 $50^{o}$ 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

### 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 $TC^2$, 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 $TC^2$ software in order to acquire and record the test data.
10) The permanent set of each contact shall be measured within the $TC^2$ 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

**Ground pin**

- **CCC for a 30°C Temperature Rise----------15.7 A per contact with 1 adjacent ground contacts powered**
- **CCC for a 30°C Temperature Rise----------13.4 A per contact with 2 adjacent ground contacts powered**
- **CCC for a 30°C Temperature Rise----------12.5 A per contact with 3 adjacent ground contacts powered**
- **CCC for a 30°C Temperature Rise----------12.1 A per contact with 4 adjacent ground contacts powered**

**Signal pin**

- **CCC for a 30°C Temperature Rise----------2.6 A per contact with 2 adjacent signal contacts powered**
- **CCC for a 30°C Temperature Rise----------2.0 A per contact with 4 adjacent signal contacts powered**
- **CCC for a 30°C Temperature Rise----------1.6 A per contact with 6 adjacent signal contacts powered**
- **CCC for a 30°C Temperature Rise----------1.4 A per contact with 8 adjacent signal contacts powered**
- **CCC for a 30°C Temperature Rise----------0.6 A per contact with all adjacent signal contacts powered**

**Ground pin and Signal pin (signal contacts powered @ 1/2 rated current @ .35 AMPS)**

- **CCC for a 30°C Temperature Rise----------10.3 A per contact with all adjacent power contacts powered**

## Mating – Unmating Forces

**Thermal Aging Group**

- **Initial**
  - **Mating**
    - **Min ---------- 4.97 Lbs**
    - **Max---------- 5.86 Lbs**
  - **Unmating**
    - **Min ---------- 2.83 Lbs**
    - **Max---------- 3.33 Lbs**
- **After Thermal**
  - **Mating**
    - **Min ---------- 3.39 Lbs**
    - **Max---------- 3.62 Lbs**
  - **Unmating**
    - **Min ---------- 2.38 Lbs**
    - **Max---------- 2.86 Lbs**

**Mating-Unmating Durability Group**

- **Initial**
  - **Mating**
    - **Min ---------- 4.82 Lbs**
    - **Max---------- 5.30 Lbs**
  - **Unmating**
    - **Min ---------- 2.66 Lbs**
    - **Max---------- 3.11 Lbs**
- **After 25 Cycles**
  - **Mating**
    - **Min ---------- 5.63 Lbs**
    - **Max---------- 6.36 Lbs**
  - **Unmating**
    - **Min ---------- 4.47 Lbs**
    - **Max---------- 5.26 Lbs**
- **Humidity**
  - **Mating**
    - **Min ---------- 3.25 Lbs**
    - **Max---------- 3.77 Lbs**
  - **Unmating**
    - **Min ---------- 2.29 Lbs**
    - **Max---------- 2.56 Lbs**

## RESULTS Continued

### Mating – Unmating Forces

**Mating-Unmating Basic (QFS-026-04.25-L-D-A/QMS-026-05.75-L-D-A)**

- **Initial**
  - **Mating**
    - **Min ---------- 2.67 Lbs**
    - **Max---------- 3.29 Lbs**
  - **Unmating**
    - **Min ---------- 1.70 Lbs**
    - **Max---------- 2.05 Lbs**
- **After 25 Cycles**
  - **Mating**
    - **Min ---------- 2.87 Lbs**
    - **Max---------- 4.02 Lbs**
  - **Unmating**
    - **Min ---------- 2.40 Lbs**
    - **Max---------- 2.82 Lbs**

**Mating-Unmating Basic (QFS-078-04.25-L-D-A/QMS-078-05.75-L-D-A)**

- **Initial**
  - **Mating**
    - **Min ----------10.09 Lbs**
    - **Max----------11.71 Lbs**
  - **Unmating**
    - **Min ---------- 5.86 Lbs**
    - **Max---------- 6.77 Lbs**
- **After 25 Cycles**
  - **Mating**
    - **Min ----------12.05 Lbs**
    - **Max----------13.34 Lbs**
  - **Unmating**
    - **Min ---------- 8.68 Lbs**
    - **Max---------- 9.77 Lbs**

**Mating-Unmating Basic (QFS-104-04.25-L-D-A/QMS-104-05.75-L-D-A)**

- **Initial**
  - **Mating**
    - **Min ----------10.66 Lbs**
    - **Max----------12.10 Lbs**
  - **Unmating**
    - **Min ---------- 6.08 Lbs**
    - **Max---------- 7.52 Lbs**
- **After 25 Cycles**
  - **Mating**
    - **Min ----------12.59 Lbs**
    - **Max----------14.20 Lbs**
  - **Unmating**
    - **Min ---------- 8.40 Lbs**
    - **Max----------10.48 Lbs**

## RESULTS Continued

### Normal Force at 0.0084 inch deflection (Signal pin)

- **Initial**
  - **Min----------78.50 gf Set ----- 0.0000 in**
  - **Max ----------84.70 gf Set ----- 0.0001 in**
- **Thermal**
  - **Min----------57.70 gf Set----- 0.0006 in**
  - **Max ----------72.50 gf Set----- 0.0021 in**

### Normal Force at 0.0048 inch deflection (Ground pin)

- **Initial**
  - **Min----------69.90 gf Set ----- 0.0000 in**
  - **Max ----------90.50 gf Set ----- 0.0001 in**
- **Thermal**
  - **Min----------66.90 gf Set----- 0.0000 in**
  - **Max ----------97.70 gf Set----- 0.0008 in**

## 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**

**Row to Row**

- **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**

**Pin to Ground**

- **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 ---------- 1000 VAC**
  - **Test Voltage ---------- 750 VAC**
  - **Working Voltage ---------- 250 VAC**

**Pin to Pin**

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

**Row to Row**

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

**Row to Row**

- **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 (192 LLCR test points)

**QFS-052-04.25-L-D-A/QMS-052-05.75-L-D-A**

**Signal pin**

- **Initial ---------- 21.30 mOhms Max**
- **Thermal**
  - **<= +5.0 mOhms ---------- 176 Points ---------- Stable**
  - **+5.1 to +10.0 mOhms ----------0 Points ---------- Minor**
  - **+10.1 to +15.0 mOhms ----------0 Points ---------- Acceptable**
  - **+15.1 to +50.0 mOhms ----------0 Points ---------- Marginal**
  - **+50.1 to +2000 mOhms----------0 Points ---------- Unstable**
  - **>+2000 mOhms----------0 Points ---------- Open Failure**

**Ground pin**

- **Initial ----------1.85 mOhms Max**
- **Thermal**
  - **<= +5.0 mOhms ----------16 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 (192 LLCR test points)

**QFS-052-04.25-L-D-A/QMS-052-05.75-L-D-A**

**Signal pin**

- **Initial ---------- 22.44 mOhms Max**
- **Gas-Tight**
  - **<= +5.0 mOhms ---------- 176 Points ---------- Stable**
  - **+5.1 to +10.0 mOhms ----------0 Points ---------- Minor**
  - **+10.1 to +15.0 mOhms ----------0 Points ---------- Acceptable**
  - **+15.1 to +50.0 mOhms ----------0 Points ---------- Marginal**
  - **+50.1 to +2000 mOhms----------0 Points ---------- Unstable**
  - **>+2000 mOhms----------0 Points ---------- Open Failure**

**Ground pin**

- **Initial ----------2.07 mOhms Max**
- **Gas-Tight**
  - **<= +5.0 mOhms ----------16 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 Mating/Unmating Durability Group (192 LLCR test points)

**QFS-052-04.25-L-D-A/QMS-052-05.75-L-D-A**

**Signal pin**

- **Initial ---------- 24.55 mOhms Max**
- **Durability, 25 Cycles**
  - **<= +5.0 mOhms ---------- 176 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 ---------- 176 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 ---------- 151 Points ---------- Stable**
  - **+5.1 to +10.0 mOhms---------- 25 Points ---------- Minor**
  - **+10.1 to +15.0 mOhms ----------0 Points ---------- Acceptable**
  - **+15.1 to +50.0 mOhms ----------0 Points ---------- Marginal**
  - **+50.1 to +2000 mOhms----------0 Points ---------- Unstable**
  - **>+2000 mOhms----------0 Points ---------- Open Failure**

**Ground pin**

- **Initial ----------1.99 mOhms Max**
- **Durability, 25 Cycles**
  - **<= +5.0 mOhms ----------16 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 ----------16 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 ----------16 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 (192 LLCR test points)

**QFS-052-04.25-L-D-A/QMS-052-05.75-L-D-A**

**Signal pin**

- **Initial ---------- 21.89 mOhms Max**
- **Shock &Vibration**
  - **<= +5.0 mOhms ---------- 176 Points ---------- Stable**
  - **+5.1 to +10.0 mOhms ----------0 Points ---------- Minor**
  - **+10.1 to +15.0 mOhms ----------0 Points ---------- Acceptable**
  - **+15.1 to +50.0 mOhms ----------0 Points ---------- Marginal**
  - **+50.1 to +2000 mOhms----------0 Points ---------- Unstable**
  - **>+2000 mOhms----------0 Points ---------- Open Failure**

**Ground pin**

- **Initial ----------1.71 mOhms Max**
- **Shock &Vibration**
  - **<= +5.0 mOhms ----------16 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**

## RESULTS Continued

### LLCR Mating/Unmating Durability (192 LLCR test points)
### 100 cycles Group (QFS-052-06.25-S-D-A/QMS-052-09.75-S-D-A)

**Signal pin**

- **Initial ---------- 26.51 mOhms Max**
- **Durability, 100 Cycles**
  - **<= +5.0 mOhms ---------- 176 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 ---------- 176 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 ---------- 172 Points ---------- Stable**
  - **+5.1 to +10.0 mOhms ----------4 Points ---------- Minor**
  - **+10.1 to +15.0 mOhms ----------0 Points ---------- Acceptable**
  - **+15.1 to +50.0 mOhms ----------0 Points ---------- Marginal**
  - **+50.1 to +2000 mOhms----------0 Points ---------- Unstable**
  - **>+2000 mOhms----------0 Points ---------- Open Failure**

**Ground pin**

- **Initial ----------1.80 mOhms Max**
- **Durability, 100 Cycles**
  - **<= +5.0 mOhms ----------16 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 ----------16 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 ----------16 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 Mating/Unmating Durability (192 LLCR test points)
### 250 cycles Group (QFS-052-06.25-S-D-A/QMS-052-09.75-S-D-A)

**Signal pin**

- **Initial ---------- 26.32 mOhms Max**
- **Durability, 250 Cycles**
  - **<= +5.0 mOhms ---------- 176 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 ---------- 176 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 ---------- 176 Points ---------- Stable**
  - **+5.1 to +10.0 mOhms ----------0 Points ---------- Minor**
  - **+10.1 to +15.0 mOhms ----------0 Points ---------- Acceptable**
  - **+15.1 to +50.0 mOhms ----------0 Points ---------- Marginal**
  - **+50.1 to +2000 mOhms----------0 Points ---------- Unstable**
  - **>+2000 mOhms----------0 Points ---------- Open Failure**

**Ground pin**

- **Initial ----------1.77 mOhms Max**
- **Durability, 250 Cycles**
  - **<= +5.0 mOhms ----------16 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 ----------16 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 ----------16 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 Mating/Unmating Durability (192 LLCR test points)
### 500 cycles Group (QFS-052-06.25-S-D-A/QMS-052-09.75-S-D-A)

**Signal pin**

- **Initial ---------- 26.28 mOhms Max**
- **Durability, 500 Cycles**
  - **<= +5.0 mOhms ---------- 176 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 ---------- 173 Points ---------- Stable**
  - **+5.1 to +10.0 mOhms ----------3 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 ---------- 173 Points ---------- Stable**
  - **+5.1 to +10.0 mOhms ----------3 Points ---------- Minor**
  - **+10.1 to +15.0 mOhms ----------0 Points ---------- Acceptable**
  - **+15.1 to +50.0 mOhms ----------0 Points ---------- Marginal**
  - **+50.1 to +2000 mOhms----------0 Points ---------- Unstable**
  - **>+2000 mOhms----------0 Points ---------- Open Failure**

**Ground pin**

- **Initial ----------1.75 mOhms Max**
- **Durability, 500 Cycles**
  - **<= +5.0 mOhms ----------16 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 ----------16 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 ----------16 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**

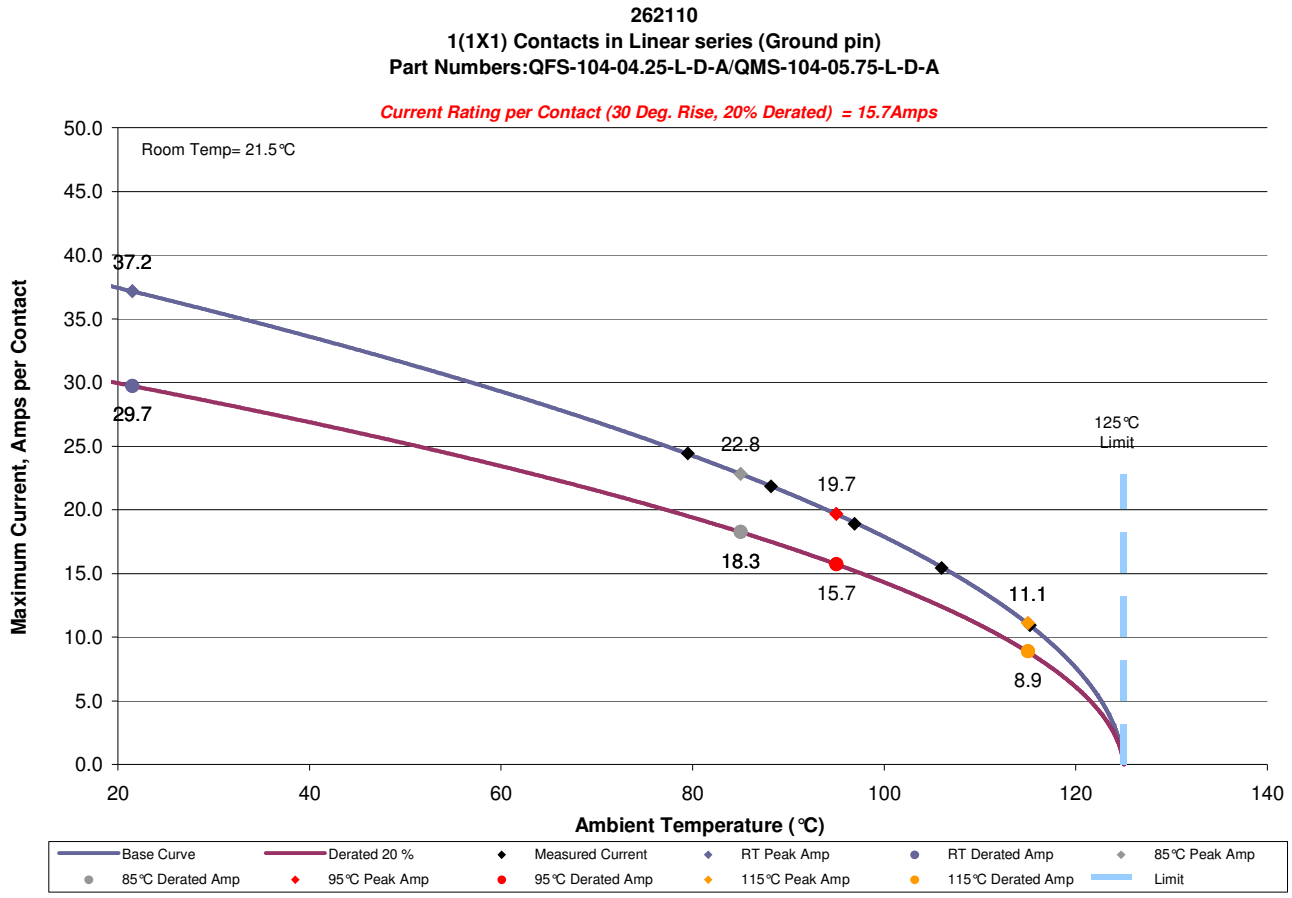
# DATA SUMMARIES

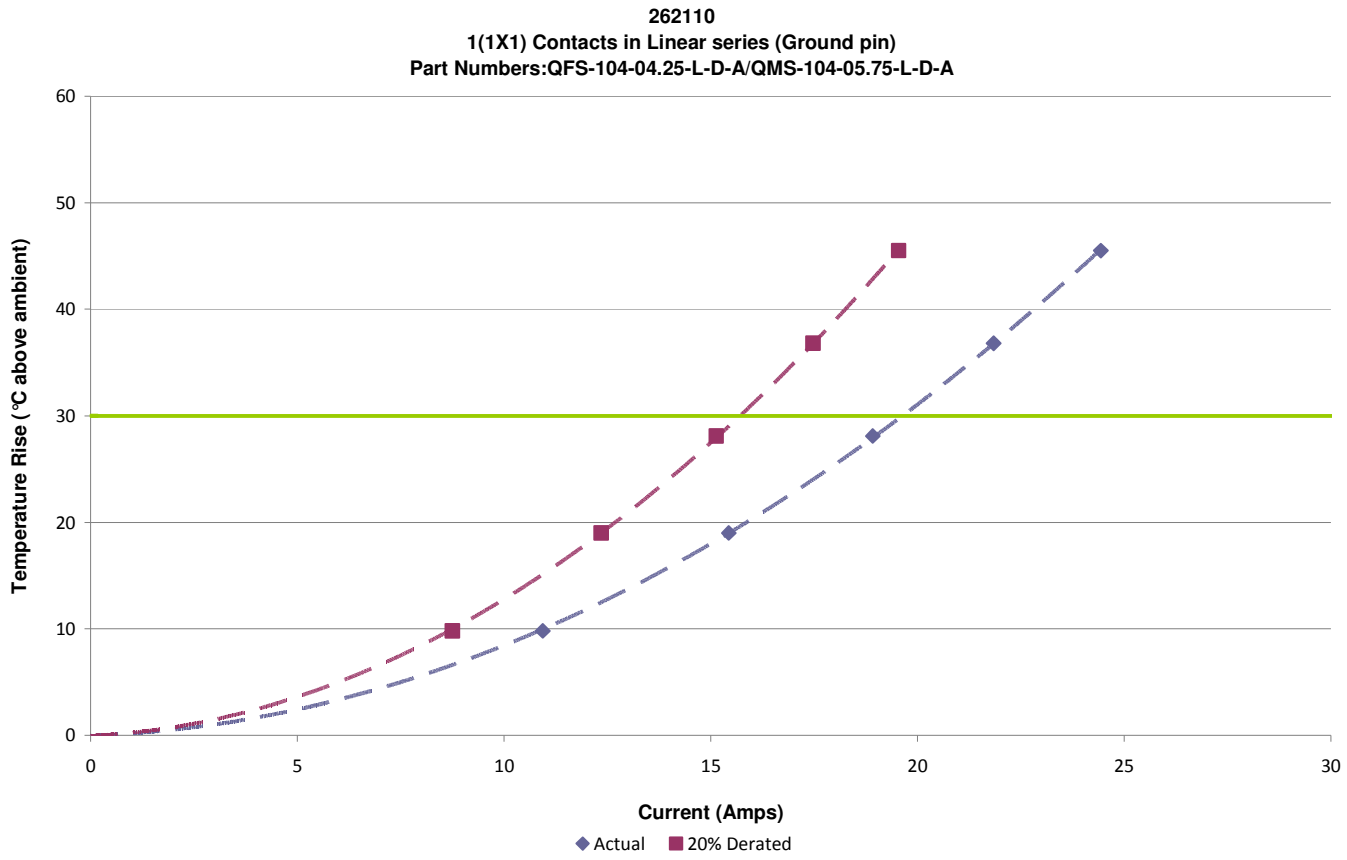
## TEMPERATURE RISE (Current Carrying Capacity, CCC):

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:

**Ground pin**

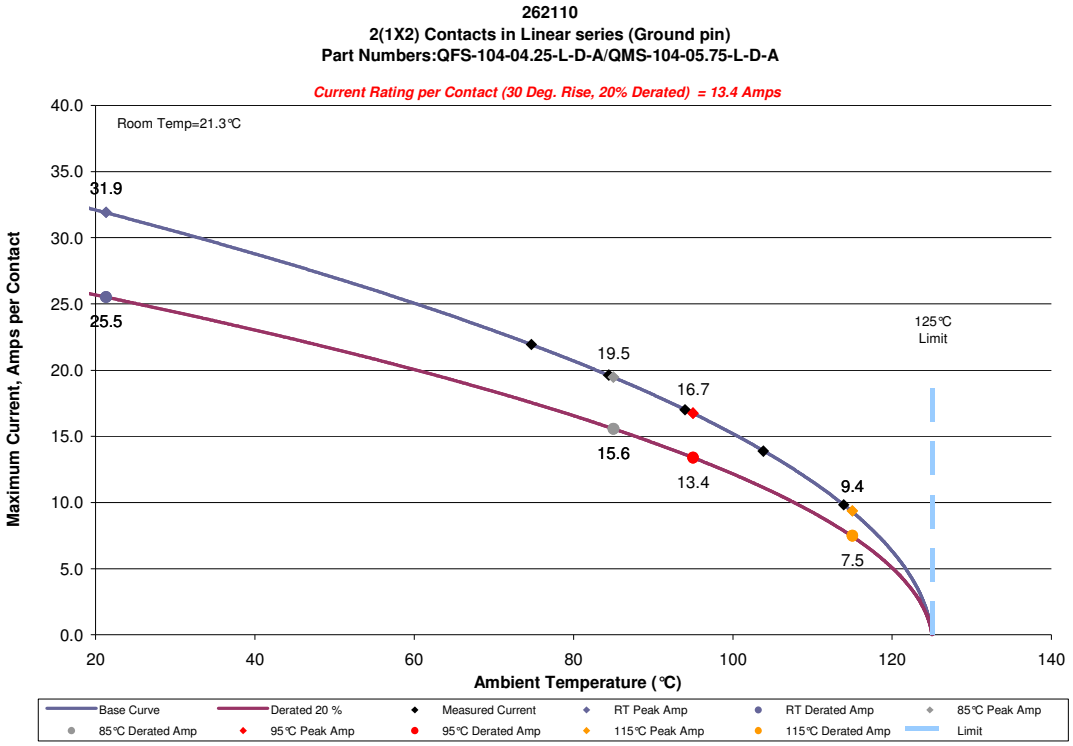
a. Linear configuration with 1 ground adjacent conductors/contacts powered

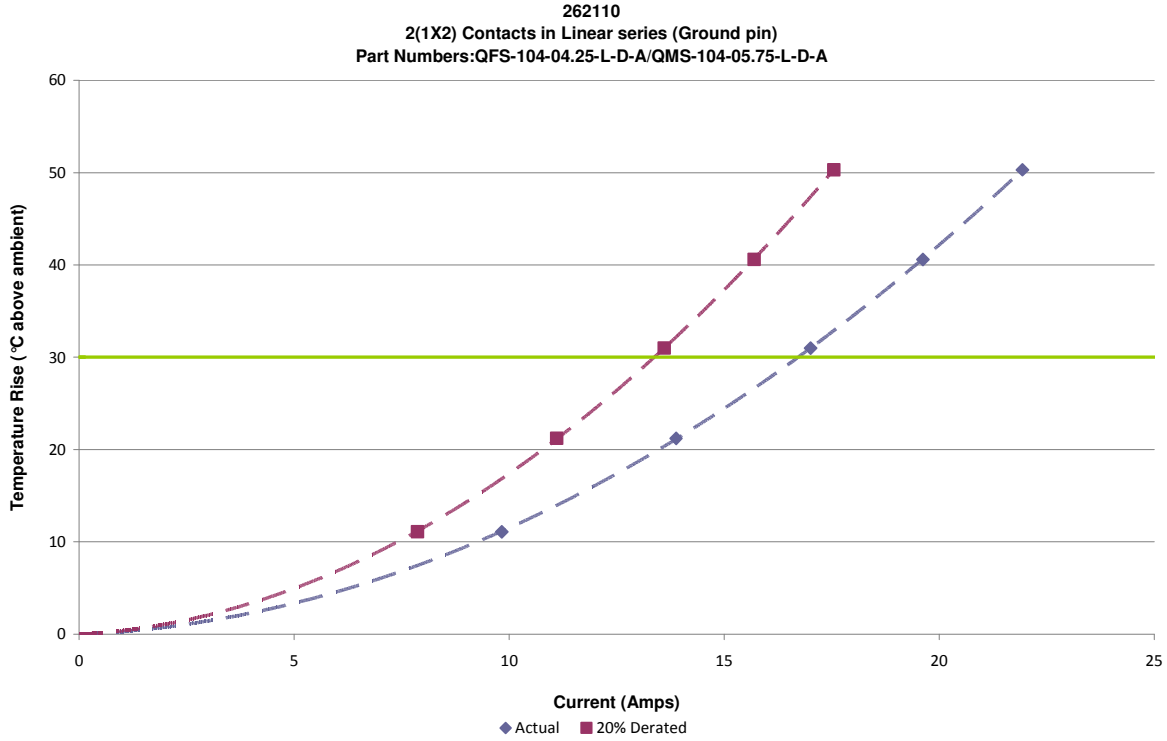



262110
1(1X1) Contacts in Linear series (Ground pin)
Part Numbers:QFS-104-04.25-L-D-A/QMS-104-05.75-L-D-A
Temperature Rise (°C above ambient)
60
50
40
30
20
10
0
0
5
10
15
20
25
30
Current (Amps)
Actual
20% Derated

# DATA SUMMARIES Continued

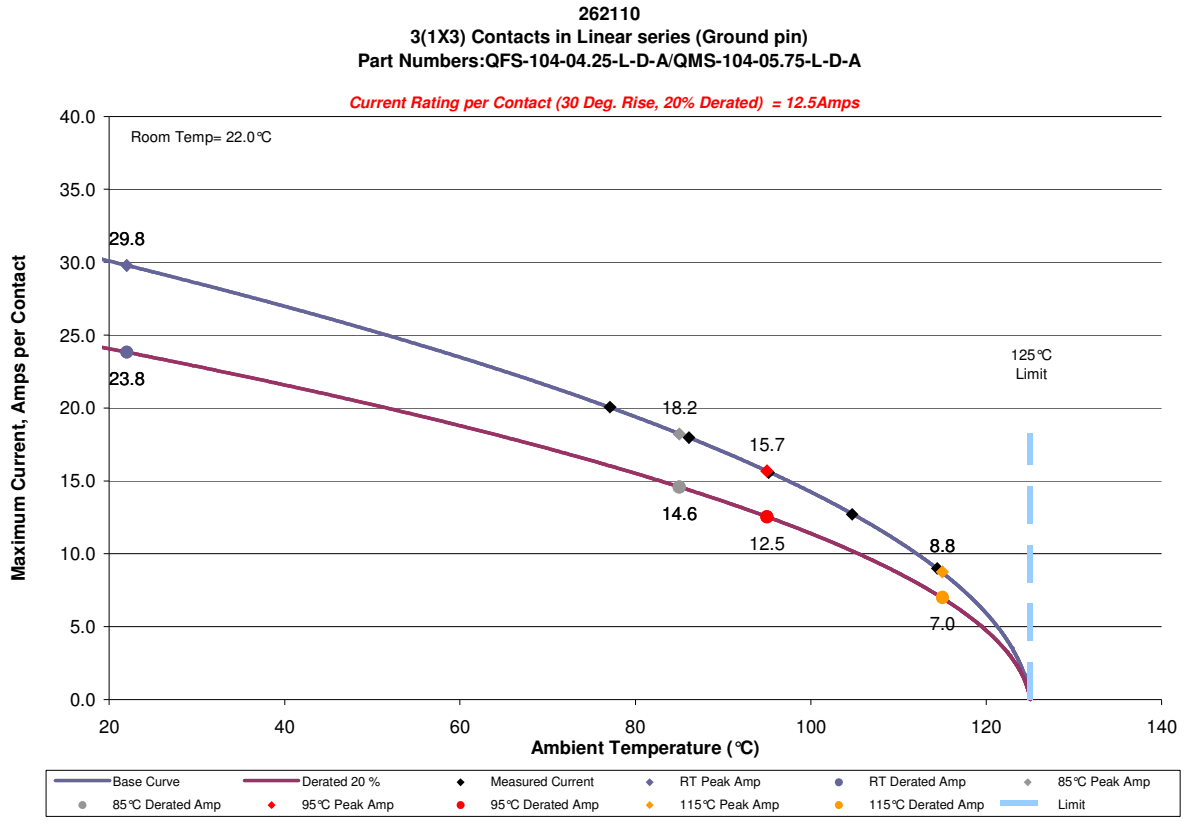
b. Linear configuration with 2 ground adjacent conductors/contacts powered

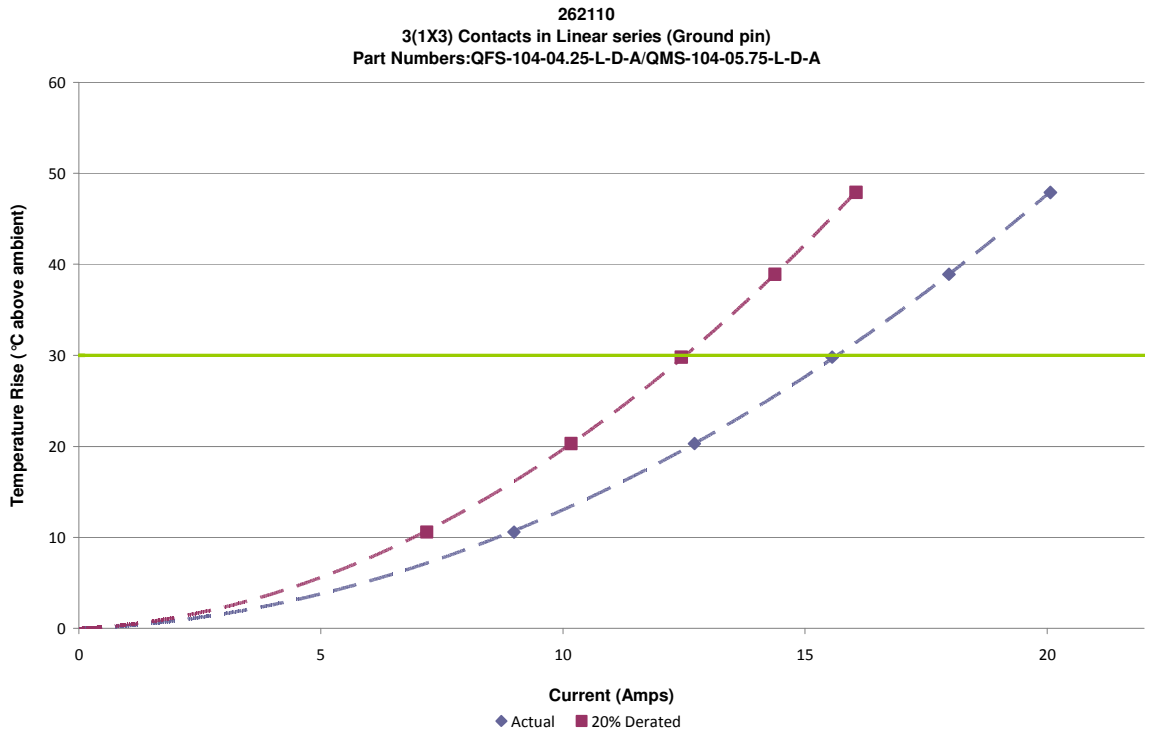


# DATA SUMMARIES Continued

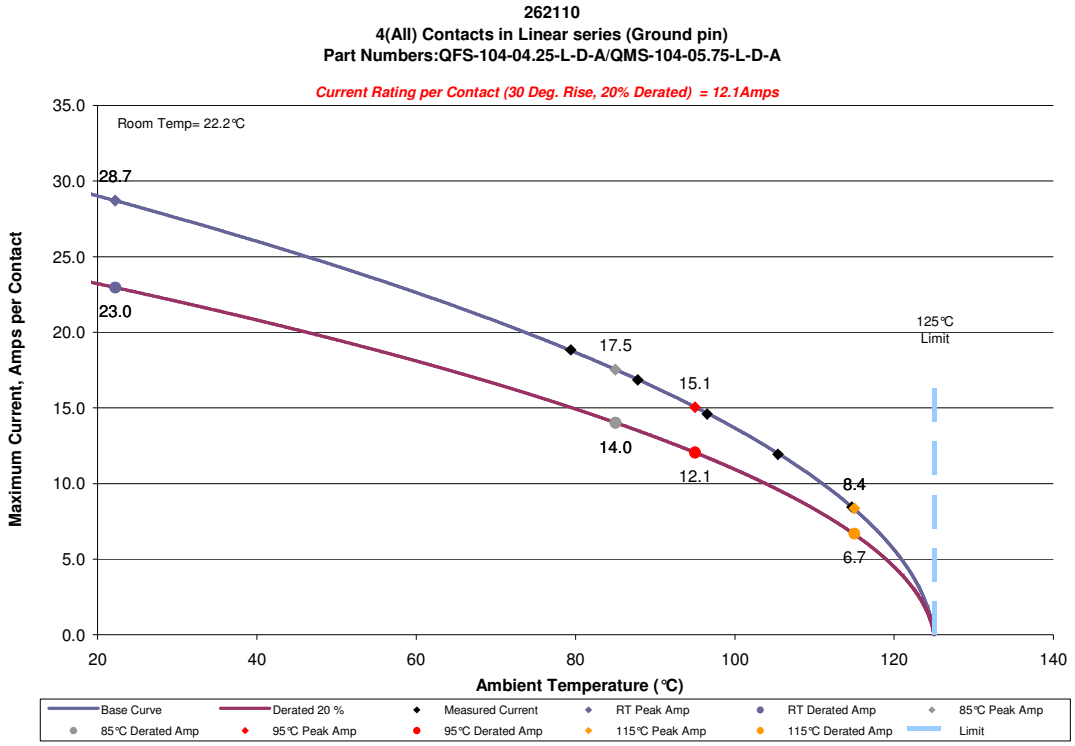
c. Linear configuration with 3 ground adjacent conductors/contacts powered

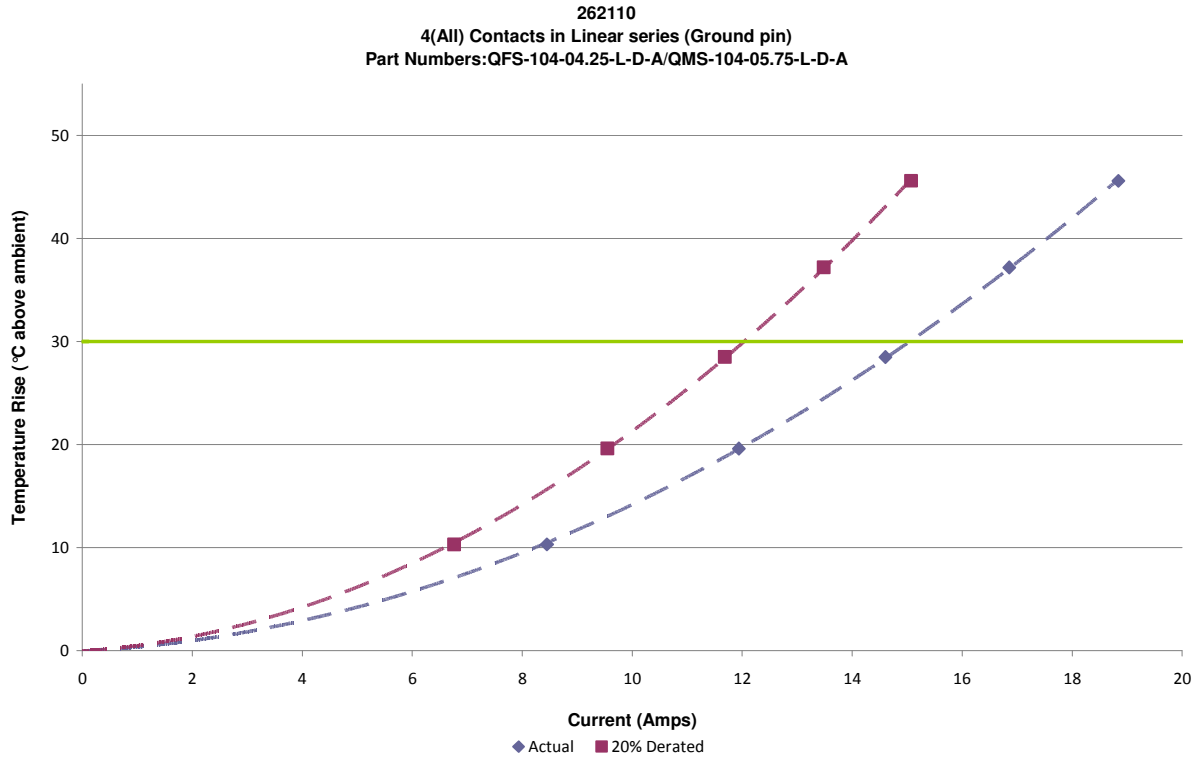


# DATA SUMMARIES Continued

d. Linear configuration with all ground adjacent conductors/contacts powered

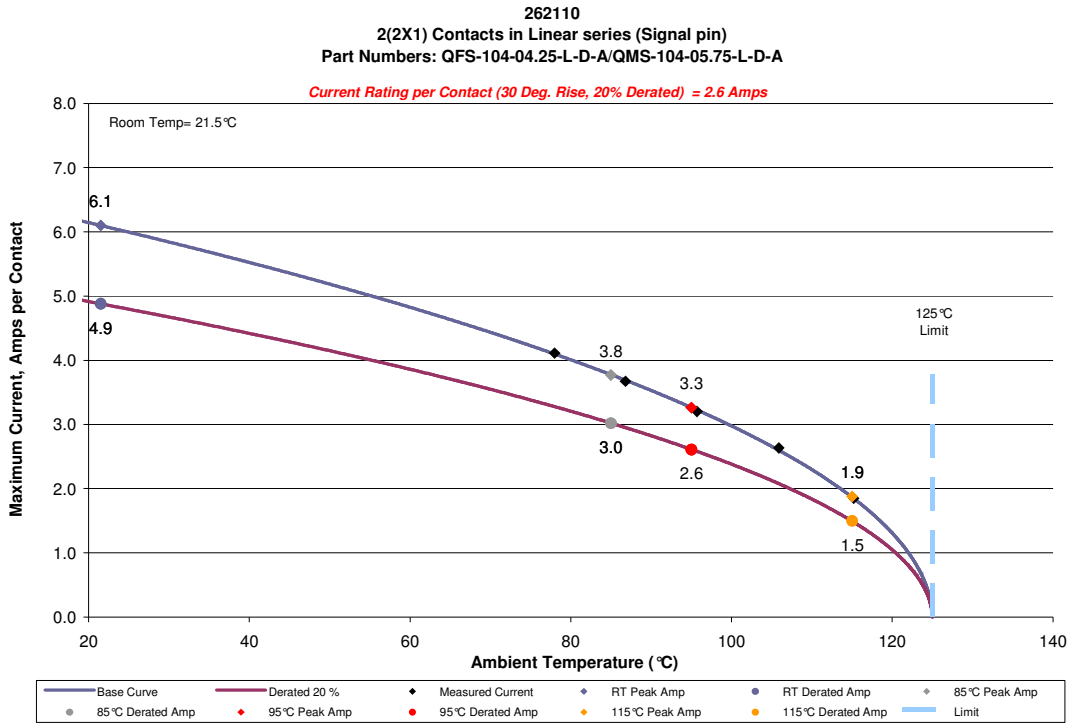


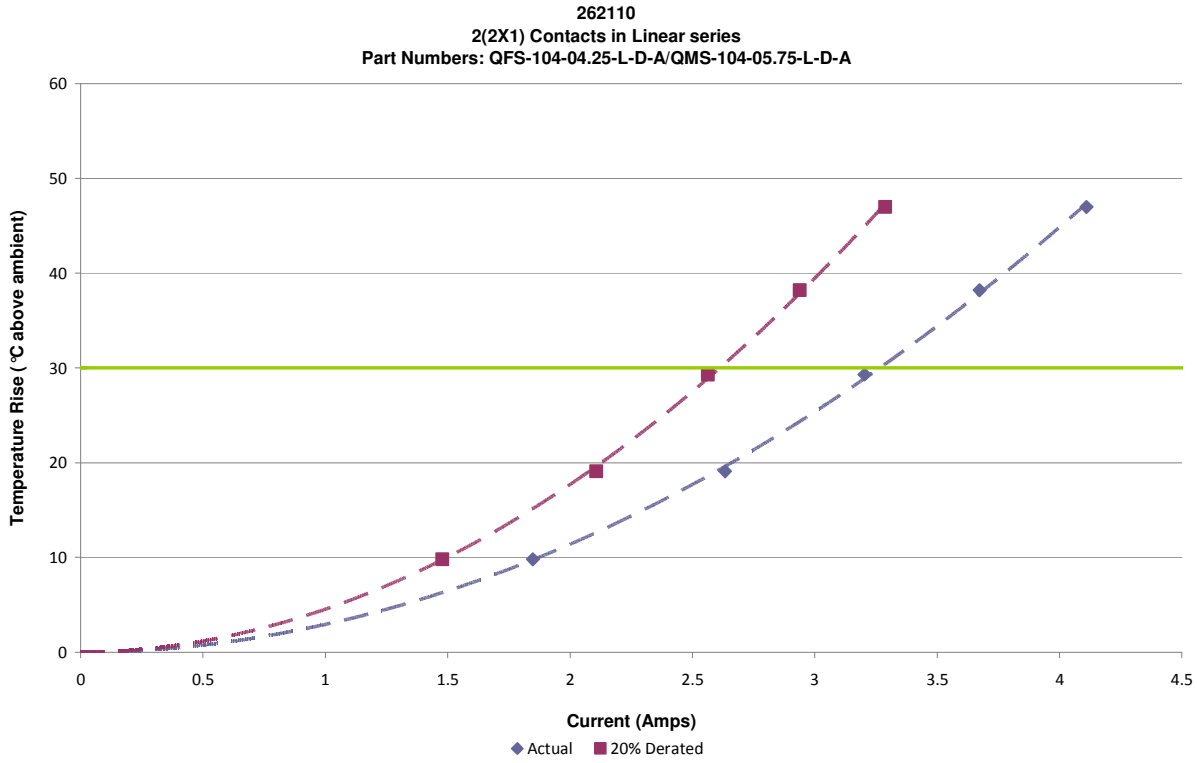



# DATA SUMMARIES Continued

## Signal pin

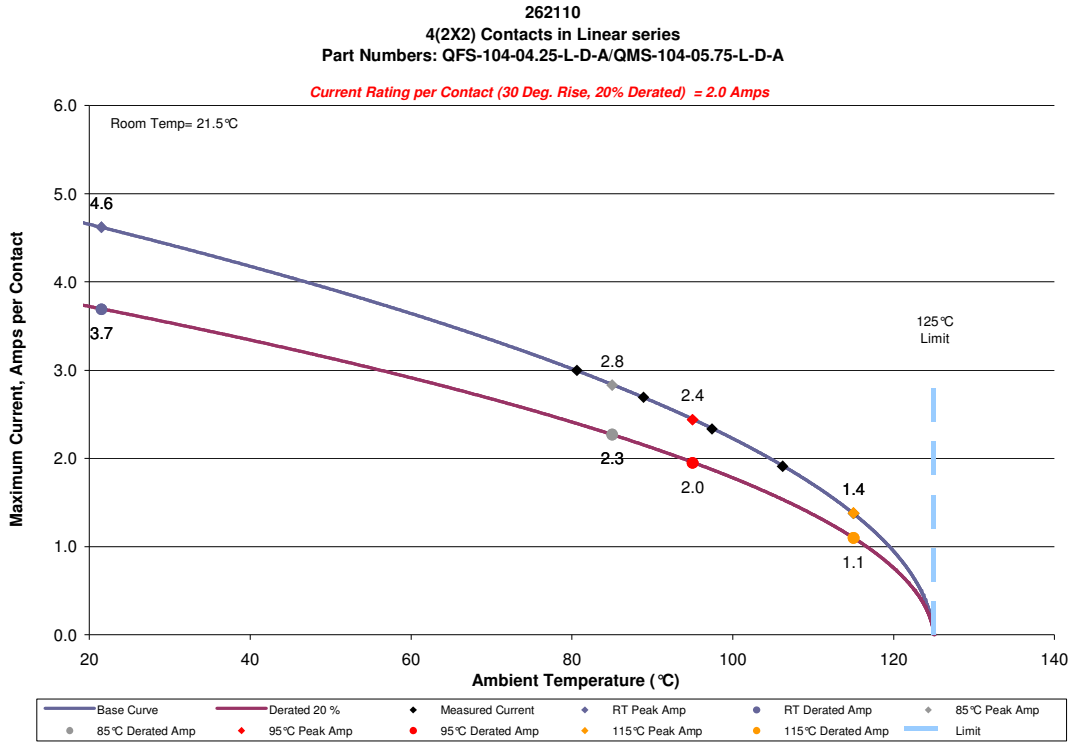
e. Linear configuration with 2 signal adjacent conductors/contacts powered

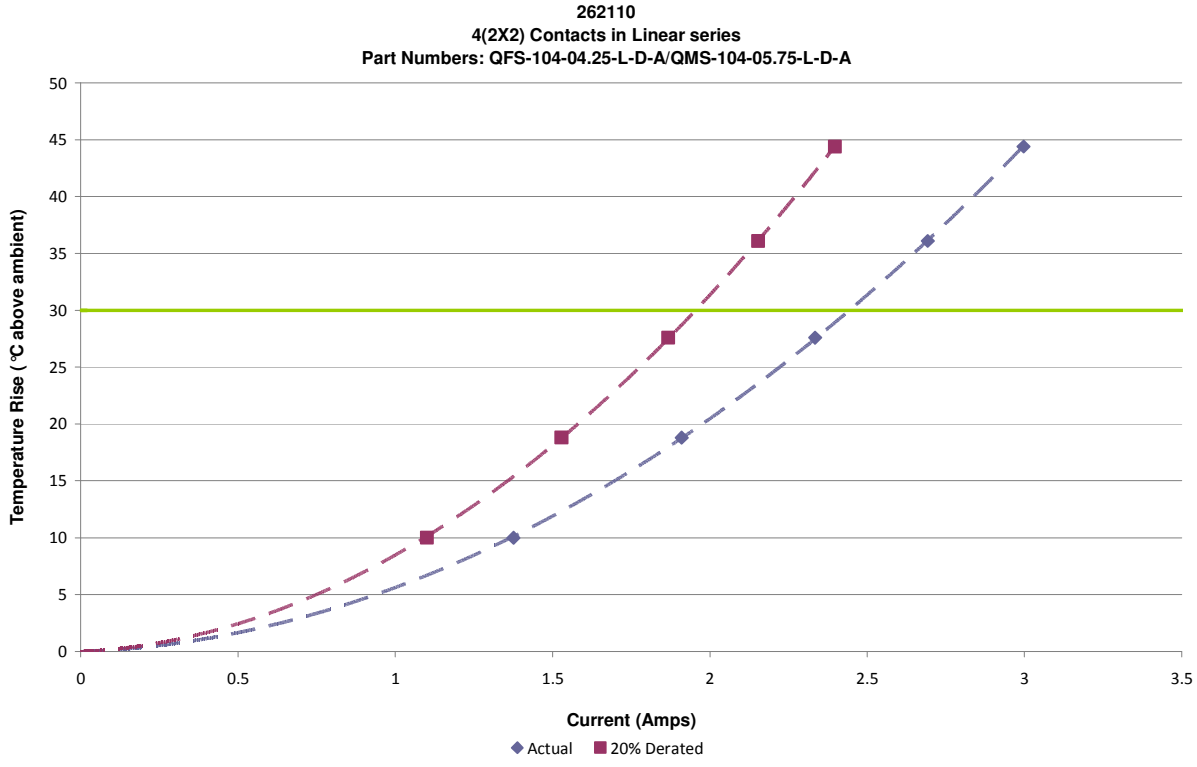


# DATA SUMMARIES Continued

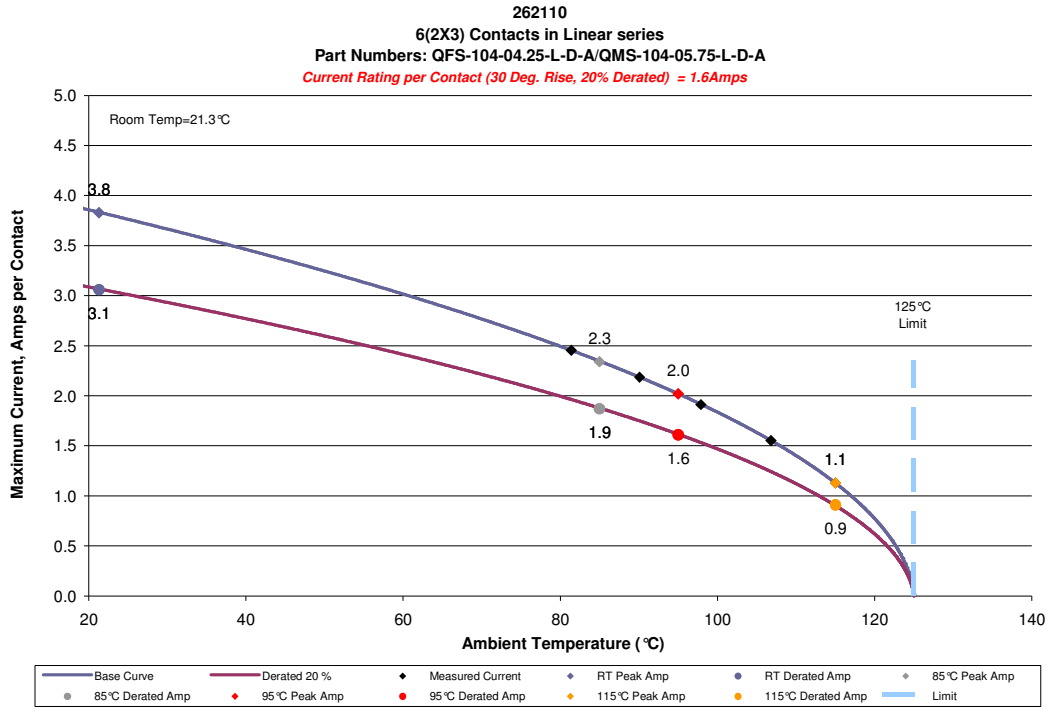
f. Linear configuration with 4 signal adjacent conductors/contacts powered

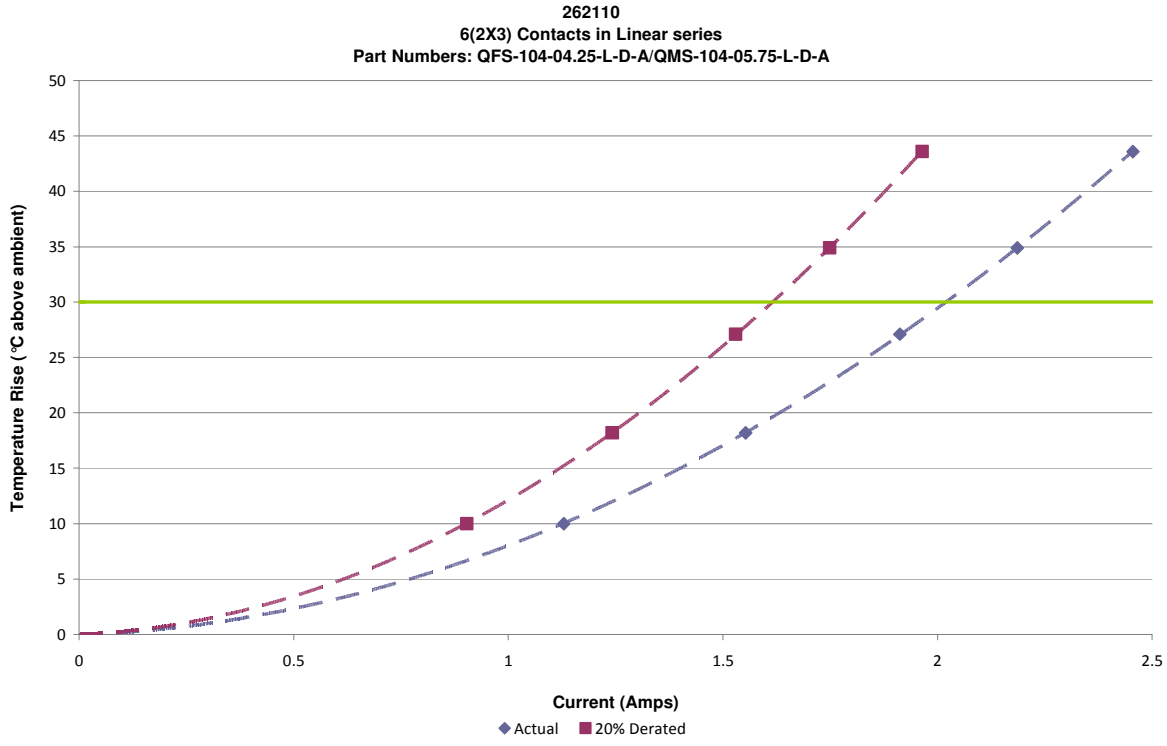


# DATA SUMMARIES Continued

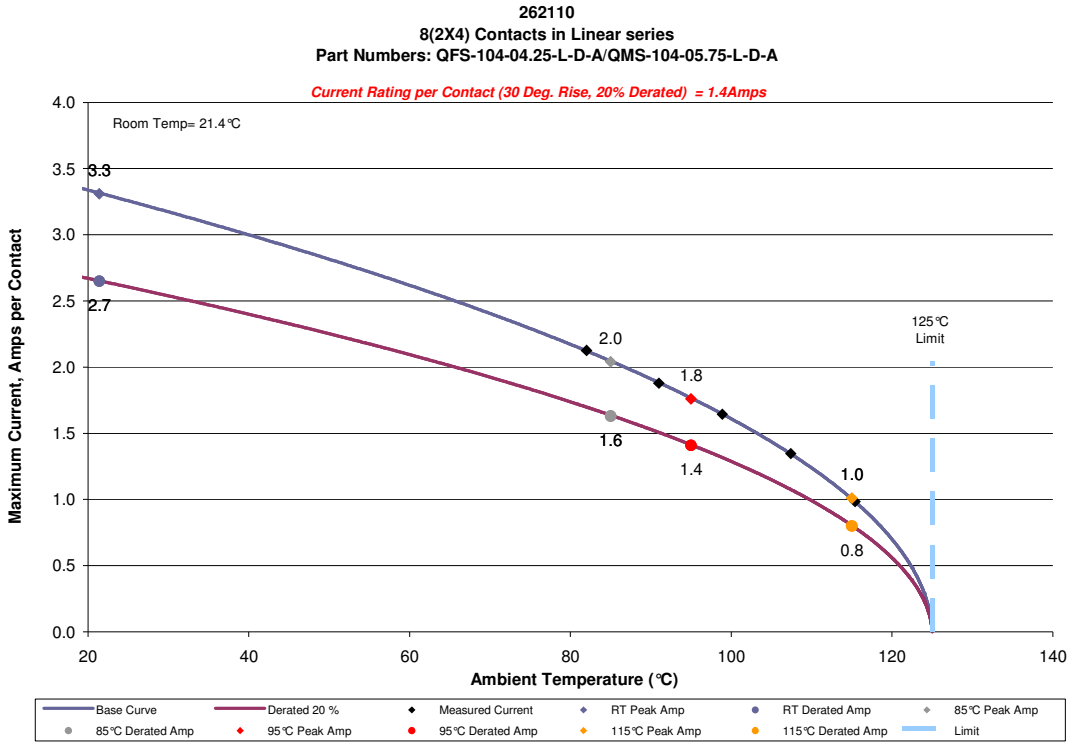
g. Linear configuration with 6 signal adjacent conductors/contacts powered

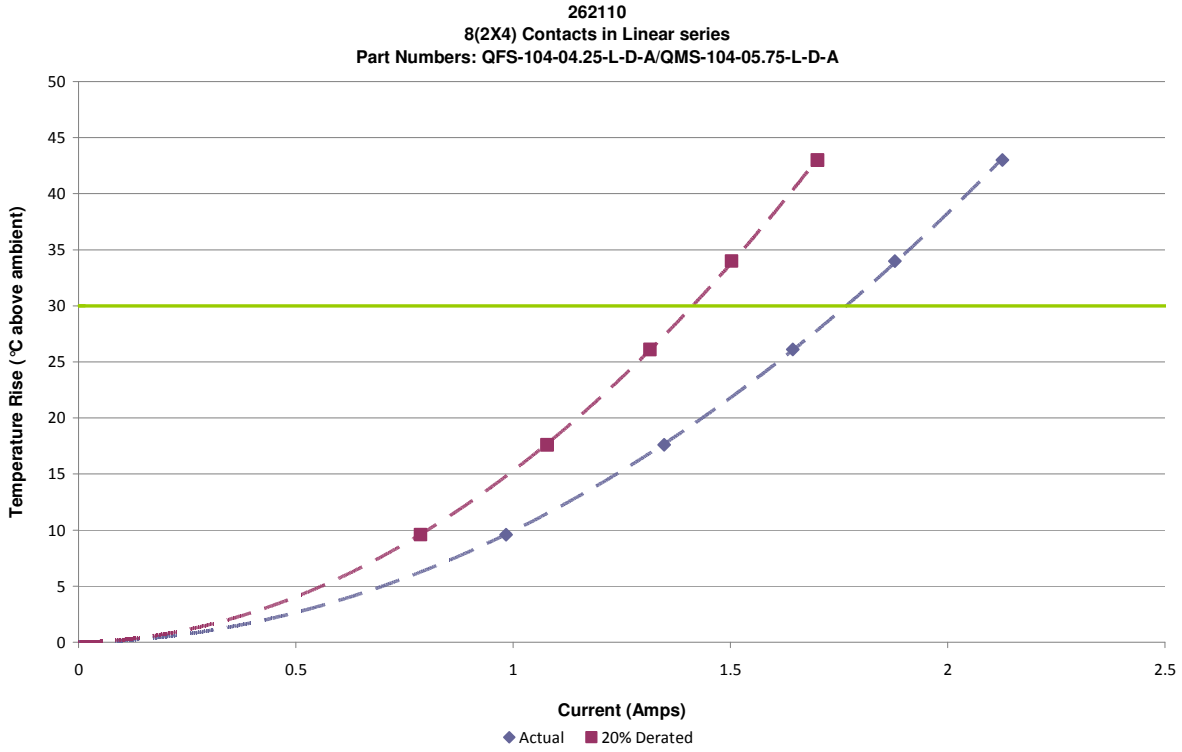


# DATA SUMMARIES Continued

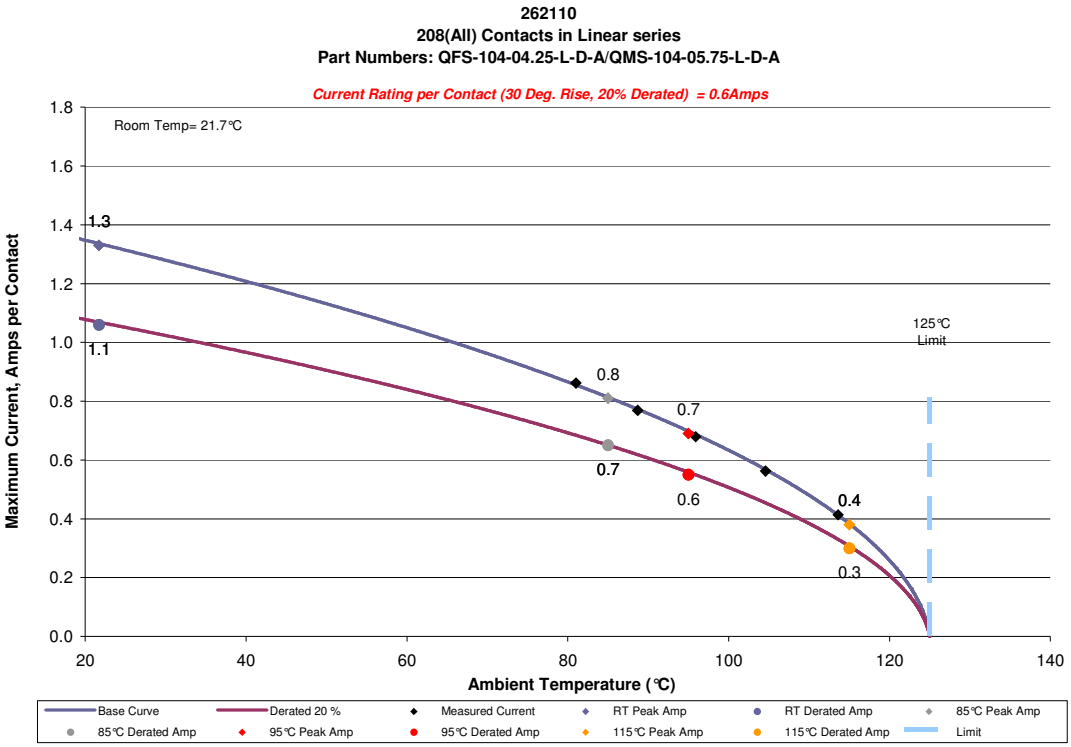
h. Linear configuration with 8 signal adjacent conductors/contacts powered

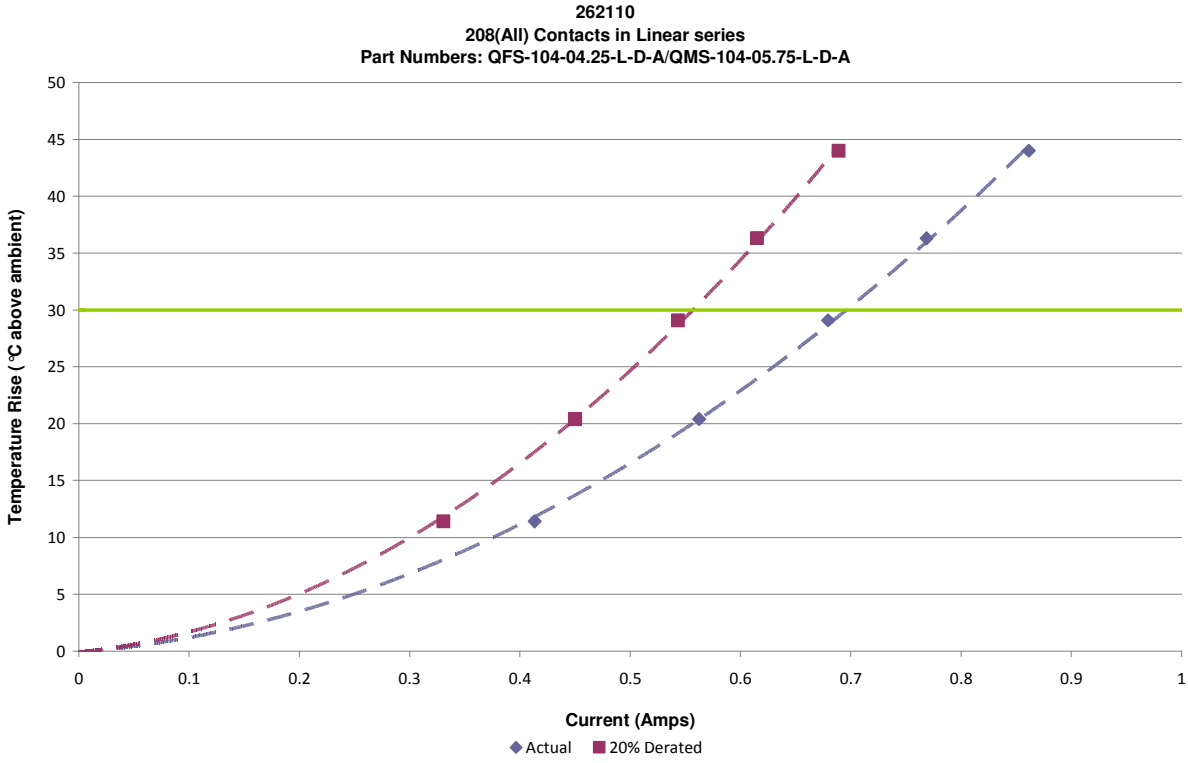


## DATA SUMMARIES Continued

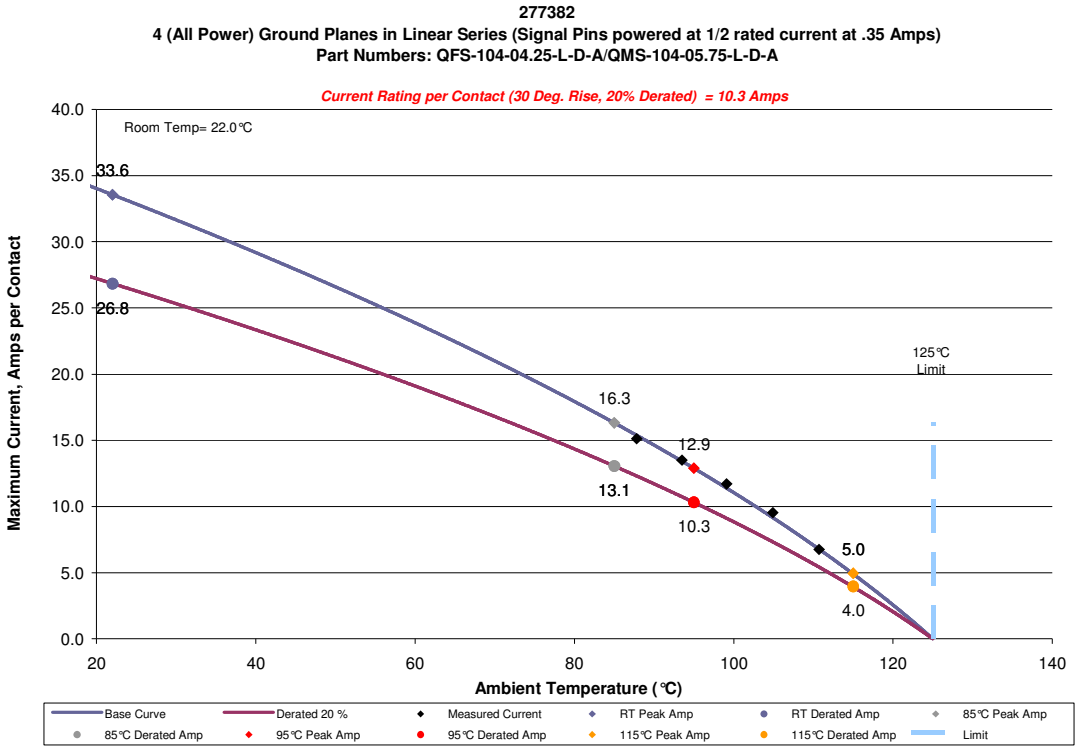
i. Linear configuration with all signal adjacent conductors/contacts powered

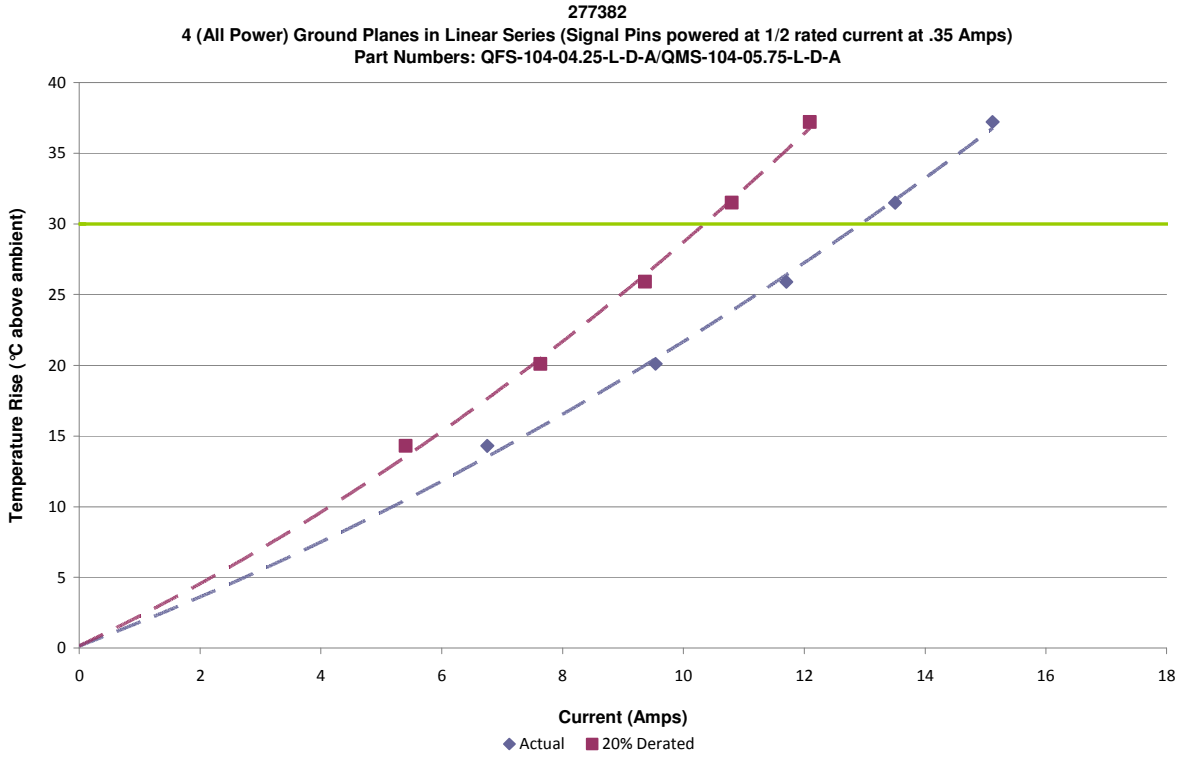


## DATA SUMMARIES Continued

j. Linear configuration with all adjacent signal conductors and ground conductors/contacts powered



## DATA SUMMARIES Continued

## MATING-UNMATING FORCE:

**Thermal Aging Group**

| | Initial | | | | After Thermals | | | |
|---|---|---|---|---|---|---|---|---|
| | **Mating** | | **Unmating** | | **Mating** | | **Unmating** | |
| | Newtons | Force (Lbs) | Newtons | Force (Lbs) | Newtons | Force (Lbs) | Newtons | Force (Lbs) |
| Minimum | 22.11 | 4.97 | 12.59 | 2.83 | 15.08 | 3.39 | 10.59 | 2.38 |
| Maximum | 26.07 | 5.86 | 14.81 | 3.33 | 16.10 | 3.62 | 12.72 | 2.86 |
| **Average** | 24.24 | **5.45** | 13.59 | **3.06** | 15.78 | **3.55** | 11.66 | **2.62** |
| St Dev | 1.26 | 0.28 | 0.82 | 0.18 | 0.36 | 0.08 | 0.68 | 0.15 |
| Count | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |

**Mating-Unmating Durability Group**

| | Initial | | | | After 25 Cycles | | | |
|---|---|---|---|---|---|---|---|---|
| | **Mating** | | **Unmating** | | **Mating** | | **Unmating** | |
| | Newtons | Force (Lbs) | Newtons | Force (Lbs) | Newtons | Force (Lbs) | Newtons | Force (Lbs) |
| Minimum | 21.44 | 4.82 | 11.83 | 2.66 | 25.04 | 5.63 | 19.88 | 4.47 |
| Maximum | 23.57 | 5.30 | 13.83 | 3.11 | 28.29 | 6.36 | 23.40 | 5.26 |
| **Average** | 22.57 | **5.07** | 12.97 | **2.92** | 27.07 | **6.09** | 21.21 | **4.77** |
| St Dev | 0.63 | 0.14 | 0.61 | 0.14 | 0.98 | 0.22 | 1.33 | 0.30 |
| Count | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |

| | After Humidity | | | |
|---|---|---|---|---|
| | **Mating** | | **Unmating** | |
| | Newtons | Force (Lbs) | Newtons | Force (Lbs) |
| Minimum | 14.46 | 3.25 | 10.19 | 2.29 |
| Maximum | 16.77 | 3.77 | 11.39 | 2.56 |
| **Average** | 15.53 | **3.49** | 10.86 | **2.44** |
| St Dev | 0.71 | 0.16 | 0.49 | 0.11 |
| Count | 8 | 8 | 8 | 8 |

## DATA SUMMARIES Continued

## MATING-UNMATING FORCE:

**Mating-Unmating Basic (QFS-026-04.25-L-D-A/QMS-026-05.75-L-D-A)**

| | Initial | | | | After 25 Cycles | | | |
|---|---|---|---|---|---|---|---|---|
| | **Mating** | | **Unmating** | | **Mating** | | **Unmating** | |
| | Newtons | Force (Lbs) | Newtons | Force (Lbs) | Newtons | Force (Lbs) | Newtons | Force (Lbs) |
| Minimum | 11.88 | 2.67 | 7.56 | 1.70 | 12.77 | 2.87 | 10.68 | 2.40 |
| Maximum | 14.63 | 3.29 | 9.12 | 2.05 | 17.88 | 4.02 | 12.54 | 2.82 |
| **Average** | 12.79 | **2.88** | 8.51 | **1.91** | 14.56 | **3.27** | 11.76 | **2.64** |
| St Dev | 0.89 | 0.20 | 0.49 | 0.11 | 1.52 | 0.34 | 0.64 | 0.14 |
| Count | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |

**Mating-Unmating Basic (QFS-078-04.25-L-D-A/QMS-078-05.75-L-D-A)**

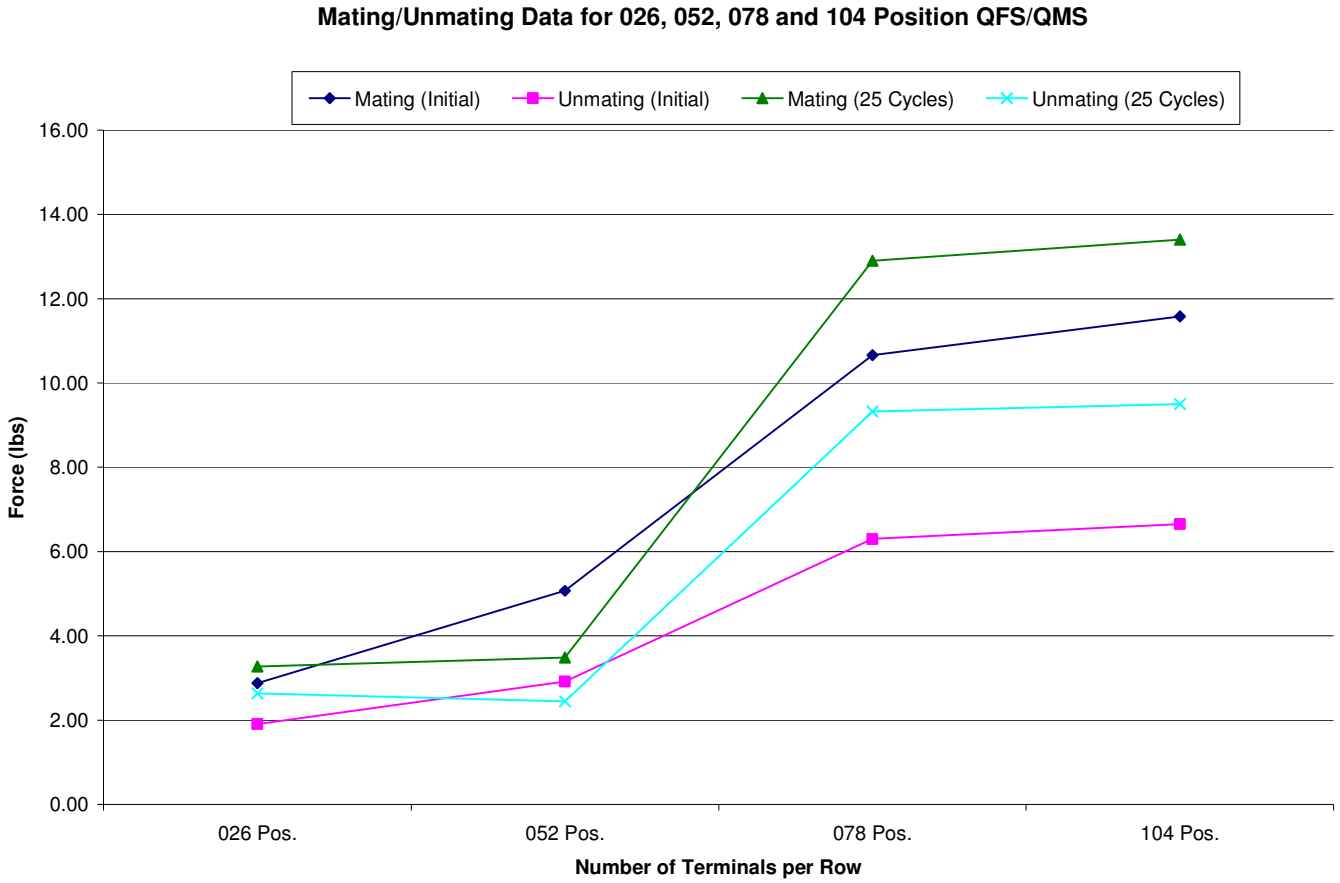
| | Initial | | | | After 25 Cycles | | | |
|---|---|---|---|---|---|---|---|---|
| | **Mating** | | **Unmating** | | **Mating** | | **Unmating** | |
| | Newtons | Force (Lbs) | Newtons | Force (Lbs) | Newtons | Force (Lbs) | Newtons | Force (Lbs) |
| Minimum | 44.88 | 10.09 | 26.07 | 5.86 | 53.60 | 12.05 | 38.61 | 8.68 |
| Maximum | 52.09 | 11.71 | 30.11 | 6.77 | 59.34 | 13.34 | 43.46 | 9.77 |
| **Average** | 47.42 | **10.66** | 28.03 | **6.30** | 57.39 | **12.90** | 41.46 | **9.32** |
| St Dev | 2.74 | 0.62 | 1.70 | 0.38 | 1.96 | 0.44 | 1.91 | 0.43 |
| Count | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |

**Mating-Unmating Basic (QFS-104-04.25-L-D-A/QMS-104-05.75-L-D-A)**

| | Initial | | | | After 25 Cycles | | | |
|---|---|---|---|---|---|---|---|---|
| | **Mating** | | **Unmating** | | **Mating** | | **Unmating** | |
| | Newtons | Force (Lbs) | Newtons | Force (Lbs) | Newtons | Force (Lbs) | Newtons | Force (Lbs) |
| Minimum | 47.42 | 10.66 | 27.04 | 6.08 | 56.00 | 12.59 | 37.36 | 8.40 |
| Maximum | 53.82 | 12.10 | 33.45 | 7.52 | 63.16 | 14.20 | 46.62 | 10.48 |
| **Average** | 51.49 | **11.58** | 29.57 | **6.65** | 59.61 | **13.40** | 42.25 | **9.50** |
| St Dev | 2.18 | 0.49 | 2.18 | 0.49 | 2.82 | 0.63 | 3.00 | 0.67 |
| Count | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |

## DATA SUMMARIES Continued

### Mating\Unmating Force Comparison



## DATA SUMMARIES Continued

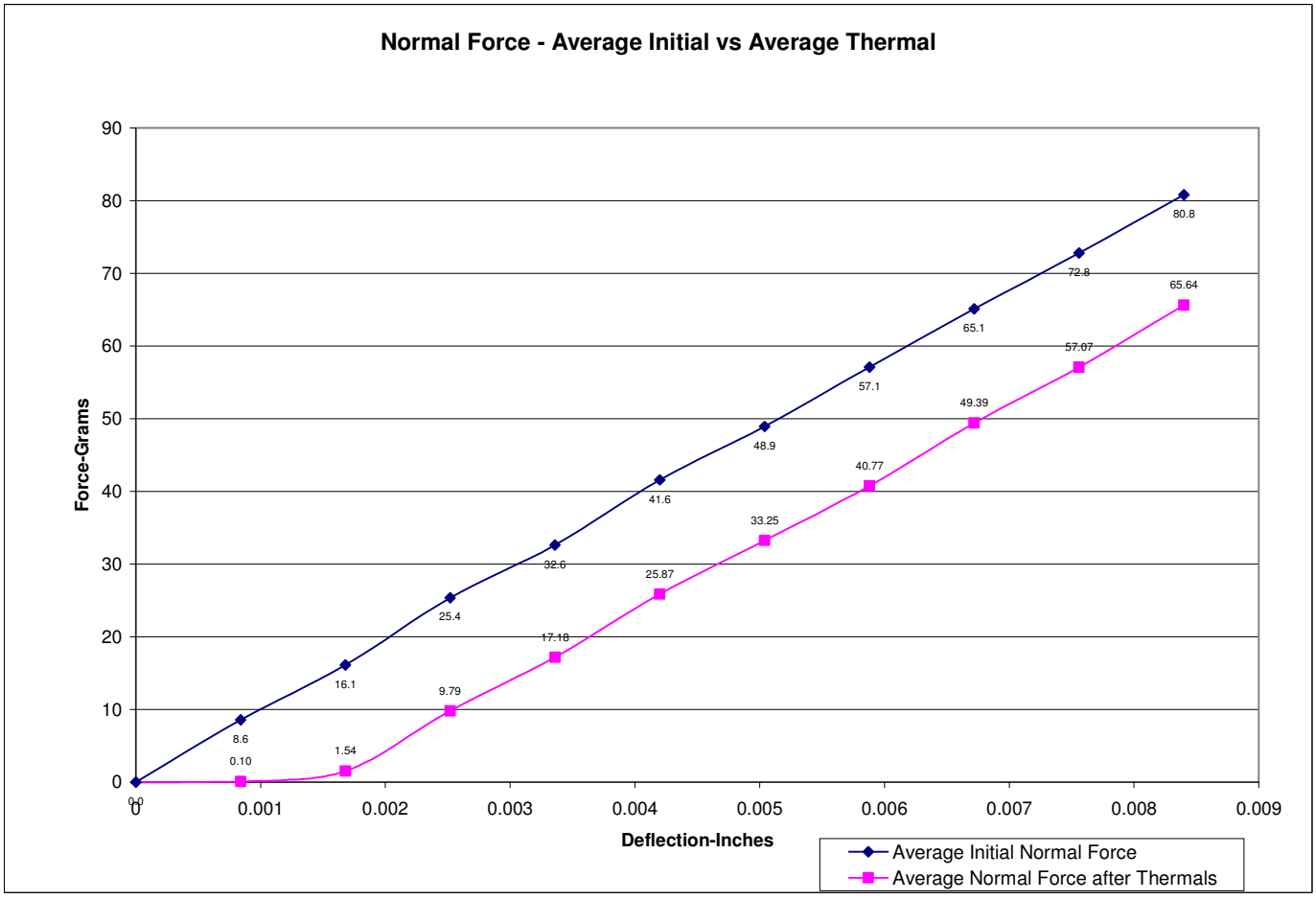
**NORMAL FORCE (FOR CONTACTS TESTED IN THE HOUSING):**

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.

**Signal pin**

| Initial | Deflections in inches Forces in Grams | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | **0.0008** | **0.0017** | **0.0025** | **0.0034** | **0.0042** | **0.0050** | **0.0059** | **0.0067** | **0.0076** | **0.0084** | ***SET*** |
| **Averages** | 8.55 | 16.13 | 25.36 | 32.62 | 41.59 | 48.94 | 57.09 | 65.08 | 72.80 | 80.82 | 0.0000 |
| **Min** | 5.90 | 14.10 | 23.60 | 31.20 | 40.00 | 47.20 | 55.60 | 63.30 | 70.80 | 78.50 | 0.0000 |
| **Max** | 9.60 | 17.20 | 27.00 | 34.30 | 43.80 | 51.10 | 59.20 | 67.50 | 75.60 | 84.70 | 0.0001 |
| **St. Dev** | 1.204 | 0.974 | 1.144 | 1.069 | 1.379 | 1.568 | 1.407 | 1.580 | 1.761 | 2.070 | 0.0000 |
| **Count** | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 |

| After Thermals | Deflections in inches Forces in Grams | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | **0.0008** | **0.0017** | **0.0025** | **0.0034** | **0.0042** | **0.0050** | **0.0059** | **0.0067** | **0.0076** | **0.0084** | ***SET*** |
| **Averages** | 0.10 | 1.54 | 9.79 | 17.18 | 25.87 | 33.25 | 40.77 | 49.39 | 57.07 | 65.64 | 0.0015 |
| **Min** | -0.20 | -0.20 | 5.10 | 11.40 | 19.60 | 26.80 | 34.00 | 42.50 | 49.60 | 57.70 | 0.0006 |
| **Max** | 0.60 | 8.20 | 17.10 | 24.30 | 32.20 | 40.30 | 47.30 | 56.20 | 63.80 | 72.50 | 0.0021 |
| **St. Dev** | 0.266 | 2.530 | 3.267 | 3.697 | 3.410 | 3.661 | 3.588 | 3.993 | 3.937 | 4.215 | 0.0004 |
| **Count** | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 |



## DATA SUMMARIES Continued

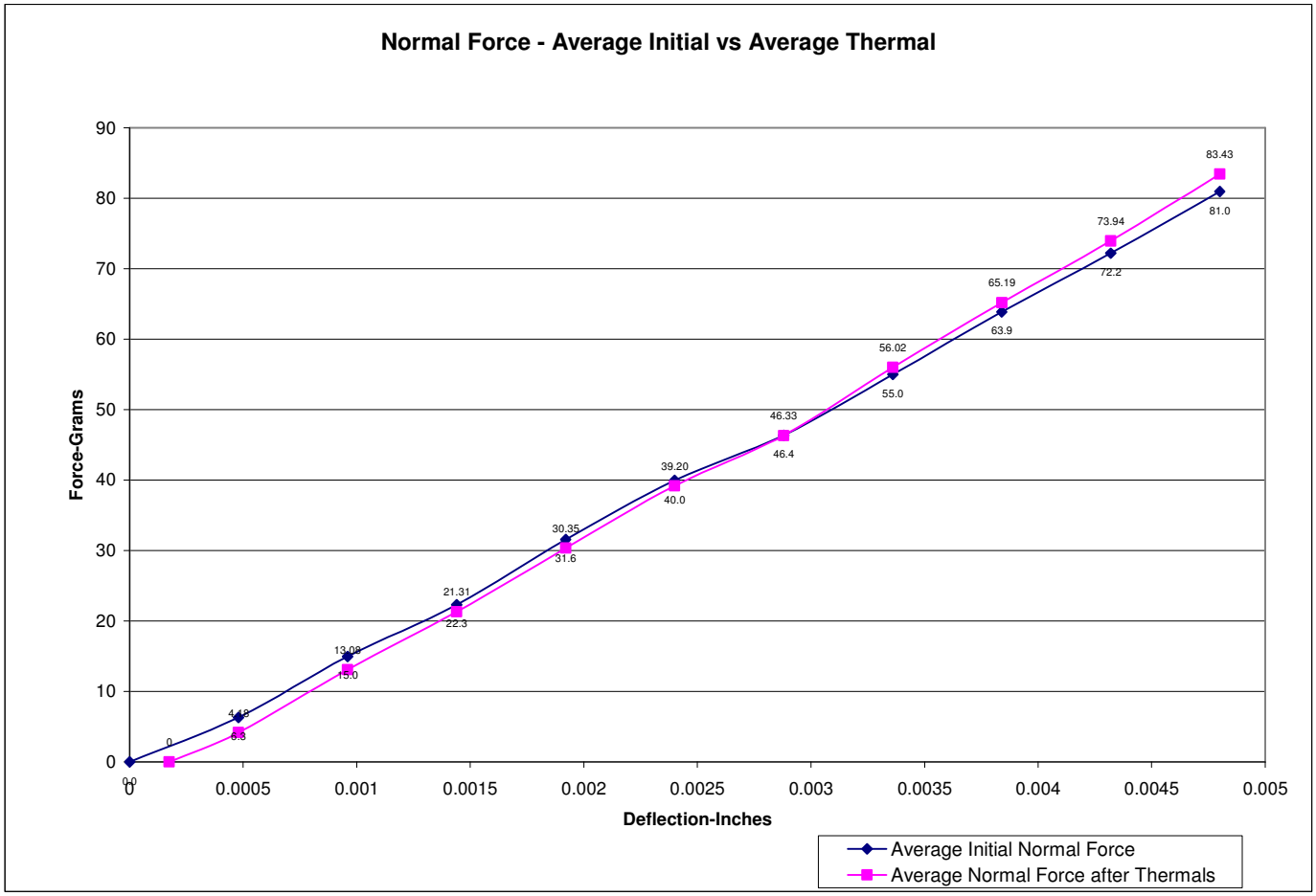
**NORMAL FORCE (FOR CONTACTS TESTED IN THE HOUSING):**

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.

**Ground pin**

| Initial | Deflections in inches Forces in Grams | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | **0.0005** | **0.0010** | **0.0014** | **0.0019** | **0.0024** | **0.0029** | **0.0034** | **0.0038** | **0.0043** | **0.0048** | ***SET*** |
| **Averages** | 6.33 | 14.98 | 22.31 | 31.56 | 39.95 | 46.38 | 54.98 | 63.88 | 72.18 | 80.97 | 0.0000 |
| **Min** | 5.00 | 13.60 | 20.60 | 28.60 | 35.30 | 41.00 | 48.70 | 55.00 | 62.80 | 69.90 | 0.0000 |
| **Max** | 9.20 | 16.60 | 25.20 | 35.50 | 45.60 | 51.30 | 62.70 | 71.80 | 81.70 | 90.50 | 0.0001 |
| **St. Dev** | 1.485 | 1.133 | 1.668 | 2.283 | 3.366 | 3.327 | 4.519 | 5.018 | 6.062 | 6.669 | 0.0000 |
| **Count** | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 |

| After Thermals | Deflections in inches Forces in Grams | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | **0.0005** | **0.0010** | **0.0014** | **0.0019** | **0.0024** | **0.0029** | **0.0034** | **0.0038** | **0.0043** | **0.0048** | ***SET*** |
| **Averages** | 4.18 | 13.08 | 21.31 | 30.35 | 39.20 | 46.33 | 56.02 | 65.19 | 73.94 | 83.43 | 0.0002 |
| **Min** | -0.10 | 0.00 | 8.50 | 17.00 | 26.90 | 31.50 | 41.50 | 49.30 | 56.90 | 66.90 | 0.0000 |
| **Max** | 10.00 | 19.90 | 30.30 | 38.90 | 50.70 | 56.70 | 69.20 | 77.40 | 88.30 | 97.70 | 0.0008 |
| **St. Dev** | 3.638 | 5.554 | 6.117 | 6.461 | 7.079 | 7.341 | 8.226 | 8.129 | 8.751 | 8.848 | 0.0002 |
| **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 | QFS/QMS | QFS | QMS |
| Initial | 10000 | 10000 | 10000 |
| Thermal | 10000 | 10000 | 10000 |
| Humidity | 10000 | 10000 | 10000 |

| | Pin to Ground | | |
|---|---|---|---|
| | Mated | Unmated | Unmated |
| Minimum | QFS/QMS | QFS | QMS |
| Initial | 10000 | 10000 | 10000 |
| Thermal | 10000 | 10000 | 10000 |
| Humidity | 10000 | 10000 | 10000 |

| | Row to Row | | |
|---|---|---|---|
| | Mated | Unmated | Unmated |
| Minimum | QFS/QMS | QFS | QMS |
| Initial | 10000 | 10000 | 10000 |
| Thermal | 10000 | 10000 | 10000 |
| Humidity | 10000 | 10000 | 10000 |

### DIELECTRIC WITHSTANDING VOLTAGE (DWV):

| Voltage Rating Summary | |
|---|---|
| Minimum | QFS/QMS |
| Break Down Voltage | 1000 |
| Test Voltage | 750 |
| Working Voltage | 250 |

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

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

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

## DATA SUMMARIES Continued

### LLCR Thermal Aging Group

1) A total of 192 points were measured.
2) EIA-364-23, *Low Level Contact Resistance Test Procedure for Electrical Connectors and Sockets.*
3) A computer program, *LLCR 221.exe*, ensures repeatability for data acquisition.
4) The following guidelines are used to categorize the changes in LLCR as a result from stressing.
   a. <= +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

**QFS-052-04.25-L-D-A/QMS-052-05.75-L-D-A**

| | ***LLCR Measurement Summaries by Pin Type*** | | | |
|---|---|---|---|---|
| Date | 2013-8-16 | 2013-8-27 | | |
| Room Temp (Deg C) | 24 | 23 | | |
| Rel Humidity (%) | 55 | 56 | | |
| Technician | Kason He | Kason He | | |
| **mOhm values** | **Actual Initial** | **Delta Thermal** | **Delta** | **Delta** |
| | **Pin Type 1: Signal** | | | |
| Average | 19.52 | 0.44 | | |
| St. Dev. | 0.62 | 0.34 | | |
| Min | 17.94 | 0.01 | | |
| Max | 21.30 | 1.57 | | |
| Summary Count | 176 | 176 | | |
| Total Count | 176 | 176 | | |
| | **Pin Type 2: Ground** | | | |
| Average | 1.66 | 0.06 | | |
| St. Dev. | 0.11 | 0.04 | | |
| Min | 1.43 | 0.00 | | |
| Max | 1.85 | 0.16 | | |
| Summary Count | 16 | 16 | | |
| Total Count | 16 | 16 | | |

| ***LLCR Delta Count by Category*** | | | | | | |
|---|---|---|---|---|---|---|
| | **Stable** | **Minor** | **Acceptable** | **Marginal** | **Unstable** | **Open** |
| **mOhms** | **<=5** | **>5 & <=10** | **>10 & <=15** | **>15 & <=50** | **>50 & <=1000** | **>1000** |
| **Thermal** | **192** | **0** | **0** | **0** | **0** | **0** |

# DATA SUMMARIES Continued

## LLCR Mating/Unmating Durability Group

1). A total of 192 points were measured.
2). EIA-364-23, *Low Level Contact Resistance Test Procedure for Electrical Connectors and Sockets.*
3). A computer program, *LLCR 221.exe*, ensures repeatability for data acquisition.
4). The following guidelines are used to categorize the changes in LLCR as a result from stressing.
   a. <= +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

### QFS-052-04.25-L-D-A/QMS-052-05.75-L-D-A

| | ***LLCR Measurement Summaries by Pin Type*** | | | |
|---|---|---|---|---|
| Date | 2013-8-16 | 2013-8-19 | 2013-8-26 | 2013-9-6 |
| Room Temp (Deg C) | 24 | 24 | 22 | 22 |
| Rel Humidity (%) | 55 | 55 | 56 | 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 | 20.25 | 0.88 | 0.70 | 2.07 |
| St. Dev. | 0.71 | 0.54 | 0.57 | 2.42 |
| Min | 18.53 | 0.01 | 0.00 | 0.00 |
| Max | 24.55 | 2.70 | 3.30 | 9.36 |
| Summary Count | 176 | 176 | 176 | 176 |
| Total Count | 176 | 176 | 176 | 176 |
| | **Pin Type 2: Ground** | | | |
| Average | 1.71 | 0.10 | 0.09 | 0.11 |
| St. Dev. | 0.17 | 0.09 | 0.07 | 0.09 |
| Min | 1.39 | 0.00 | 0.01 | 0.00 |
| Max | 1.99 | 0.35 | 0.27 | 0.28 |
| Summary Count | 16 | 16 | 16 | 16 |
| Total Count | 16 | 16 | 16 | 16 |

| ***LLCR Delta Count by Category*** | | | | | | |
|---|---|---|---|---|---|---|
| | **Stable** | **Minor** | **Acceptable** | **Marginal** | **Unstable** | **Open** |
| **mOhms** | **<=5** | **>5 & <=10** | **>10 & <=15** | **>15 & <=50** | **>50 & <=1000** | **>1000** |
| **25 Cycles** | **192** | **0** | **0** | **0** | **0** | **0** |
| **Therm Shck** | **192** | **0** | **0** | **0** | **0** | **0** |
| **Humidity** | **167** | **25** | **0** | **0** | **0** | **0** |

## DATA SUMMARIES Continued

### LLCR Gas Tight Group

1) A total of 192 points were measured.
2) EIA-364-23, *Low Level Contact Resistance Test Procedure for Electrical Connectors and Sockets.*
3) A computer program, *LLCR 221.exe*, ensures repeatability for data acquisition.
4) The following guidelines are used to categorize the changes in LLCR as a result from stressing.
   a. <= +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

**QFS-052-04.25-L-D-A/QMS-052-05.75-L-D-A**

| *LLCR Measurement Summaries by Pin Type* | | | | |
|---|---|---|---|---|
| Date | 2013-9-3 | 2013-9-5 | | |
| Room Temp (Deg C) | 22 | 22 | | |
| Rel Humidity (%) | 56 | 58 | | |
| Technician | Kason He | Kason He | | |
| **mOhm values** | **Actual Initial** | **Delta Acid Vapor** | **Delta** | **Delta** |
| | **Pin Type 1: Signal** | | | |
| Average | 20.13 | 0.54 | | |
| St. Dev. | 0.68 | 0.43 | | |
| Min | 18.47 | 0.01 | | |
| Max | 22.44 | 2.05 | | |
| Summary Count | 176 | 176 | | |
| Total Count | 176 | 176 | | |
| | **Pin Type 2: Ground** | | | |
| Average | 1.75 | 0.15 | | |
| St. Dev. | 0.14 | 0.10 | | |
| Min | 1.52 | 0.02 | | |
| Max | 2.07 | 0.37 | | |
| Summary Count | 16 | 16 | | |
| Total Count | 16 | 16 | | |

| *LLCR Delta Count by Category* | | | | | | |
|---|---|---|---|---|---|---|
| | **Stable** | **Minor** | **Acceptable** | **Marginal** | **Unstable** | **Open** |
| **mOhms** | **<=5** | **>5 & <=10** | **>10 & <=15** | **>15 & <=50** | **>50 & <=1000** | **>1000** |
| **Acid Vapor** | **192** | **0** | **0** | **0** | **0** | **0** |

## DATA SUMMARIES Continued

### LLCR Shock & Vibration Group

1) A total of 192 points were measured.
2) EIA-364-23, *Low Level Contact Resistance Test Procedure for Electrical Connectors and Sockets.*
3) A computer program, *LLCR 221.exe*, ensures repeatability for data acquisition.
4) The following guidelines are used to categorize the changes in LLCR as a result from stressing.
   a. <= +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

**QFS-052-04.25-L-D-A/QMS-052-05.75-L-D-A**

| | ***LLCR Measurement Summaries by Pin Type*** | | | |
|---|---|---|---|---|
| Date | 2013-9-19 | 2013-9-23 | | |
| Room Temp (Deg C) | 22 | 22 | | |
| Rel Humidity (%) | 45 | 48 | | |
| Technician | Craig Ryan | Craig Ryan | | |
| **mOhm values** | **Actual Initial** | **Delta Shock-Vib** | **Delta** | **Delta** |
| | **Pin Type 1: Signal** | | | |
| Average | 20.00 | 0.18 | | |
| St. Dev. | 0.70 | 0.18 | | |
| Min | 17.36 | 0.00 | | |
| Max | 21.89 | 0.79 | | |
| Summary Count | 176 | 176 | | |
| Total Count | 176 | 176 | | |
| | **Pin Type 2: Ground** | | | |
| Average | 1.60 | 0.14 | | |
| St. Dev. | 0.08 | 0.05 | | |
| Min | 1.46 | 0.08 | | |
| Max | 1.71 | 0.23 | | |
| Summary Count | 16 | 16 | | |
| Total Count | 16 | 16 | | |

| ***LLCR Delta Count by Category*** | | | | | | |
|---|---|---|---|---|---|---|
| | **Stable** | **Minor** | **Acceptable** | **Marginal** | **Unstable** | **Open** |
| **mOhms** | **<=5** | **>5 & <=10** | **>10 & <=15** | **>15 & <=50** | **>50 & <=1000** | **>1000** |
| **Shock-Vib** | **192** | **0** | **0** | **0** | **0** | **0** |

### Nanosecond Event Detection:

| Shock and Vibration Event Detection Summary | |
|---|---|
| Contacts tested | 60 |
| Test Condition | C, 100g's, 6ms, Half-Sine |
| Shock Events | 0 |
| Test Condition | V-B, 7.56 rms g |
| Vibration Events | 0 |
| Total Events | 0 |

# DATA SUMMARIES Continued

## LLCR Mating/Unmating Durability ----100 cycles Group

1). A total of 192 points were measured.
2). EIA-364-23, *Low Level Contact Resistance Test Procedure for Electrical Connectors and Sockets.*
3). A computer program, *LLCR 221.exe*, ensures repeatability for data acquisition.
4). The following guidelines are used to categorize the changes in LLCR as a result from stressing.
   a. <= +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

### QFS-052-06.25-S-D-A/QMS-052-09.75-S-D-A

| | ***LLCR Measurement Summaries by Pin Type*** | | | |
|---|---|---|---|---|
| Date | 2013-8-30 | 2013-9-5 | 2013-9-17 | 2013-10-28 |
| Room Temp (Deg C) | 23 | 23 | 23 | 23 |
| Rel Humidity (%) | 57 | 58 | 58 | 47 |
| Technician | Peter Chen | Peter Chen | Peter Chen | Peter Chen |
| **mOhm values** | **Actual Initial** | **Delta 100 Cycles** | **Delta Therm Shck** | **Delta Humidity** |
| | **Pin Type 1: Signal** | | | |
| Average | 23.79 | 1.01 | 1.04 | 1.34 |
| St. Dev. | 1.09 | 0.79 | 0.84 | 1.23 |
| Min | 21.46 | 0.00 | 0.01 | 0.01 |
| Max | 26.51 | 4.49 | 4.13 | 5.86 |
| Summary Count | 176 | 176 | 176 | 176 |
| Total Count | 176 | 176 | 176 | 176 |
| | **Pin Type 2: Ground** | | | |
| Average | 1.62 | 0.06 | 0.17 | 0.23 |
| St. Dev. | 0.09 | 0.04 | 0.13 | 0.17 |
| Min | 1.48 | 0.00 | 0.00 | 0.04 |
| Max | 1.80 | 0.15 | 0.42 | 0.71 |
| Summary Count | 16 | 16 | 16 | 16 |
| Total Count | 16 | 16 | 16 | 16 |

| ***LLCR Delta Count by Category*** | | | | | | |
|---|---|---|---|---|---|---|
| | **Stable** | **Minor** | **Acceptable** | **Marginal** | **Unstable** | **Open** |
| **mOhms** | **<=5** | **>5 & <=10** | **>10 & <=15** | **>15 & <=50** | **>50 & <=1000** | **>1000** |
| **100 Cycles** | **192** | **0** | **0** | **0** | **0** | **0** |
| **Therm Shck** | **192** | **0** | **0** | **0** | **0** | **0** |
| **Humidity** | **188** | **4** | **0** | **0** | **0** | **0** |

# DATA SUMMARIES Continued

## LLCR Mating/Unmating Durability---- 250 cycles Group

1). A total of 192 points were measured.
2). EIA-364-23, *Low Level Contact Resistance Test Procedure for Electrical Connectors and Sockets.*
3). A computer program, *LLCR 221.exe*, ensures repeatability for data acquisition.
4). The following guidelines are used to categorize the changes in LLCR as a result from stressing.
   a. <= +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

### QFS-052-06.25-S-D-A/QMS-052-09.75-S-D-A

| | ***LLCR Measurement Summaries by Pin Type*** | | | |
|---|---|---|---|---|
| Date | 2013-8-30 | 2013-9-6 | 2013-9-17 | 2013-10-28 |
| Room Temp (Deg C) | 23 | 23 | 23 | 22 |
| Rel Humidity (%) | 57 | 58 | 58 | 48 |
| Technician | Peter Chen | Peter Chen | Peter Chen | Peter Chen |
| **mOhm values** | **Actual Initial** | **Delta 250 Cycles** | **Delta Therm Shck** | **Delta Humidity** |
| | **Pin Type 1: Signal** | | | |
| Average | 23.73 | 0.97 | 1.04 | 1.01 |
| St. Dev. | 1.07 | 0.77 | 0.76 | 0.96 |
| Min | 21.72 | 0.00 | 0.02 | 0.00 |
| Max | 26.32 | 3.85 | 3.71 | 4.51 |
| Summary Count | 176 | 176 | 176 | 176 |
| Total Count | 176 | 176 | 176 | 176 |
| | **Pin Type 2: Ground** | | | |
| Average | 1.63 | 0.08 | 0.07 | 0.06 |
| St. Dev. | 0.07 | 0.05 | 0.07 | 0.06 |
| Min | 1.52 | 0.01 | 0.00 | 0.00 |
| Max | 1.77 | 0.18 | 0.25 | 0.20 |
| Summary Count | 16 | 16 | 16 | 16 |
| Total Count | 16 | 16 | 16 | 16 |

| ***LLCR Delta Count by Category*** | | | | | | |
|---|---|---|---|---|---|---|
| | **Stable** | **Minor** | **Acceptable** | **Marginal** | **Unstable** | **Open** |
| **mOhms** | **<=5** | **>5 & <=10** | **>10 & <=15** | **>15 & <=50** | **>50 & <=1000** | **>1000** |
| **250 Cycles** | **192** | **0** | **0** | **0** | **0** | **0** |
| **Therm Shck** | **192** | **0** | **0** | **0** | **0** | **0** |
| **Humidity** | **192** | **0** | **0** | **0** | **0** | **0** |

# DATA SUMMARIES Continued

## LLCR Mating/Unmating Durability 500 cycles Group

1). A total of 192 points were measured.
2). EIA-364-23, *Low Level Contact Resistance Test Procedure for Electrical Connectors and Sockets.*
3). A computer program, *LLCR 221.exe*, ensures repeatability for data acquisition.
4). The following guidelines are used to categorize the changes in LLCR as a result from stressing.
   a. <= +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

### QFS-052-06.25-S-D-A/QMS-052-09.75-S-D-A

| | ***LLCR Measurement Summaries by Pin Type*** | | | |
|---|---|---|---|---|
| Date | 2013-9-9 | 2013-9-11 | 2013-9-24 | 2013-10-28 |
| Room Temp (Deg C) | 23 | 23 | 23 | 23 |
| Rel Humidity (%) | 59 | 59 | 59 | 48 |
| Technician | Peter Chen | Peter Chen | Peter Chen | Peter Chen |
| **mOhm values** | **Actual Initial** | **Delta 500 Cycles** | **Delta Therm Shck** | **Delta Humidity** |
| | **Pin Type 1: Signal** | | | |
| Average | 23.45 | 0.74 | 24.30 | 1.20 |
| St. Dev. | 1.07 | 0.60 | 1.09 | 1.16 |
| Min | 21.63 | 0.00 | 0.01 | -0.20 |
| Max | 26.28 | 3.79 | 6.82 | 5.92 |
| Summary Count | 176 | 176 | 176 | 176 |
| Total Count | 176 | 176 | 176 | 176 |
| | **Pin Type 2: Ground** | | | |
| Average | 1.61 | 0.06 | 1.97 | 0.11 |
| St. Dev. | 0.05 | 0.03 | 0.12 | 0.06 |
| Min | 1.53 | 0.00 | 0.05 | 0.01 |
| Max | 1.75 | 0.13 | 0.50 | 0.20 |
| Summary Count | 16 | 16 | 16 | 16 |
| Total Count | 16 | 16 | 16 | 16 |

| ***LLCR Delta Count by Category*** | | | | | | |
|---|---|---|---|---|---|---|
| | **Stable** | **Minor** | **Acceptable** | **Marginal** | **Unstable** | **Open** |
| **mOhms** | **<=5** | **>5 & <=10** | **>10 & <=15** | **>15 & <=50** | **>50 & <=1000** | **>1000** |
| **500 Cycles** | **192** | **0** | **0** | **0** | **0** | **0** |
| **Therm Shck** | **189** | **3** | **0** | **0** | **0** | **0** |
| **Humidity** | **189** | **3** | **0** | **0** | **0** | **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: 07/09/2014, 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