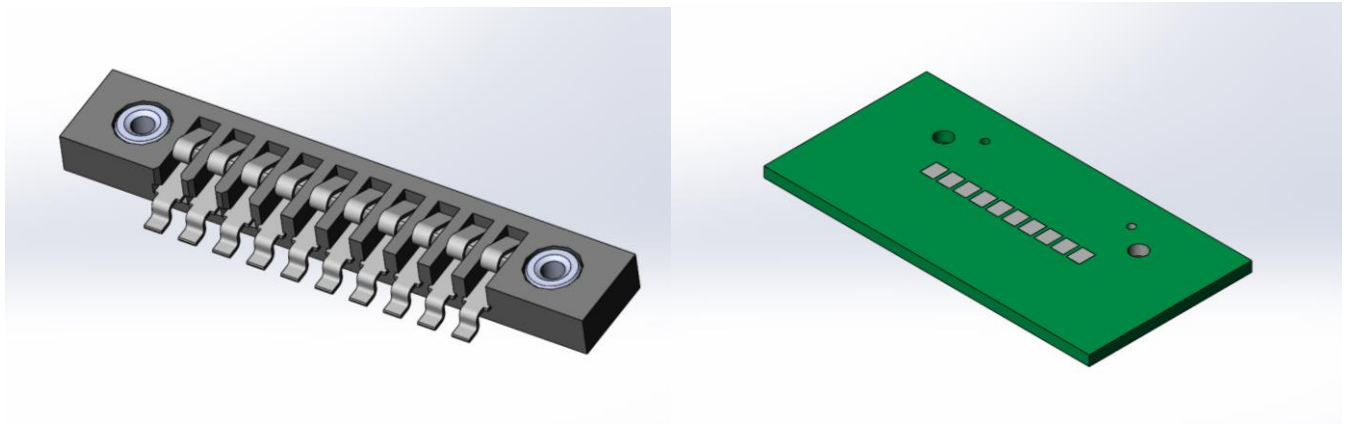




Project Number: 453911	Tracking Code: 453911_Power Test Report_Rev_1 .doc
Requested by: Catie Eichhorn	Date: 11/19/2015
Part #: OPP-10-01-T-S-M-AD/EDGE CARD	
Part description: OPP/EDGE CARD	Technician: Peter Chen
Test Start: 05/28/2015	Test Completed: 06/17/2015



# **SAMTEC POWER CHARACTERIZATION**

## **PART DESCRIPTION**

### **OPP-10-01-T-S-M-AD/EDGE CARD**

### **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**

1. Temperature Rise/Current Carrying Capacity
  - 1.1. To determine the amount of current the device under test (DUT) can safely carry over the operating temperature range of the DUT.
  - 1.2. Contact loading will also be addressed in this document which will determine how much current can be carried as the number of energized contacts is varied.
2. Current Cycling
  - 2.1. To determine the performance of the device under test (DUT) when subjected to the power-on/power-off cycling that heats and cools the DUT in normal everyday use.
  - 2.2. Contact loading will set to 100% throughout the test.

### **APPLICABLE DOCUMENTS**

Standards: EIA Publication 364-70 Temperature Rise  
EIA Publication 364-06 Contact Resistance  
EIA Publication 364-55 Current Cycling  
TLPM-032 Current Carrying Capacity  
TLPM-084 Current Cycling  
IEC 512-3 Electromechanical Components for Electronic Equipment: Basic Testing Procedures and Measuring Methods, Part 3: Current Carrying Capacity Tests

### **TEST SAMPLES AND PREPARATION**

- 1) All materials shall be manufactured in accordance with the applicable product specification.
- 2) All test samples shall be identified and encoded to maintain traceability throughout the test sequences.
- 3) After soldering, the parts to be used shall be cleaned according to TLWI-0001.
- 4) All samples shall be visually inspected and cleaned as necessary.
- 5) Any additional preparation shall be noted in the individual test sequences.
- 6) Solder Information: Lead Free
- 7) All products designed to operate mounted on a printed circuits board shall be tested mounted to test boards in accordance with EIA-364-70.

PREPARED TEST SAMPLE

- 8) The following loading configurations shall be tested for Temperature Rise/Current Carrying Capacity testing of single row connector systems:
- a. One contact energized only
  - b. Two contacts energized adjacent to each other
  - c. Three contacts energized adjacent to each other
  - d. Four contacts energized adjacent to each other
  - e. All contacts energized

✦ Indicates energized contacts

✦ Indicates thermocouple monitored, energized contacts

- 9) For Current Cycling, only 100 % loading will be tested.

Test Condition as in 9.1 above





# POWER INTEGRITY TEST REPORT

**453911**  
**INITIAL RELEASE**

## FLOWCHARTS

### Current Carrying Capacity

Group 1  
OPP-10-01-T-S-M-AD  
EDGE CARD  
1 Pins Powered  
Signal

**Step Description**

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

Group 2  
OPP-10-01-T-S-M-AD  
EDGE CARD  
2 Pins Powered  
Signal

**Step Description**

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

Group 3  
OPP-10-01-T-S-M-AD  
EDGE CARD  
3 Pins Powered  
Signal

**Step Description**

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

Group 4  
OPP-10-01-T-S-M-AD  
EDGE CARD  
4 Pins Powered  
Signal

**Step Description**

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

---

Group 5  
OPP-10-01-T-S-M-AD  
EDGE CARD  
10 Pins Powered  
Signal

**Step Description**

1. CCC (1)  
Rows = 1  
Number of Positions = 10

---

(1) CCC = EIA-364-70

Method 2, Temperature Rise Versus Current Curve

(TIN PLATING) - Tabulate calculated current at RT, 65°C, 75°C and 95°C after derating 20% and based on 105°C

(GOLD PLATING) - Tabulate calculated current at RT, 85°C, 95°C and 115°C after derating 20% and based on 125°C

### Current Cycling

Group 1  
OPP-10-01-T-S-M-AD  
EDGE CARD  
8 Assemblies

**Step Description**

1. Current Cycle (1)

---

(1) Current Cycle = EIA 364-55

Test Condition = B (125% Rated Current)

Method = 4 (On: 45 Minutes, Off: 15 Minutes)

Number of Cycles = 500



**POWER INTEGRITY TEST  
REPORT**

**453911**  
**INITIAL RELEASE**

**TEST PROCEDURES**

<b>Part No.</b>	<b>OPP-10-01-T-S-M-AD</b>	<b>Mating Part No.</b>	<b>Edge card</b>
<b>Sample Size</b>	<b>10</b>	<b>Technician</b>	<b>Peter Chen</b>
<b>Start Date</b>	<b>05/28/2015</b>	<b>Complete Date</b>	<b>06/17/2015</b>
<b>Room Ambient</b>	<b>23°C</b>	<b>Relative Humidity</b>	<b>56%</b>
<b>Equipment ID#: HZ-MO-01, HZ-PS-01, HZ-TCS-001, HZ-TCS-003, HZ-TCS-005</b>			

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

- 1) Thermocouples shall be calibrated in accordance with Samtec documents; TLWI 0003, Thermocouple Welding Procedure and TLWI 0005, Thermocouple Calibration
- 2) The thermocouples shall be placed at a location to sense the maximum temperature generated during testing.
- 3) Temperature stability shall be defined as the temperature at which three successive readings, 5 minutes apart, differ not more than 1° C (computer controlled data acquisition). This is the Temperature Rise that the Current Carrying Capacity and De-rating curves are based on.
- 4) The following loading configurations shall be tested (double for two row systems):
  - a. One contact energized only
  - b. Two contacts energized adjacent to each other
  - c. Three contacts energized adjacent to each other
  - d. Four contacts energized adjacent to each other
  - e. All contacts energized
- 5) Three samples shall be tested for each of the above configurations for a total of eighteen assemblies.
- 6) Temperature Rise measurements shall be made at 5 different current levels yielding temperature rises in the 10 to 70°C range.
- 7) The base curve for the Current Rating chart will be derived from the average (maximum) value of three test specimens in accordance with IEC 512-3, Test 5b.



**POWER INTEGRITY TEST  
REPORT**

**453911**  
**INITIAL RELEASE**

**TEST PROCEDURES**

<b>Part No.</b>	<b>OPP-10-01-T-S-M-AD</b>	<b>Mating Part No.</b>	<b>Edge card</b>
<b>Sample Size</b>	<b>10</b>	<b>Technician</b>	<b>Peter Chen</b>
<b>Start Date</b>	<b>05/28/2015</b>	<b>Complete Date</b>	<b>06/17/2015</b>
<b>Room Ambient</b>	<b>23°C</b>	<b>Relative Humidity</b>	<b>56%</b>
<b>Equipment ID#: HZ-MO-01, HZ-PS-01, HZ-TCS-001, HZ-TCS-003, HZ-TCS-005</b>			

**CURRENT CYCLING**

1. Samples shall be prepared and tested as above (paragraph 14.5).
2. Current Cycling shall be performed in accordance with EIA-364-55, Test Condition
3. Testing shall be as follows:
  - 3.1. Test Current: 1.2 Amps (125% of 30°C Rating)
  - 3.2. "ON" Time: 45 Minutes
  - 3.3. "OFF" Time: 15 Minutes
  - 3.4. Number of Cycles: 500
  - 3.5. Measurements: 40 minutes into ON cycle
    - 3.5.1. Temperature
    - 3.5.2. Voltage Drop/Contact Resistance
4. Temperature vs. Number of Cycles and Voltage Drop vs. Number of Cycles shall be measured and recorded.



**TEST RESULTS**

**CURRENT CARRYING CAPACITY (CCC) RESULTS**

- There was no evidence of physical damage to the test samples as tested.
- The following is a summary of the observed data:

**Temperature Rise, CCC at a 20% de-rating**

- CCC for a 30°C Temperature Rise -----9.6 A per contact with 1 adjacent signal contacts powered
- CCC for a 30°C Temperature Rise -----7.8 A per contact with 2 adjacent signal contacts powered
- CCC for a 30°C Temperature Rise -----6.7 A per contact with 3 adjacent signal contacts powered
- CCC for a 30°C Temperature Rise -----6.2 A per contact with 4 adjacent signal contacts powered
- CCC for a 30°C Temperature Rise -----4.8 A per contact with all adjacent signal contacts powered

**CURRENT CYCLING RESULTS**

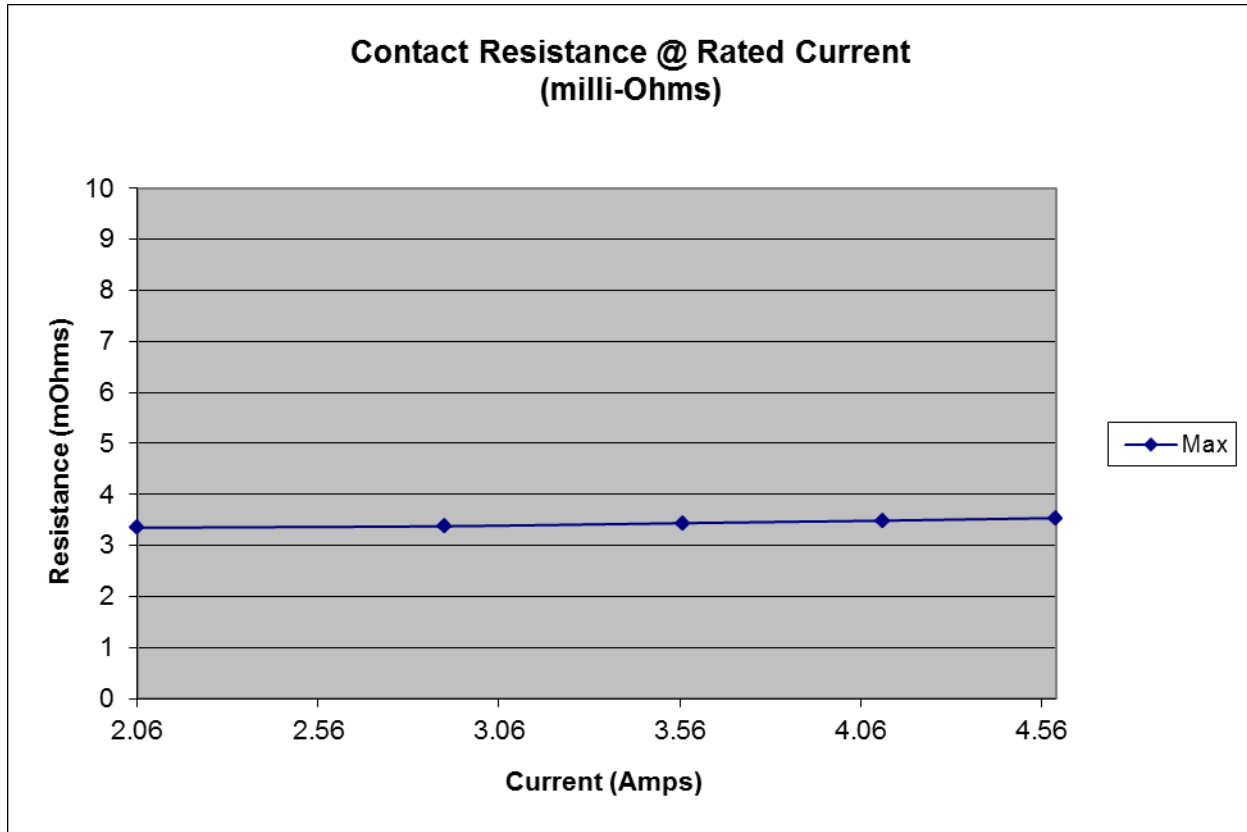
**Test Condition: 500 Cycles, 45 minutes ON and 15 minutes OFF**

- Test Current ----- 6.0 Amps
- Contact Resistances, Measured 40 minutes into the FIRST and LAST ON cycle
  - Initial
    - Min ----- 2.28mOhms
    - Max----- 3.35 mOhms
  - Final
    - Min ----- 2.35 mOhms
    - Max----- 3.54 mOhms
- Temperature Change, Measured 40 minutes into the FIRST and LAST ON cycle
  - Initial Temperature Change -----28.8°C
  - Final Temperature Change -----29.3°C

**TEST DATA**

**CONTACT RESISTANCE @ RATED CURRENT - DC Resistance (DCR)**

The following data represents the Voltage drop and Contact Resistance at Rated Current for the 100% energized samples:



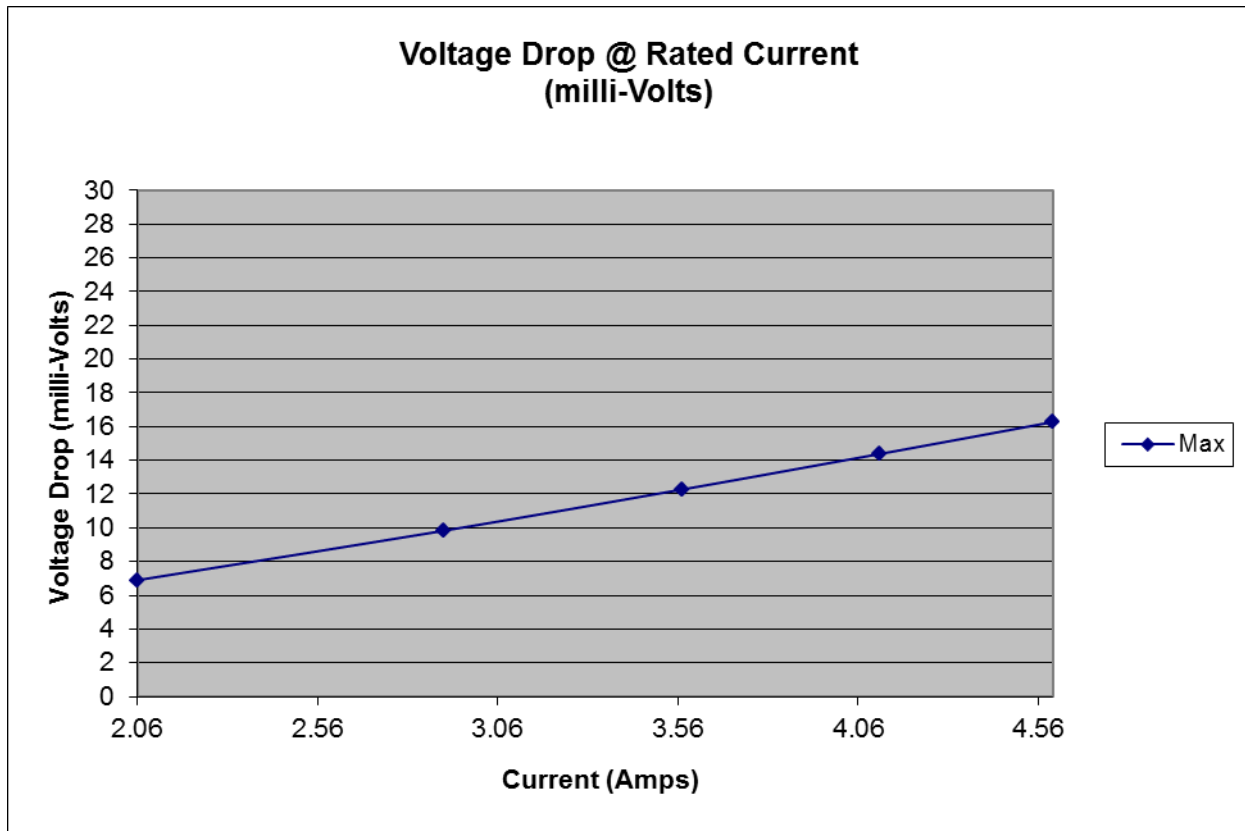
**CONTACT RESISTANCE DATA  
ALL CONTACTS ENERGIZED  
(mΩ)**

TEST CURRENT AMPS	2.06	2.91	3.57	4.12	4.6
Min	2.28	2.29	2.32	2.34	2.35
Max	3.35	3.38	3.44	3.49	3.54
Avg	2.74	2.79	2.87	2.89	3

**TEST DATA**

**VOLTAGE DROP @ RATED CURRENT**

The following data represents the Voltage drop at Rated Current for the 100% energized samples:



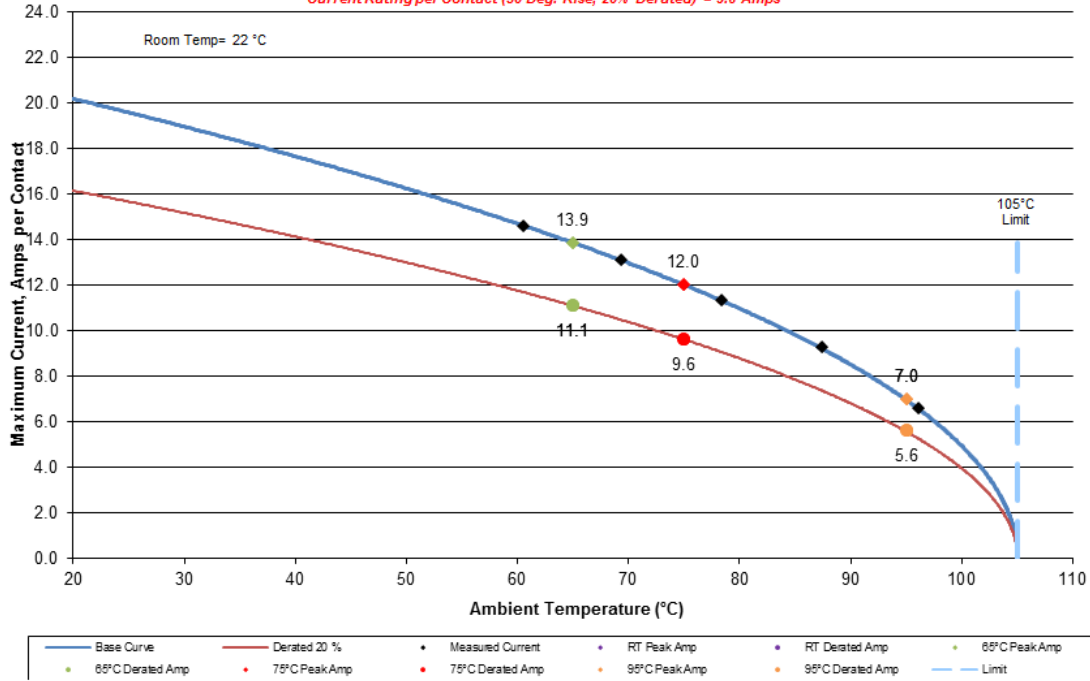
**VOLTAGE DROP DATA  
ALL CONTACTS ENERGIZED  
(mV)**

TEST CURRENT AMPS	2.06	2.91	3.57	4.12	4.6
Min	4.69	6.67	8.27	9.71	10.82
Max	6.9	9.83	12.27	14.38	16.27
Avg	5.32	7.63	9.61	11.18	12.86

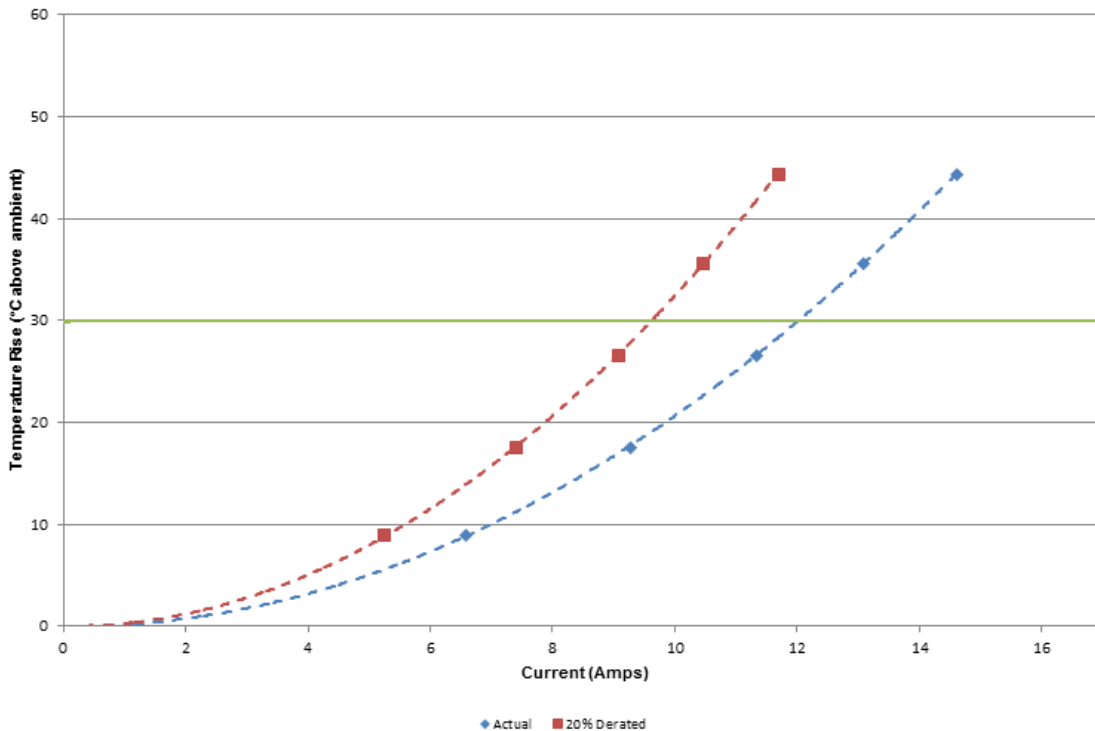
## CURRENT CARRYING CAPACITY DATA

453911  
1 (1x1) Signal Pins Powered in Series  
Part Numbers: OPP-10-01-T-S-M-AD/EDGE CARD

*Current Rating per Contact (30 Deg. Rise, 20% Derated) = 9.6 Amps*



453911  
1 (1x1) Signal Pins Powered in Series  
Part Numbers: OPP-10-01-T-S-M-AD/EDGE CARD





# POWER INTEGRITY TEST REPORT

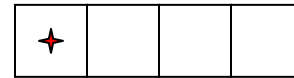
**453911**  
**INITIAL RELEASE**

## TEMPERATURE RISE DATA TWO CONTACT ENERGIZED (Degrees Celsius above ambient)

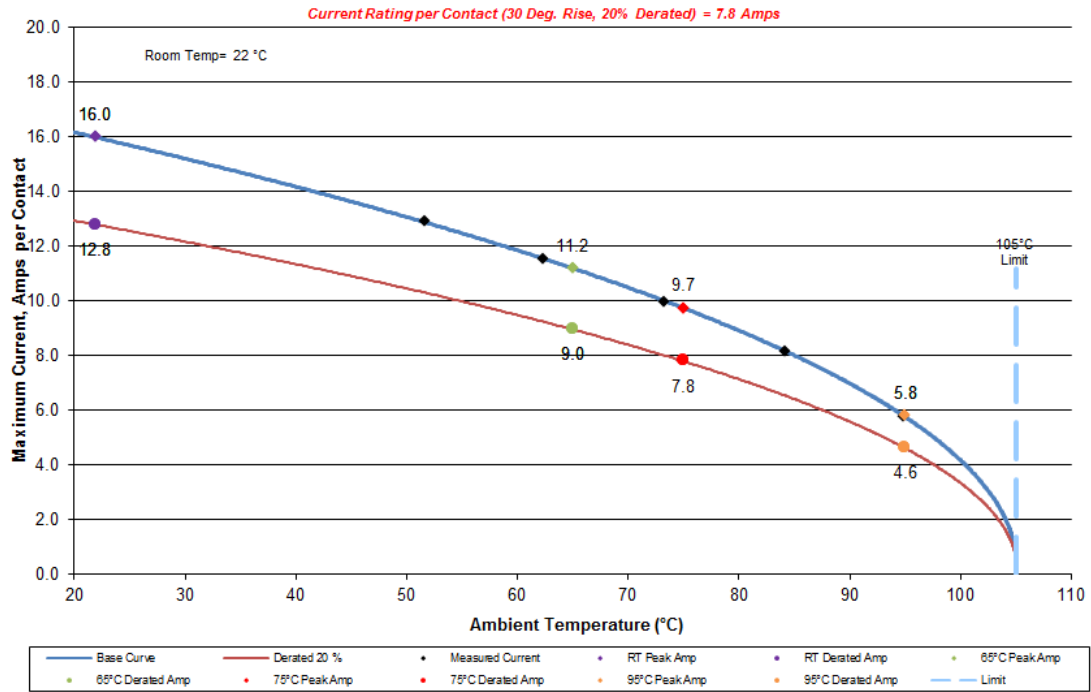
TEST CURRENT AMPS	6.56	9.27	11.33	13.07	14.61
Sample 1	8.7	17.7	27	36.2	45.6
Sample 2	9.4	18.2	27.1	36.1	45.4
Sample 3	8.5	16.9	25.8	34.6	42.3
Min	8.5	16.9	25.8	34.6	42.3
Max	9.4	18.2	27.1	36.2	45.6
Avg	8.87	17.6	26.63	35.63	44.43

Single Row Configuration

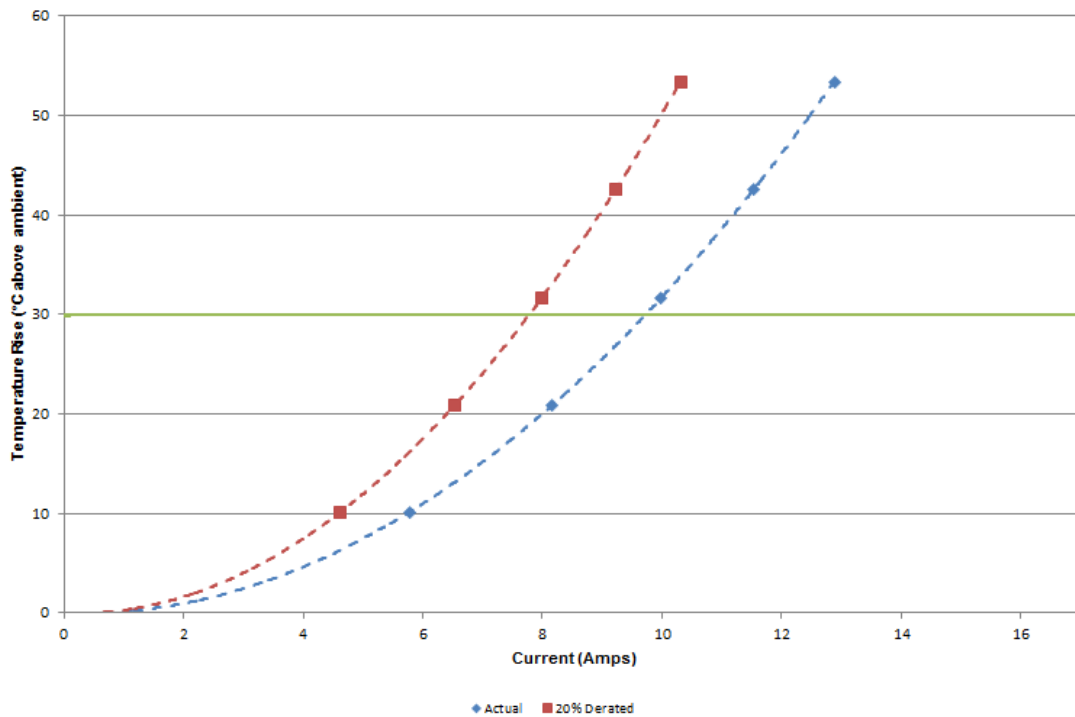
- ✦ Indicates energized contacts
- ✦ Indicates thermocouple monitored, energized contacts



453911  
2 (1x2) Signal Pins Powered in Series  
Part Numbers: OPP-10-01-T-S-M-AD/EDGE CARD



453911  
2 (1x2) Signal Pins Powered in Series  
Part Numbers: OPP-10-01-T-S-M-AD/EDGE CARD





# POWER INTEGRITY TEST REPORT

**453911**  
**INITIAL RELEASE**

## TEMPERATURE RISE DATA FOUR CONTACTS ENERGIZED (Degrees Celsius above ambient)

TEST CURRENT AMPS	5.78	5.78	9.98	11.54	12.89
Sample 4	8	19.4	30.6	42.4	52.7
Sample 5	7.2	18.5	29.1	40	51.4
Sample 6	7	18.7	29	39.5	50.4
Min	7	18.5	29	39.5	50.4
Max	8	19.4	30.6	42.4	52.7
Avg	7.4	18.87	29.57	40.63	51.5

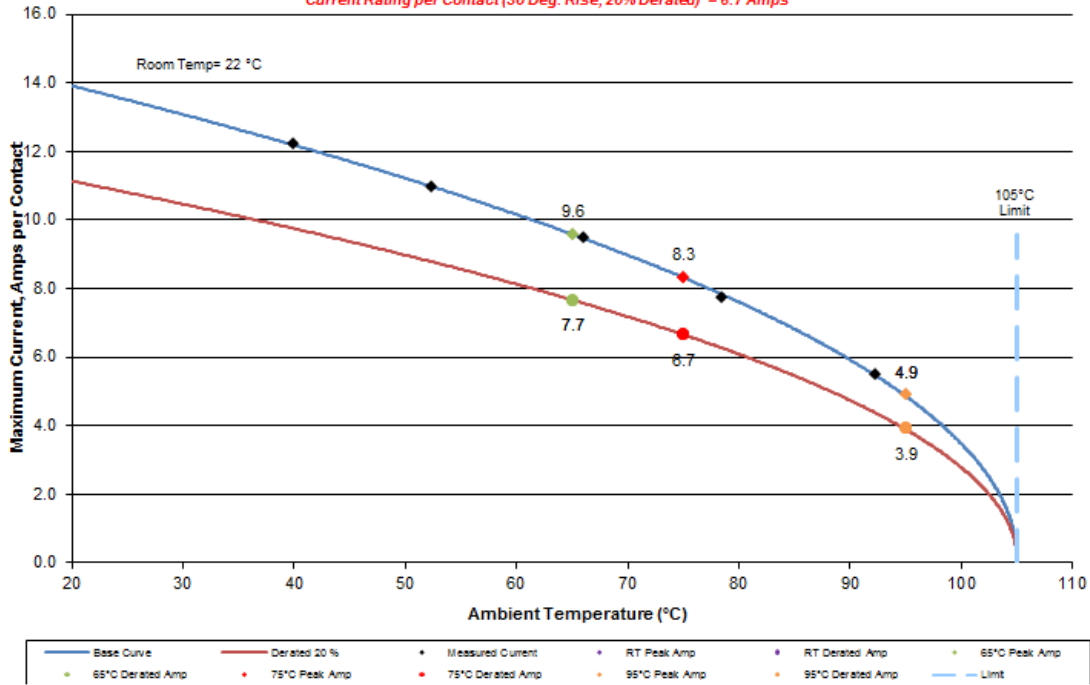
✦ Indicates energized contacts

✦ Indicates thermocouple monitored, energized contacts

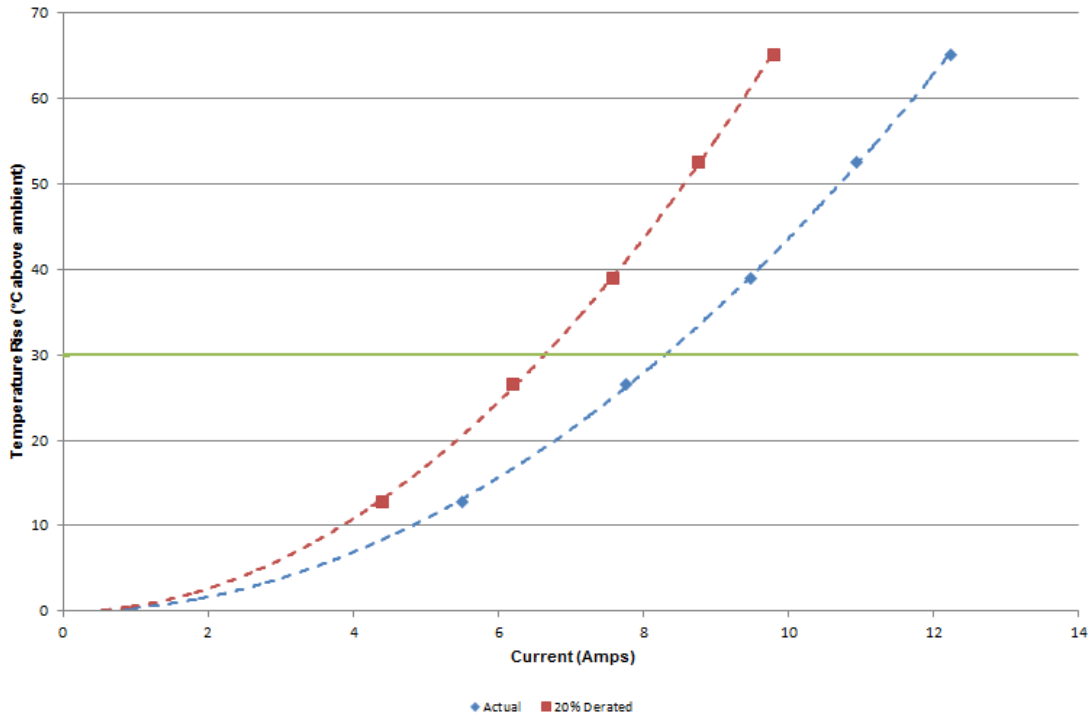
✦	✦		
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453911  
3 (1x3) Signal Pins Powered in Series  
Part Numbers: OPP-10-01-T-S-M-AD/EDGE CARD

*Current Rating per Contact (30 Deg. Rise, 20% Derated) = 6.7 Amps*



453911  
3 (1x3) Signal Pins Powered in Series  
Part Numbers: OPP-10-01-T-S-M-AD/EDGE CARD





# POWER INTEGRITY TEST REPORT

**453911**  
**INITIAL RELEASE**

## TEMPERATURE RISE DATA SIX CONTACTS ENERGIZED (Degrees Celsius above ambient)

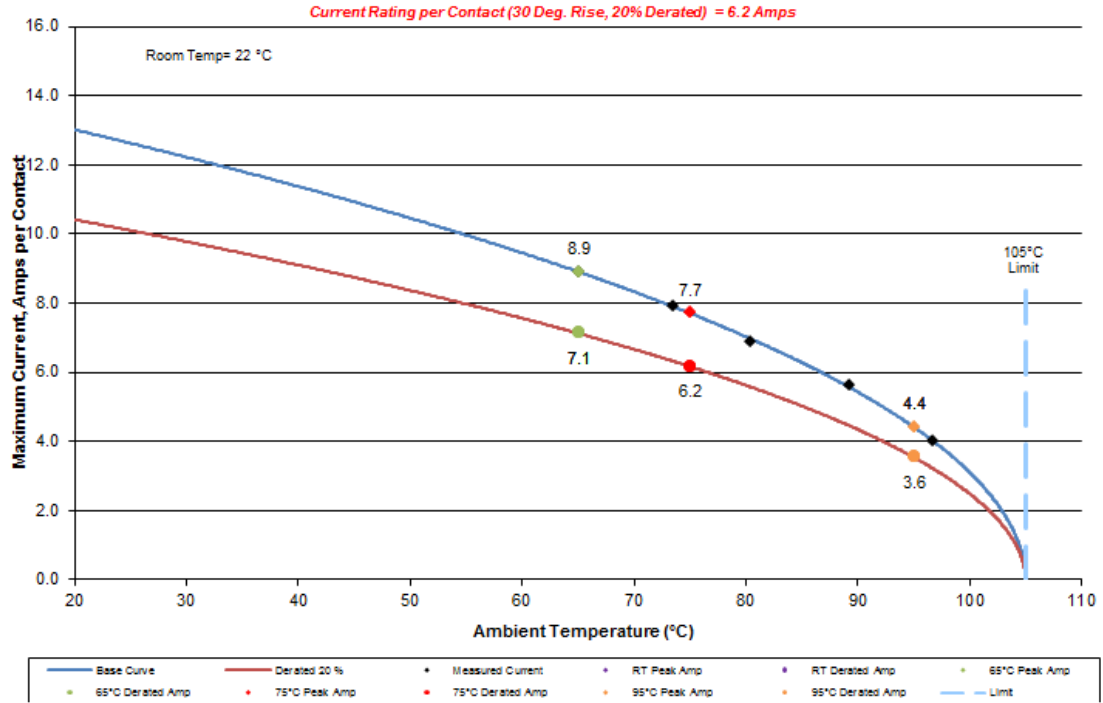
TEST CURRENT AMPS	5.48	7.76	9.47	10.94	12.22
Sample 7	8.6	16.8	24.9	33.3	52.5
Sample 8	9.5	18.8	27.8	36.6	51.2
Sample 9	9.3	19.2	28.9	38.2	50.2
Min	8.6	16.8	24.9	33.3	50.2
Max	9.5	19.2	28.9	38.2	52.5
Avg	9.13	18.27	27.2	36.03	51.3

✦ Indicates energized contacts

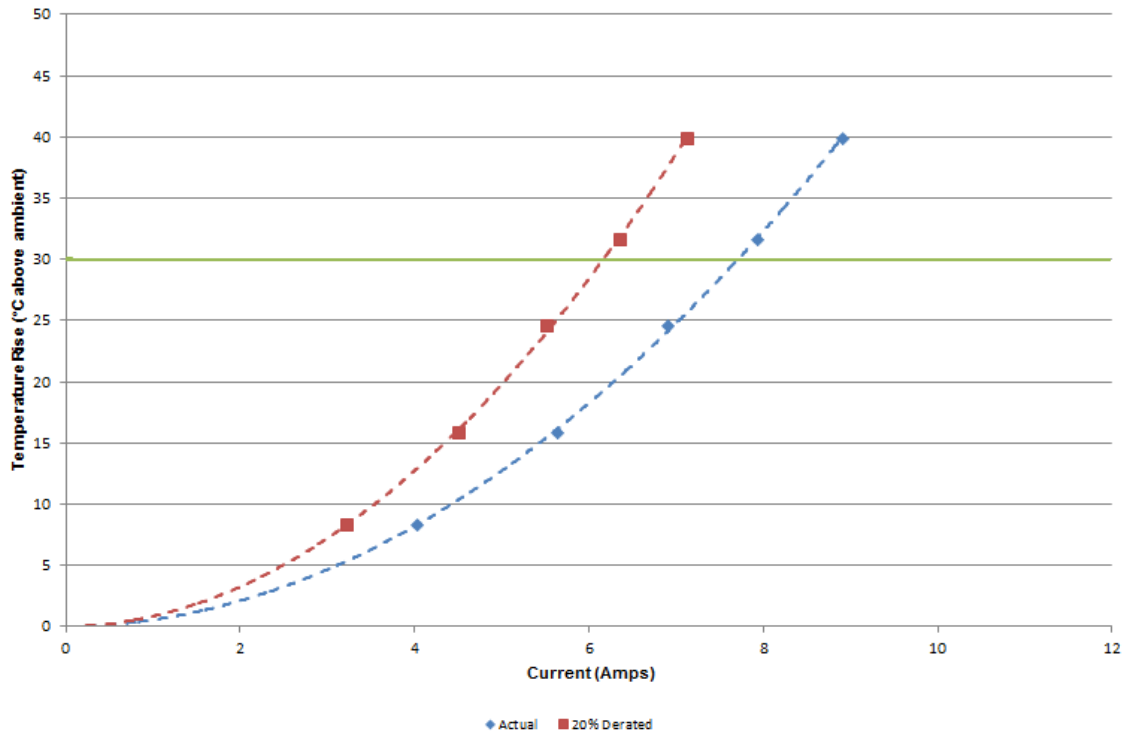
✦ Indicates thermocouple monitored, energized contacts

✦	✦	✦	
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453911  
4 (1x4) Signal Pins Powered in Series  
Part Numbers: OPP-10-01-T-S-M-AD/EDGE CARD



453911  
4 (1x4) Signal Pins Powered in Series  
Part Numbers: OPP-10-01-T-S-M-AD/EDGE CARD





# POWER INTEGRITY TEST REPORT

**453911**  
**INITIAL RELEASE**

## TEMPERATURE RISE DATA EIGHT CONTACTS ENERGIZED (Degrees Celsius above ambient)

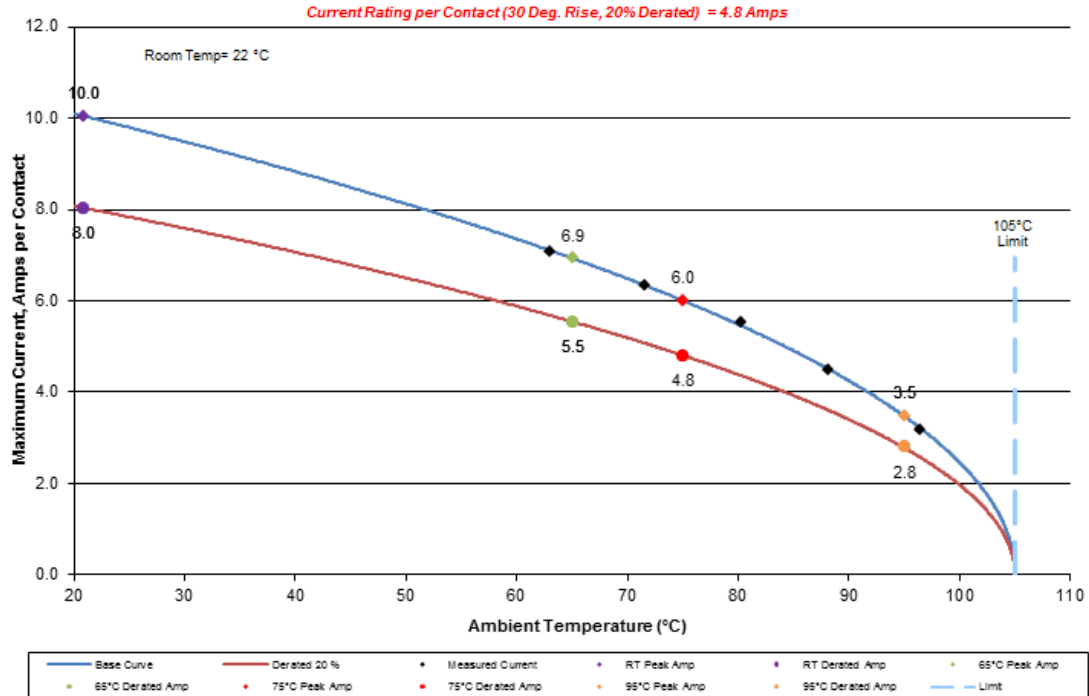
TEST CURRENT AMPS	4.02	5.64	6.9	7.93	8.9
Sample 10	9	17.8	26.6	34.6	42.5
Sample 11	9.3	18.7	28.2	37.6	46.8
Sample 12	9	18.1	27	35.3	43.2
Min	9	17.8	26.6	34.6	42.5
Max	9.3	18.7	28.2	37.6	46.8
Avg	9.1	18.2	27.27	35.83	44.17

✦ Indicates energized contacts

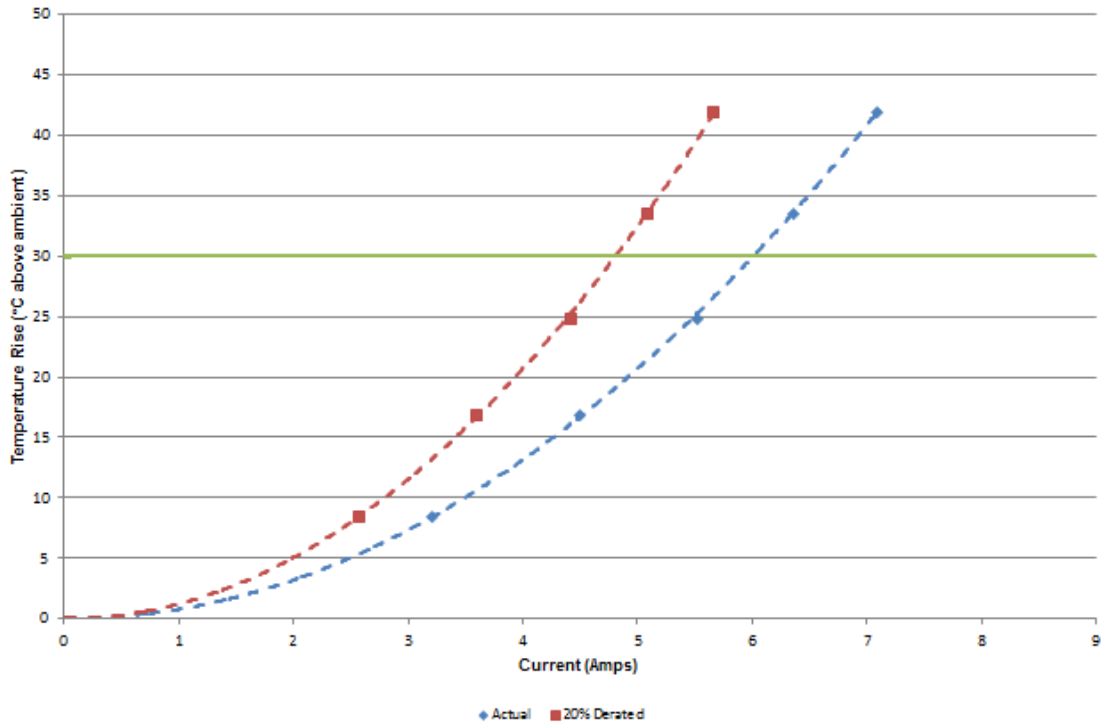
✦ Indicates thermocouple monitored, energized contacts



453911  
All (1x10) Signal Pins Powered in Series  
Part Numbers: OPP-10-01-T-S-M-AD/EDGE CARD



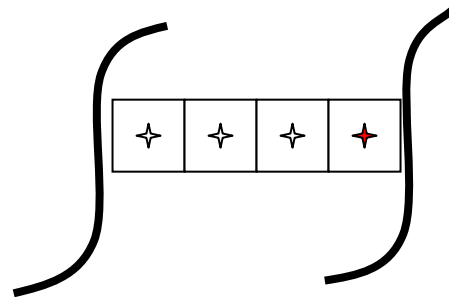
453911  
All (1x10) Signal Pins Powered in Series  
Part Numbers: OPP-10-01-T-S-M-AD/EDGE CARD

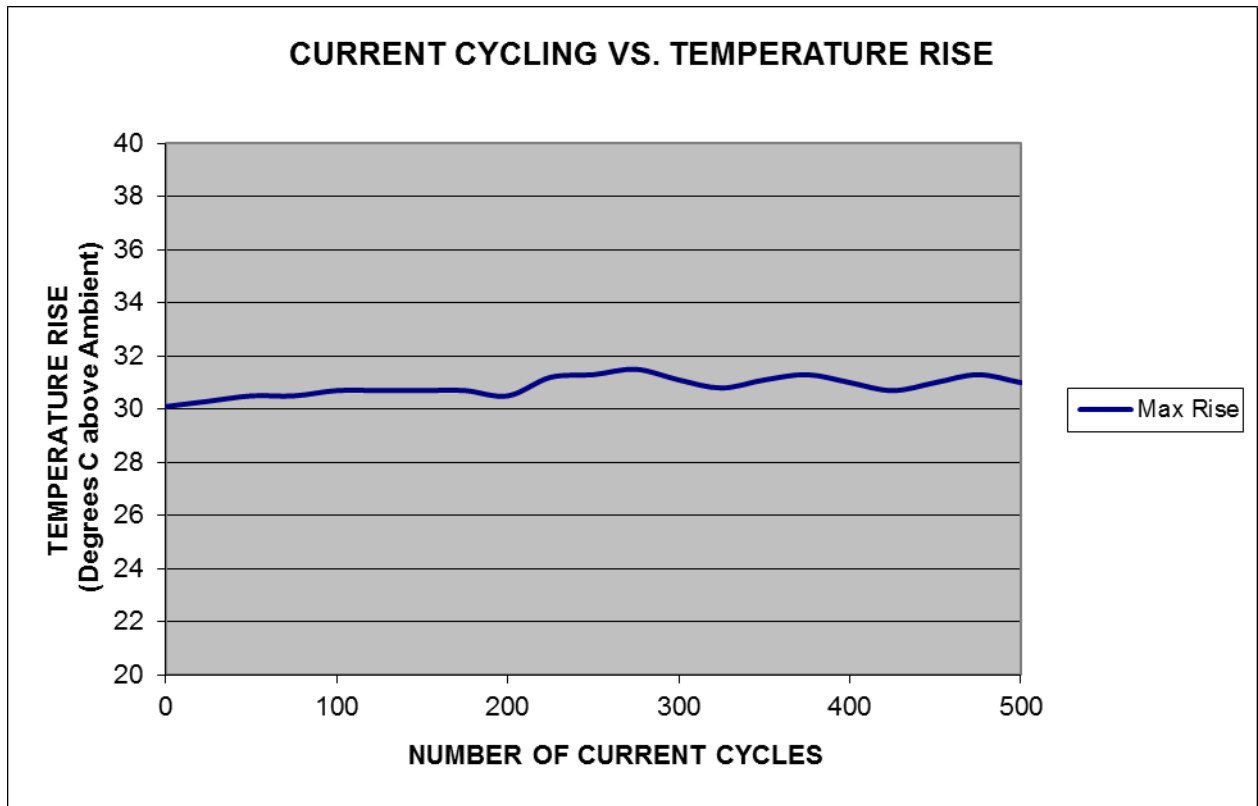


**TEMPERATURE RISE DATA  
ALL CONTACTS ENERGIZED  
(Degrees Celsius above ambient)**

TEST CURRENT AMPS	2.06	2.91	3.57	4.12	4.6
Sample 13	9.2	18.2	27.4	36.1	44.2
Sample 14	8.4	16.1	23.4	30.4	36.7
Sample 15	8.5	16.5	24.3	31.7	38.6
Min	8.4	16.1	23.4	30.4	36.7
Max	9.2	18.2	27.4	36.1	44.2
Avg	8.7	16.93	25.03	32.73	39.83

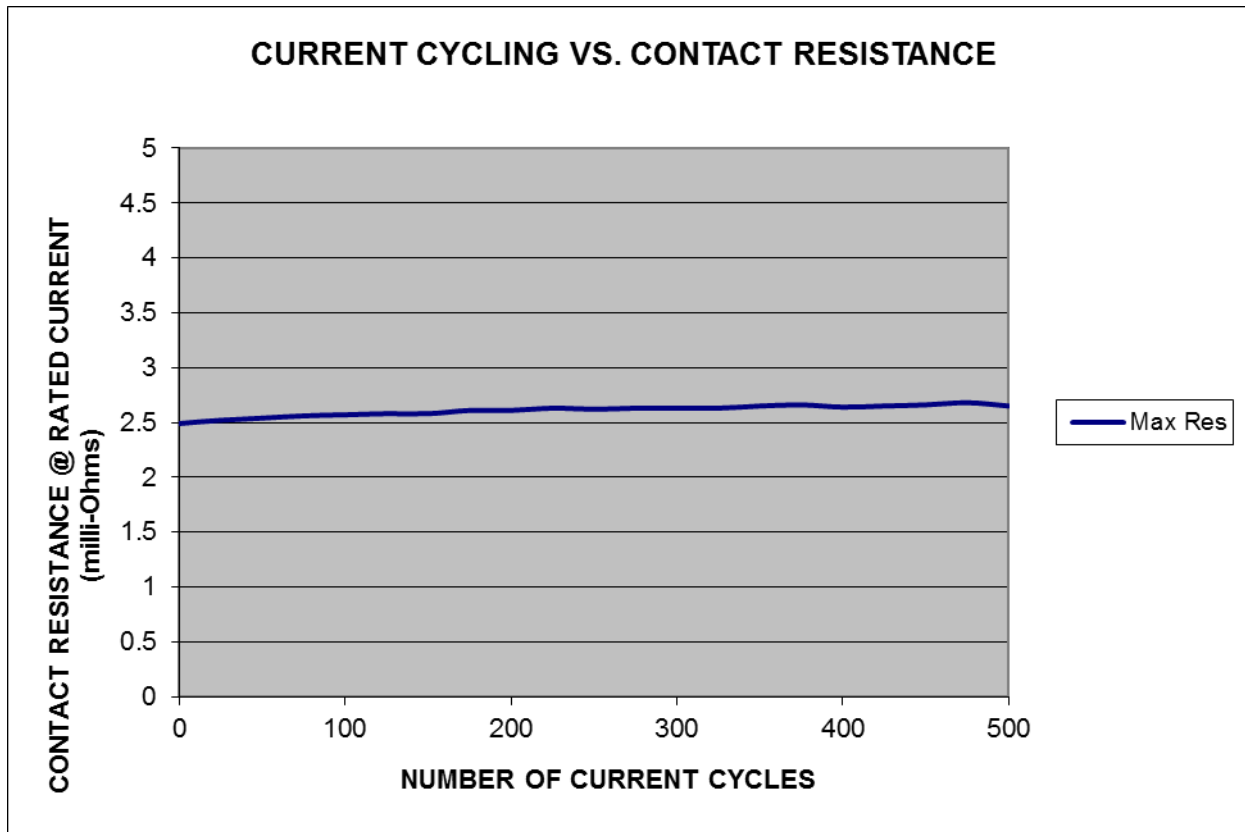
- ✦ Indicates energized contacts
- ✦ Indicates thermocouple monitored, energized contacts





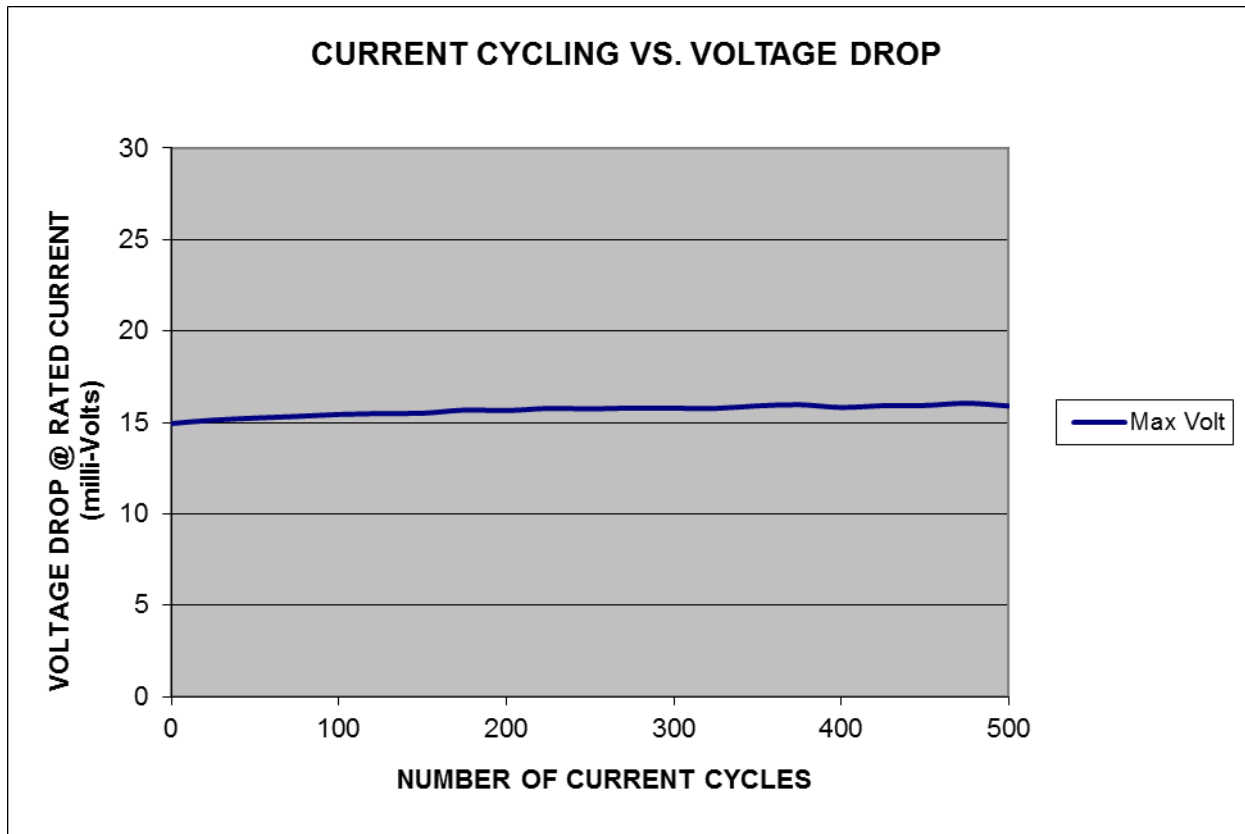
**TEMPERATURE RISE DATA  
ALL CONTACTS ENERGIZED  
(Degrees Celsius above ambient)**

	<b>INITIAL</b>	<b>50 CYCLES</b>	<b>100 CYCLES</b>	<b>200 CYCLES</b>	<b>500 CYCLES</b>
<b>Min</b>	27.6	27.9	27.7	27.9	28.1
<b>Max</b>	30.1	30.5	30.7	30.5	31
<b>Avg</b>	28.8	28.9	29	29.1	29.3



**CONTACT RESISTANCE DATA  
ALL CONTACTS ENERGIZED  
(mΩ)**

	<b>INITIAL</b>	<b>50 CYCLES</b>	<b>100 CYCLES</b>	<b>200 CYCLES</b>	<b>500 CYCLES</b>
<b>Min</b>	1.37	1.37	1.38	1.38	1.37
<b>Max</b>	2.49	2.54	2.57	2.61	2.65
<b>Avg</b>	1.67	1.68	1.69	1.7	1.7



**VOLTAGE DROP DATA  
ALL CONTACTS ENERGIZED  
(MV)**

	INITIAL	50 CYCLES	100 CYCLES	200 CYCLES	500 CYCLES
<b>Min</b>	8.19	8.23	8.26	8.25	8.23
<b>Max</b>	14.94	15.24	15.44	15.65	15.9
<b>Avg</b>	10.03	10.09	10.15	10.18	10.2



**POWER INTEGRITY TEST  
REPORT**

**453911**

**INITIAL RELEASE**

**EQUIPMENT AND CALIBRATION SCHEDULES**

**Equipment #:** HZ-MO-01

**Description:** Multimeter /Data Acquisition System

**Manufacturer:** Keithley

**Model:** 2700

**Serial #:** 1199807

**Accuracy:** See Manual

... Last Cal: 06/01/2015, Next Cal: 05/31/2016

**Equipment #:** HZ-PS-01

**Description:** 20 V, 120 A DC Power Supply - AutoRanging SO/HPIB

**Manufacturer:** Hewlett Packard / Agilent

**Model:** AT-6031A

**Serial #:** 2721A00648

**Accuracy:** See Manual

... Last Cal: Reference Only, Next Cal: Reference Only

**Equipment #:** HZ-MO-06

**Description:** Model 2750 Multimeter/Switch System

**Manufacturer:** Keithley

**Model:** 2750

**Serial #:** 13107320

**Accuracy:** See Manual

... Last Cal: 01/30/2015, Next Cal: 01/29/2016

**Equipment #:** HZ-PS-03

**Description:** 60 V, 30 A DC Power Supply - AutoRanging SO

**Manufacturer:** Hewlett Packard / Agilent

**Model:** AT-6033A

**Serial #:** 3329A-07330

**Accuracy:** See Manual

... Last Cal: Reference Only, Next Cal: Reference Only