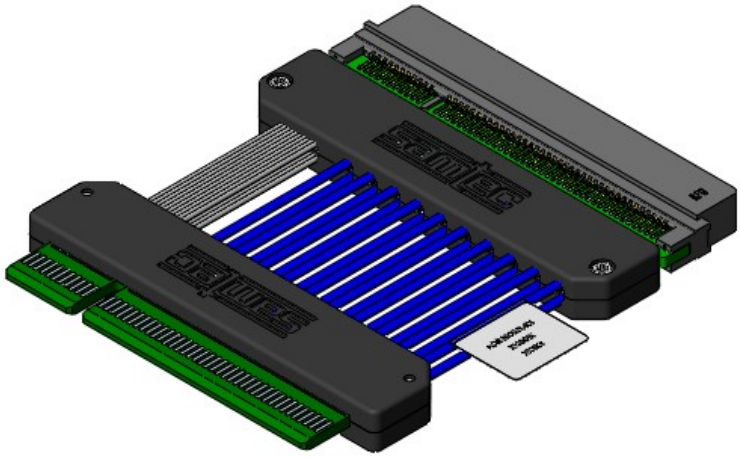
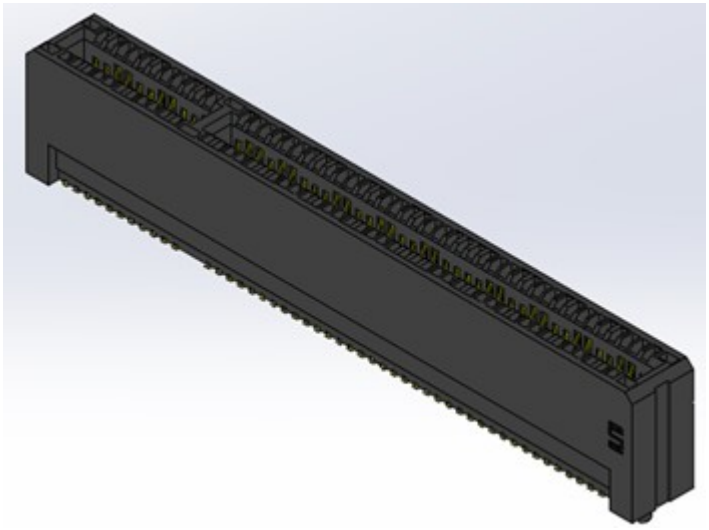
Project Number: Design Qualification Test Report	Tracking Code: CR-980401_Report_Rev_1
Requested by: Leo Lee	Date: 12/28/2023
Part #: PCIEC-G5-164-0400-M1-P-85\PCIE-G5-16-01-L-DP-A-WT	
Part description: PCIEC/PCIE	Tech: Kason He
Test Start: 9/6/2023	Test Completed: 9/25/2023





DESIGN QUALIFICATION TEST REPORT

PCIEC/PCIE
PCIEC-G5-164-0400-M1-P-85\PCIE-G5-16-01-L-DP-A-WT

REVISION HISTORY

DATA	REV.NUM.	DESCRIPTION	ENG
12/28/2023	**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 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-111954-TST/PCB-111955-TST/PCB-111956-TST.

FLOWCHARTS

IR/DWV

Pin-to-Pin

Group 1
PCIEC-G5-164-0400-M1-P-85
PCIE-G5-16-01-L-DP-A-WT
2 Assemblies

Step	Description
1.	DWV Breakdown (2)

Group 2
PCIEC-G5-164-0400-M1-P-85
2 Assemblies

Step	Description
1.	DWV Breakdown (2)

Group 3
PCIE-G5-16-01-L-DP-A-WT
2 Assemblies

Step	Description
1.	DWV Breakdown (2)

Group 4
PCIEC-G5-164-0400-M1-P-85
PCIE-G5-16-01-L-DP-A-WT
2 Assemblies

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-Row

Group 5
PCIEC-G5-164-0400-M1-P-85
PCIE-G5-16-01-L-DP-A-WT
2 Assemblies

Step	Description
1.	DWV Breakdown (2)

Group 6
PCIEC-G5-164-0400-M1-P-85
2 Assemblies

Step	Description
1.	DWV Breakdown (2)

Group 7
PCIE-G5-16-01-L-DP-A-WT
2 Assemblies

Step	Description
1.	DWV Breakdown (2)

Group 8
PCIEC-G5-164-0400-M1-P-85
PCIE-G5-16-01-L-DP-A-WT
2 Assemblies

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
PCIEC-G5-164-0400-M1-P-85
PCIE-G5-16-01-L-DP-A-WT
2 Pins Powered
Signal

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

Group 2
PCIEC-G5-164-0400-M1-P-85
PCIE-G5-16-01-L-DP-A-WT
4 Pins Powered
Signal

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

Group 3
PCIEC-G5-164-0400-M1-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-M1-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-M1-P-85
PCIE-G5-16-01-L-DP-A-WT
66 Pins Powered
Signal

Step	Description
1.	CCC (2) Rows = 2 Number of Positions = 33

Group 6
PCIEC-G5-164-0400-M1-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-M1-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-M1-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-M1-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-M1-P-85
PCIE-G5-16-01-L-DP-A-WT
All Power

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 Pull

Group 1 PCIEC-G5-164-0400-M1-P-85 5 Assemblies 90 Degrees		Group 2 PCIEC-G5-036-0400-M1-P-85 5 Assemblies 90 Degrees		Group 3 PCIEC-G5-064-0400-M1-P-85 5 Assemblies 90 Degrees	
Step	**Description**	**Step**	**Description**	**Step**	**Description**
1.	Cable Pull (1)	1.	Cable Pull (1)	1.	Cable Pull (1)

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

Cable Flex

Group 1
PCIEC-G5-164-0400-M1-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.

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. 40^o C
    c. 50^o C
    d. 70^o 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.

CABLE PULL:

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

Fig. 1
90° Connector pull.

CABLE FLEX:

1) Oscillate and monitor electrical continuity for open circuit indication.
    a. ± 70°Flex Mode, bend up to 500 cycles. load on cable end.

Fig. 1
(Setup picture)

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).

RESULTS

Temperature Rise, CCC at a 20% de-rating

Signal Pin at Cable

- **CCC for a 30°C Temperature Rise----------1.00 A per contact with 2 contacts (2x1) powered.**
- **CCC for a 30°C Temperature Rise----------0.97 A per contact with 4 contacts (2x2) powered.**
- **CCC for a 30°C Temperature Rise----------0.89 A per contact with 6 contacts (2x3) powered.**
- **CCC for a 30°C Temperature Rise----------0.91 A per contact with 8 contacts (2x4) powered.**
- **CCC for a 30°C Temperature Rise----------0.83 A per contact with 66 contacts (2x33) powered.**

Power Pin at Cable

- **CCC for a 30°C Temperature Rise----------2.3 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----------1.5 A per contact with 6 contacts (2x3) powered.**
- **CCC for a 30°C Temperature Rise----------1.2 A per contact with 8 contacts (2x4) powered.**
- **CCC for a 30°C Temperature Rise----------1.1 A per contact with 11 contacts powered.**

Cable Pull force

PCIEC-G5-164-0400-M1-P-85

- **90° Pull**
  - **Min---------- 254.45 lbs**
  - **Max ---------- 267.67 lbs**

PCIEC-G5-036-0400-M1-P-85

- **90° Pull**
  - **Min----------62.80 lbs**
  - **Max ----------66.72 lbs**

PCIEC-G5-064-0400-M1-P-85

- **90° Pull**
  - **Min---------- 105.60 lbs**
  - **Max ---------- 116.79 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 ---------- 45000Meg Ω ---------- Passed**
- **Humidity**
  - **Mated ---------- 45000 Meg Ω ---------- Passed**
  - **Unmated ---------- 45000 Meg Ω ---------- Passed**

Dielectric Withstanding Voltage minimums, DWV

- **Minimums**
  - **Breakdown Voltage ---------- 905 VAC**
  - **Test Voltage ---------- 680 VAC**
  - **Working Voltage ---------- 225 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----------21500 Meg Ω ----------Passed**
- **After 500 Flex Cycles**
  - **Mated----------34000 Meg Ω ----------Passed**

Row to Row

- **Initial**
  - **Mated----------45000 Meg Ω ----------Passed**
- **After 500 Flex Cycles**
  - **Mated----------45000 Meg Ω ----------Passed**

Dielectric Withstanding Voltage minimums, DWV

- **Test Voltage ----------680 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.**

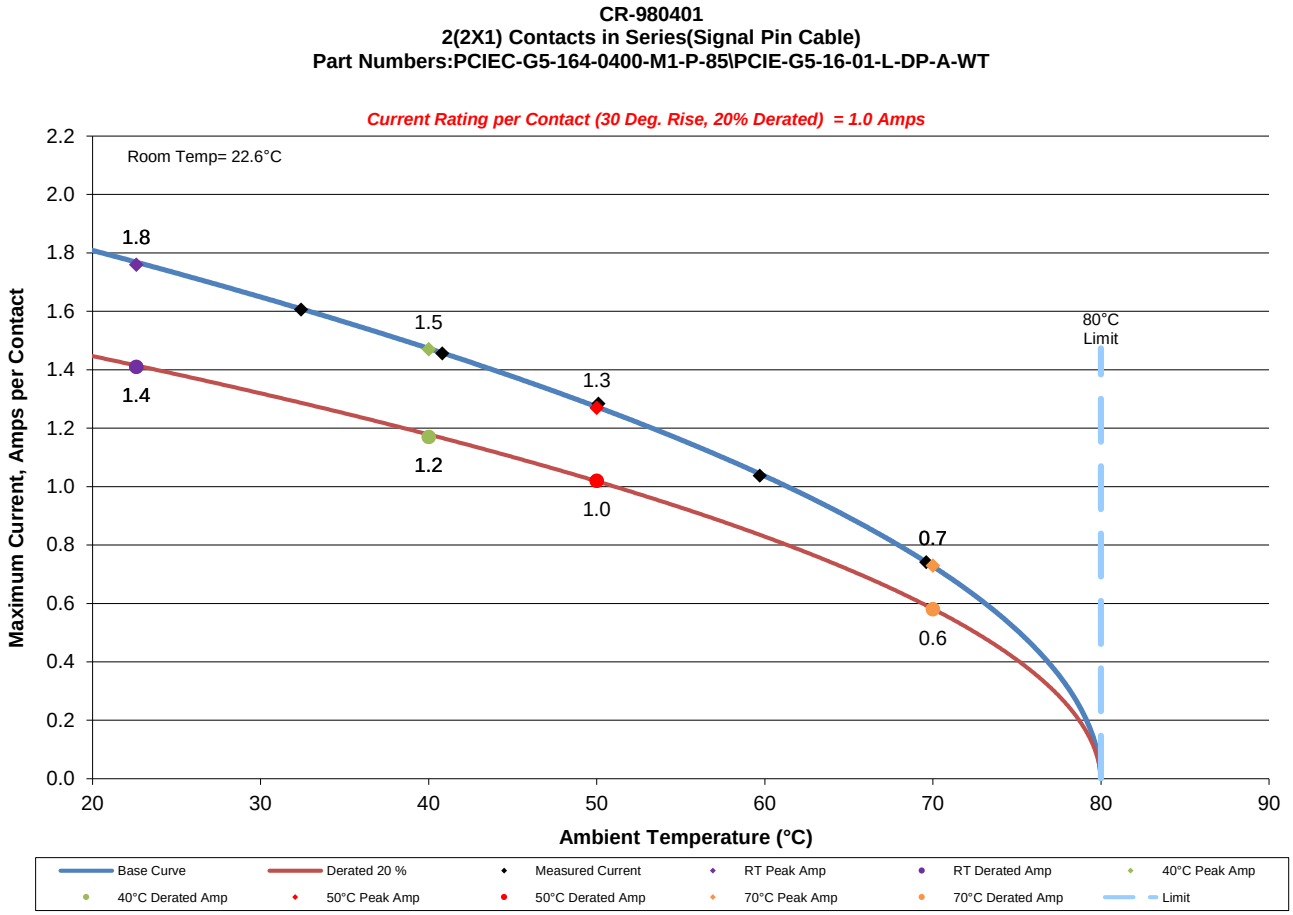
DATA SUMMARIES

TEMPERATURE RISE (Current Carrying Capacity, CCC):

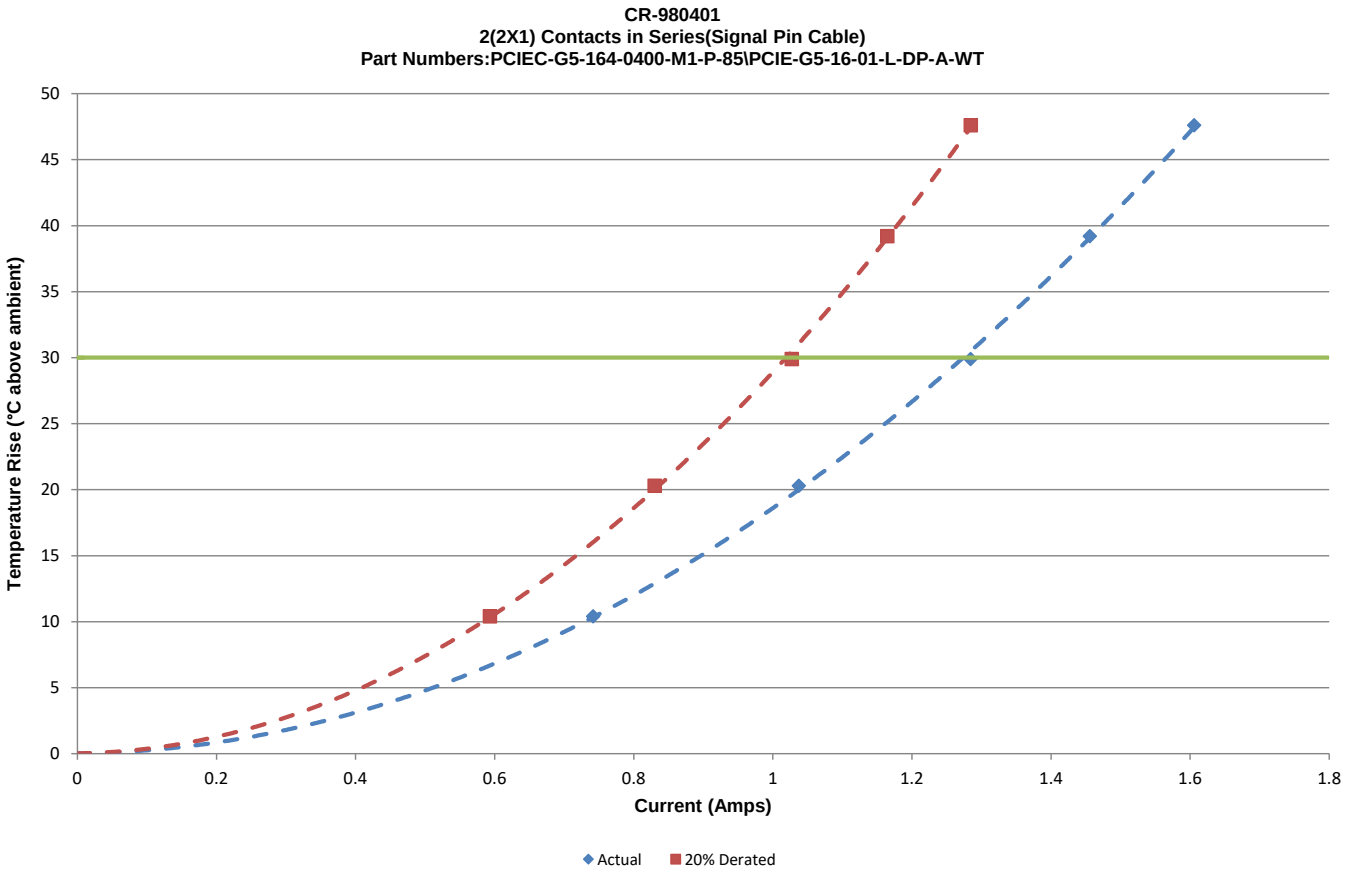
1) High quality thermocouples whose temperature slopes track one another were used for temperature monitoring.
2) The thermocouples were placed at a location to sense the maximum temperature generated during testing.
3) Temperature readings recorded are those for which three successive readings, 15 minutes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

Signal Pin at Cable

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

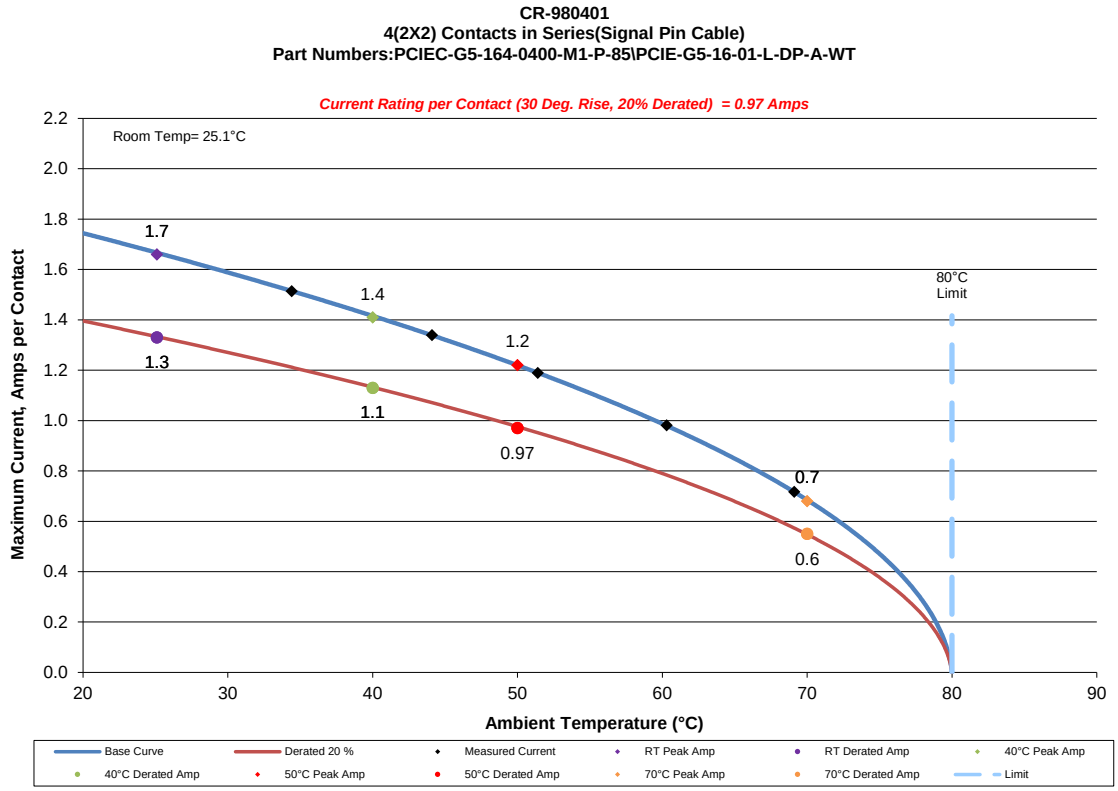


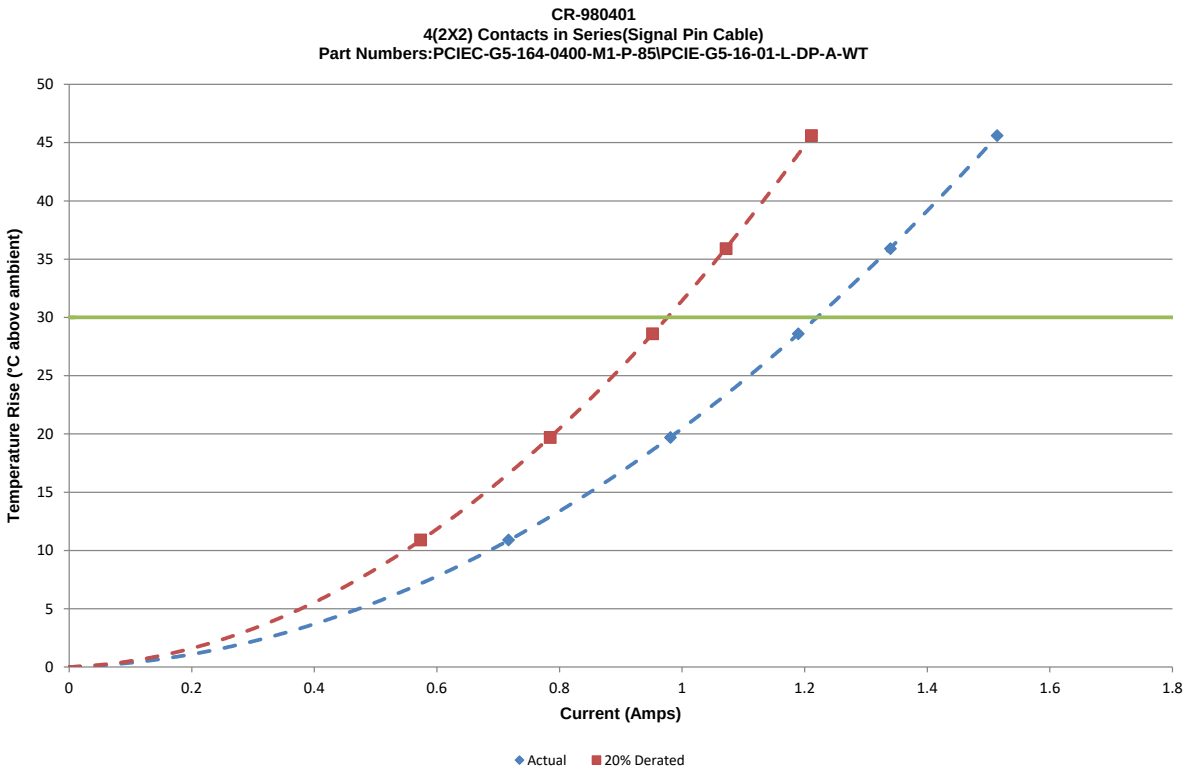
DATA SUMMARIES Continued



DATA SUMMARIES Continued

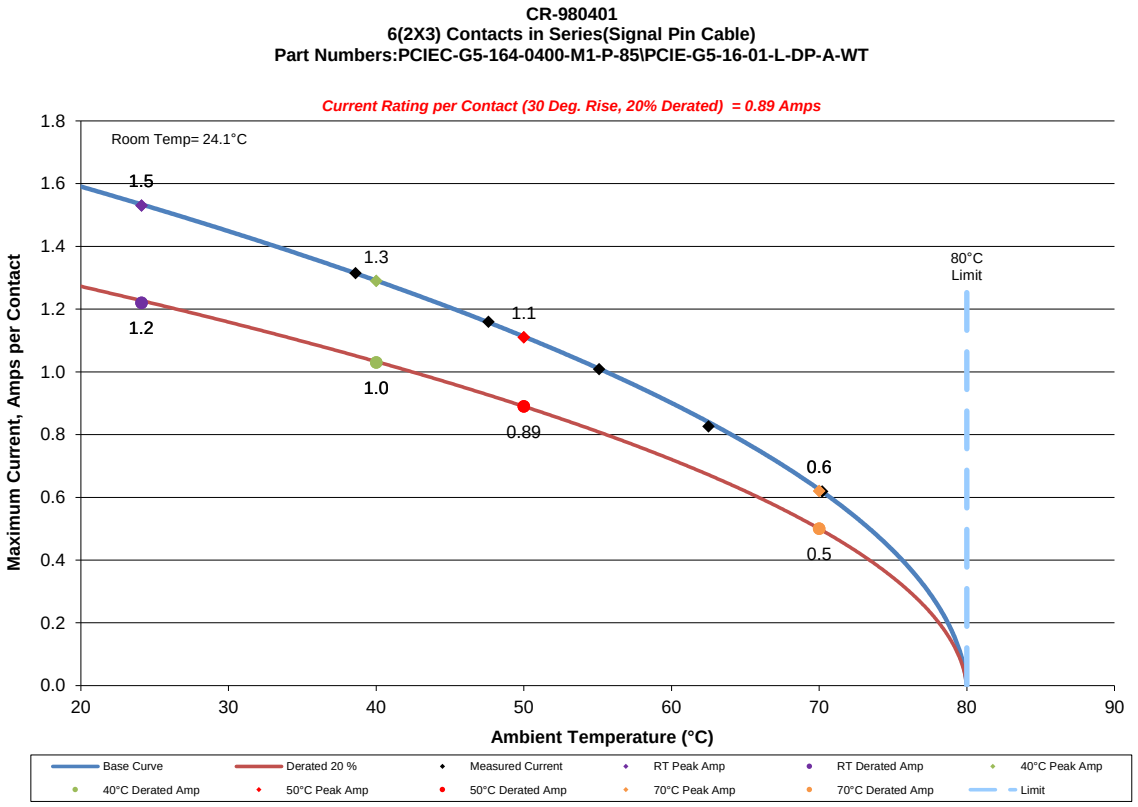
b. Linear configuration with 4 adjacent conductors/contacts powered.

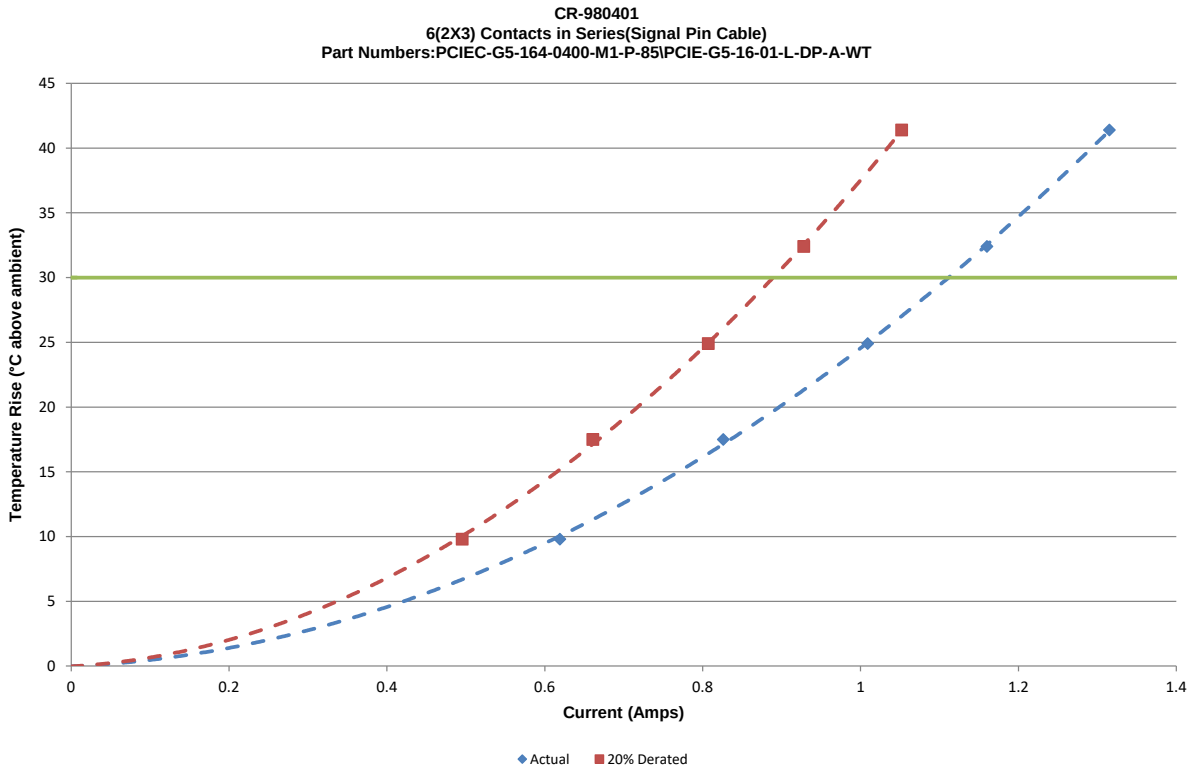




DATA SUMMARIES Continued

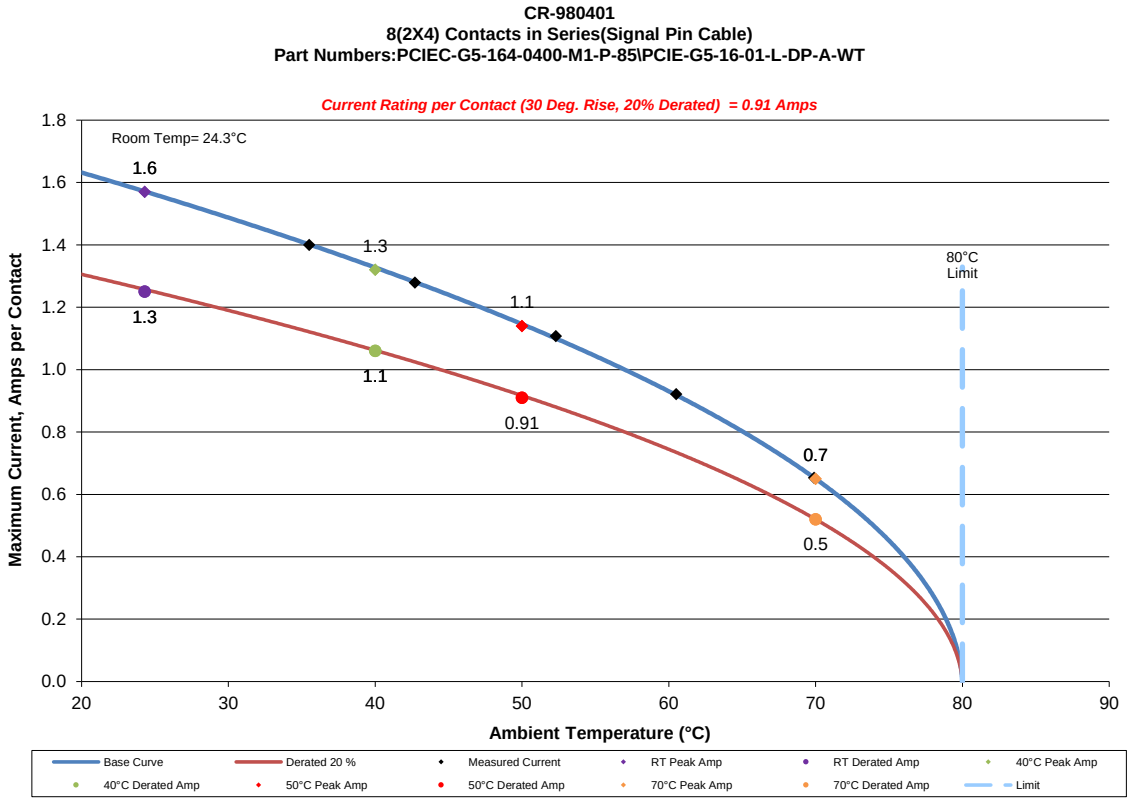
c. Linear configuration with 6 adjacent conductors/contacts powered.

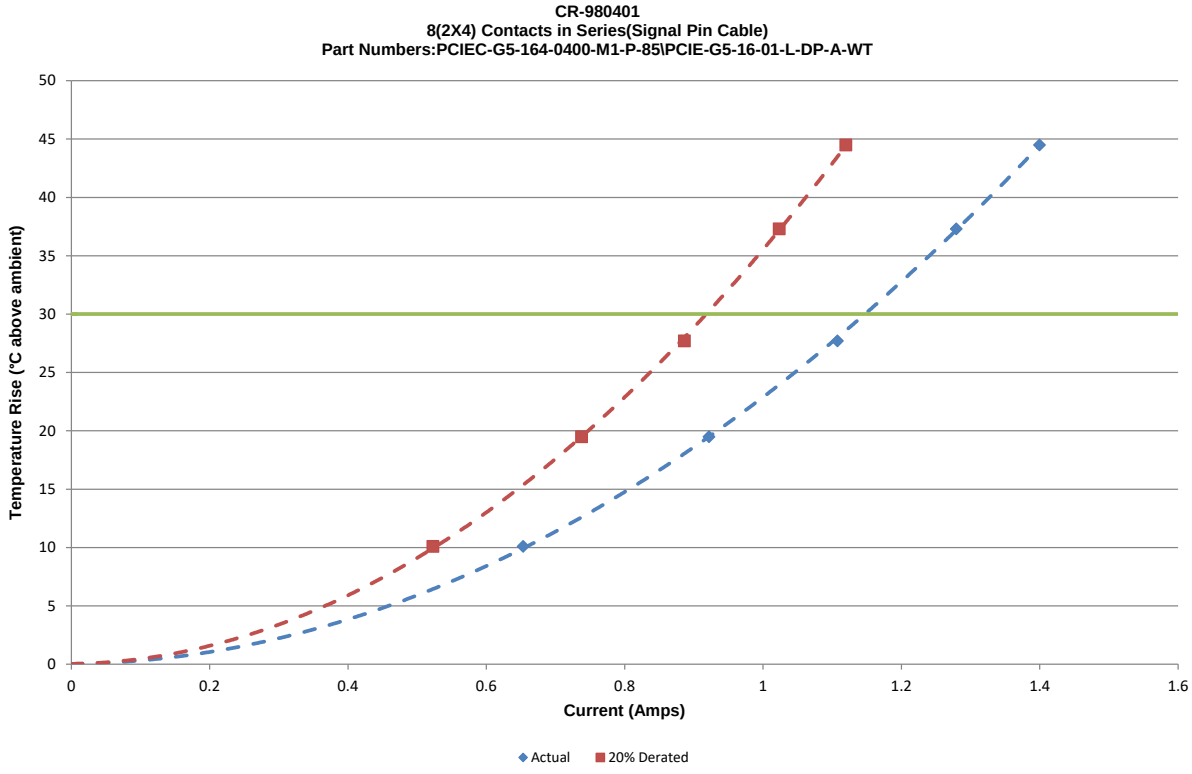




DATA SUMMARIES Continued

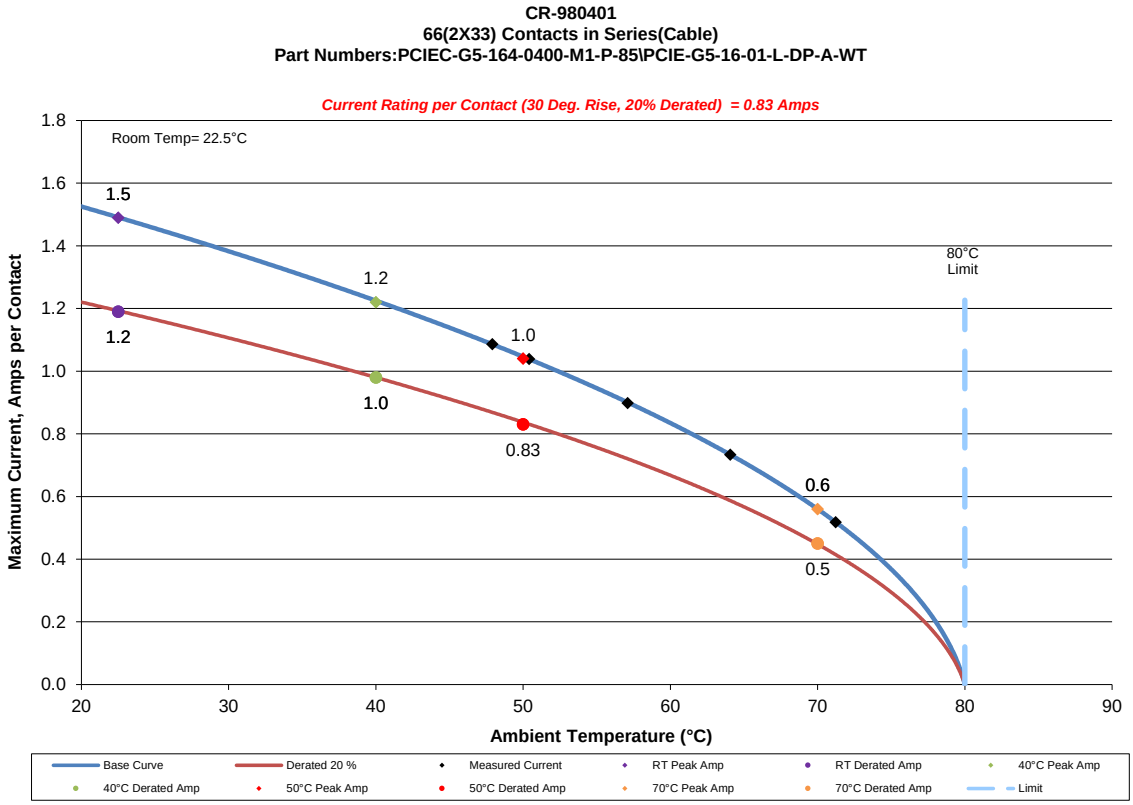
d. Linear configuration with 8 adjacent conductors/contacts powered.

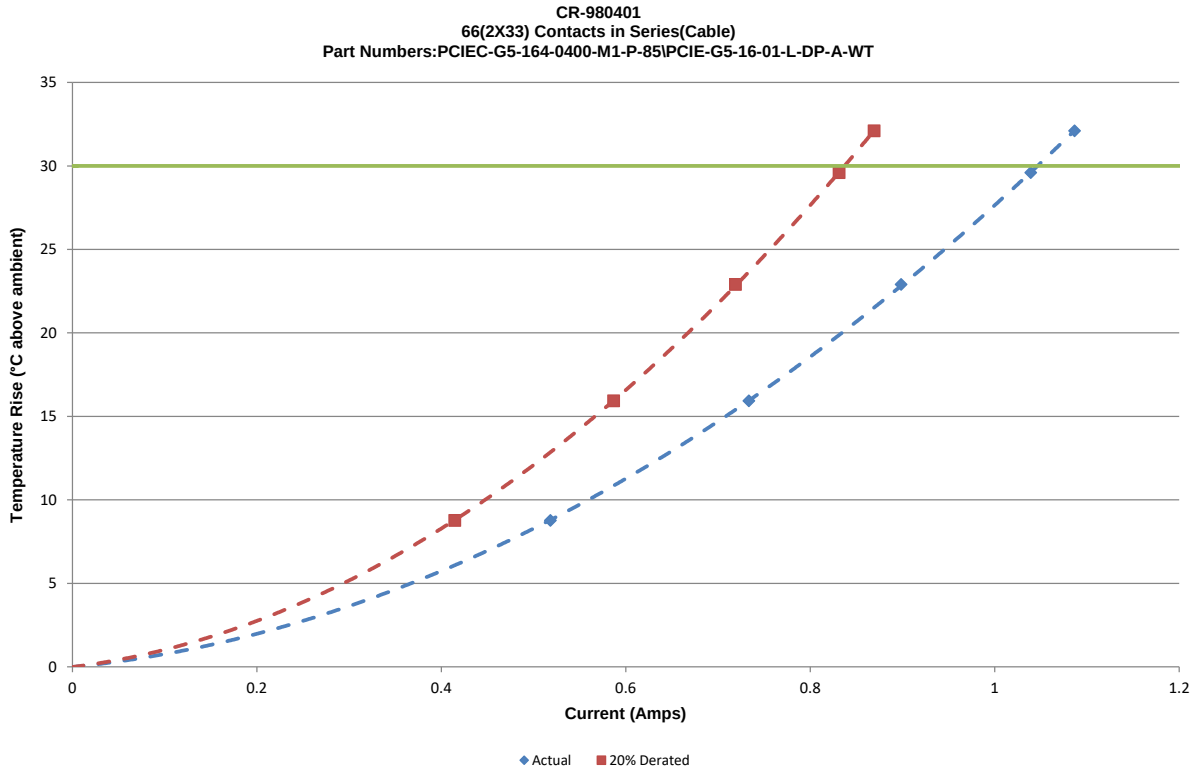




DATA SUMMARIES Continued

e. Linear configuration with all adjacent conductors/contacts powered.

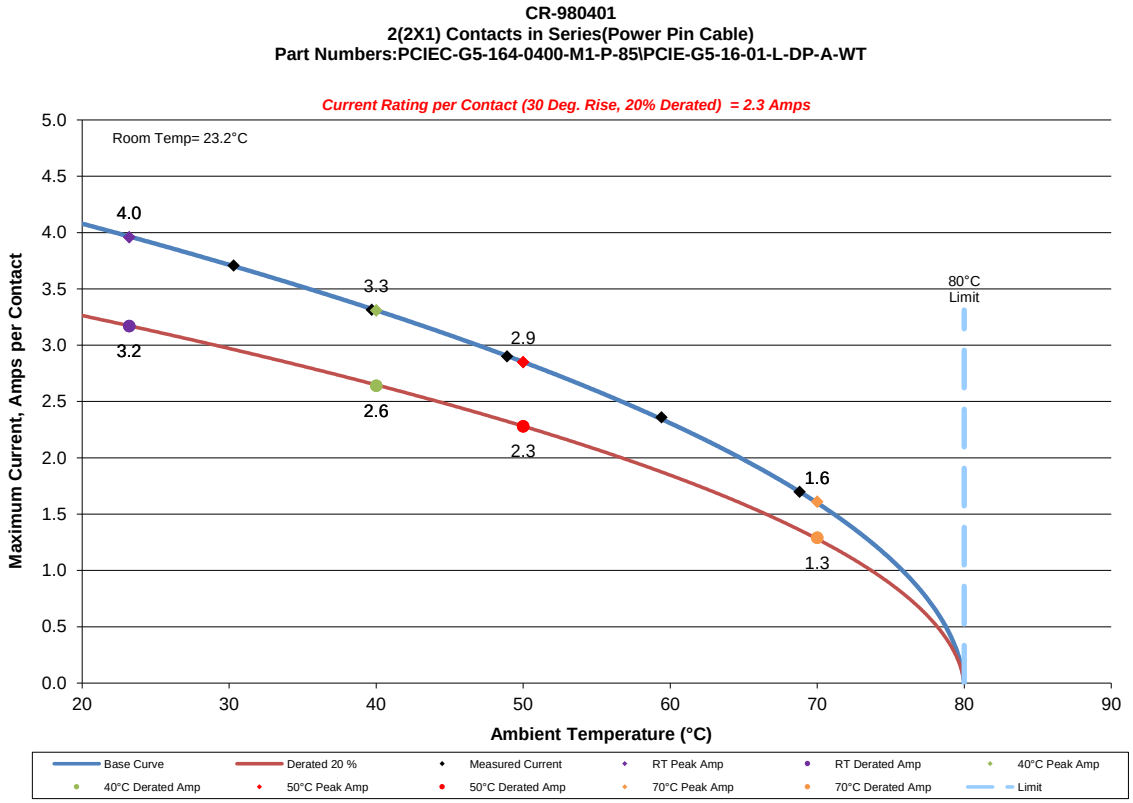


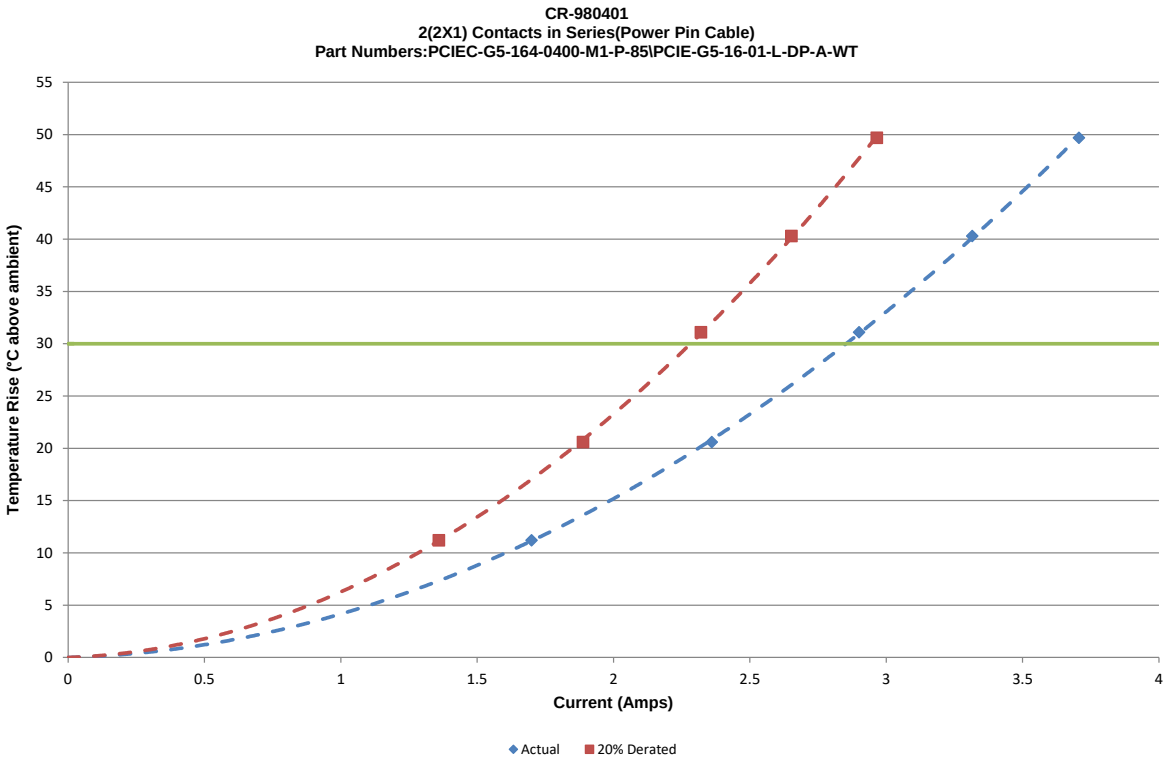


DATA SUMMARIES Continued

Power Pin at Cable

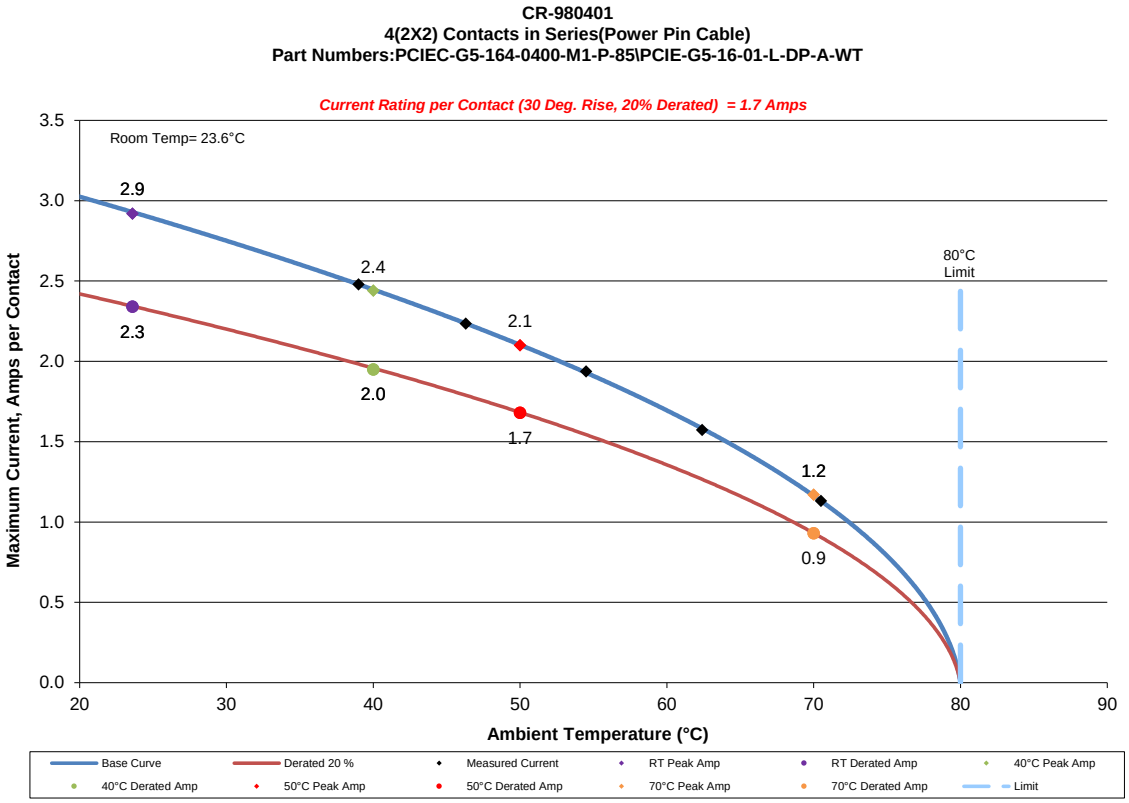
a. Linear configuration with 2 adjacent conductors/contacts powered.

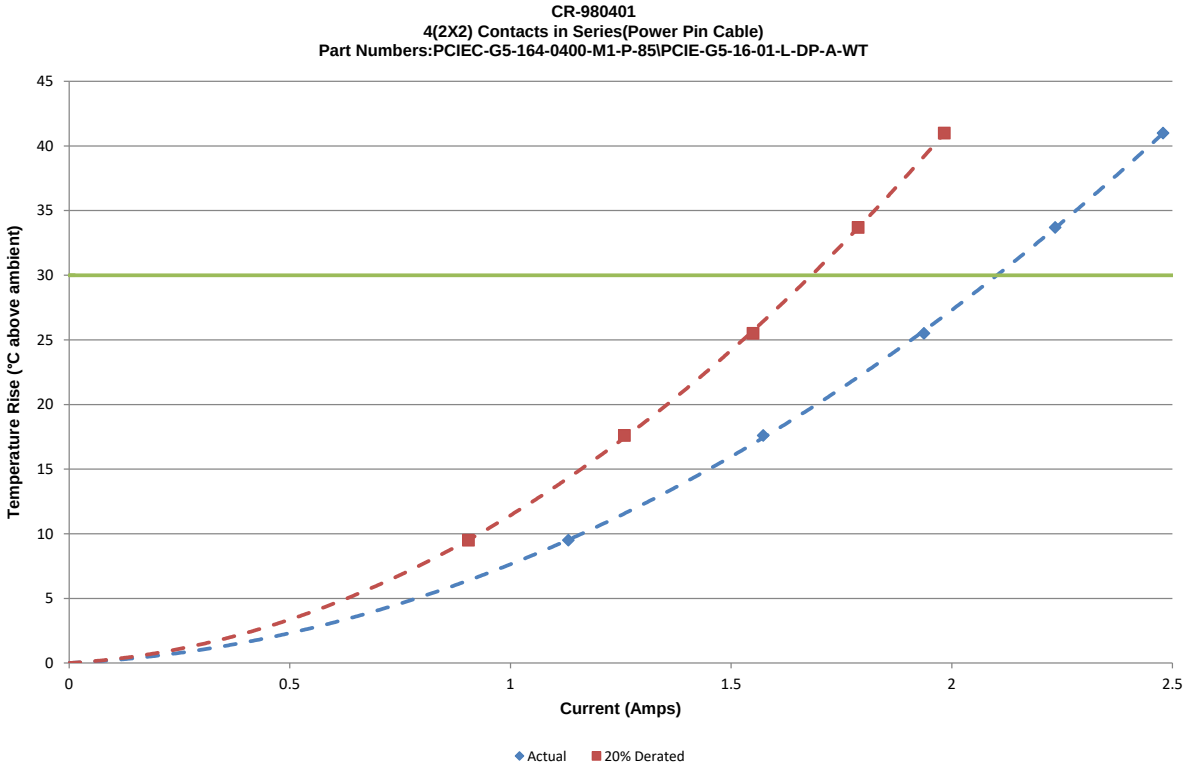




DATA SUMMARIES Continued

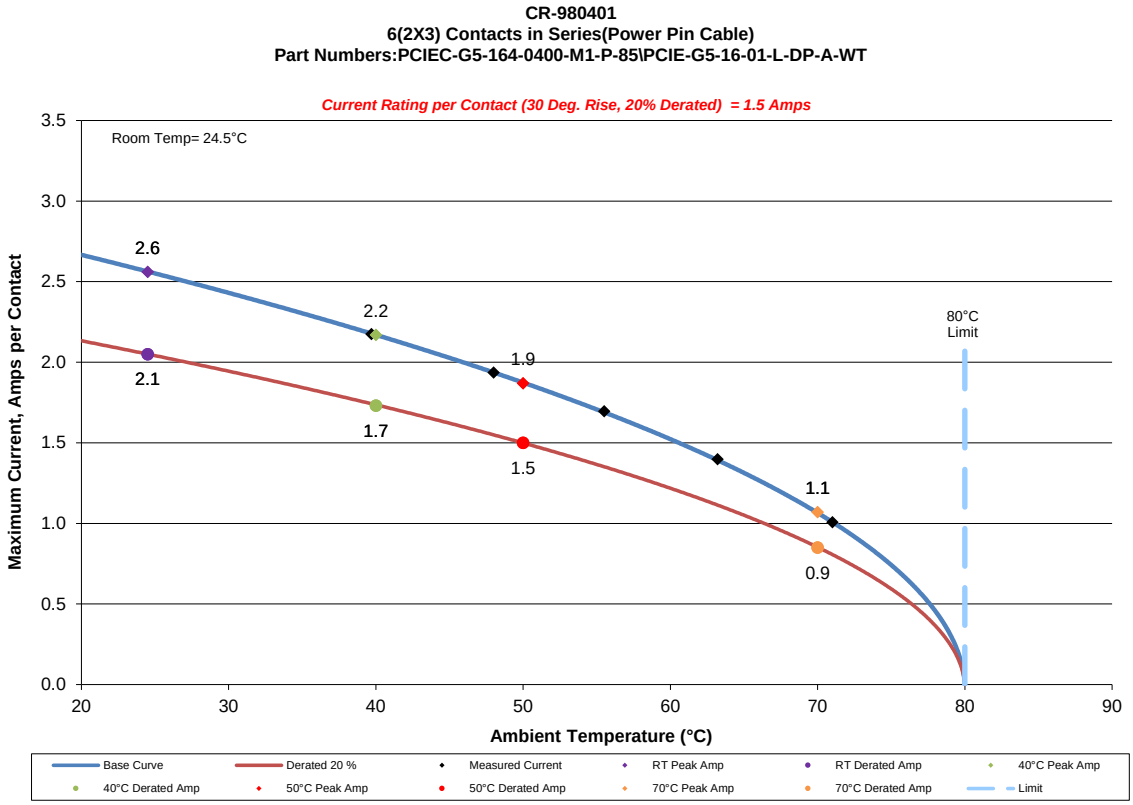
b. Linear configuration with 4 adjacent conductors/contacts powered.

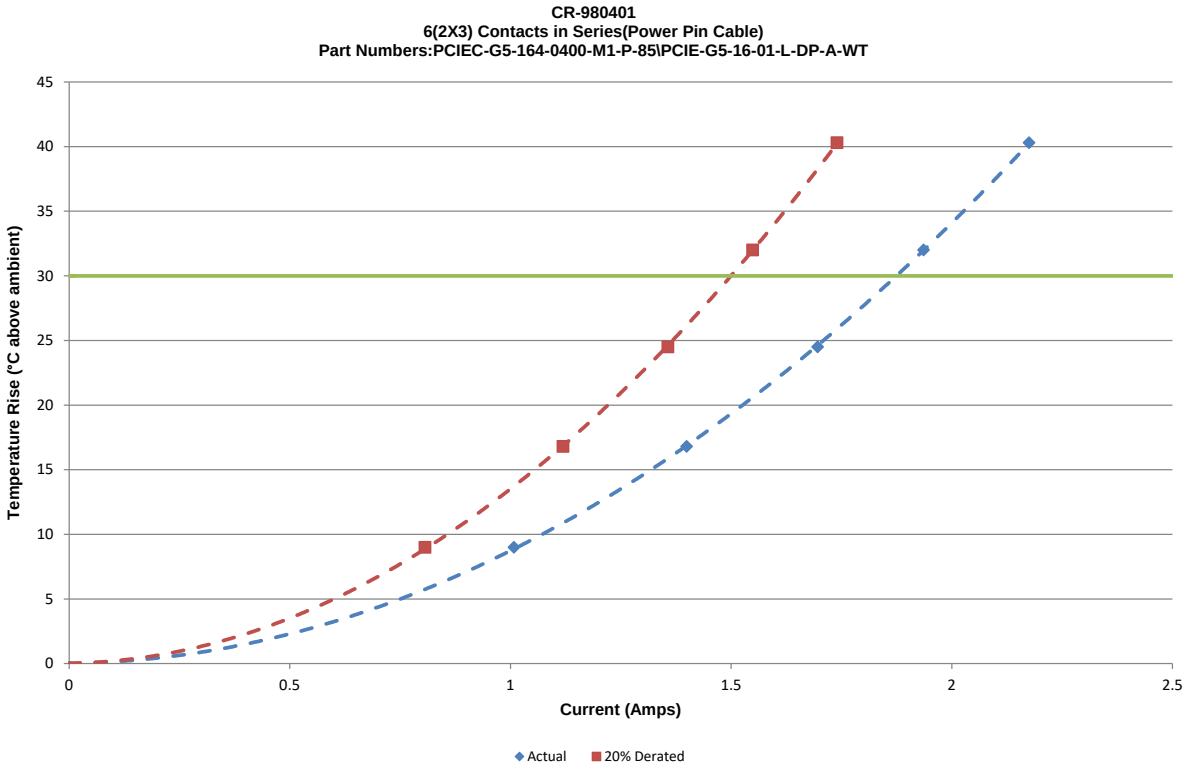




DATA SUMMARIES Continued

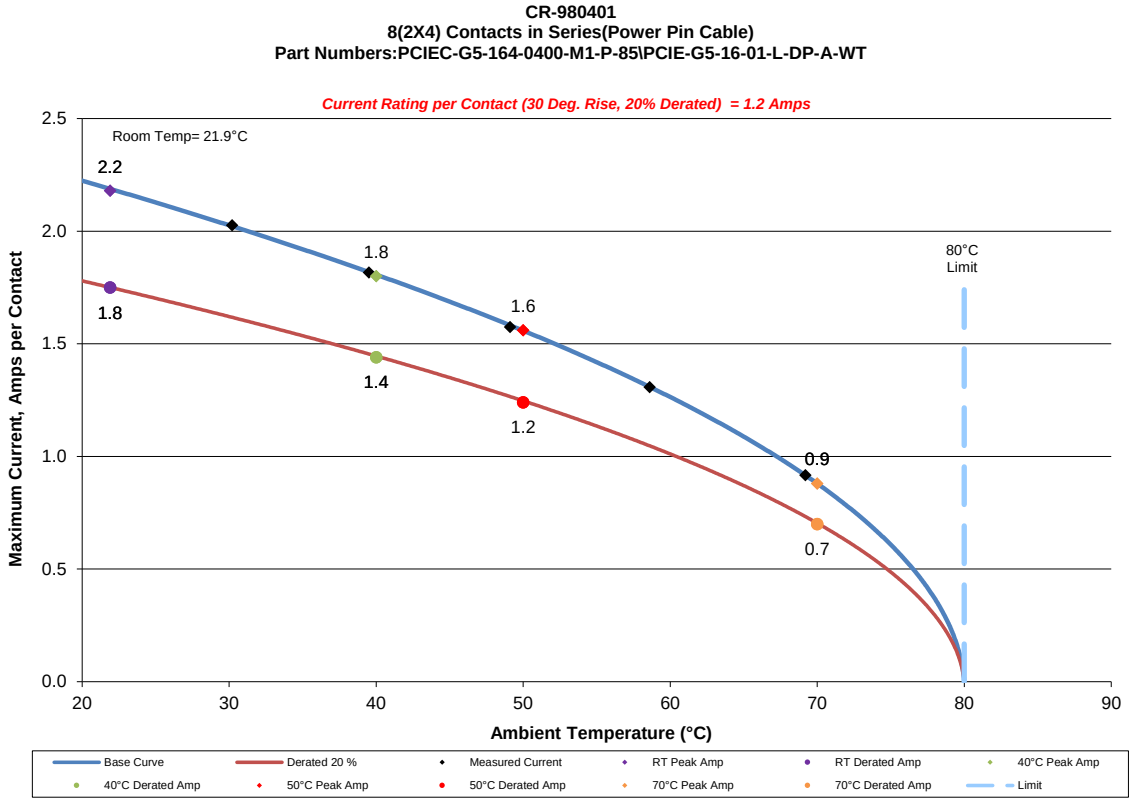
c. Linear configuration with 6 adjacent conductors/contacts powered.

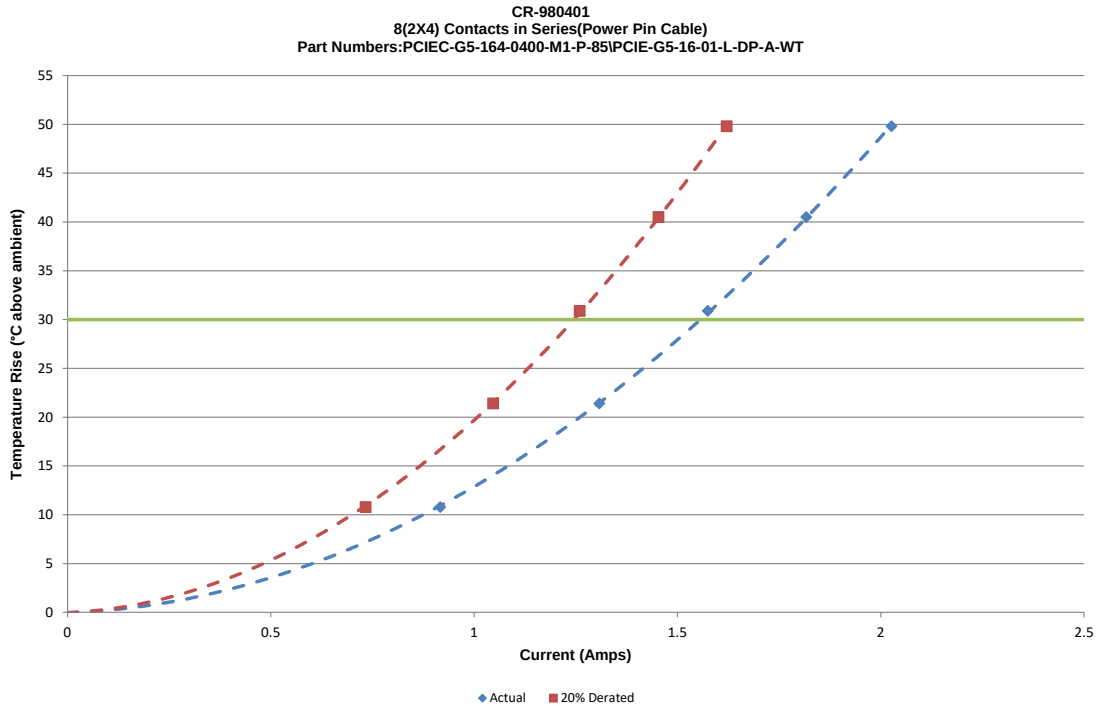




DATA SUMMARIES Continued

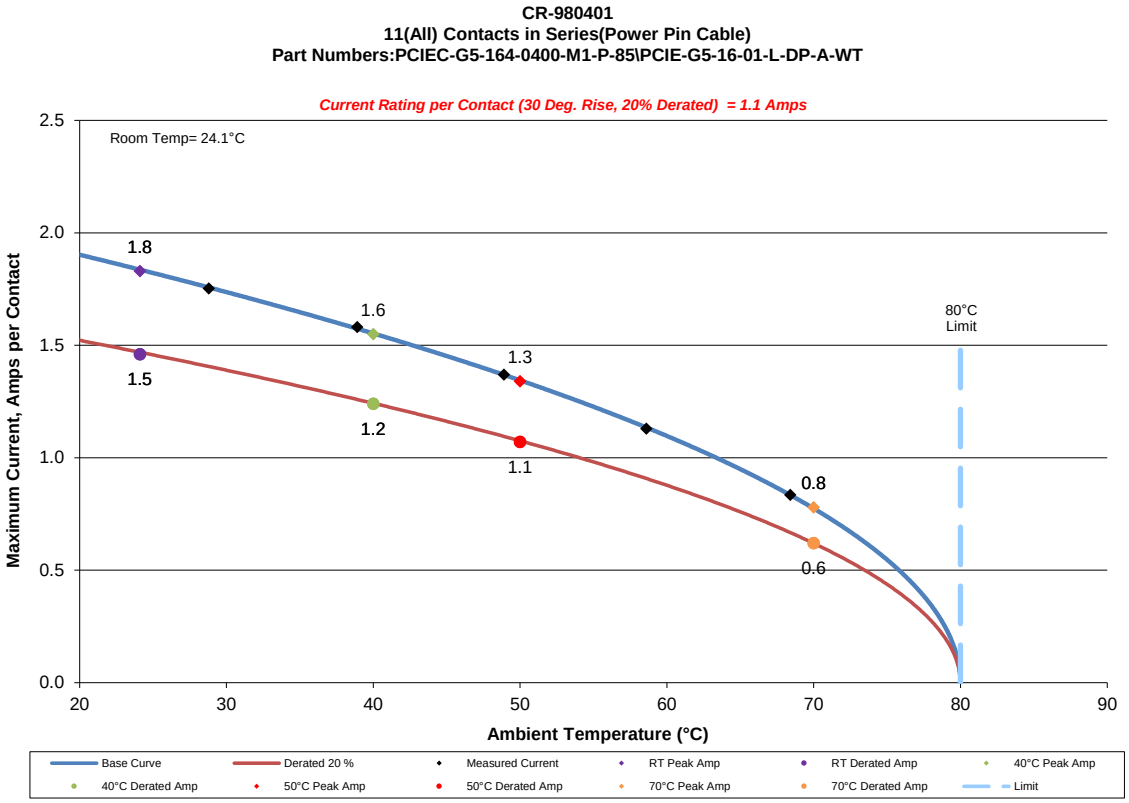
d. Linear configuration with 8 adjacent conductors/contacts powered.

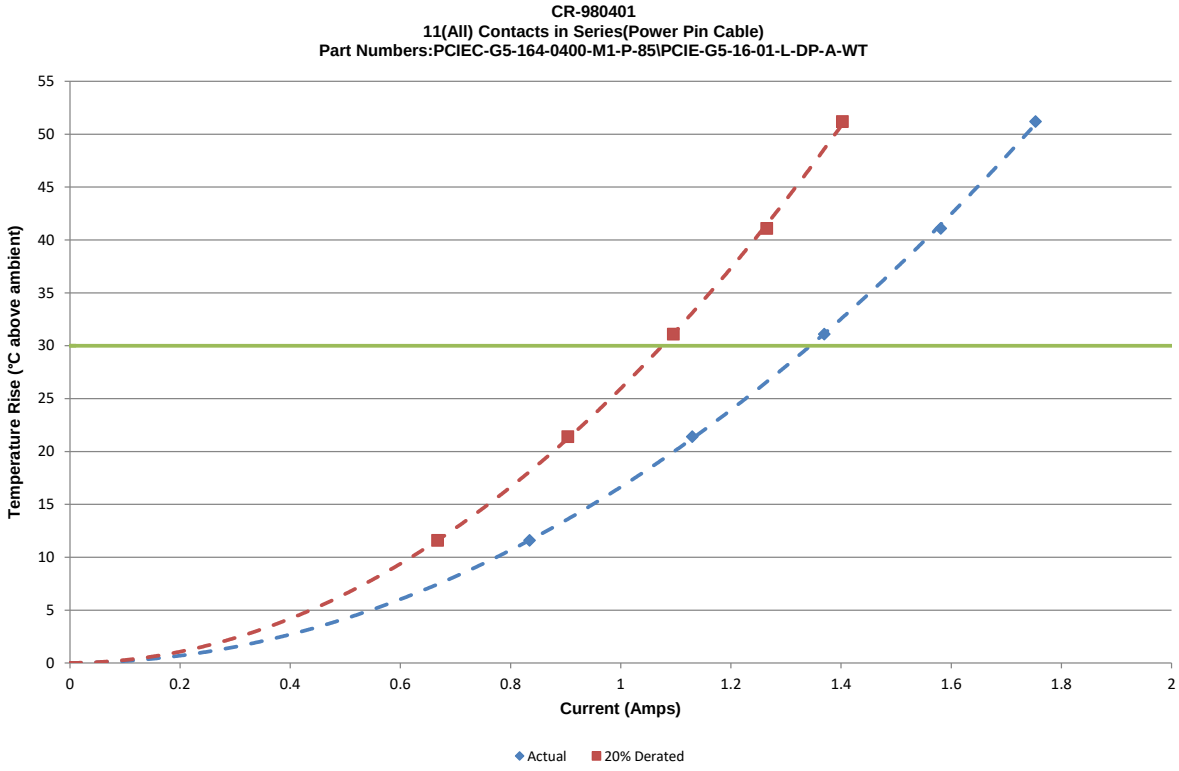




DATA SUMMARIES Continued

e. Linear configuration with all adjacent conductors/contacts powered.





DATA SUMMARIES Continued

Cable Pull Force:
90° Pull

PCIEC-G5-164-0400-M1-P-85

	Force (lbs)
Minimum	**254.45**
Maximum	267.67
Average	261.57

PCIEC-G5-036-0400-M1-P-85

	Force (lbs)
Minimum	**62.80**
Maximum	66.72
Average	65.53

PCIEC-G5-064-0400-M1-P-85

	Force (lbs)
Minimum	**105.60**
Maximum	116.79
Average	113.25

DATA SUMMARIES Continued

INSULATION RESISTANCE (IR):

	Pin to Pin		
	Mated	Unmated	Unmated
Minimum	**PCIEC-G5/PCIE**	**PCIEC-G5**	**PCIE**
Initial	45000	45000	45000
Thermal	45000	45000	45000
Humidity	45000	45000	45000

	Row to Row		
	Mated	Unmated	Unmated
Minimum	**PCIEC-G5/PCIE**	**PCIEC-G5**	**PCIE**
Initial	45000	45000	45000
Thermal	45000	45000	45000
Humidity	45000	45000	45000

DIELECTRIC WITHSTANDING VOLTAGE (DWV):

Voltage Rating Summary	
Minimum	**PCIEC-G5/PCIE**
Break Down Voltage	905
Test Voltage	680
Working Voltage	225

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

Cable Flex:

Insulation Resistance minimums, IR

Pin to Pin	
Mated	
Minimum	
Initial	21500
After 500 Flex Cycles	34000

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

Dielectric Withstanding Voltage minimums, DWV

Voltage Rating Summary	
Minimum	**PCIEC-G5/PCIE**
Test Voltage	680

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

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

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: 3/5/2023, Next Cal: 3/4/2024

Equipment #: DG-THC-01
Description: Humidity transmitter
Manufacturer: Thermtron
Model: SM-8-8200
Serial #: 50613
Accuracy: Last Cal: 12/4/2023, Next Cal: 12/3/2024

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: 04/16/2023, Next Cal: 04/15/2024

Equipment #: DG-HPT-01
Description: Hipot Safety Tester
Manufacturer: Vitrek
Model: V73
Serial #: 025866
Accuracy:
… Last Cal: 04/16/2023, Next Cal: 04/15/2024

Equipment #: HZ-MO-05
Description: Micro-ohmmeter
Manufacturer: Keithley
Model: 3706
Serial #: 1285188
Accuracy: Last Cal: 1/2/2023, Next Cal: 1/1/2024

Equipment #: HZ-MO-01
Description: Micro-ohmmeter
Manufacturer: Keithley
Model: 2700
Serial #: 1199807
Accuracy: Last Cal: 05/19/2023, Next Cal: 05/18/2024

Equipment #: HZ-PS-01
Description: Power Supply
Manufacturer: Agilent
Model: 6031A
Serial #: MY41000982
Accuracy: Last Cal: 04/16/2023, Next Cal: 04/15/2024