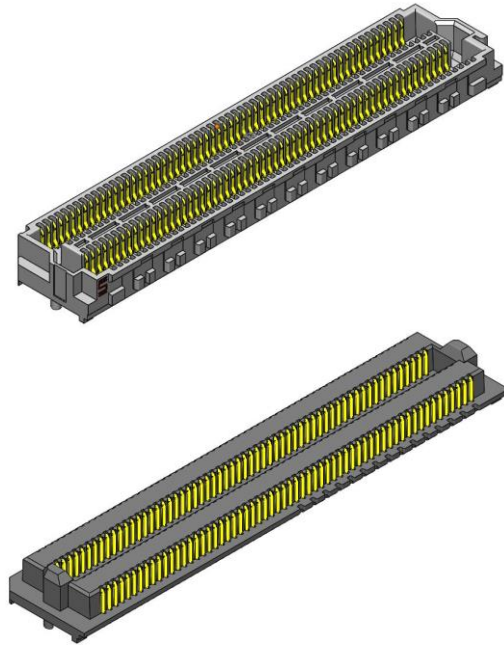




Project Number: Design Qualification Test Report	Tracking Code: 2029000_Report_Rev_1
Requested by: Jonathan Ochsner	Date: 4/23/2021
Part #: APF6-060-03.5-L-04-2-A/APM6-060-01.5-L-04-2-A	
Part description: APF6/APM6	Tech: John Crawford
Test Start: 7/3/2019	Test Completed: 8/9/2019



DESIGN QUALIFICATION TEST REPORT
APF6/APM6
APF6-060-03.5-L-04-2-A/APM6-060-01.5-L-04-2-A

Tracking Code: 2029000_Report_Rev_1	Part #: APF6-060-03.5-L-04-2-A/APM6-060-01.5-L-04-2-A
Part description: APF6/APM6	

REVISION HISTORY

DATA	REV.NUM.	DESCRIPTION	ENG
4/20/2020	1	Initial Issue	KH

CERTIFICATION

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

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SCOPE

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

APPLICABLE DOCUMENTS

Standards: EIA Publication 364

TEST SAMPLES AND PREPARATION

- 1) All materials were manufactured in accordance with the applicable product specification.
- 2) All test samples were identified and encoded to maintain traceability throughout the test sequences.
- 3) After soldering, the parts to be used for LLCR and DWV/IR testing were cleaned according to CO-SC-WI-3029.
- 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 and DWV/IR 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-109585-TST-XX/PCB-109969-TST-XX/PCB-109584-TST-XX
PCB-109582-TST-XX

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

APF6-060-03.5-L-04-2-A
APM6-060-01.5-L-04-2-A
8 Assemblies

Group 2

APF6-020-03.5-S-04-2-A
APM6-020-01.5-S-04-2-A
8 Assemblies
Smallest

Group 1

APF6-100-03.5-L-04-2-A
APM6-100-01.5-L-04-2-A
8 Assemblies
Largest

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

(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

APF6-060-03.5-L-04-2-A
APM6-060-01.5-L-04-2-A
2 Assemblies

Group 2

APF6-060-03.5-L-04-2-A

2 Assemblies

Group 3

APM6-060-01.5-L-04-2-A
2 Assemblies

Group 4

APF6-060-03.5-L-04-2-A
APM6-060-01.5-L-04-2-A
2 Assemblies

Step	Description
1.	DWV Breakdown (2)

Step	Description
1.	DWV Breakdown (2)

Step	Description
1.	DWV Breakdown (2)

Step	Description
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-RowGroup 5

APF6-060-03.5-L-04-2-A
APM6-060-01.5-L-04-2-A
2 Assemblies

Group 6

APF6-060-03.5-L-04-2-A

2 Assemblies

Group 7

APM6-060-01.5-L-04-2-A
2 Assemblies

Group 8

APF6-060-03.5-L-04-2-A
APM6-060-01.5-L-04-2-A
2 Assemblies

Step	Description
1.	DWV Breakdown (2)

Step	Description
1.	DWV Breakdown (2)

Step	Description
1.	DWV Breakdown (2)

Step	Description
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

APF6-060-03.5-L-04-2-A
APM6-060-01.5-L-04-2-A
4 Pins Powered
Signal

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

Group 2

APF6-060-03.5-L-04-2-A
APM6-060-01.5-L-04-2-A
8 Pins Powered
Signal

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

Group 3

APF6-060-03.5-L-04-2-A
APM6-060-01.5-L-04-2-A
12 Pins Powered
Signal

Step	Description
1.	CCC ⁽¹⁾ Rows = 4 Number of Positions = 3

Group 4

APF6-060-03.5-L-04-2-A
APM6-060-01.5-L-04-2-A
16 Pins Powered
Signal

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

Group 5

APF6-060-03.5-L-04-2-A
APM6-060-01.5-L-04-2-A
240 Pins Powered
Signal

Step	Description
1.	CCC ⁽¹⁾ Rows = 4 Number of Positions = 60

Group 1

APF6-100-03.5-L-04-2-A
APM6-100-01.5-L-04-2-A
400 Pins Powered
Signal

Step	Description
1.	CCC ⁽¹⁾ Number of Positions = 100 Rows = 4

(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

APF6-060-03.5-L-04-2-A

APM6-060-01.5-L-04-2-A

8 Assemblies

Step Description

1. LLCR (1)
2. Mechanical Shock (2)
3. Random Vibration (3)
4. LLCR (1)
Max Delta = 15 mOhm

(1) LLCR = EIA-364-23

Open Circuit Voltage = 20 mV Max
Test Current = 100 mA Max

(2) Mechanical Shock = EIA-364-27

Test Condition = C (100 G Peak, 6 milliseconds, Half Sine)
Number of Shocks = 3 Per Direction, Per Axis, 18 Total

(3) Random Vibration = EIA-364-28

Condition = VB (7.56 gRMS Average, 2 Hours/Axis)

Mechanical Shock/Random Vibration/Event DetectionGroup 1

APF6-060-03.5-L-04-2-A

APM6-060-01.5-L-04-2-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**Mechanical Shock/Random Vibration/LLCR**Group 1

APF6-100-03.5-L-04-2-A

APM6-100-01.5-L-04-2-A

8 Assemblies

Step Description

1. LLCR (1)
2. Mechanical Shock (2)
3. Random Vibration (3)
4. LLCR (1)
Max Delta = 15 mOhm

(1) LLCR = EIA-364-23

Open Circuit Voltage = 20 mV Max
Test Current = 100 mA Max

(2) Mechanical Shock = EIA-364-27

Test Condition = C (100 G Peak, 6 milliseconds, Half Sine)
Number of Shocks = 3 Per Direction, Per Axis, 18 Total

(3) Random Vibration = EIA-364-28

Condition = VB (7.56 gRMS Average, 2 Hours/Axis)

Mechanical Shock/Random Vibration/Event DetectionGroup 1

APF6-100-03.5-L-04-2-A

APM6-100-01.5-L-04-2-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)

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

VIBRATION:

- 1) Reference document: EIA-364-28, *Vibration Test Procedure for Electrical Connectors*
- 2) Test Condition V, Letter B
- 3) Power Spectral Density: 0.04 G² / Hz
- 4) G 'RMS': 7.56
- 5) Frequency: 50 to 2000 Hz
- 6) Duration: 2.0 Hours per axis (3 axis total)

NANOSECOND-EVENT DETECTION:

- 1) Reference document: EIA-364-87, *Nanosecond-Event Detection for Electrical Connectors*
- 2) Prior to test, the samples were characterized to assure the low nanosecond event being monitored will trigger the detector.
- 3) After characterization it was determined the test samples could be monitored for 50 nanosecond events

MATING/UNMATING:

- 1) Reference document: EIA-364-13, *Mating and Unmating Forces Test Procedure for Electrical Connectors*.
- 2) The full insertion position was to within 0.003” to 0.004” of the plug bottoming out in the receptacle to prevent damage to the system under test.
- 3) One of the mating parts is secured to a floating X-Y table to prevent damage during cycling.

ATTRIBUTE DEFINITIONS Continued

The following is a brief, simplified description of attributes

TEMPERATURE RISE (Current Carrying Capacity, CCC):

- 1) EIA-364-70, *Temperature Rise versus Current Test Procedure for Electrical Connectors and Sockets*.
- 2) When current passes through a contact, the temperature of the contact increases as a result of I^2R (resistive) heating.
- 3) The number of contacts being investigated plays a significant part in power dissipation and therefore temperature rise.
- 4) The size of the temperature probe can affect the measured temperature.
- 5) Copper traces on PC boards will contribute to temperature rise:
 - a. Self-heating (resistive)
 - b. Reduction in heat sink capacity affecting the heated contacts
- 6) A de-rating curve, usually 20%, is calculated.
- 7) Calculated de-rated currents at four temperature points are reported:
 - a. Ambient
 - b. 85° C
 - c. 95° C
 - d. 115° C
- 8) Typically, neighboring contacts (in close proximity to maximize heat build up) are energized.
- 9) The thermocouple (or temperature measuring probe) will be positioned at a location to sense the maximum temperature in the vicinity of the heat generation area.
- 10) A computer program, *TR 803.exe*, ensures accurate stability for data acquisition.
- 11) Hook-up wire cross section is larger than the cross section of any connector leads/PC board traces, jumpers, etc.
- 12) Hook-up wire length is longer than the minimum specified in the referencing standard.

LLCR:

- 1) EIA-364-23, *Low Level Contact Resistance Test Procedure for Electrical Connectors and Sockets*.
- 2) A computer program, *LLCR 221.exe*, ensures repeatability for data acquisition.
- 3) The following guidelines are used to categorize the changes in LLCR as a result from stressing
 - a. $\leq +5.0$ mOhms: -----Stable
 - b. $+5.1$ to $+10.0$ mOhms:-----Minor
 - c. $+10.1$ to $+15.0$ mOhms: -----Acceptable
 - d. $+15.1$ to $+50.0$ mOhms: -----Marginal
 - e. $+50.1$ to $+1000$ mOhms: -----Unstable
 - f. $>+1000$ mOhms:-----Open Failure

ATTRIBUTE DEFINITIONS Continued

The following is a brief, simplified description of attributes

INSULATION RESISTANCE (IR):

To determine the resistance of insulation materials to leakage of current through or on the surface of these materials when a DC potential is applied.

- 1) PROCEDURE:
 - a. Reference document: EIA-364-21, *Insulation Resistance Test Procedure for Electrical Connectors*.
 - b. Test Conditions:
 - i. Between Adjacent Contacts or Signal-to-Ground
 - ii. Electrification Time 2.0 minutes
 - iii. Test Voltage (500 VDC) corresponds to calibration settings for measuring resistances.
- 2) MEASUREMENTS:
- 3) When the specified test voltage is applied (VDC), the insulation resistance shall not be less than 5000 megohms.

DIELECTRIC WITHSTANDING VOLTAGE (DWV):

To determine if the sockets can operate at its rated voltage and withstand momentary over potentials due to switching, surges, and other similar phenomenon. Separate samples are used to evaluate the effect of environmental stresses so not to influence the readings from arcing that occurs during the measurement process.

- 1) PROCEDURE:
 - a. Reference document: EIA-364-20, *Withstanding Voltage Test Procedure for Electrical Connectors*.
 - b. Test Conditions:
 - i. Between Adjacent Contacts or Signal-to-Ground
 - ii. Barometric Test Condition 1
 - iii. Rate of Application 500 V/Sec
 - iv. Test Voltage (VAC) until breakdown occurs
- 2) MEASUREMENTS/CALCULATIONS
 - a. The breakdown voltage shall be measured and recorded.
 - b. The dielectric withstanding voltage shall be recorded as 75% of the minimum breakdown voltage.
 - c. The working voltage shall be recorded as one-third (1/3) of the dielectric withstanding voltage (one-fourth of the breakdown voltage).

RESULTS

Temperature Rise, CCC at a 20% de-rating

- CCC for a 30°C Temperature Rise-----1.4 A per contact with 4 contacts (4x1) powered.
- CCC for a 30°C Temperature Rise-----1.1 A per contact with 8 contacts (4x2) powered.
- CCC for a 30°C Temperature Rise-----0.9 A per contact with 12 contacts (4x3) powered.
- CCC for a 30°C Temperature Rise-----0.8 A per contact with 16 contacts (4x4) powered.
- CCC for a 30°C Temperature Rise-----0.4 A per contact with 240 contacts (4x60) powered.
- CCC for a 30°C Temperature Rise-----0.3 A per contact with 400 contacts (4x100) powered.

Mating – Unmating Forces

Mating/Unmating Durability Group

APF6-060-03.5-L-04-2-A/APM6-060-01.5-L-04-2-A

- **Initial**
 - **Mating**
 - Min -----10.50 lbs
 - Max-----12.83 lbs
 - **Unmating**
 - Min ----- 5.83 lbs
 - Max----- 7.02 lbs
- **After 25 Cycles**
 - **Mating**
 - Min -----12.98 lbs
 - Max-----14.16 lbs
 - **Unmating**
 - Min ----- 7.10 lbs
 - Max----- 8.94 lbs
- **After Humidity**
 - **Mating**
 - Min ----- 7.38 lbs
 - Max----- 9.11 lbs
 - **Unmating**
 - Min ----- 4.84 lbs
 - Max----- 6.10 lbs

Mating/Unmating Basic Group

APF6-020-03.5-L-04-2-A/APM6-020-01.5-L-04-2-A

- **Initial**
 - **Mating**
 - Min ----- 3.66 lbs
 - Max----- 5.85 lbs
 - **Unmating**
 - Min ----- 1.95 lbs
 - Max----- 5.66 lbs
- **After 25 Cycles**
 - **Mating**
 - Min ----- 4.21 lbs
 - Max----- 6.66 lbs
 - **Unmating**
 - Min ----- 2.61 lbs
 - Max----- 6.30 lbs

RESULTS Continued**Mating/Unmating Basic Group****APF6-100-03.5-L-04-2-A/APM6-100-01.5-L-04-2-A**

- **Initial**
 - **Mating**
 - **Min** -----19.26 lbs
 - **Max** -----21.72 lbs
 - **Unmating**
 - **Min** -----10.29 lbs
 - **Max** -----16.27 lbs
- **After 25 Cycles**
 - **Mating**
 - **Min** -----21.31 lbs
 - **Max** -----23.92 lbs
 - **Unmating**
 - **Min** -----12.25 lbs
 - **Max** -----17.19 lbs

RESULTS Continued

Insulation Resistance minimums, IR

Pin to Pin

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

Row to Row

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

Dielectric Withstanding Voltage minimums, DWV

- **Minimums**
 - Breakdown Voltage -----563 VAC
 - Test Voltage -----425 VAC
 - Working Voltage -----141 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

RESULTS Continued**LLCR Durability (192 LLCR test points)**

- **Initial** ----- 20.86 mOhms Max
- **Durability, 25 Cycles**
 - **<= +5.0 mOhms**-----192 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**-----192 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
- **Humidity**
 - **<= +5.0 mOhms**-----191 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**-----1 Points ----- Open Failure

Note: APX6, Sample 2, Position D01, Cause of LLCR Failure, Solder Pad Pulled from PCB.

RESULTS Continued**LLCR Shock & Vibration (192 LLCR test points)**

APF6-060-03.5-L-04-2-A/APM6-060-01.5-L-04-2-A

- **Initial** ----- 20.81 mOhms Max
- **Shock & Vibration**
 - <= +5.0 mOhms-----192 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

Mechanical Shock & Random Vibration:

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

APF6-100-03.5-L-04-2-A/APM6-100-01.5-L-04-2-A

- **Initial** ----- 22.19 mOhms Max
- **Shock & Vibration**
 - <= +5.0 mOhms-----192 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

Mechanical Shock & Random Vibration:

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

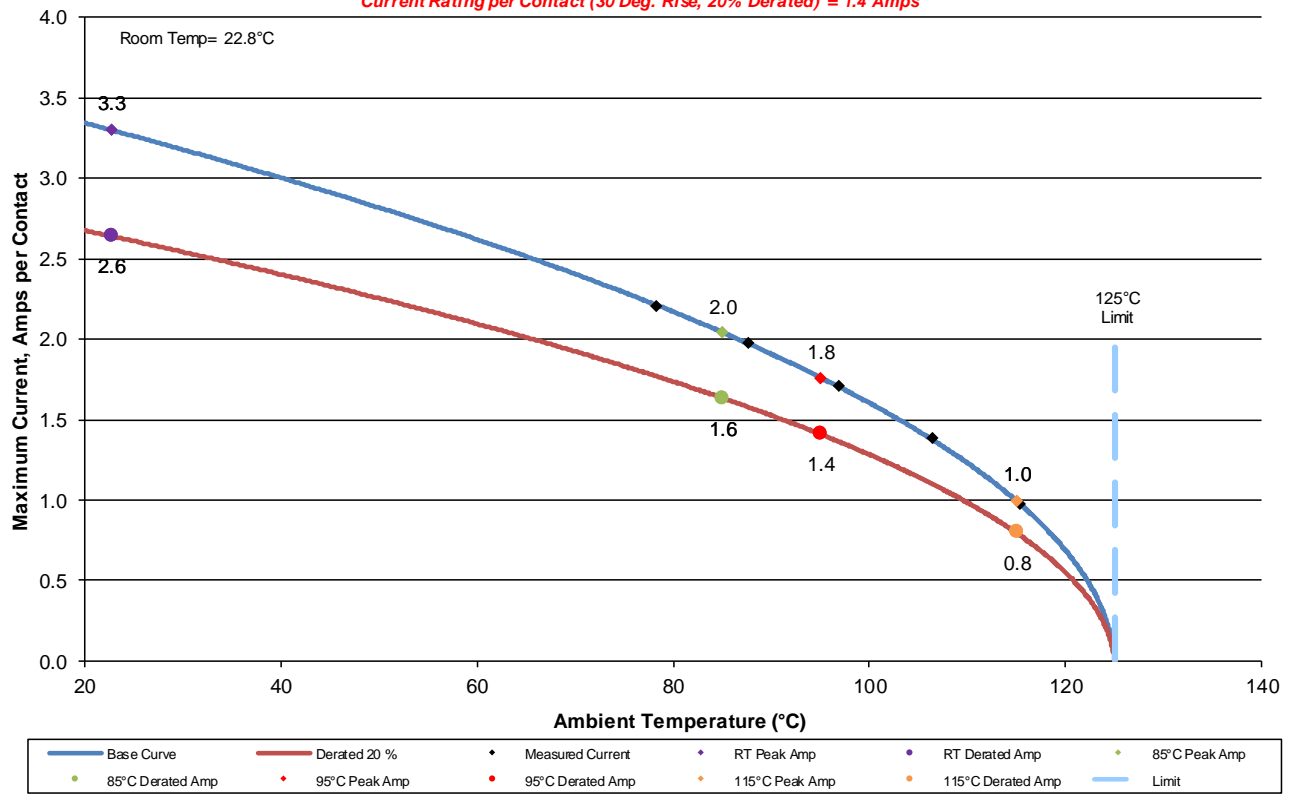
DATA SUMMARIES

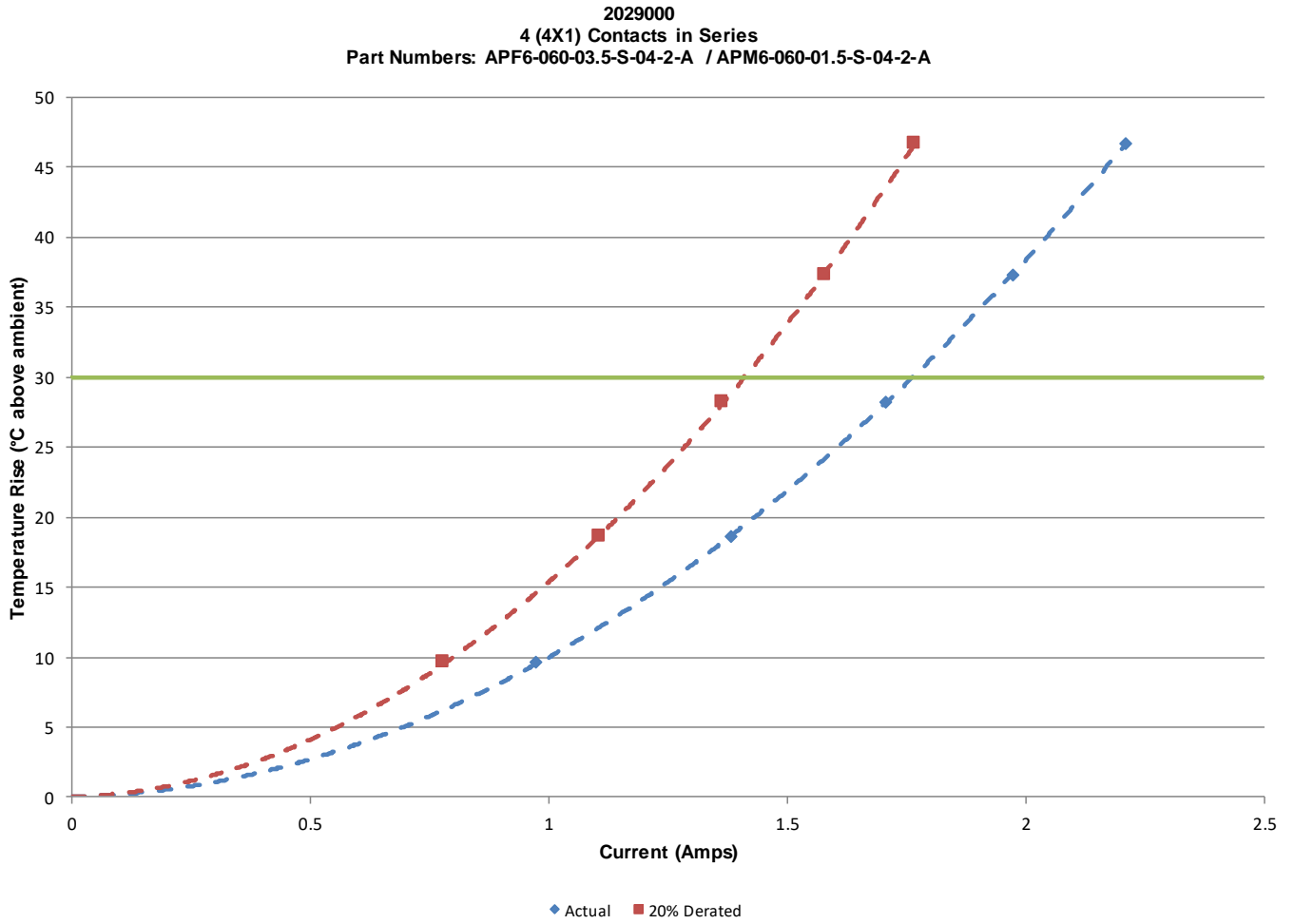
TEMPERATURE RISE (Current Carrying Capacity, CCC):

- 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 4 adjacent conductors/contacts powered

2029000
4 (4X1) Contacts in Series
Part Numbers: APF6-060-03.5-S-04-2-A / APM6-060-01.5-S-04-2-A

Current Rating per Contact (30 Deg. Rise, 20% Derated) = 1.4 Amps

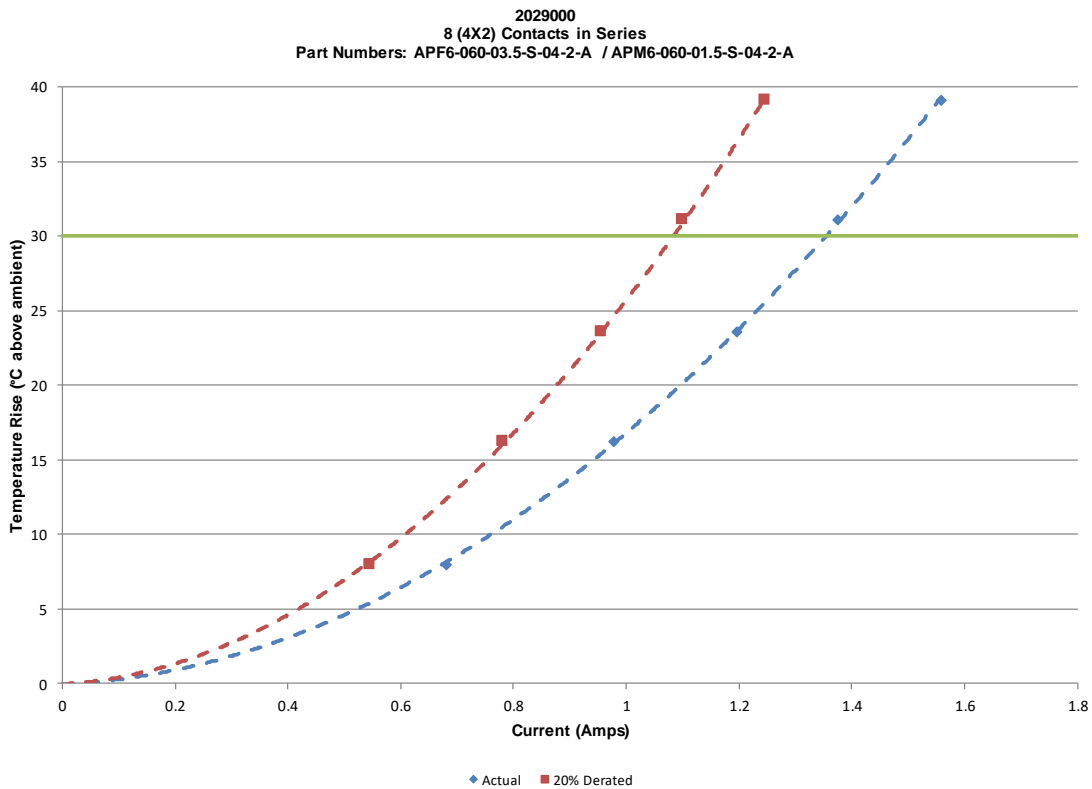
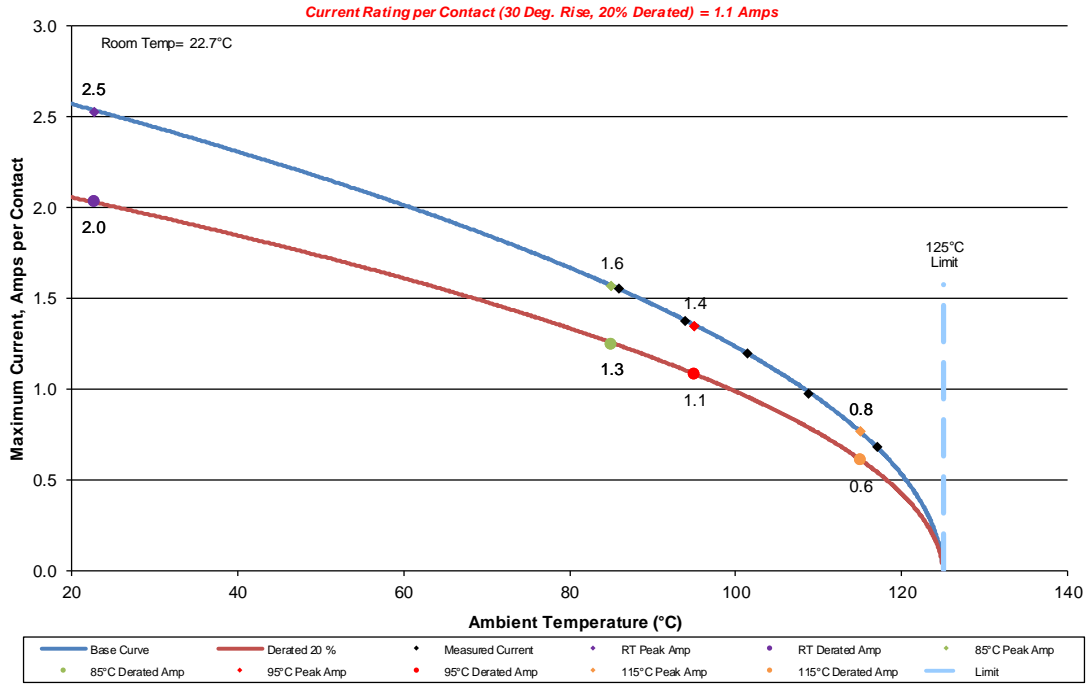




DATA SUMMARIES Continued

b. Linear configuration with 8 adjacent conductors/contacts powered

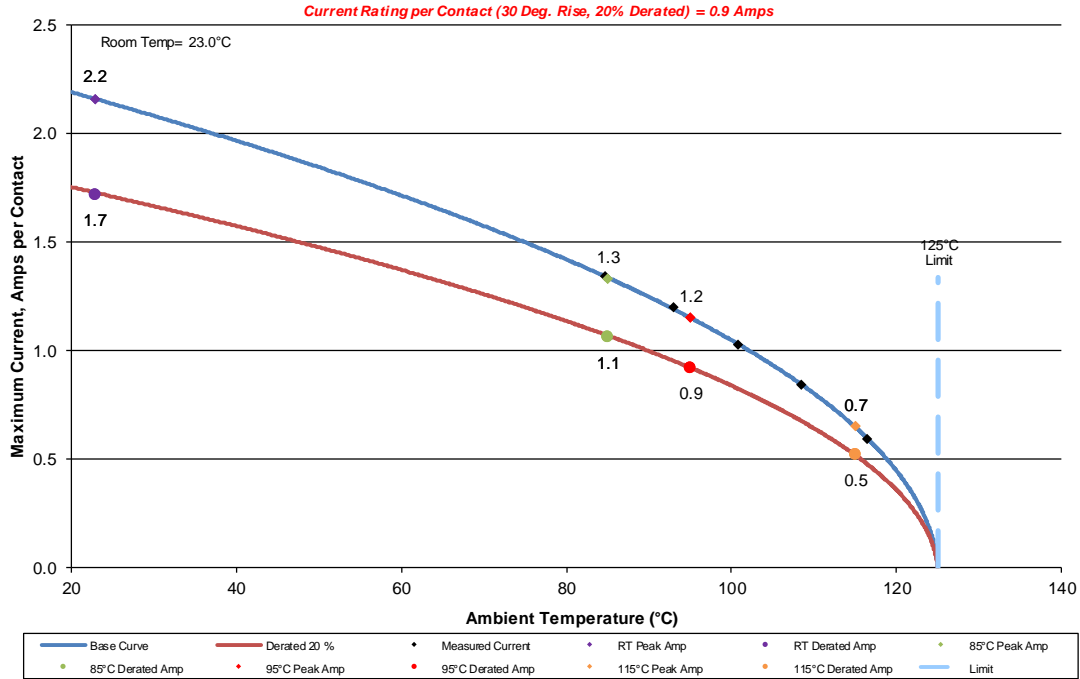
2029000
 8 (4X2) Contacts in Series
 Part Numbers: APF6-060-03.5-S-04-2-A / APM6-060-01.5-S-04-2-A



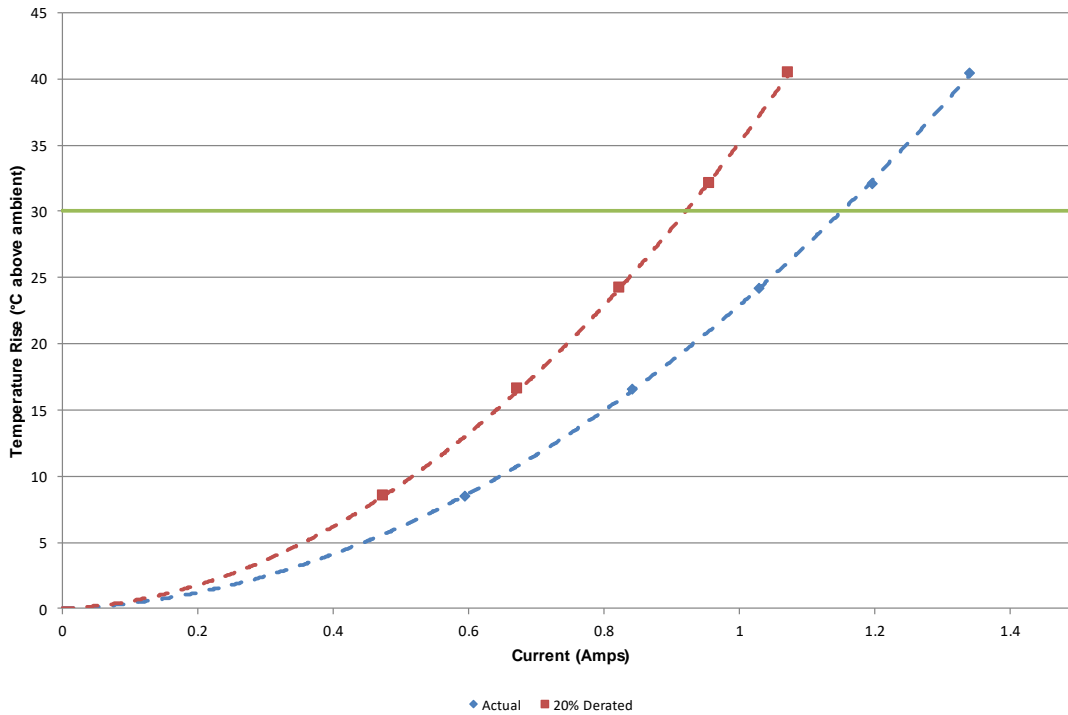
DATA SUMMARIES Continued

c. Linear configuration with 12 adjacent conductors/contacts powered

2029000
 12 (4X3) Contacts in Series
 Part Numbers: APF6-060-03.5-S-04-2-A / APM6-060-01.5-S-04-2-A



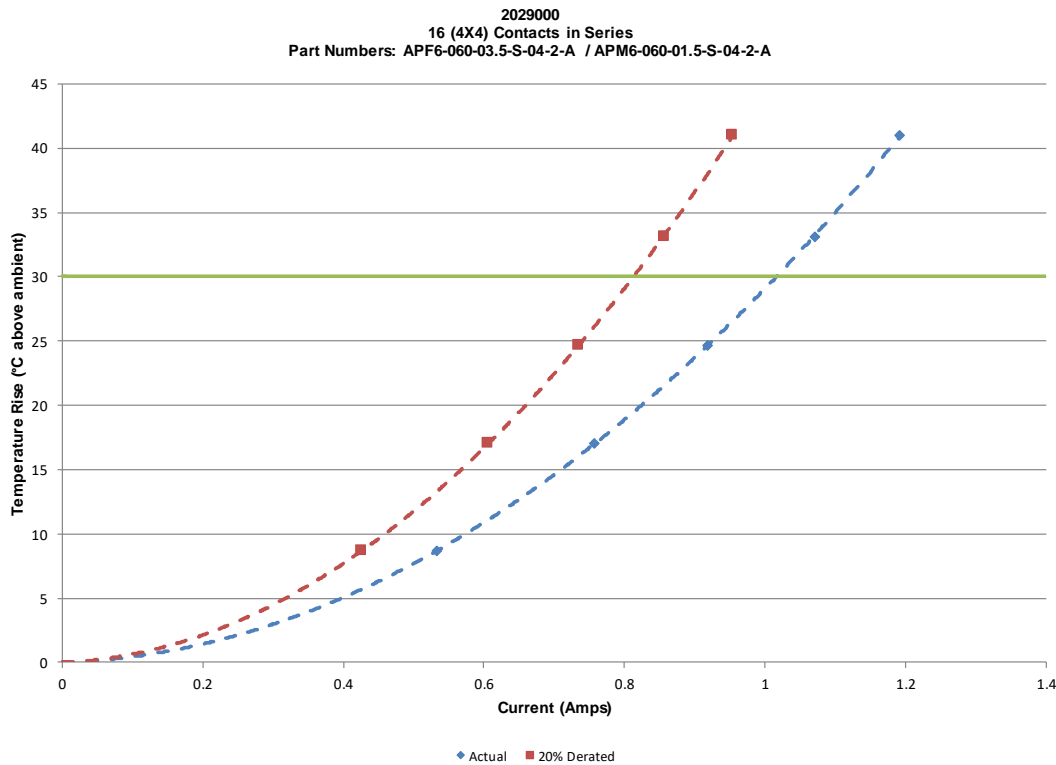
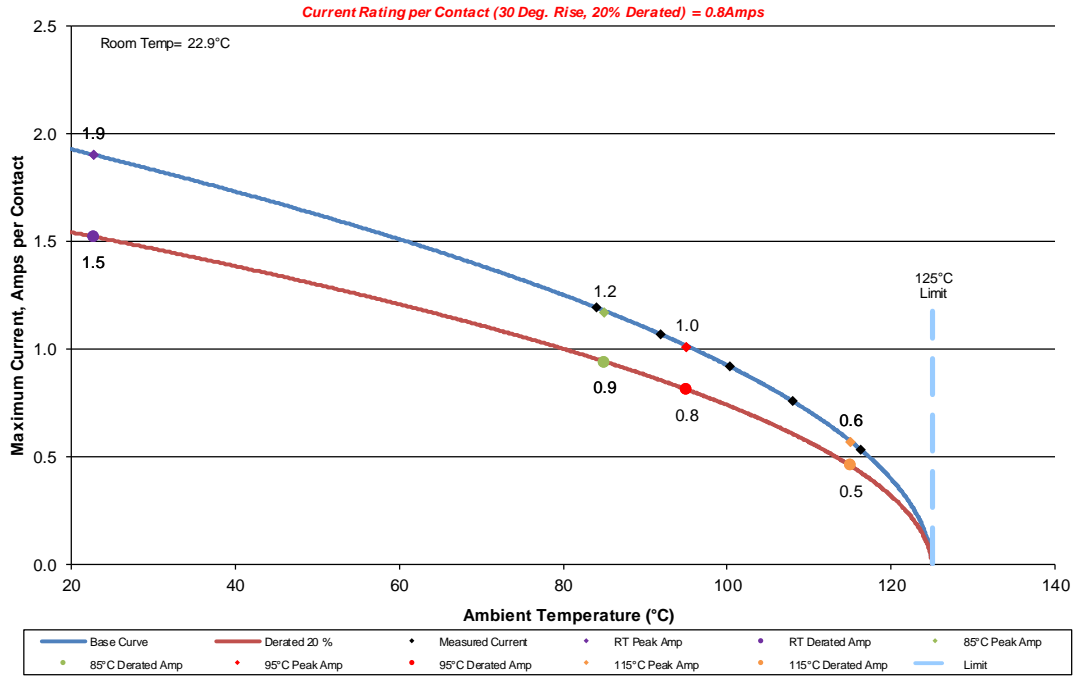
2029000
 12 (4X3) Contacts in Series
 Part Numbers: APF6-060-03.5-S-04-2-A / APM6-060-01.5-S-04-2-A



DATA SUMMARIES Continued

d. Linear configuration with 16 adjacent conductors/contacts powered

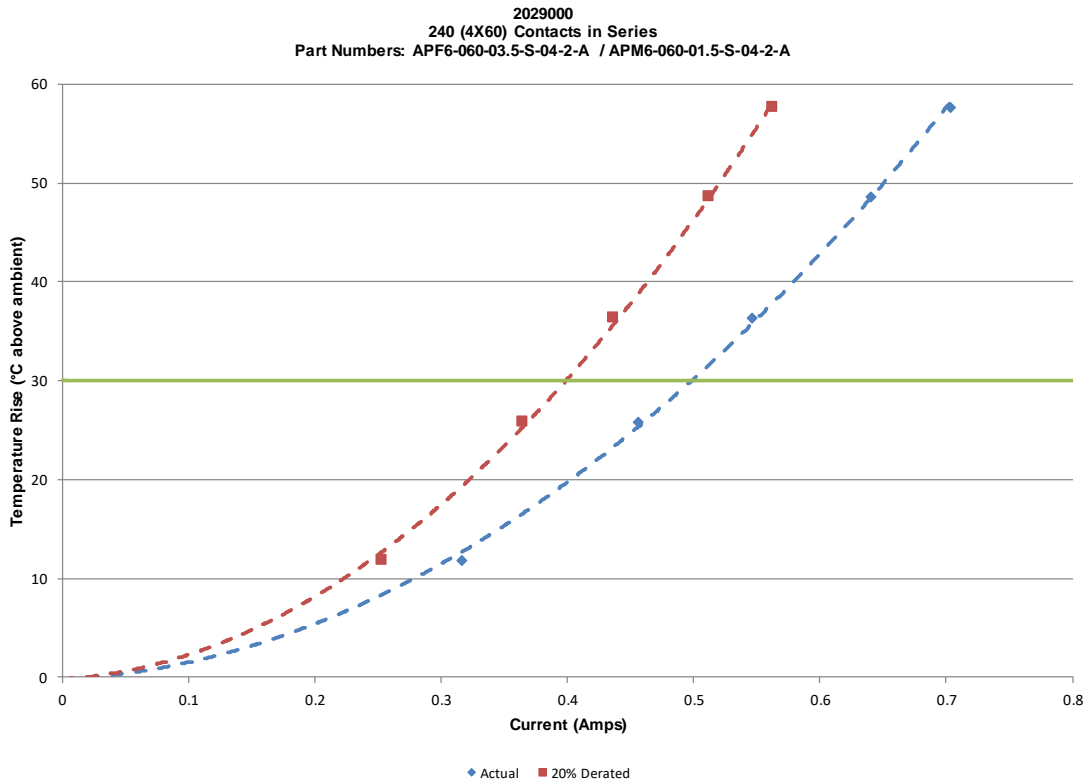
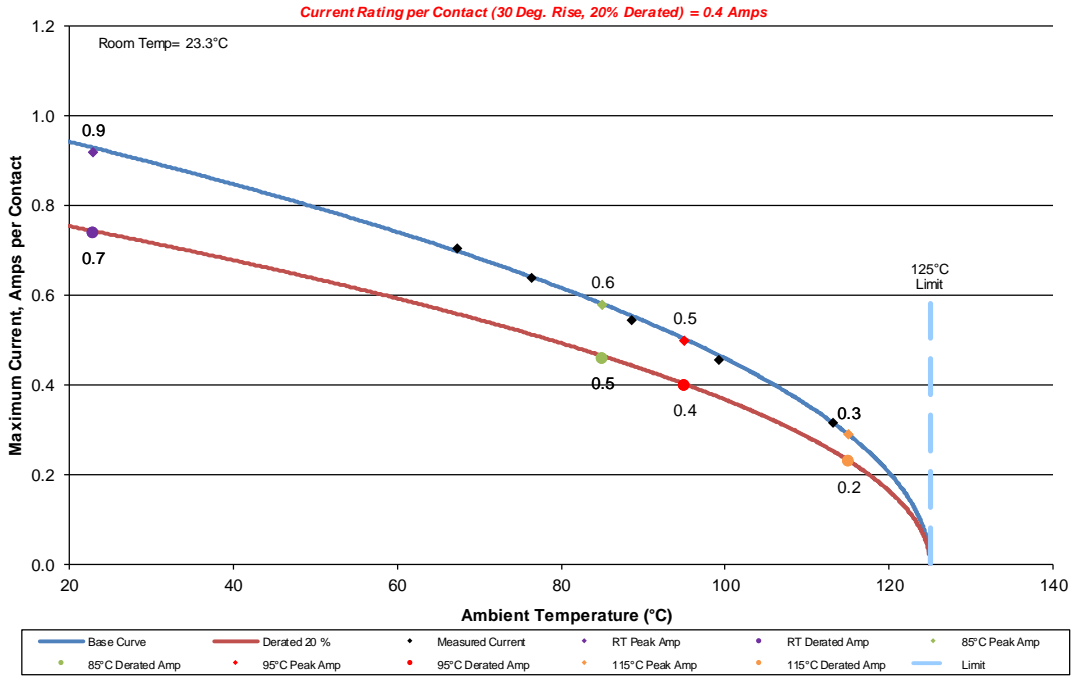
2029000
 16 (4X4) Contacts in Series
 Part Numbers: APF6-060-03.5-S-04-2-A / APM6-060-01.5-S-04-2-A



DATA SUMMARIES Continued

e. Linear configuration with 240 adjacent conductors/contacts powered

2029000
 240 (4X60) Contacts in Series
 Part Numbers: APF6-060-03.5-S-04-2-A / APM6-060-01.5-S-04-2-A

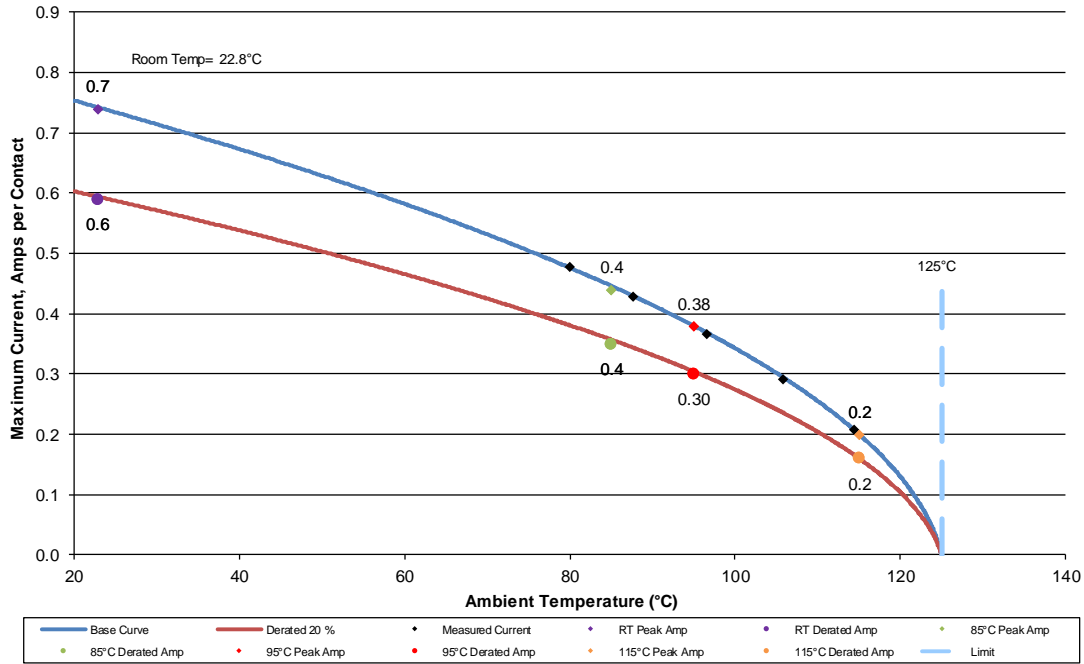


DATA SUMMARIES Continued

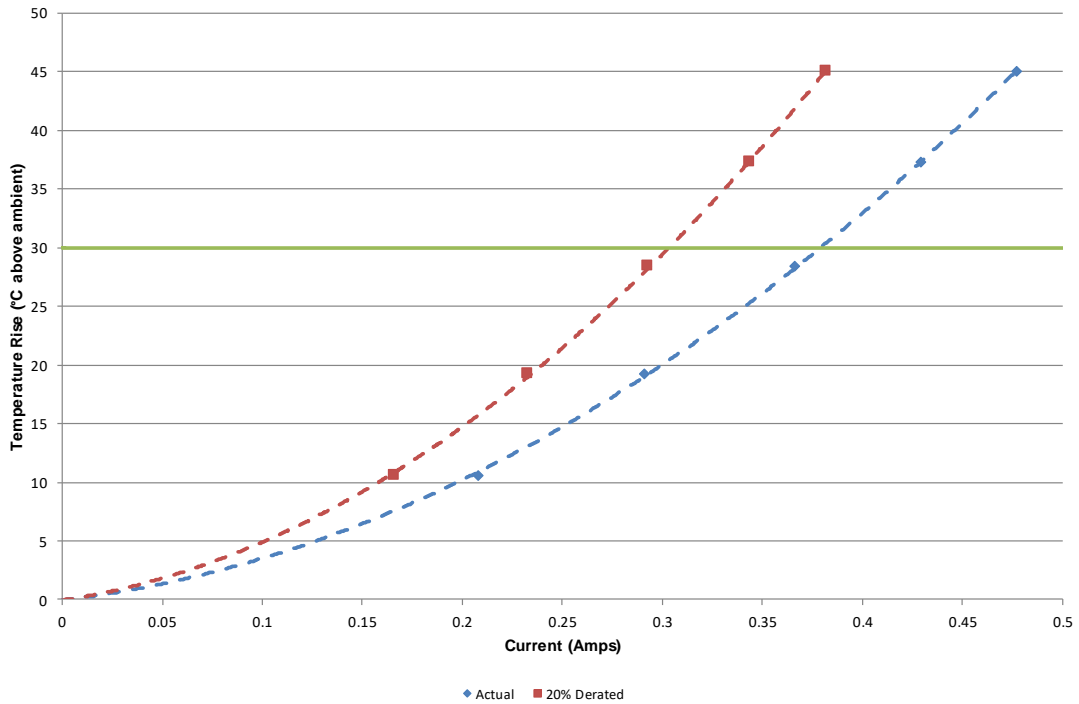
f. Linear configuration with 400 adjacent conductors/contacts powered

2246233
 400 (All Power) Contacts Powered in Series
 Part Numbers: APF6-100-03.5-L-04-2-A/APM6-100-01.5-L-04-2-A

Current Rating per Contact (30 Deg. Rise, 20% Derated) = 0.30



2246233
 400 (All Power) Contacts Powered in Series
 Part Numbers: APF6-100-03.5-L-04-2-A/APM6-100-01.5-L-04-2-A



DATA SUMMARIES Continued**MATING/UNMATING:****Mating/Unmating Durability Group****APF6-060-03.5-L-04-2-A/APM6-060-01.5-L-04-2-A**

	Initial				25 Cycles			
	Mating		Unmating		Mating		Unmating	
	Newton	Force (Lbs)	Newton	Force (Lbs)	Newton	Force (Lbs)	Newton	Force (Lbs)
Minimum	46.70	10.50	25.93	5.83	57.74	12.98	31.58	7.10
Maximum	57.07	12.83	31.22	7.02	62.98	14.16	39.77	8.94
Average	52.84	11.88	29.56	6.65	59.48	13.37	35.37	7.95
St Dev	2.97	0.67	1.72	0.39	1.93	0.43	2.46	0.55
Count	8	8	8	8	8	8	8	8
	After Humidity							
	Mating		Unmating					
	Newton	Force (Lbs)	Newton	Force (Lbs)				
Minimum	32.80	7.38	21.54	4.84				
Maximum	40.50	9.11	27.15	6.10				
Average	37.59	8.45	23.59	5.30				
St Dev	2.43	0.55	1.88	0.42				
Count	8	8	8	8				

Mating/Unmating Basic Group**APF6-020-03.5-S-04-2-A/APM6-020-01.5-S-04-2-A**

	Initial				25 Cycles			
	Mating		Unmating		Mating		Unmating	
	Newton	Force (Lbs)	Newton	Force (Lbs)	Newton	Force (Lbs)	Newton	Force (Lbs)
Minimum	16.28	3.66	8.67	1.95	18.73	4.21	11.61	2.61
Maximum	26.02	5.85	25.18	5.66	29.62	6.66	28.02	6.30
Average	19.35	4.35	12.12	2.73	21.60	4.86	14.94	3.36
St Dev	3.23	0.73	5.33	1.20	3.45	0.78	5.39	1.21
Count	8	8	8	8	8	8	8	8

DATA SUMMARIES Continued

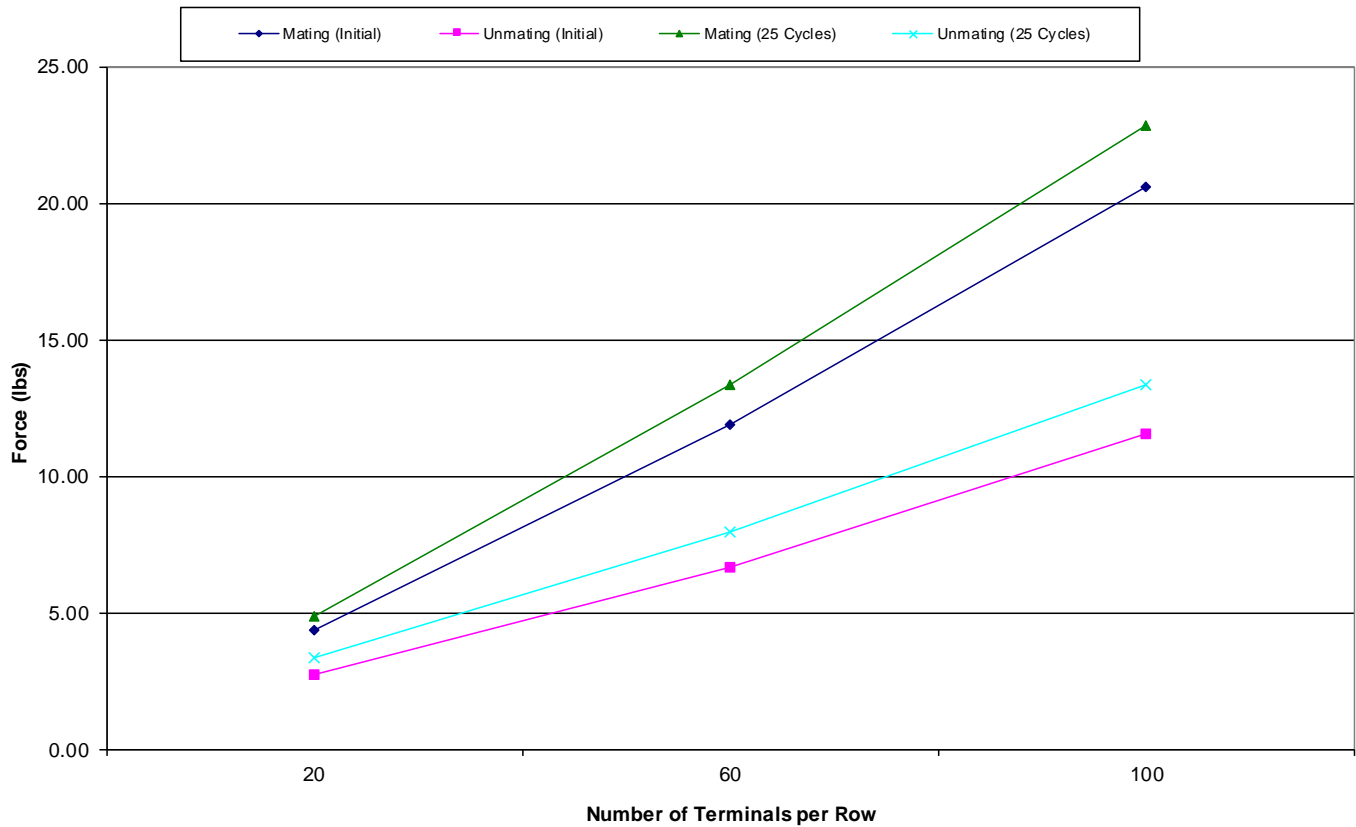
Mating/Unmating Basic Group

APF6-100-03.5-S-04-2-A/APM6-100-01.5-S-04-2-A

	Initial				25 Cycles			
	Mating		Unmating		Mating		Unmating	
	Newtons	Force (Lbs)	Newtons	Force (Lbs)	Newtons	Force (Lbs)	Newtons	Force (Lbs)
Minimum	85.67	19.26	45.77	10.29	94.79	21.31	54.49	12.25
Maximum	96.61	21.72	72.37	16.27	106.40	23.92	76.46	17.19
Average	91.52	20.58	51.30	11.53	101.58	22.84	59.36	13.35
St Dev	4.23	0.95	8.63	1.94	4.46	1.00	7.06	1.59
Count	8	8	8	8	8	8	8	8

Mating\Unmating Force Comparison

Mating/Unmating Data for 20, 60 and 100 Position APF6/APM6



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

	Pin to Pin		
	Mated	Unmated	Unmated
Minimum	APF6/APM6	APF6	APM6
Initial	45000	45000	45000
Thermal	45000	45000	45000
Humidity	45000	45000	45000

	Row to Row		
	Mated	Unmated	Unmated
Minimum	APF6/APM6	APF6	APM6
Initial	45000	45000	45000
Thermal	45000	45000	45000
Humidity	45000	45000	45000

DIELECTRIC WITHSTANDING VOLTAGE (DWV):

Voltage Rating Summary	
Minimum	APF6/APM6
Break Down Voltage	563
Test Voltage	425
Working Voltage	140

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

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

DATA SUMMARIES Continued

LLCR Durability:

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

LLCR Measurement Summaries by Pin Type				
Date	7/2/2019	7/9/2019	7/29/2019	8/9/2019
Room Temp (Deg C)	23	23	22	22
Rel Humidity (%)	50	49	50	54
Technician	John Crawford	John Crawford	John Crawford	John Crawford
mOhm values				
	Actual Initial	Delta 25 Cycles	Delta Therm Shck	Delta Humidity
Pin Type 1: Signal				
Average	17.32	0.74	0.79	9.97
St. Dev.	1.04	0.75	0.71	126.13
Min	14.87	0.00	0.00	0.00
Max	20.86	4.97	3.34	1753.09
Summary Count	192	192	192	192
Total Count	192	192	192	192

LLCR Delta Count by Category						
	Stable	Minor	Acceptable	Marginal	Unstable	Open
mOhms	≤ 5	$>5 \ \& \ \leq 10$	$>10 \ \& \ \leq 15$	$>15 \ \& \ \leq 50$	$>50 \ \& \ \leq 1000$	>1000
25 Cycles	192	0	0	0	0	0
Therm Shck	192	0	0	0	0	0
Humidity	191	0	0	0	0	1

Note: APX6, Sample 2, Position D01, Cause of LLCR Failure, Solder Pad Pulled from PCB.

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). The following guidelines are used to categorize the changes in LLCR as a result from stressing.
 - a. $\leq +5.0$ mOhms: -----Stable
 - b. $+5.1$ to $+10.0$ mOhms: -----Minor
 - c. $+10.1$ to $+15.0$ mOhms: -----Acceptable
 - d. $+15.1$ to $+50.0$ mOhms: -----Marginal
 - e. $+50.1$ to $+1000$ mOhms -----Unstable
 - f. $>+1000$ mOhms:-----Open Failure

APF6-060-03.5-L-04-2-A/APM6-060-01.5-L-04-2-A

LLCR Measurement Summaries by Pin Type				
Date	6/27/2019	7/23/2019		
Room Temp (Deg C)	23	22		
Rel Humidity (%)	45	49		
Technician	John Crawford	John Crawford		
mOhm values	Actual	Delta	Delta	Delta
	Initial	Shock-Vib		
Pin Type 1: Signal				
Average	17.30	0.30		
St. Dev.	1.03	0.28		
Min	14.91	0.00		
Max	20.81	1.75		
Summary Count	192	192		
Total Count	192	192		

LLCR Delta Count by Category						
	Stable	Minor	Acceptable	Marginal	Unstable	Open
mOhms	≤ 5	$>5 \ \& \ \leq 10$	$>10 \ \& \ \leq 15$	$>15 \ \& \ \leq 50$	$>50 \ \& \ \leq 1000$	>1000
Shock-Vib	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 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). The following guidelines are used to categorize the changes in LLCR as a result from stressing.
 - a. $\leq +5.0$ mOhms: -----Stable
 - b. $+5.1$ to $+10.0$ mOhms: -----Minor
 - c. $+10.1$ to $+15.0$ mOhms: -----Acceptable
 - d. $+15.1$ to $+50.0$ mOhms: -----Marginal
 - e. $+50.1$ to $+1000$ mOhms -----Unstable
 - f. $>+1000$ mOhms:-----Open Failure

APF6-100-03.5-L-04-2-A/APM6-100-01.5-L-04-2-A

LLCR Measurement Summaries by Pin Type				
Date	1/8/2020	2/11/2020		
Room Temp (Deg C)	23	22		
Rel Humidity (%)	36	30		
Technician	Aaron McKim	Aaron McKim		
mOhm values	Actual	Delta	Delta	Delta
	Initial	Shock-Vib		
Pin Type 1: Signal				
Average	18.48	0.64		
St. Dev.	0.94	0.52		
Min	15.63	0.01		
Max	22.19	2.77		
Summary Count	192	192		
Total Count	192	192		

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

EQUIPMENT AND CALIBRATION SCHEDULES**Equipment #:** TCT-04**Description:** Dillon Quantrol TC21 25-1000 mm/min series test stand**Manufacturer:** Dillon Quantrol**Model:** TC2 I series test stand**Serial #:** 04-1041-04**Accuracy:** Speed Accuracy: +/- 5% of indicated speed; Speed Accuracy: +/- 5% of indicated speed;
... Last Cal: 05/29/2019, Next Cal: 05/29/2020**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

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

... Last Cal: 11/14/2019, Next Cal: 11/14/2020

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

... Last Cal: 06/30/2019, Next Cal: 06/30/2020

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 #: OV-05**Description:** Forced Air Oven, 5 Cu. Ft., 120 V (Chamber Room)**Manufacturer:** Sheldon Mfg.**Model:** CE5F**Serial #:** 02008008**Accuracy:** +/- 5 deg. C

... Last Cal: 02/05/2019, Next Cal: 02/05/2020

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

... Last Cal: 09/11/2019, Next Cal: 09/11/2020

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

... Last Cal: NOT CALIBRATED

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