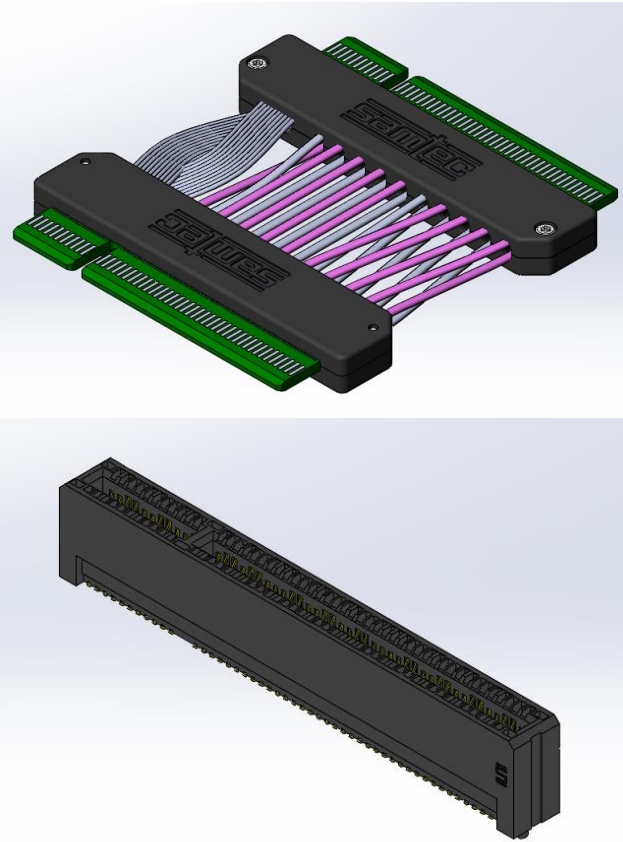




Project Number: Design Qualification Test Report	Tracking Code: 3296875_Report_Rev_1
Requested by: Leo Lee	Date: 8/3/2022
Part #: PCIEC-G5-164-0400-C2-P-85/PCIE-G5-16-01-L-DP-A-WT	Tech: Peter Chen
Part description: PCIEC-G5/ PCIE-G5	Qty to test: 60
Test Start: 01/13/2022	Test Completed: 3/2/2022



DESIGN QUALIFICATION TEST REPORT

PCIEC-G5/ PCIE-G5
PCIEC-G5-164-0400-C2-P-85/PCIE-G5-16-01-L-DP-A-WT

REVISION HISTORY

DATA	REV.NUM.	DESCRIPTION	ENG
7/22/2022	1	Initial Issue	PC

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 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 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-111962-TST, PCB-111965-TST.

FLOWCHARTS

Gas Tight

Group 1

PCIEC-G5-164-0400-C2-P-85

PCIE-G5-16-01-L-DP-A-WT

8 Assemblies

Step	Description
------	-------------

- | | |
|----|---------------------------------|
| 1. | LLCR (2) |
| 2. | Gas Tight (1) |
| 3. | LLCR (2)
Max Delta = 15 mOhm |

(1) Gas Tight = EIA-364-36

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

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

PCIEC-G5-164-0400-C2-P-85
PCIE-G5-16-01-L-DP-A-WT
8 Assemblies

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

Group 2

PCIEC-G5-036-0400-C2-P-85
PCIE-G5-01-01-L-DP-A
8 Assemblies

Step	Description
1.	Contact Gaps
2.	Mating/Unmating Force (3)
3.	Cycles Quantity = 25 Cycles
4.	Mating/Unmating Force (3)
5.	Cycles Quantity = 25 Cycles
6.	Mating/Unmating Force (3)
7.	Cycles Quantity = 25 Cycles
8.	Mating/Unmating Force (3)
9.	Cycles Quantity = 25 Cycles
10.	Mating/Unmating Force (3)

Group 3

PCIEC-G5-098-0400-C2-P-85
PCIE-G5-08-01-L-DP-A
8 Assemblies

Step	Description
1.	Contact Gaps
2.	Mating/Unmating Force (3)
3.	Cycles Quantity = 25 Cycles
4.	Mating/Unmating Force (3)
5.	Cycles Quantity = 25 Cycles
6.	Mating/Unmating Force (3)
7.	Cycles Quantity = 25 Cycles
8.	Mating/Unmating Force (3)
9.	Cycles Quantity = 25 Cycles
10.	Mating/Unmating Force (3)

(1) Humidity = EIA-364-31

Test Condition = B (240 Hours)

Test Method = III (+25°C to +65°C @ 90% RH to 98% RH)

Test Exceptions: ambient pre-condition and delete steps 7a and 7b

(2) LLCR = EIA-364-23

Open Circuit Voltage = 20 mV Max

Test Current = 100 mA Max

(3) Mating/Unmating Force = EIA-364-13**(4) Thermal Shock = EIA-364-32**

Exposure Time at Temperature Extremes = 1/2 Hour

Method A, Test Condition = I (-55°C to +85°C)

Test Duration = A-3 (100 Cycles)

FLOWCHARTS Continued**IR/DWV****Pin-to-Pin**

<u>Group 1</u> PCIEC-G5-164-0400-C2-P-85 PCIE-G5-16-01-L-DP-A-WT 2 Assemblies		<u>Group 2</u> PCIEC-G5-164-0400-C2-P-85 2 Assemblies		<u>Group 3</u> PCIE-G5-16-01-L-DP-A-WT 2 Assemblies		<u>Group 4</u> PCIEC-G5-164-0400-C2-P-85 PCIE-G5-16-01-L-DP-A-WT 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

<u>Group 5</u> PCIEC-G5-164-0400-C2-P-85 PCIE-G5-16-01-L-DP-A-WT 2 Assemblies		<u>Group 6</u> PCIEC-G5-164-0400-C2-P-85 2 Assemblies		<u>Group 7</u> PCIE-G5-16-01-L-DP-A-WT 2 Assemblies		<u>Group 8</u> PCIEC-G5-164-0400-C2-P-85 PCIE-G5-16-01-L-DP-A-WT 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

PCIEC-G5-164-0400-C2-P-85
PCIE-G5-16-01-L-DP-A-WT
2 Pins Powered
Signal

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

Group 2

PCIEC-G5-164-0400-C2-P-85
PCIE-G5-16-01-L-DP-A-WT
4 Pins Powered
Signal

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

Group 3

PCIEC-G5-164-0400-C2-P-85
PCIE-G5-16-01-L-DP-A-WT
6 Pins Powered
Signal

Step	Description
1.	CCC ⁽²⁾ Rows = 2 Number of Positions = 3

Group 4

PCIEC-G5-164-0400-C2-P-85
PCIE-G5-16-01-L-DP-A-WT
8 Pins Powered
Signal

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

Group 5

PCIEC-G5-164-0400-C2-P-85
PCIE-G5-16-01-L-DP-A-WT
156 Pins Powered
Signal

Step	Description
1.	CCC ⁽²⁾ Rows = 2 Number of Positions = 78

Group 6

PCIEC-G5-164-0400-C2-P-85
PCIE-G5-16-01-L-DP-A-WT
2 Pins Powered
Power

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

Group 7

PCIEC-G5-164-0400-C2-P-85
PCIE-G5-16-01-L-DP-A-WT
4 Pins Powered
Power

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

Group 8

PCIEC-G5-164-0400-C2-P-85
PCIE-G5-16-01-L-DP-A-WT
6 Pins Powered
Power

Step	Description
1.	CCC ⁽²⁾ Rows = 2 Number of Positions = 3

Group 9

PCIEC-G5-164-0400-C2-P-85
PCIE-G5-16-01-L-DP-A-WT
8 Pins Powered
Power

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

Group 10

PCIEC-G5-164-0400-C2-P-85
PCIE-G5-16-01-L-DP-A-WT
All Power

Step	Description
1.	CCC - All Power ⁽¹⁾

Group 11

PCIEC-G5-164-0400-C2-P-85
PCIE-G5-16-01-L-DP-A-WT
All Power 12V Pins

Step	Description
1.	CCC - All Power ⁽¹⁾

Group 12

PCIEC-G5-164-0400-C2-P-85
PCIE-G5-16-01-L-DP-A-WT
All Power 3.3V Pins

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**Cable Flex****Group 1**

PCIEC-G5-164-0400-C2-P-85

PCIE-G5-16-01-L-DP-A-WT

8 Assemblies

Flat Cable

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

(1) Cable Flex = EIA-364-41

Circular Jacket Cable - to be tested 90° each direction (180° total)

Flat Cable - to be tested 70° each direction (140° total)

Monitor continuity during flex testing

Failure = Discontinuity >1 microsecond at 10 ohms

(2) DWV at Test Voltage = EIA-364-20

Test Condition = 1 (Sea Level)

DWV test voltage is equal to 75% of the lowest breakdown voltage

Test voltage applied for 60 seconds

(3) IR = EIA-364-21

Test Condition = 500 Vdc, 2 Minutes Max

ATTRIBUTE DEFINITIONS

The following is a brief, simplified description of attributes.

THERMAL 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.

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.

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.

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 buildup) are energized.
- 9) The thermocouple (or temperature measuring probe) will be positioned at a location to sense the maximum temperature in the vicinity of the heat generation area.
- 10) A computer program, *TR 803.exe*, ensures accurate stability for data acquisition.
- 11) Hook-up wire cross section is larger than the cross section of any connector leads/PC board traces, jumpers, etc.
- 12) Hook-up wire length is longer than the minimum specified in the referencing standard.

ATTRIBUTE DEFINITIONS Continued

The following is a brief, simplified description of attributes.

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

GAS TIGHT:

To provide method for evaluating the ability of the contacting surfaces in preventing penetration of harsh vapors which might lead to oxide formation that may degrade the electrical performance of the contact system.

- 1) EIA-364-23, *Low Level Contact Resistance Test Procedure for Electrical Connectors and Sockets*.
- 2) A computer program, *LLCR 221.exe*, ensures repeatability for data acquisition.
- 3) The following guidelines are used to categorize the changes in LLCR as a result from stressing
 - a. $\leq +5.0$ mOhms: -----Stable
 - b. $+5.1$ to $+10.0$ mOhms:-----Minor
 - c. $+10.1$ to $+15.0$ mOhms: -----Acceptable
 - d. $+15.1$ to $+50.0$ mOhms: -----Marginal
 - e. $+50.1$ to $+1000$ mOhms: -----Unstable
 - f. $>+1000$ mOhms:-----Open Failure
- 4) Procedure:
 - a. Reference document: EIA-364-36, *Test Procedure for Determination of Gas-Tight Characteristics for Electrical Connectors, Sockets and/or Contact Systems*.
 - b. Test Conditions:
 - i. Class II--- Mated pairs of contacts assembled to their plastic housings.
 - ii. Reagent grade Nitric Acid shall be used of sufficient volume to saturate the test chamber
 - iii. The ratio of the volume of the test chamber to the surface area of the acid shall be 10:1.
 - iv. The chamber shall be saturated with the vapor for at least 15 minutes before samples are added.
 - v. Exposure time, 55 to 65 minutes.
 - vi. The samples shall be no closer to the chamber walls than 1 inch and no closer to the surface of the acid than 3 inches.
 - vii. The samples shall be dried after exposure for a minimum of 1 hour.
 - viii. Drying temperature 50° C
 - ix. The final LLCR shall be conducted within 1 hour after drying.

ATTRIBUTE DEFINITIONS Continued

The following is a brief, simplified description of attributes

INSULATION RESISTANCE (IR):

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

- 1) PROCEDURE:
 - a. Reference document: EIA-364-21, *Insulation Resistance Test Procedure for Electrical Connectors*.
 - b. Test Conditions:
 - i. Between Adjacent Contacts or Signal-to-Ground
 - ii. Electrification Time 2.0 minutes
 - iii. Test Voltage (500 VDC) corresponds to calibration settings for measuring resistances.
- 2) MEASUREMENTS:
- 3) When the specified test voltage is applied (VDC), the insulation resistance shall not be less than 1000 megohms.

DIELECTRIC WITHSTANDING VOLTAGE (DWV):

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

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

ATTRIBUTE DEFINITIONS Continued

The following is a brief, simplified description of attributes.

CABLE PULL:

- 1) Secure cable near center and pull on connector
 - a. At 0 Degrees
 - b. At 90 Degrees



Fig. 1

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

CABLE FLEX:

- 1) Oscillate and monitor electrical continuity for open circuit indication.
 - a. $\pm 70^\circ$ Flex Mode, bend up to 500 cycles. 16 oz load on cable end .

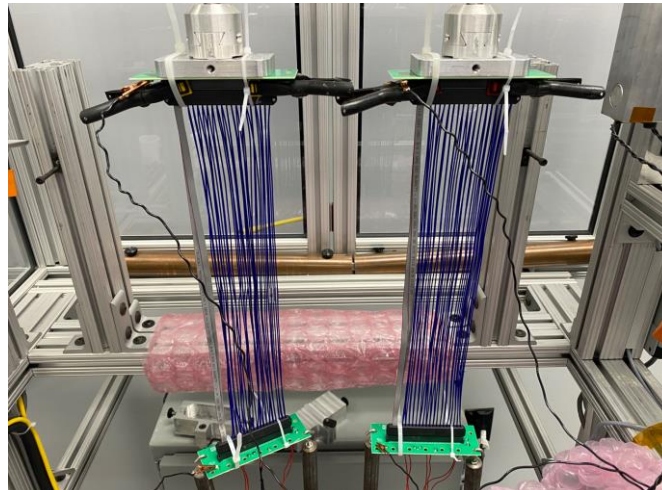


Fig. 2
(Typical set-up)

RESULTS

Temperature Rise, CCC at a 20% de-rating

Signal

- CCC for a 30°C Temperature Rise-----1.1 A per contact with 2 contacts (2x1) powered
- CCC for a 30°C Temperature Rise-----1.0 A per contact with 4 contacts (2x2) powered
- CCC for a 30°C Temperature Rise-----1.0 A per contact with 6 contacts (2x3) powered
- CCC for a 30°C Temperature Rise-----0.9 A per contact with 8 contacts (2x4) powered
- CCC for a 30°C Temperature Rise-----0.7 A per contact with All contacts (2x78) powered

Ground

- CCC for a 30°C Temperature Rise-----2.2 A per contact with 2 contacts (2x1) powered
- CCC for a 30°C Temperature Rise-----1.7 A per contact with 4 contacts (2x2) powered
- CCC for a 30°C Temperature Rise-----1.4 A per contact with 6 contacts (2x3) powered
- CCC for a 30°C Temperature Rise-----1.3 A per contact with 8 contacts (2x4) powered
- CCC for a 30°C Temperature Rise-----1.1 A per contact with All contacts (2x10) powered
- CCC for a 30°C Temperature Rise-----5.6 A per contact with All power 12V pins contacts powered
- CCC for a 30°C Temperature Rise-----4.6 A per contact with All Power 3.3V Pins contacts powered

Mating – Unmating Forces

Mating-Unmating Durability Group

- **Initial**
 - **Mating**
 - **Min** ----- 7.45 Lbs
 - **Max** ----- 9.38 Lbs
 - **Unmating**
 - **Min** ----- 3.93 Lbs
 - **Max** ----- 4.97 Lbs
- **After 25 Cycles**
 - **Mating**
 - **Min** ----- 7.47 Lbs
 - **Max** ----- 10.05 Lbs
 - **Unmating**
 - **Min** ----- 3.80 Lbs
 - **Max** ----- 5.60 Lbs
- **After 50 Cycles**
 - **Mating**
 - **Min** ----- 7.85 Lbs
 - **Max** ----- 10.45 Lbs
 - **Unmating**
 - **Min** ----- 4.78 Lbs
 - **Max** ----- 6.13 Lbs
- **After 75 Cycles**
 - **Mating**
 - **Min** ----- 8.02 Lbs
 - **Max** ----- 10.69 Lbs
 - **Unmating**
 - **Min** ----- 5.03 Lbs
 - **Max** ----- 6.42 Lbs

RESULTS Continued**Mating – Unmating Forces**

- **After 100 Cycles**
 - **Mating**
 - **Min** ----- 6.61 Lbs
 - **Max** ----- 10.05 Lbs
 - **Unmating**
 - **Min** ----- 5.36 Lbs
 - **Max** ----- 6.69 Lbs
- **Humidity**
 - **Mating**
 - **Min** ----- 7.03 Lbs
 - **Max** ----- 8.89 Lbs
 - **Unmating**
 - **Min** ----- 4.06 Lbs
 - **Max** ----- 5.40 Lbs

Mating-Unmating Basic (PCIEC-G5-036-0400-C2-P-85/ PCIE-G5-01-01-L-DP-A)

- **Initial**
 - **Mating**
 - **Min** ----- 1.55 Lbs
 - **Max** ----- 1.83 Lbs
 - **Unmating**
 - **Min** ----- 0.32 Lbs
 - **Max** ----- 0.71 Lbs
- **After 25 Cycles**
 - **Mating**
 - **Min** ----- 1.35 Lbs
 - **Max** ----- 1.89 Lbs
 - **Unmating**
 - **Min** ----- 0.27 Lbs
 - **Max** ----- 1.06 Lbs
- **After 50 Cycles**
 - **Mating**
 - **Min** ----- 1.43 Lbs
 - **Max** ----- 1.95 Lbs
 - **Unmating**
 - **Min** ----- 0.45 Lbs
 - **Max** ----- 2.14 Lbs
- **After 75 Cycles**
 - **Mating**
 - **Min** ----- 1.60 Lbs
 - **Max** ----- 2.01 Lbs
 - **Unmating**
 - **Min** ----- 0.34 Lbs
 - **Max** ----- 2.20 Lbs
- **After 100 Cycles**
 - **Mating**
 - **Min** ----- 1.89 Lbs
 - **Max** ----- 2.51 Lbs
 - **Unmating**
 - **Min** ----- 0.58 Lbs
 - **Max** ----- 2.31 Lbs

RESULTS Continued**Mating-Unmating Basic (PCIEC-G5-098-0400-C2-P-85A/ PCIE-G5-08-01-L-DP-A)**

- **Initial**
 - **Mating**
 - **Min** ----- 4.87 Lbs
 - **Max** ----- 6.66 Lbs
 - **Unmating**
 - **Min** ----- 2.37 Lbs
 - **Max** ----- 4.10 Lbs
- **After 25 Cycles**
 - **Mating**
 - **Min** ----- 4.57 Lbs
 - **Max** ----- 7.00 Lbs
 - **Unmating**
 - **Min** ----- 2.59 Lbs
 - **Max** ----- 4.67 Lbs
- **After 50 Cycles**
 - **Mating**
 - **Min** ----- 4.66 Lbs
 - **Max** ----- 7.13 Lbs
 - **Unmating**
 - **Min** ----- 3.49 Lbs
 - **Max** ----- 4.78 Lbs
- **After 75 Cycles**
 - **Mating**
 - **Min** ----- 4.73 Lbs
 - **Max** ----- 7.30 Lbs
 - **Unmating**
 - **Min** ----- 3.67 Lbs
 - **Max** ----- 4.89 Lbs
- **After 100 Cycles**
 - **Mating**
 - **Min** ----- 4.05 Lbs
 - **Max** ----- 7.22 Lbs
 - **Unmating**
 - **Min** ----- 3.81 Lbs
 - **Max** ----- 4.92 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 -----45000Meg 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-----840 VAC
 - Test Voltage -----630 VAC
 - Working Voltage -----210 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**Cable Flex:****Insulation Resistance minimums, IR****Pin to Pin**

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

Row to Row

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

Dielectric Withstanding Voltage minimums, DWV

- Test Voltage -----630 VAC

Pin to Pin

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

Row to Row

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

RESULTS Continued**LLCR Gas Tight Group (192 LLCR test points)****Signal Type 1**

- Initial ----- 195.99 mOhms Max

Signal Type 2

- Initial ----- 92.85 mOhms Max

Ground

- Initial ----- 14.62 mOhms Max
- Gas-Tight
 - <= +5.0 mOhms ----- 185 Points ----- Stable
 - +5.1 to +10.0 mOhms ----- 7 Points ----- Minor
 - +10.1 to +15.0 mOhms ----- 0 Points ----- Acceptable
 - +15.1 to +50.0 mOhms ----- 0 Points ----- Marginal
 - +50.1 to +1000 mOhms ----- 0 Points ----- Unstable
 - >+1000 mOhms ----- 0 Points ----- Open Failure

LLCR Mating/Unmating Durability Group (192 LLCR test points)**Signal Type 1**

- Initial ----- 192.51 mOhms Max

Signal Type 2

- Initial ----- 88.60 mOhms Max

Ground

- Initial ----- 13.55 mOhms Max
- Durability, 100 Cycles
 - <= +5.0 mOhms ----- 167 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 +1000 mOhms ----- 0 Points ----- Unstable
 - >+1000 mOhms ----- 0 Points ----- Open Failure
- Thermal Shock
 - <= +5.0 mOhms ----- 179 Points ----- Stable
 - +5.1 to +10.0 mOhms ----- 13 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 ----- 175 Points ----- Stable
 - +5.1 to +10.0 mOhms ----- 17 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

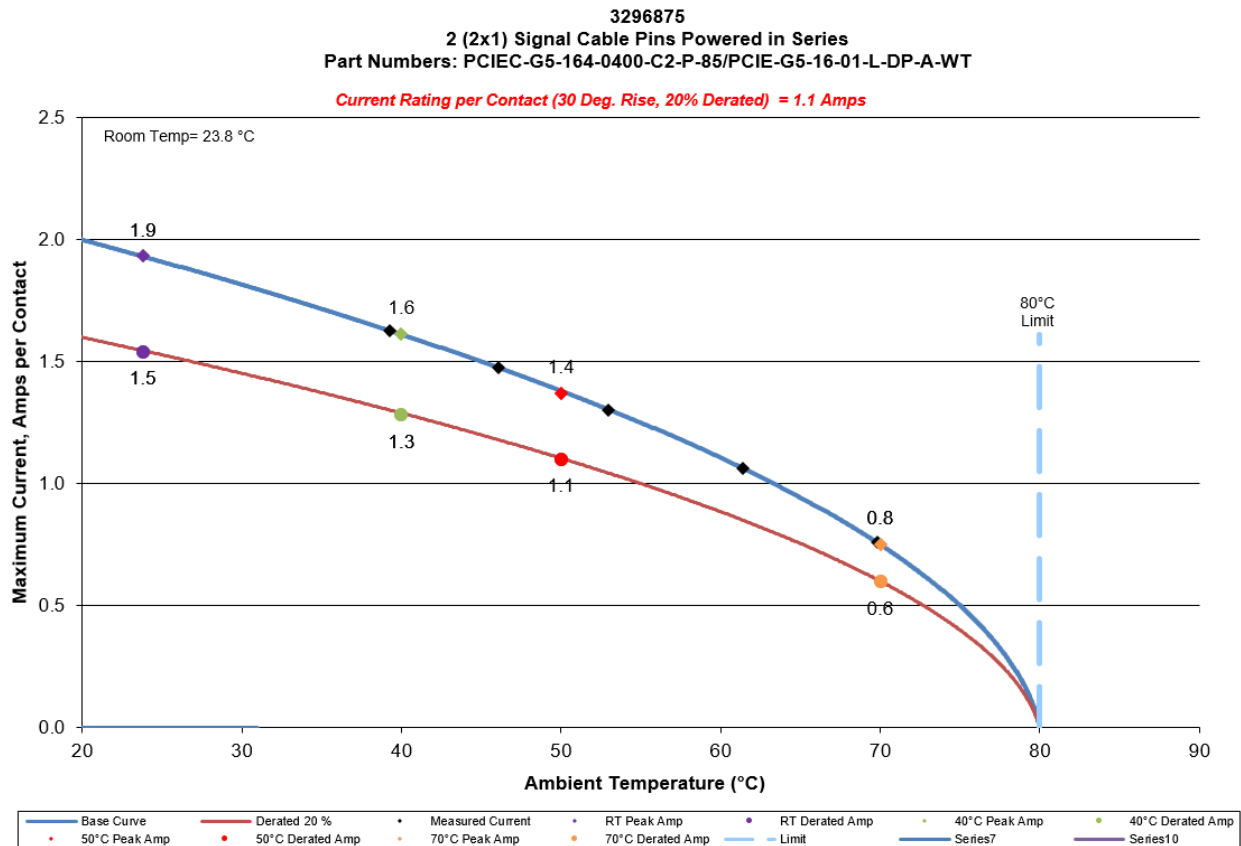
DATA SUMMARIES

TEMPERATURE RISE (Current Carrying Capacity, CCC):

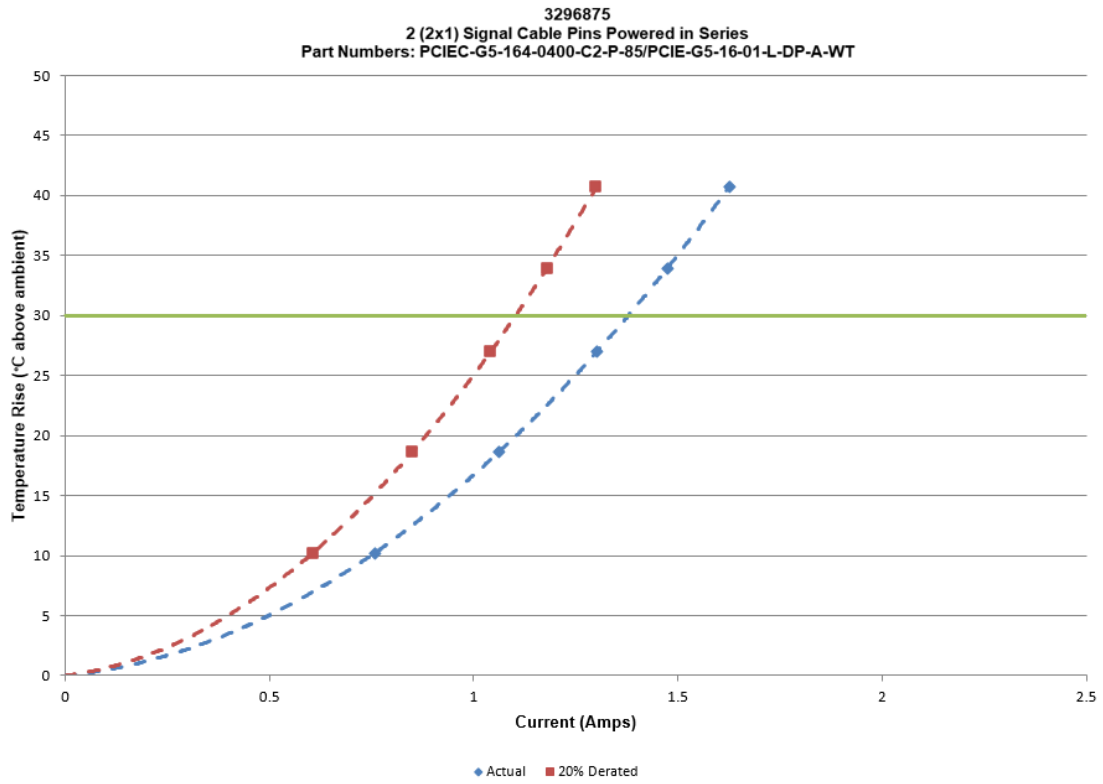
- 1) High quality thermocouples whose temperature slopes track one another were used for temperature monitoring.
- 2) The thermocouples were placed at a location to sense the maximum temperature generated during testing.
- 3) Temperature readings recorded are those for which three successive readings, 15 minutes apart, differ less than 1° C (computer controlled data acquisition).
- 4) Adjacent contacts were powered:

Signal

- a. Linear configuration with 2 adjacent conductors/contacts powered

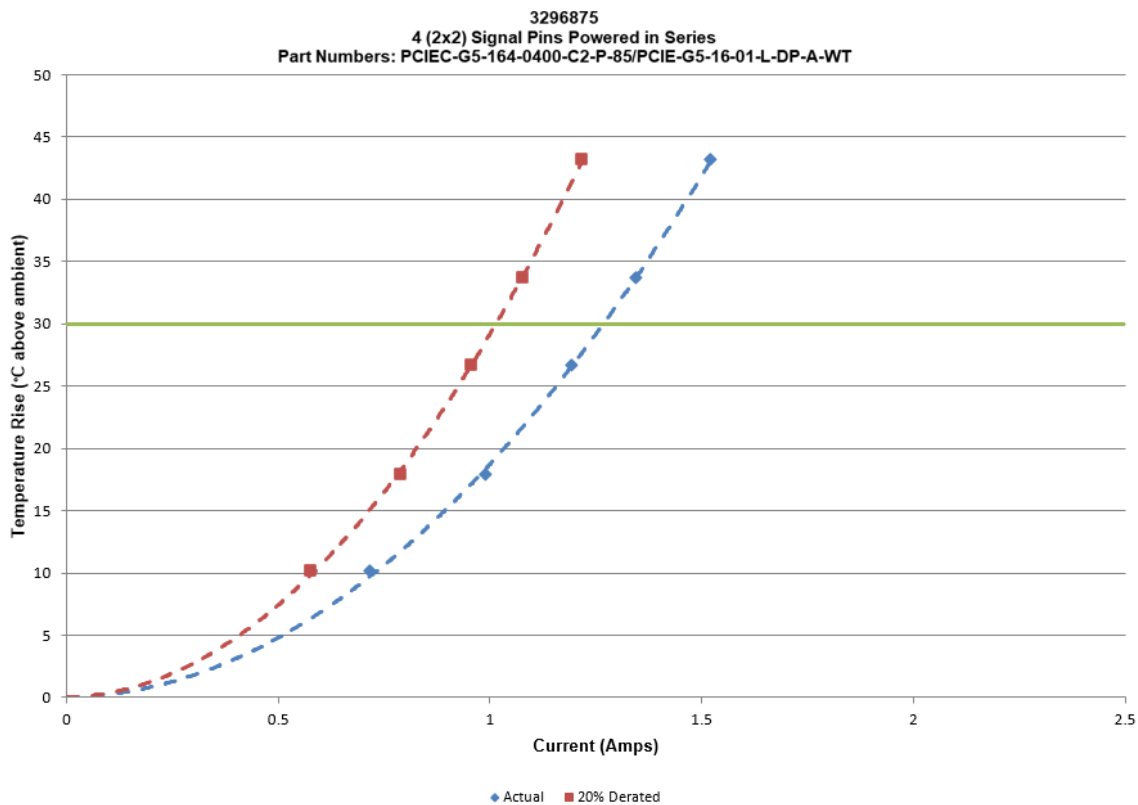
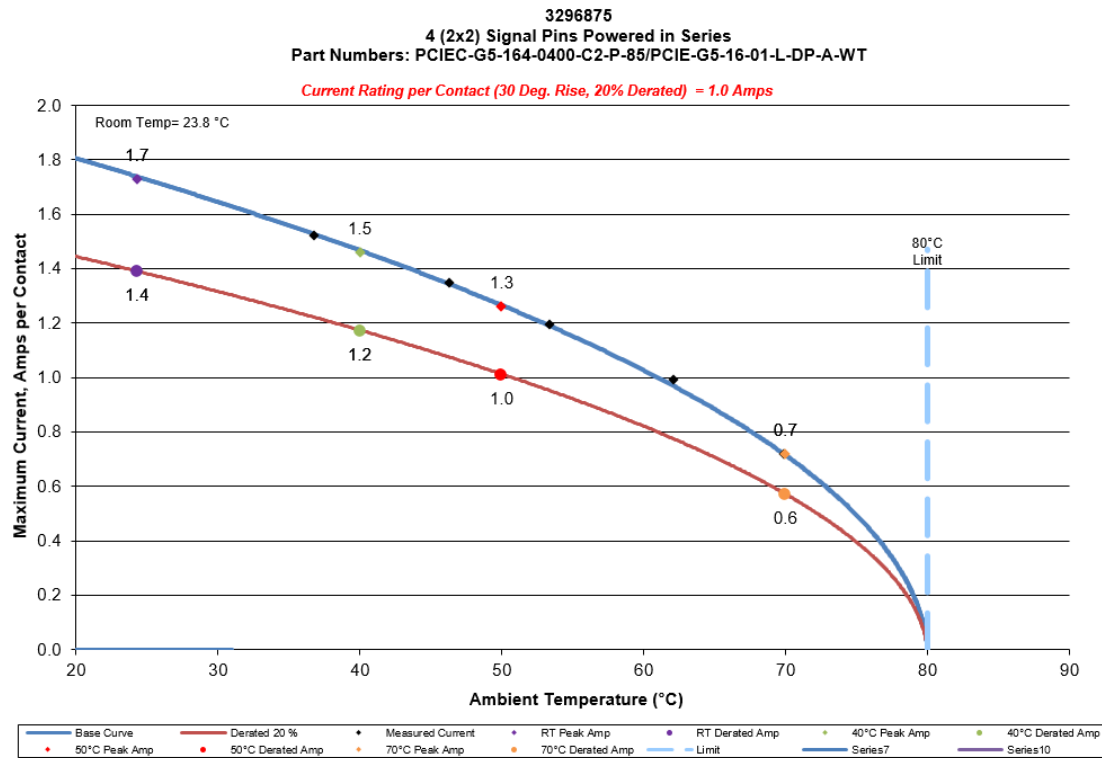


DATA SUMMARIES Continued



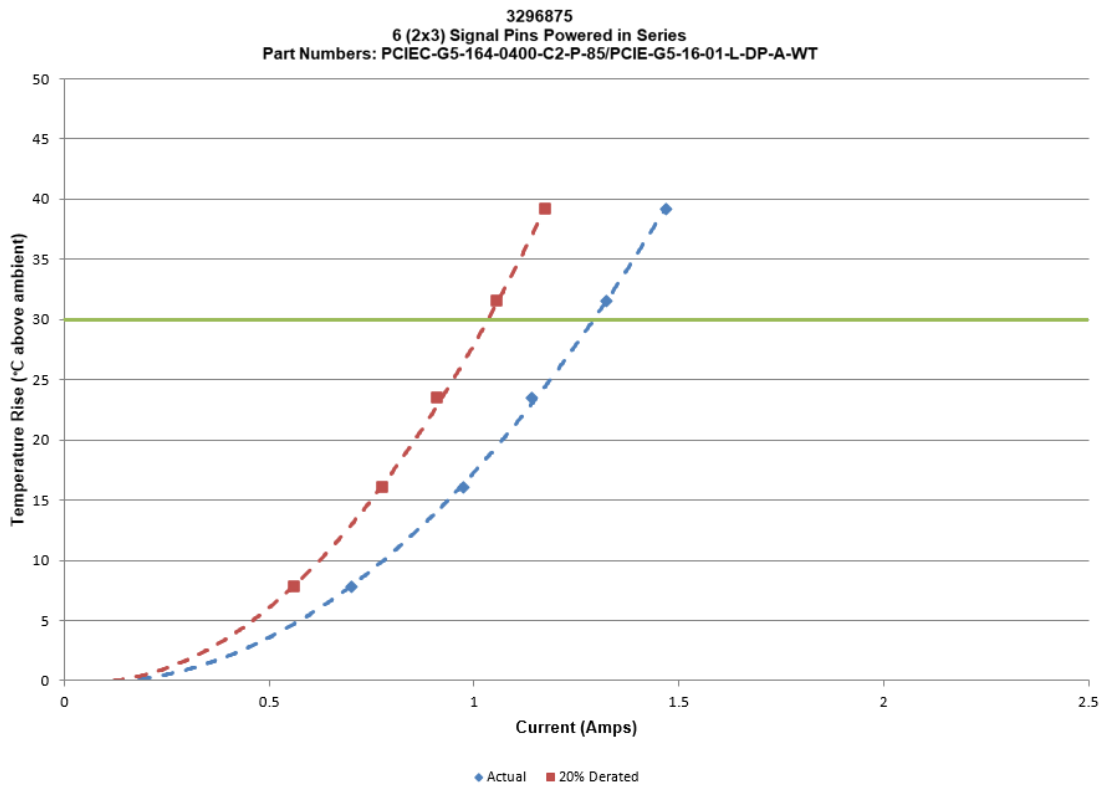
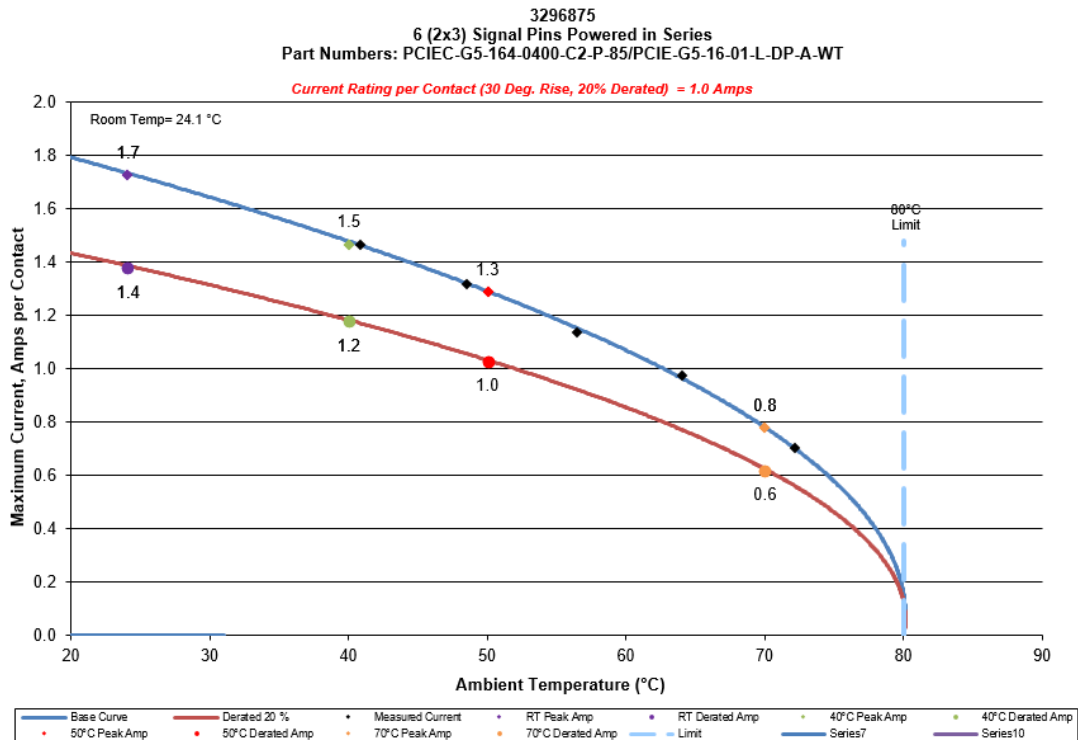
DATA SUMMARIES Continued

b. Linear configuration with 4 adjacent conductors/contacts powered



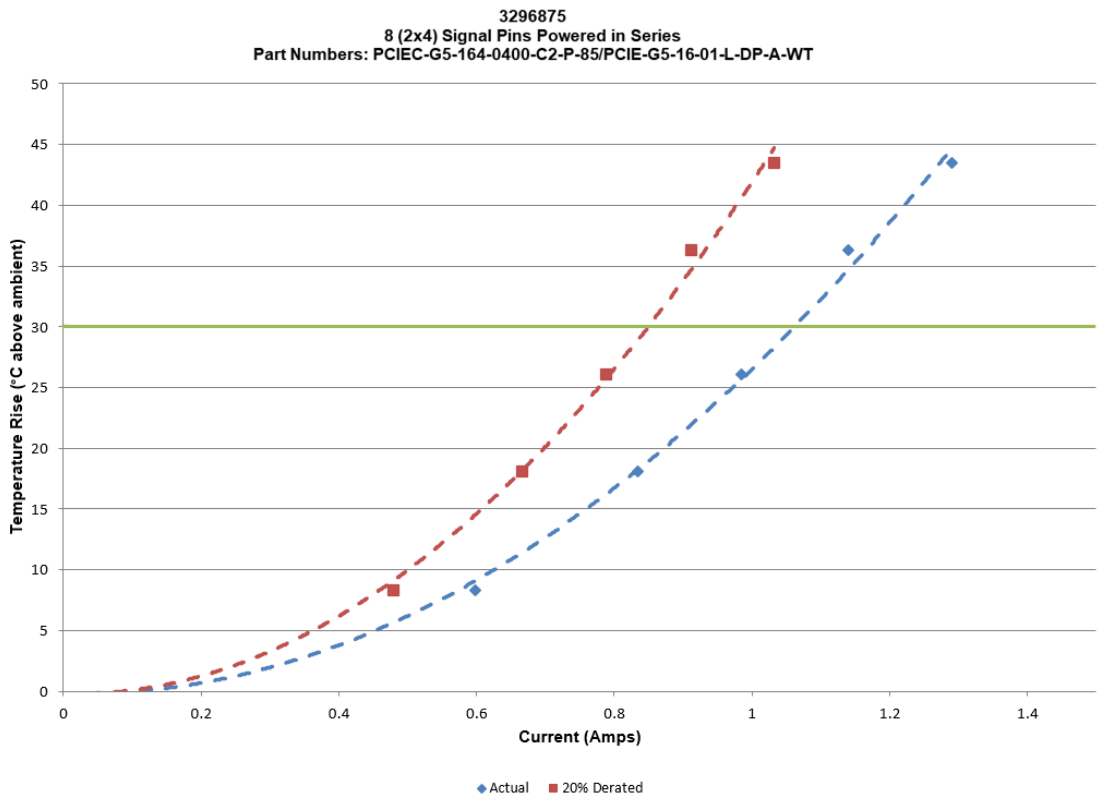
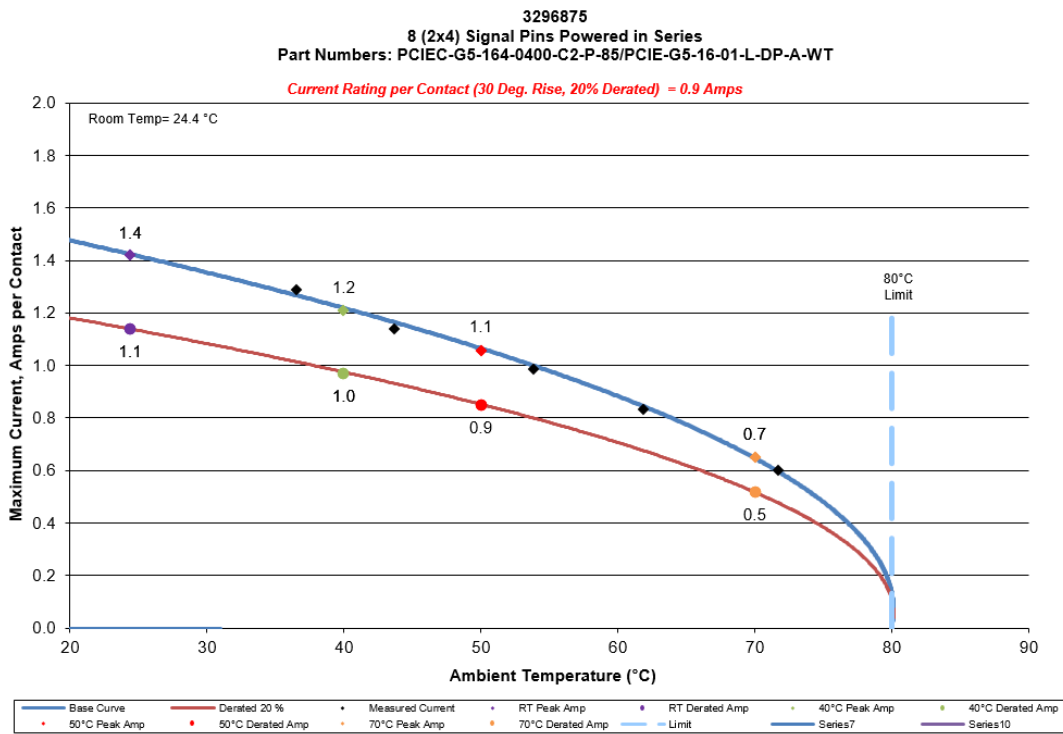
DATA SUMMARIES Continued

c. Linear configuration with 6 adjacent conductors/contacts powered



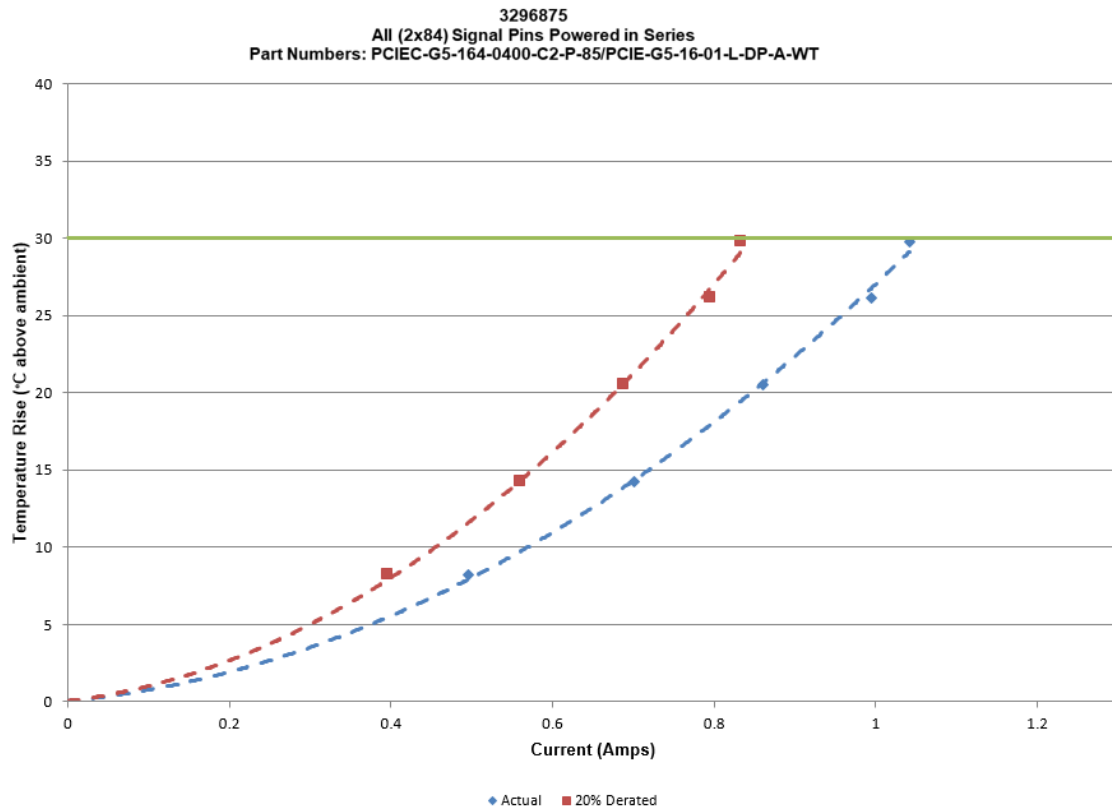
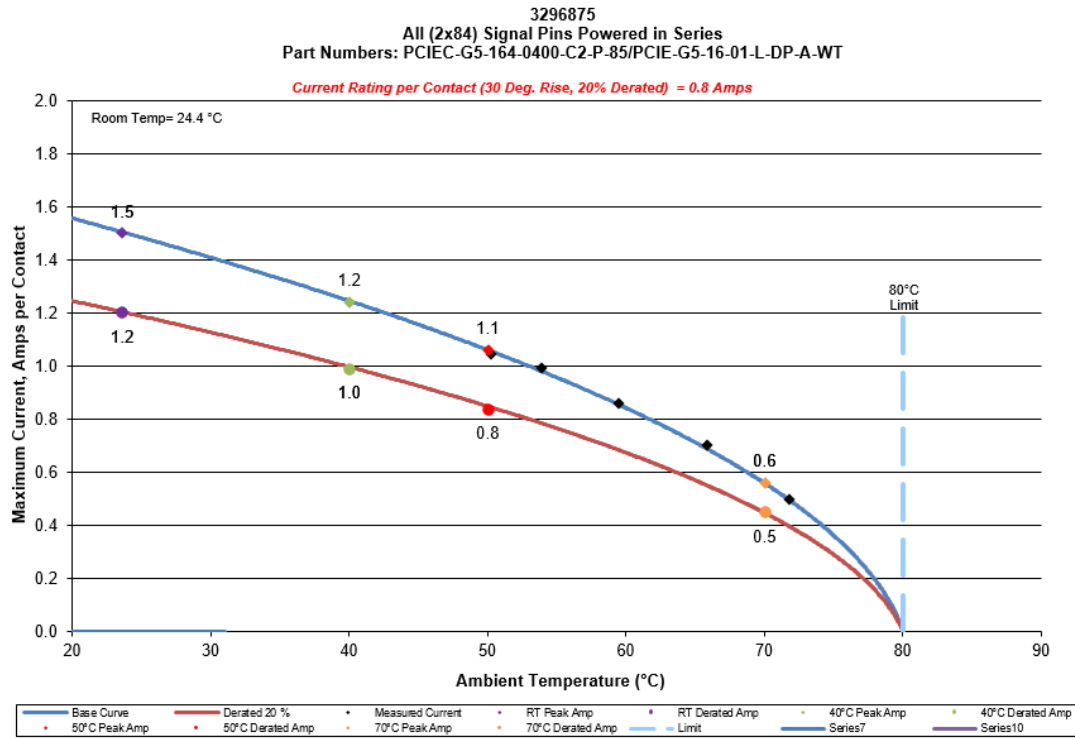
DATA SUMMARIES Continued

d. Linear configuration with 8 adjacent conductors/contacts powered



DATA SUMMARIES Continued

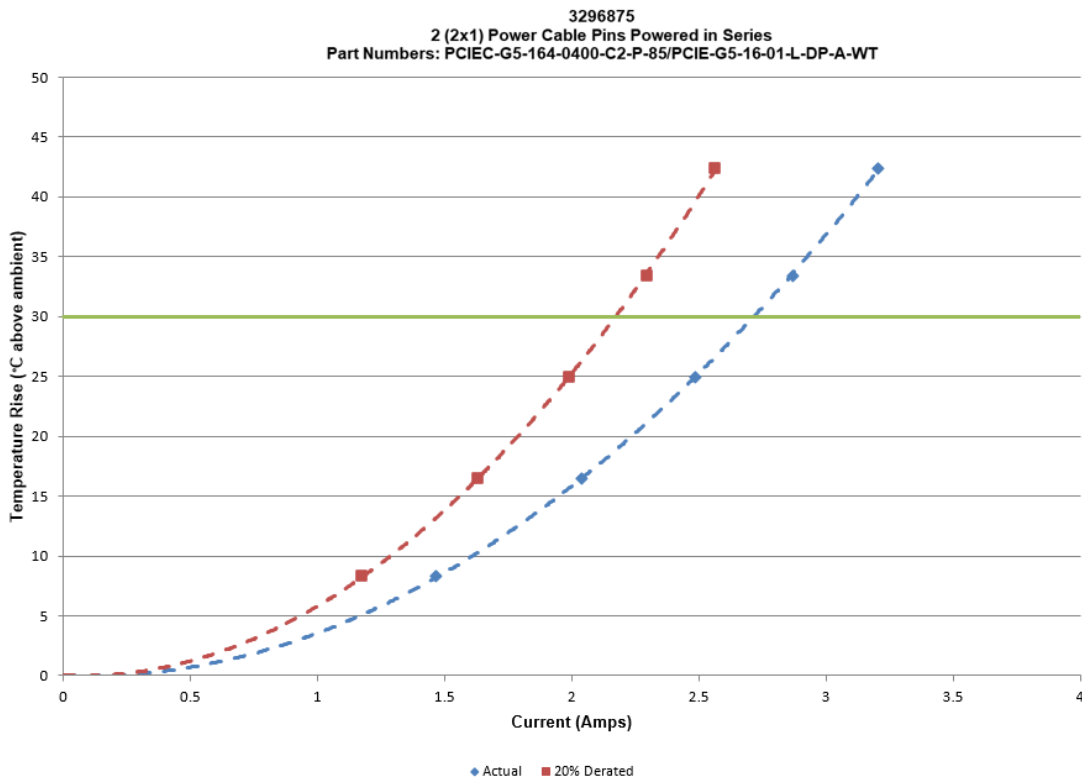
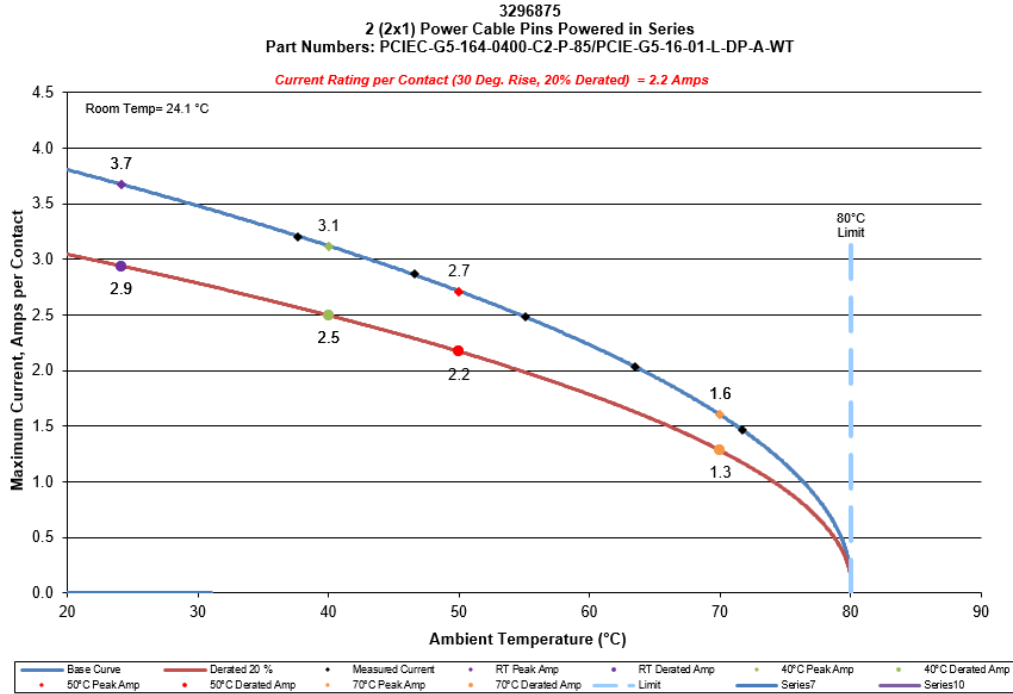
e. Linear configuration with all adjacent conductors/contacts powered



DATA SUMMARIES Continued

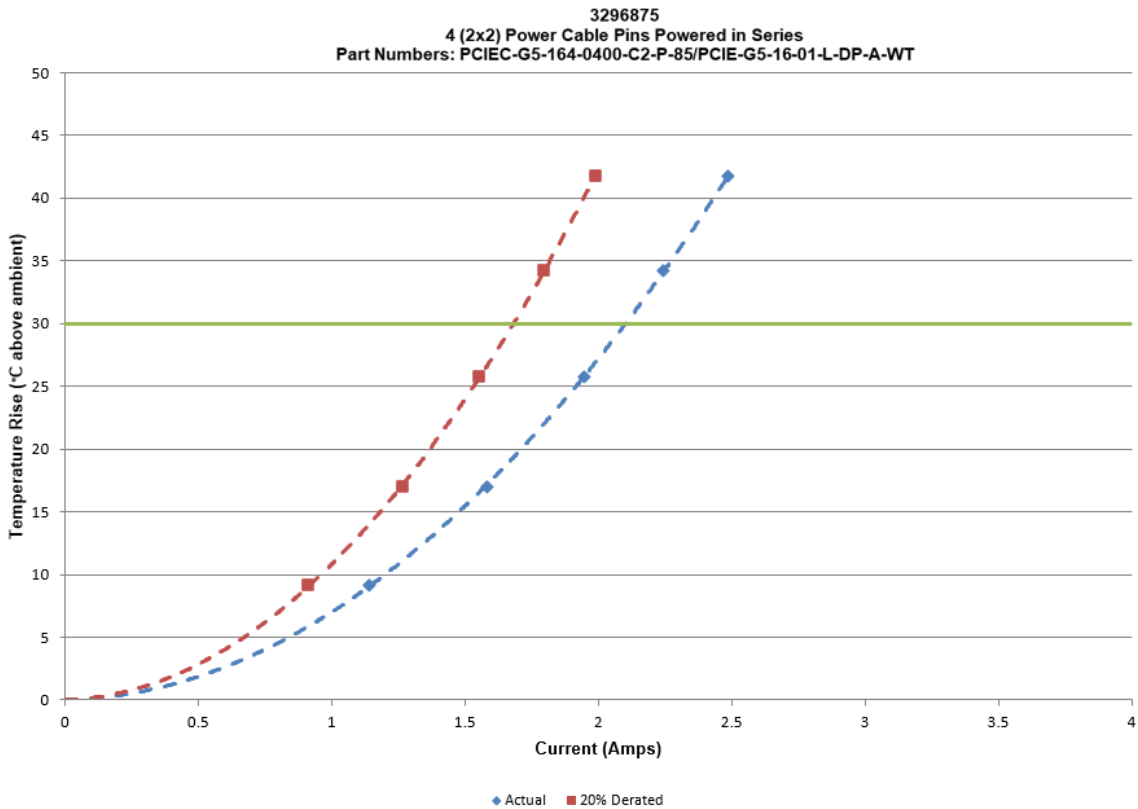
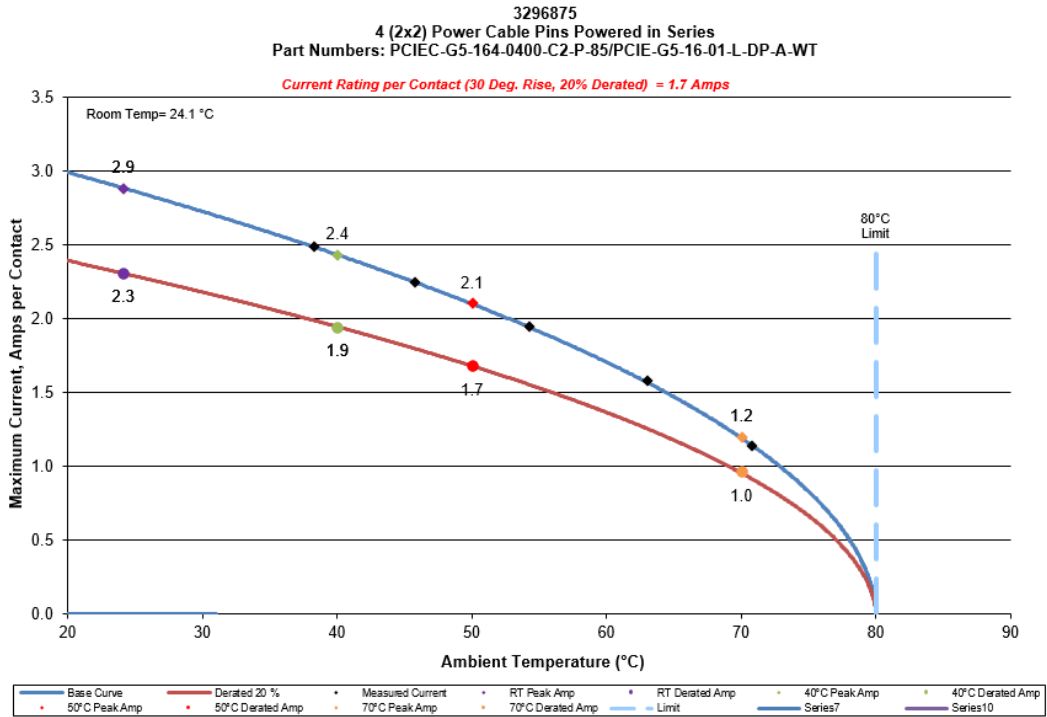
Ground

a. Linear configuration with 2 adjacent conductors/contacts powered



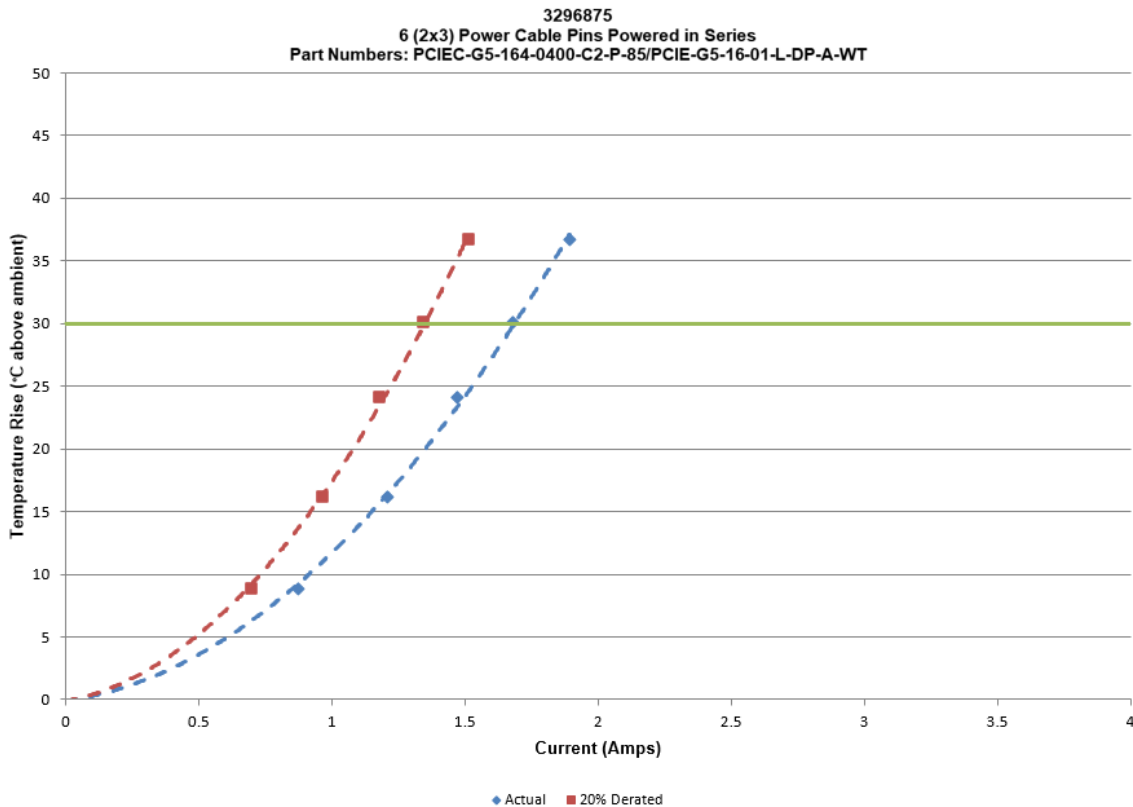
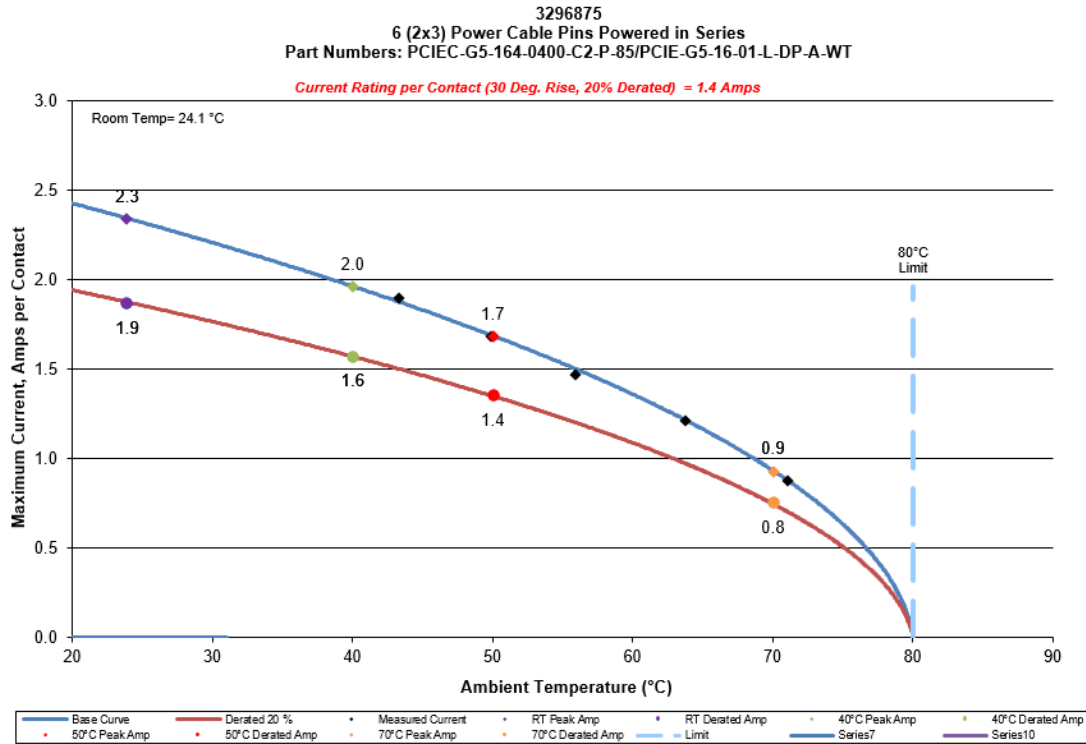
DATA SUMMARIES Continued

b. Linear configuration with 4 adjacent conductors/contacts powered



DATA SUMMARIES Continued

c. Linear configuration with 6 adjacent conductors/contacts powered

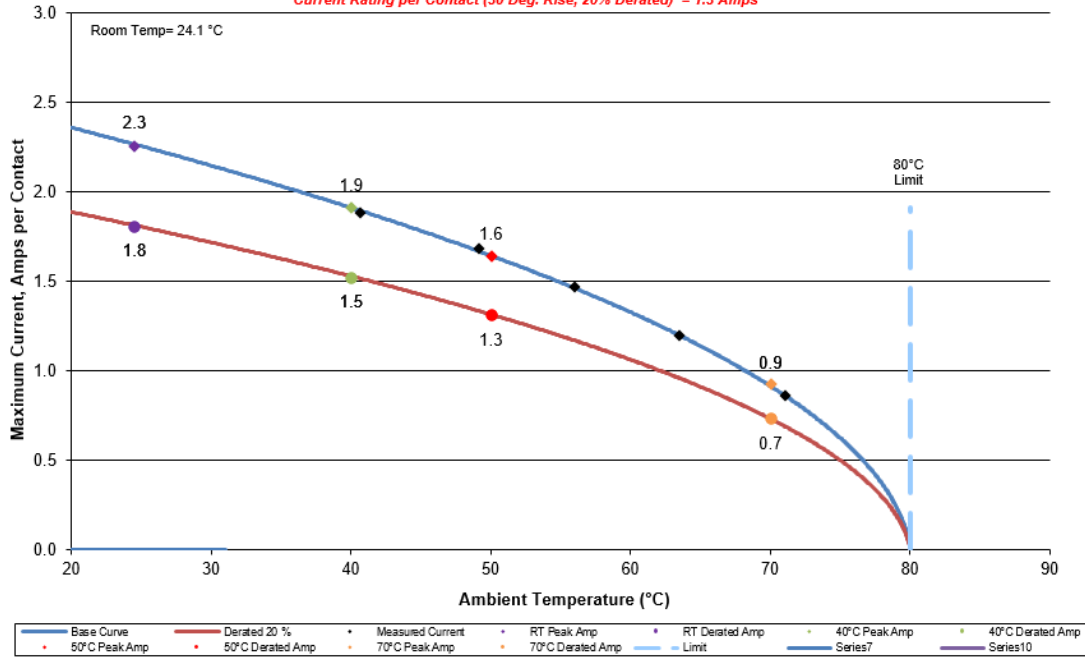


DATA SUMMARIES Continued

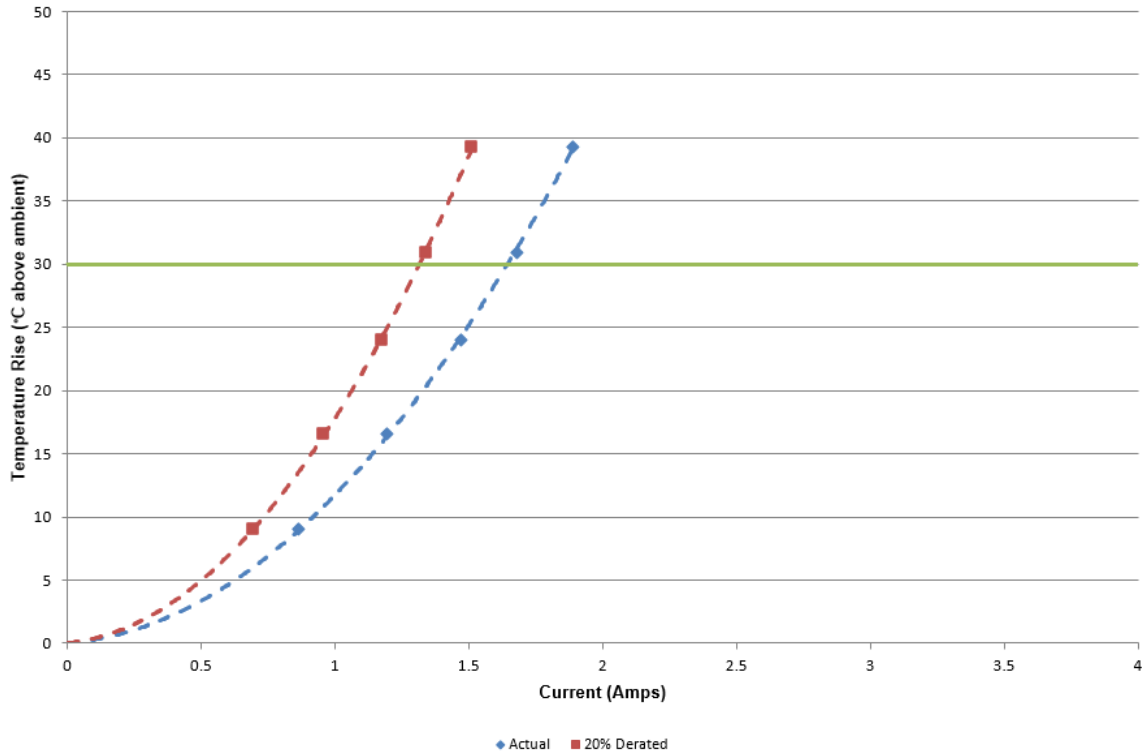
d. Linear configuration with 8 adjacent conductors/contacts powered

3296875
 8 (2x4) Power Cable Pins Powered in Series
 Part Numbers: PCIEC-G5-164-0400-C2-P-85/PCIE-G5-16-01-L-DP-A-WT

Current Rating per Contact (30 Deg. Rise, 20% Derated) = 1.3 Amps

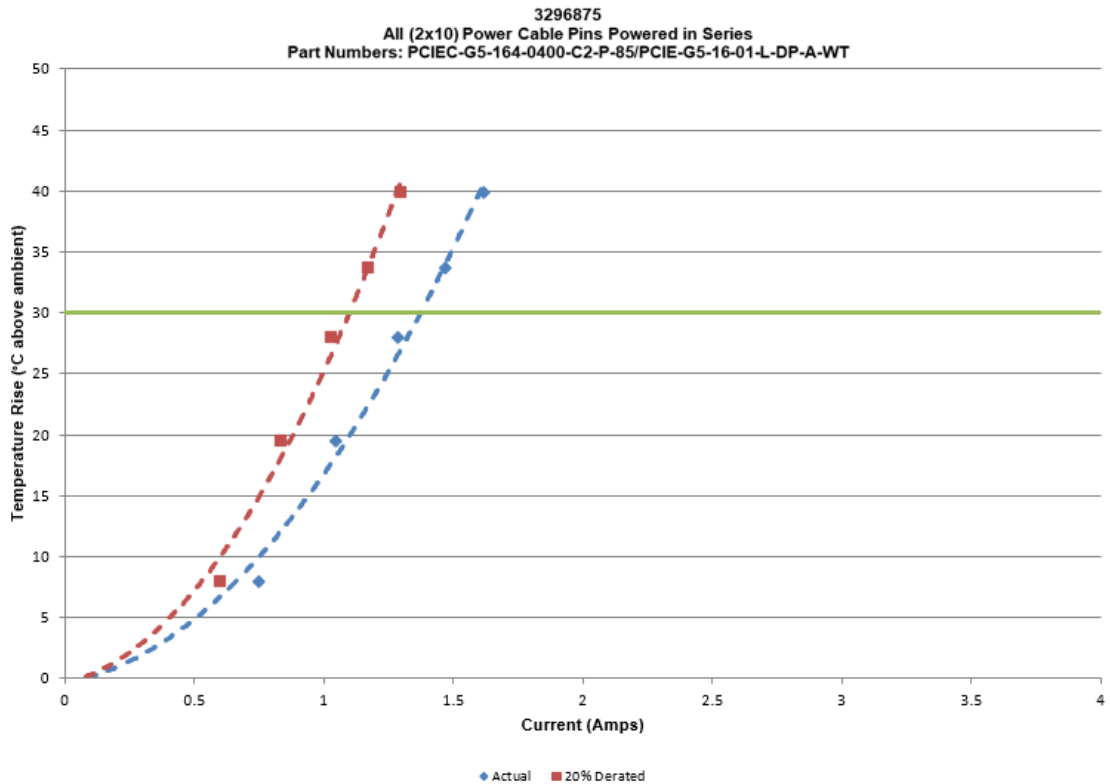
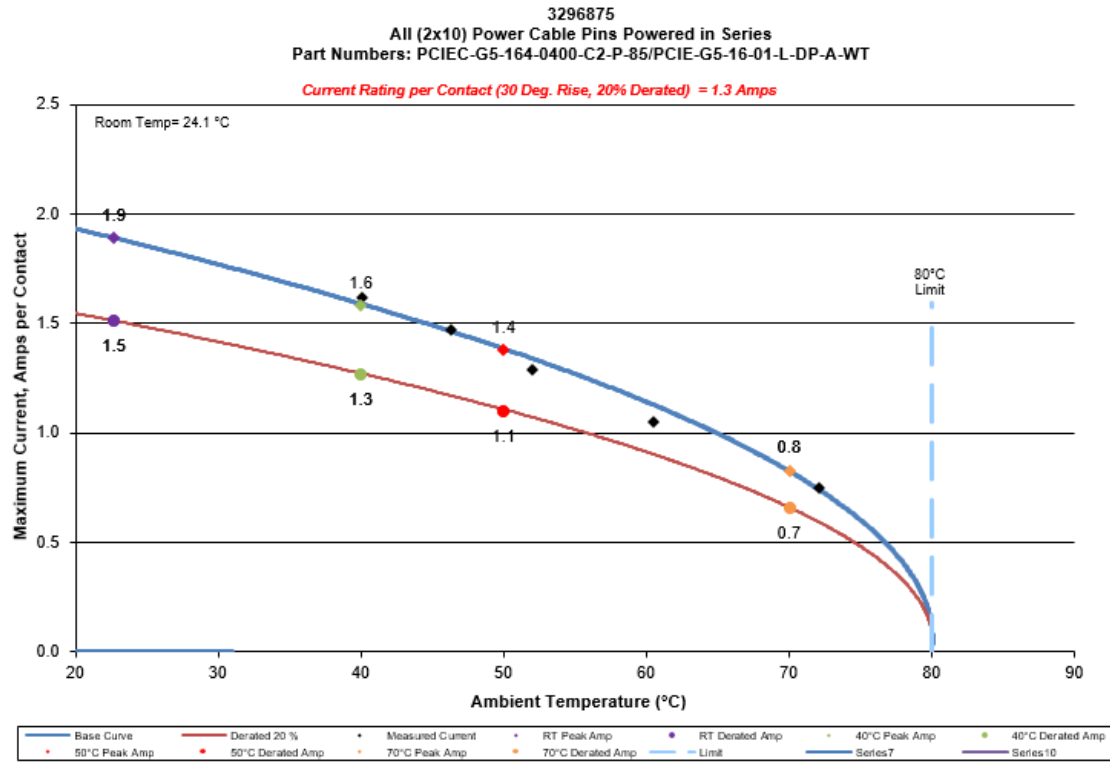


3296875
 8 (2x4) Power Cable Pins Powered in Series
 Part Numbers: PCIEC-G5-164-0400-C2-P-85/PCIE-G5-16-01-L-DP-A-WT



DATA SUMMARIES Continued

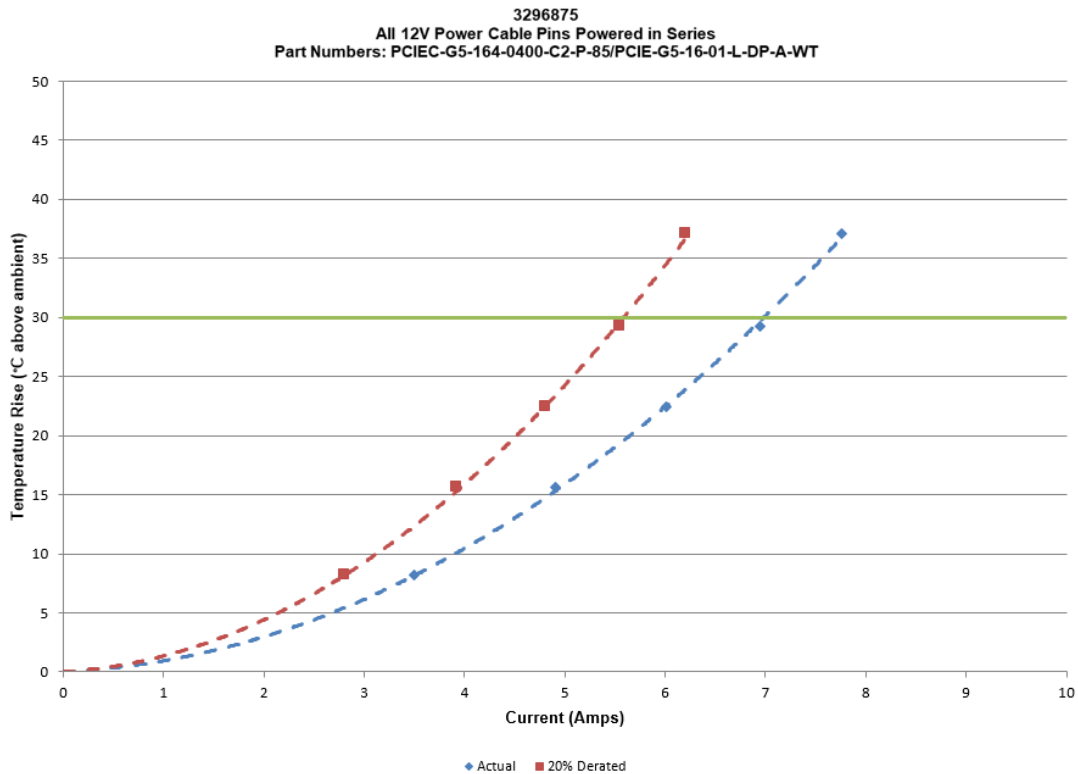
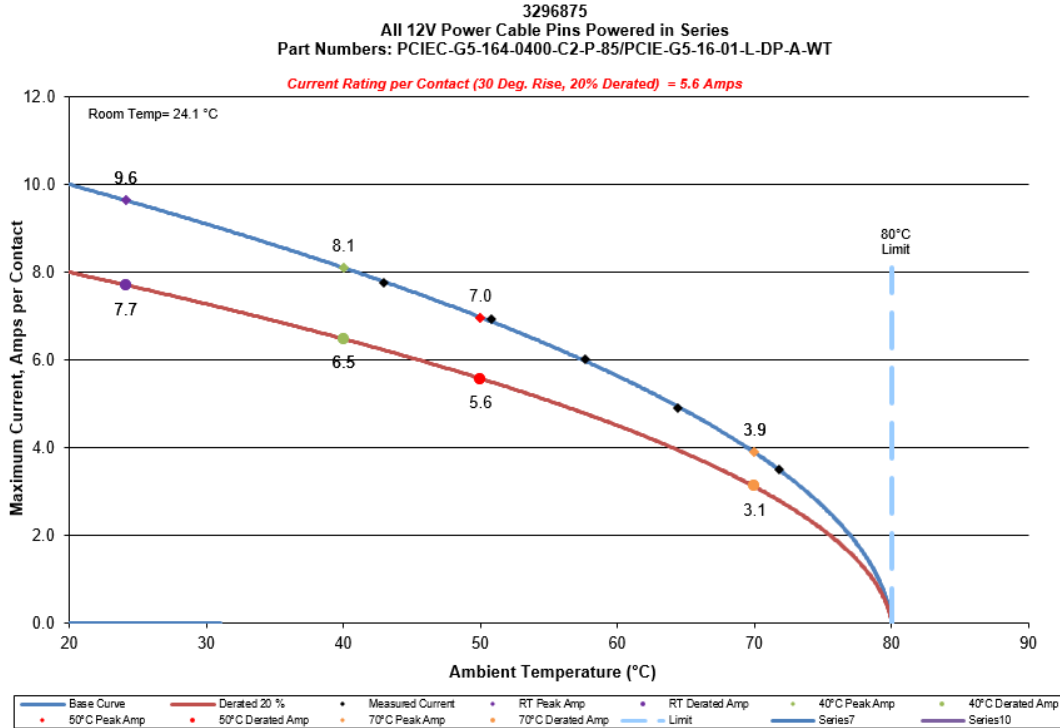
e. Linear configuration with all adjacent conductors/contacts powered



DATA SUMMARIES Continued

All Power 12V Pins

a. Linear configuration with All adjacent conductors/contacts powered



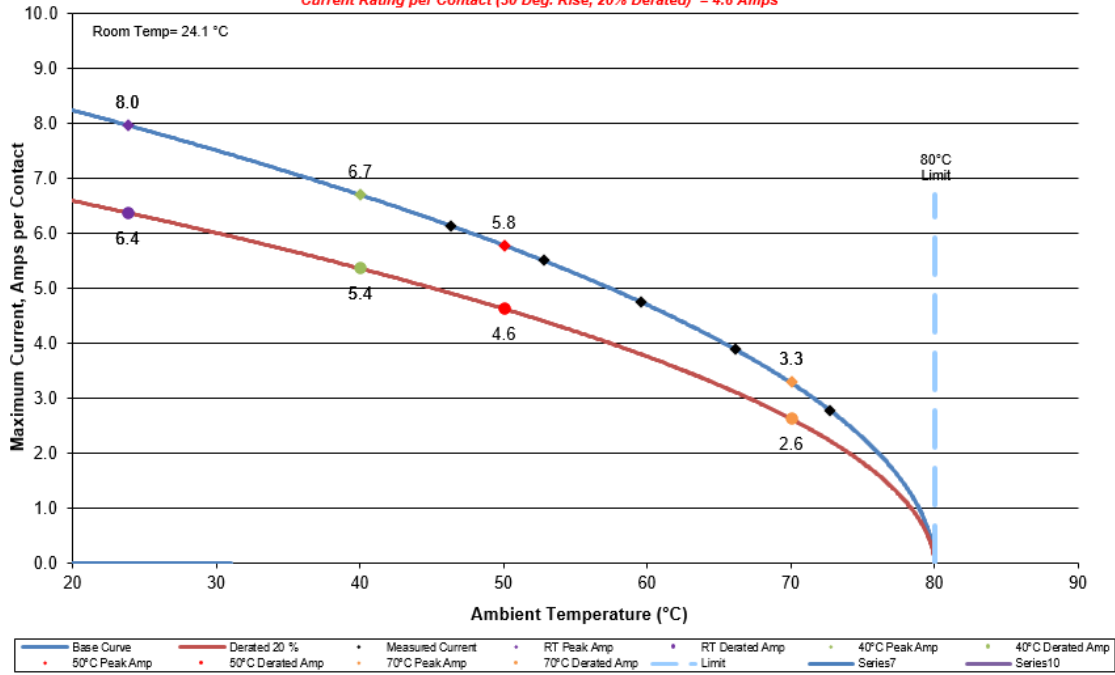
DATA SUMMARIES Continued

All Power 3.3V Pins

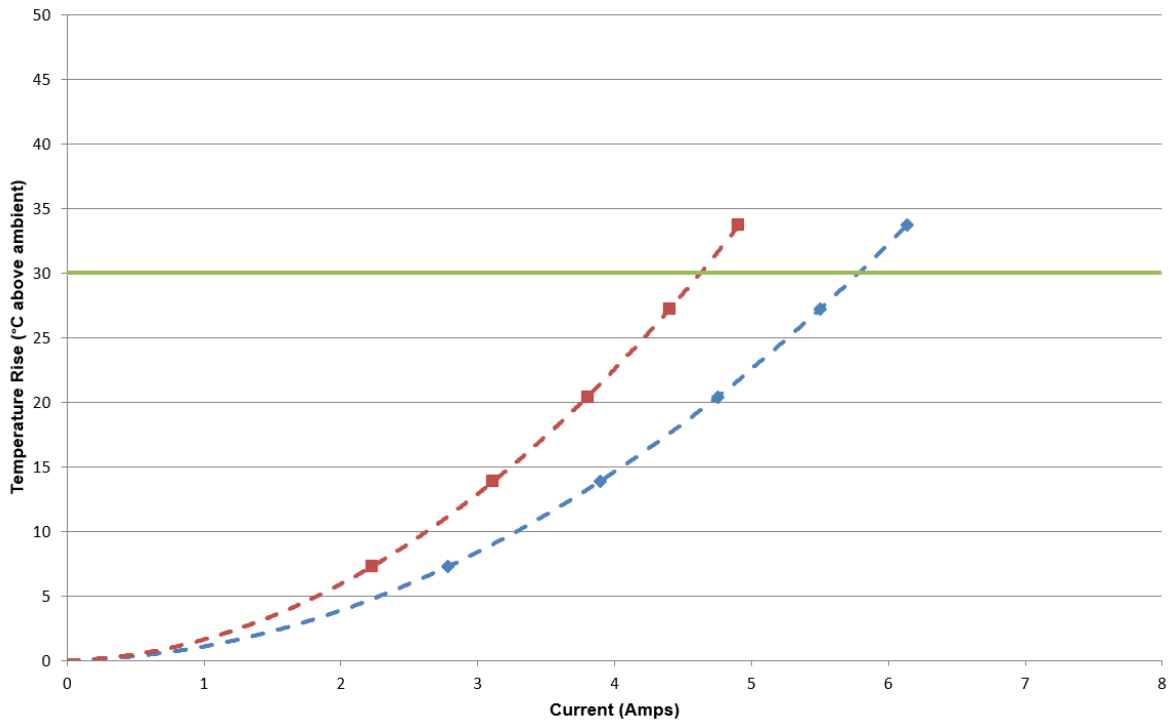
b. Linear configuration with all adjacent conductors/contacts powered

3296875
 All Power 3.3V Cable Pins Powered in Series
 Part Numbers: PCIEC-G5-164-0400-C2-P-85/PCIE-G5-16-01-L-DP-A-WT

Current Rating per Contact (30 Deg. Rise, 20% Derated) = 4.6 Amps



3296875
 All Power 3.3V Cable Pins Powered in Series
 Part Numbers: PCIEC-G5-164-0400-C2-P-85/PCIE-G5-16-01-L-DP-A-WT



DATA SUMMARIES Continued**MATING-UNMATING FORCE:****Mating-Unmating Durability Group**

	Initial				After 25 Cycles			
	Mating		Unmating		Mating		Unmating	
	Newton	Force (Lbs)	Newton	Force (Lbs)	Newton	Force (Lbs)	Newton	Force (Lbs)
Minimum	33.14	7.45	17.48	3.93	33.23	7.47	16.90	3.80
Maximum	41.72	9.38	22.11	4.97	44.70	10.05	24.91	5.60
Average	37.74	8.49	19.48	4.38	39.21	8.82	21.22	4.77
St Dev	3.01	0.68	1.74	0.39	4.27	0.96	2.69	0.60
Count	8	8	8	8	8	8	8	8
	After 50 Cycles				After 75 Cycles			
	Mating		Unmating		Mating		Unmating	
	Newton	Force (Lbs)	Newton	Force (Lbs)	Newton	Force (Lbs)	Newton	Force (Lbs)
Minimum	34.92	7.85	21.26	4.78	35.67	8.02	22.37	5.03
Maximum	46.48	10.45	27.27	6.13	47.55	10.69	28.56	6.42
Average	40.70	9.15	24.10	5.42	41.78	9.39	25.64	5.76
St Dev	4.27	0.96	2.34	0.53	4.36	0.98	2.28	0.51
Count	8	8	8	8	8	8	8	8
	After 100 Cycles				After Humidity			
	Mating		Unmating		Mating		Unmating	
	Newton	Force (Lbs)	Newton	Force (Lbs)	Newton	Force (Lbs)	Newton	Force (Lbs)
Minimum	29.40	6.61	23.84	5.36	31.27	7.03	18.06	4.06
Maximum	44.70	10.05	29.76	6.69	39.54	8.89	24.02	5.40
Average	37.14	8.35	27.01	6.07	35.80	8.05	20.82	4.68
St Dev	5.16	1.16	2.11	0.47	2.88	0.65	2.06	0.46
Count	8	8	8	8	8	8	8	8

DATA SUMMARIES Continued**Mating-Unmating Basic (PCIEC-G5-098-0400-C2-P-85A/ PCIE-G5-08-01-L-DP-A)**

	Initial				After 25 Cycles			
	Mating		Unmating		Mating		Unmating	
	Newton's	Force (Lbs)	Newton's	Force (Lbs)	Newton's	Force (Lbs)	Newton's	Force (Lbs)
Minimum	21.66	4.87	10.54	2.37	20.33	4.57	11.52	2.59
Maximum	29.62	6.66	18.24	4.10	31.14	7.00	20.77	4.67
Average	24.68	5.55	13.69	3.08	26.49	5.96	14.98	3.37
St Dev	2.39	0.54	2.66	0.60	3.35	0.75	3.53	0.79
Count	8	8	8	8	8	8	8	8
	After 50 Cycles				After 75 Cycles			
	Mating		Unmating		Mating		Unmating	
	Newton's	Force (Lbs)	Newton's	Force (Lbs)	Newton's	Force (Lbs)	Newton's	Force (Lbs)
Minimum	20.73	4.66	15.52	3.49	21.04	4.73	16.32	3.67
Maximum	31.71	7.13	21.26	4.78	32.47	7.30	21.75	4.89
Average	27.33	6.14	18.18	4.09	27.94	6.28	19.04	4.28
St Dev	3.48	0.78	1.95	0.44	3.58	0.81	1.89	0.42
Count	8	8	8	8	8	8	8	8
	After 100 Cycles							
	Mating		Unmating					
	Newton's	Force (Lbs)	Newton's	Force (Lbs)				
Minimum	18.01	4.05	16.95	3.81				
Maximum	32.11	7.22	21.88	4.92				
Average	26.86	6.04	19.74	4.44				
St Dev	5.15	1.16	1.77	0.40				
Count	8	8	8	8				

DATA SUMMARIES Continued**Mating-Unmating Basic (PCIEC-G5-036-0400-C2-P-85/ PCIE-G5-01-01-L-DP-A)**

	Initial				After 25 Cycles			
	Mating		Unmating		Mating		Unmating	
	Newton's	Force (Lbs)	Newton's	Force (Lbs)	Newton's	Force (Lbs)	Newton's	Force (Lbs)
Minimum	6.89	1.55	1.42	0.32	6.00	1.35	1.20	0.27
Maximum	8.14	1.83	3.16	0.71	8.41	1.89	4.71	1.06
Average	7.44	1.67	2.47	0.56	7.37	1.66	2.70	0.61
St Dev	0.40	0.09	0.62	0.14	0.93	0.21	1.19	0.27
Count	8	8	8	8	8	8	8	8
	After 50 Cycles				After 75 Cycles			
	Mating		Unmating		Mating		Unmating	
	Newton's	Force (Lbs)	Newton's	Force (Lbs)	Newton's	Force (Lbs)	Newton's	Force (Lbs)
Minimum	6.36	1.43	2.00	0.45	7.12	1.60	1.51	0.34
Maximum	8.67	1.95	9.52	2.14	8.94	2.01	9.79	2.20
Average	8.03	1.81	5.31	1.19	7.96	1.79	5.58	1.25
St Dev	0.75	0.17	2.12	0.48	0.66	0.15	2.31	0.52
Count	8	8	8	8	8	8	8	8
	After 100 Cycles							
	Mating		Unmating					
	Newton's	Force (Lbs)	Newton's	Force (Lbs)				
Minimum	8.41	1.89	2.58	0.58				
Maximum	11.16	2.51	10.27	2.31				
Average	9.47	2.13	6.24	1.40				
St Dev	1.00	0.22	2.14	0.48				
Count	8	8	8	8				

DATA SUMMARIES Continued**Cable Pull
0° Pull**

	Force (lbs)
Minimum	6.68
Maximum	8.25
Average	7.66

90° Pull

	Force (lbs)
Minimum	13.56
Maximum	16.66
Average	15.10

Cable Flex**INSULATION RESISTANCE (IR):**

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

Row to Row	
Mated	
Minimum	
Initial	45000
After 500 Flex Cycles	45000

DIELECTRIC WITHSTANDING VOLTAGE (DWV):

Voltage Rating Summary	
Minimum	PCIEC/PCIE
Test Voltage	630

Pin to Pin	
Initial Test Voltage	Pass
After 500 Flex Cycles Test Voltage	Pass

Row to Row	
Initial Test Voltage	Pass
After 500 Flex Cycles Test Voltage	Pass

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

	Pin to Pin		
	Mated	Unmated	Unmated
Minimum	PCIEC/PCIE	PCIEC	PCIE
Initial	45000	45000	45000
Thermal	45000	45000	45000
Humidity	45000	45000	45000

	Row to Row		
	Mated	Unmated	Unmated
Minimum	PCIEC/PCIE	PCIEC	PCIE
Initial	45000	45000	45000
Thermal	45000	45000	45000
Humidity	45000	45000	45000

DIELECTRIC WITHSTANDING VOLTAGE (DWV):

Voltage Rating Summary	
Minimum	PCIEC/PCIE
Break Down Voltage	840
Test Voltage	630
Working Voltage	210

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 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. $\leq +5.0$ 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	4/21/2022	4/25/2022	5/5/2022	5/17/2022
Room Temp (Deg C)	23	23	23	23
Rel Humidity (%)	54	54	56	54
Technician	Peter Chen	Peter Chen	Peter Chen	Peter Chen
mOhm values	Actual	Delta	Delta	Delta
	Initial	100 Cycles	Therm Shck	Humidity
Pin Type 1: Signal				
Average	185.91	2.88	2.40	2.47
St. Dev.	2.62	2.06	1.73	1.85
Min	181.80	0.07	0.01	0.03
Max	192.51	9.32	7.55	7.52
Summary Count	136	136	136	136
Total Count	136	136	136	136
Pin Type 2: Signal				
Average	85.46	1.50	1.45	1.43
St. Dev.	1.30	1.03	1.55	1.19
Min	83.51	0.12	0.06	0.09
Max	88.60	3.62	6.34	3.72
Summary Count	16	16	16	16
Total Count	16	16	16	16
Pin Type 3: Ground				
Average	10.91	1.06	1.16	1.00
St. Dev.	0.87	0.89	0.81	0.90
Min	9.37	0.00	0.12	0.06
Max	13.55	3.48	3.96	4.13
Summary Count	40	40	40	40
Total Count	40	40	40	40

LLCR Delta Count by Category						
mOhms	Stable	Minor	Acceptable	Marginal	Unstable	Open
	≤ 5	>5 & ≤ 10	>10 & ≤ 15	>15 & ≤ 50	>50 & ≤ 1000	>1000
100 Cycles	167	25	0	0	0	0
Therm Shck	179	13	0	0	0	0
Humidity	175	17	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. $\leq +5.0$ 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	4/21/2022	4/22/2022		
Room Temp (Deg C)	23	23		
Rel Humidity (%)	54	54		
Technician	Peter Chen	Peter Chen		
mOhm values	Actual Initial	Delta Acid Vapor	Delta	Delta
Pin Type 1: Signal				
Average	185.68	1.18		
St. Dev.	3.02	1.61		
Min	181.12	0.02		
Max	195.99	9.97		
Summary Count	136	136		
Total Count	136	136		
Pin Type 2: Signal				
Average	86.45	1.21		
St. Dev.	2.14	1.30		
Min	83.61	0.01		
Max	92.85	5.17		
Summary Count	16	16		
Total Count	16	16		
Pin Type 3: Ground				
Average	11.46	0.65		
St. Dev.	1.37	0.70		
Min	9.50	0.01		
Max	14.62	2.70		
Summary Count	40	40		
Total Count	40	40		

LLCR Delta Count by Category						
mOhms	Stable	Minor	Acceptable	Marginal	Unstable	Open
	≤ 5	>5 & ≤ 10	>10 & ≤ 15	>15 & ≤ 50	>50 & ≤ 1000	>1000
Acid Vapor	185	7	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: 4/26/2022, Next Cal: 4/25/2023**Equipment #:** HZ-THC-01**Description:** Humidity transmitter**Manufacturer:** Thermtron**Model:** SM-8-8200**Serial #:** 38846**Accuracy:** Last Cal: 2/28/2022, Next Cal: 2/27/2023**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: 06/28/2022, Next Cal: 06/27/2023

Equipment #: HZ-HPM-01**Description:** NA9636H**Manufacturer:** Ainuo**Model:** 6031A**Serial #:** 089601091**Accuracy:** Last Cal: 3/7/2022, Next Cal: 3/6/2023**Equipment #:** HZ-MO-05**Description:** Micro-ohmmeter**Manufacturer:** Keithley**Model:** 3706**Serial #:** 1285188**Accuracy:** Last Cal: 11/15/2022, Next Cal: 11/14/2023**Equipment #:** MO-04**Description:** Multimeter /Data Acquisition System**Manufacturer:** Keithley**Model:** 2700**Serial #:** 0798688**Accuracy:** See Manual

... Last Cal: 04/30/2022, Next Cal: 04/30/2023

EQUIPMENT AND CALIBRATION SCHEDULES Continued**Equipment #:** HZ-MO-01**Description:** Micro-ohmmeter**Manufacturer:** Keithley**Model:** 2700**Serial #:** 1199807**Accuracy:** Last Cal: 04/28/2022, Next Cal: 04/28/2023**Equipment #:** HZ-PS-01**Description:** Power Supply**Manufacturer:** Agilent**Model:** 6031A**Serial #:** MY41000982**Accuracy:** Last Cal: 04/28/2022, Next Cal: 04/28/2023