Project Number: 277524	Tracking Code: 277524_Power Test Report_Rev_1 .doc
Requested by: Catie Eichhorn	Date: 12/20/2013
Part #: MPPT-10-01-01-L-RA-SD/MPPT-10-01-01-L-RA-SD	
Part description: MPPT/MPPT	Technician: Kason He
Test Start: 11/12/2013	Test Completed: 12/16/2013

SAMTEC POWER CHARACTERIZATION

PART DESCRIPTION

MPPT-10-01-01-L-RA-SD/MPPT-10-01-01-L-RA-SD

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

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.

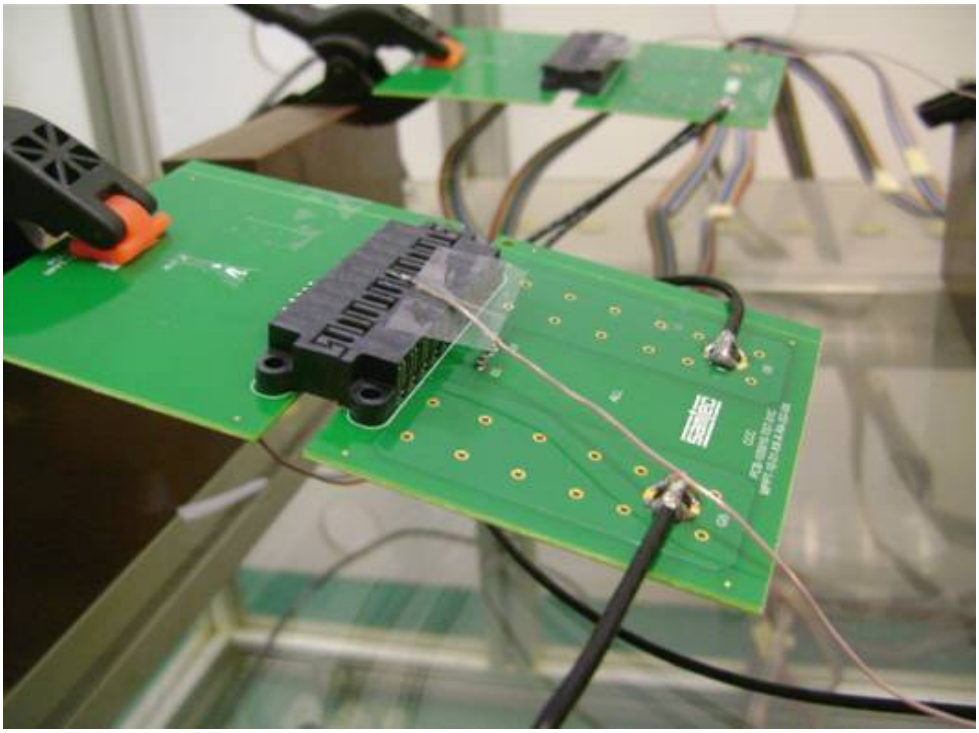
APPLICABLE DOCUMENTS

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) Re-Flow Time/Temp: See accompanying profile.
8) 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



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

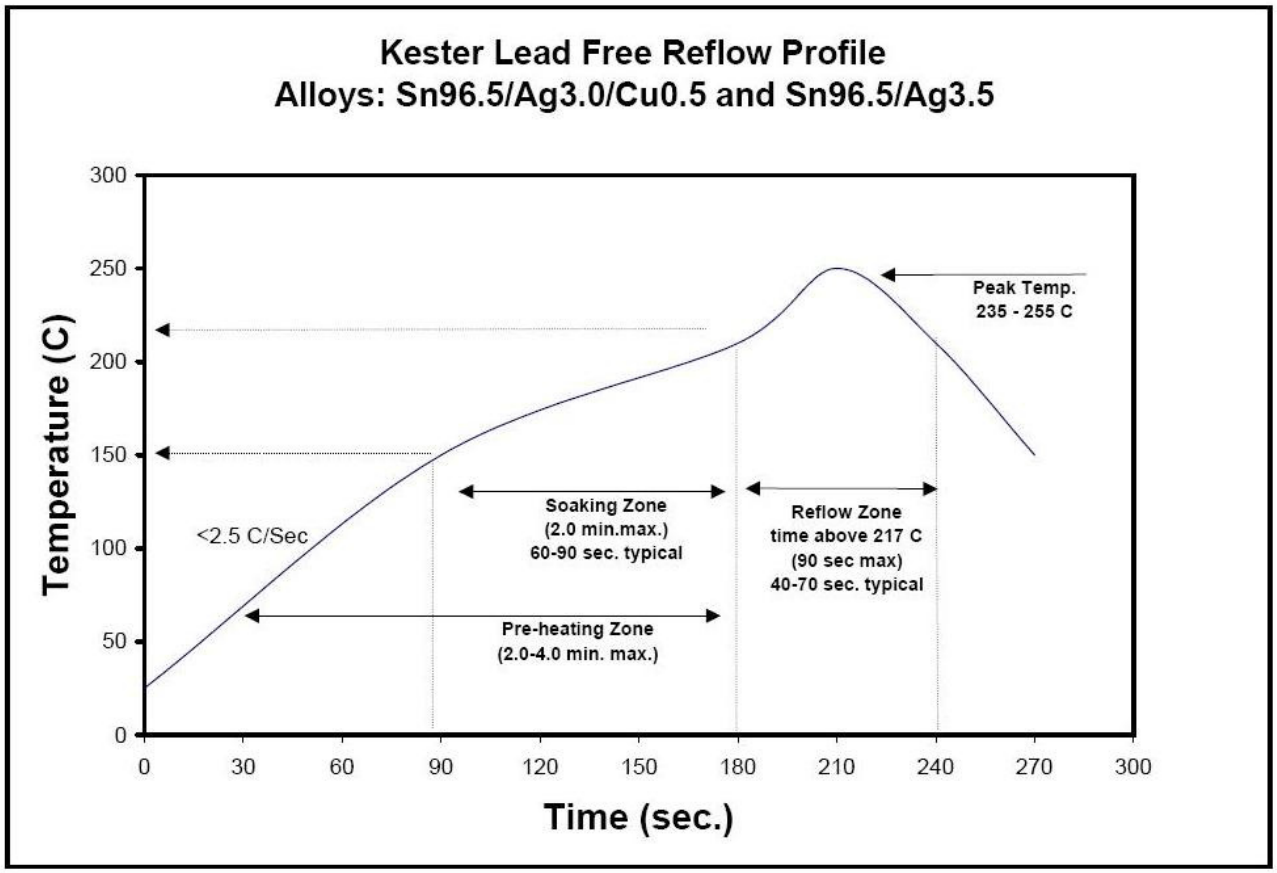
Test Condition as in 9.1 above

✧ Indicates energized contacts

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

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

OVEN PROFILE (Soldering Parts to Test Boards)



FLOWCHARTS

Current Carrying Capacity

Group 1	Group 2	Group 3	Group 4
MPPT-10-01-01-L-RA-SD	MPPT-10-01-01-L-RA-SD	MPPT-10-01-01-L-RA-SD	MPPT-10-01-01-L-RA-SD
MPPT-10-01-01-L-RA-SD	MPPT-10-01-01-L-RA-SD	MPPT-10-01-01-L-RA-SD	MPPT-10-01-01-L-RA-SD
1 Pins Powered	2 Pins Powered	3 Pins Powered	4 Pins Powered
Signal	Signal	Signal	Signal
Step **Description**	**Step** **Description**	**Step** **Description**	**Step** **Description**
1. CCC (1) Rows = 1 Number of Positions = 1	1. CCC (1) Rows = 1 Number of Positions = 2	1. CCC (1) Rows = 1 Number of Positions = 3	1. CCC (1) Rows = 1 Number of Positions = 4

Group 5
MPPT-10-01-01-L-RA-SD
MPPT-10-01-01-L-RA-SD
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
MPPT-10-01-01-L-RA-SD
MPPT-10-01-01-L-RA-SD
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

TEST PROCEDURES

Part No.	MPPT-10-01-01-L-RA-SD	Mating Part No.	MPPT-10-01-01-L-RA-SD
Sample Size	9	Technician	Kason He
Start Date	11/12/2013	Complete Date	11/13/2013
Room Ambient	22°C	Relative Humidity	53%
Equipment ID#: HZ-MO-01, HZ-PS-01, 277524-(039 - 047)			

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) The following loading configurations shall be tested for Temperature Rise/Current Carrying Capacity testing of two row connector systems:
   a. Two by One contact energized
   b. Two by Two contacts energized adjacent to each other
   c. Two by Three contacts energized adjacent to each other
   d. Two by Four contacts energized adjacent to each other
   e. All contacts energized
6) Three samples shall be tested for each of the above configurations for a total of eighteen assemblies.
7) Temperature Rise measurements shall be made at 5 different current levels yielding temperature rises in the 10 to 70°C range.
8) 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.

Part No.	**MPPT-10-01-01-L-RA-SD**	**Mating Part No.**	**MPPT-10-01-01-L-RA-SD**
Sample Size	**8**	**Technician**	Kason He
Start Date	11/20/2013	**Complete Date**	12/16/2013
Room Ambient	**22°C**	**Relative Humidity**	**50%**
Equipment ID#:	**HZ-MO-06, HZ-PS-03, 277524(048 - 055)**		

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: 25.2 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 ----------35.5 A per contact with 1 contacts (1 x 1) powered**
- **CCC for a 30°C Temperature Rise ----------29.6 A per contact with 2 contacts (1 x 2) powered**
- **CCC for a 30°C Temperature Rise ----------27.6 A per contact with 3 contacts (1 x 3) powered**
- **CCC for a 30°C Temperature Rise ----------24.4 A per contact with 4 contacts (1 x 4 powered**
- **CCC for a 30°C Temperature Rise ----------20.2 A per contact with 10 contacts (All) powered**

CURRENT CYCLING RESULTS

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

- **Test Current ----------25.2 Amps**

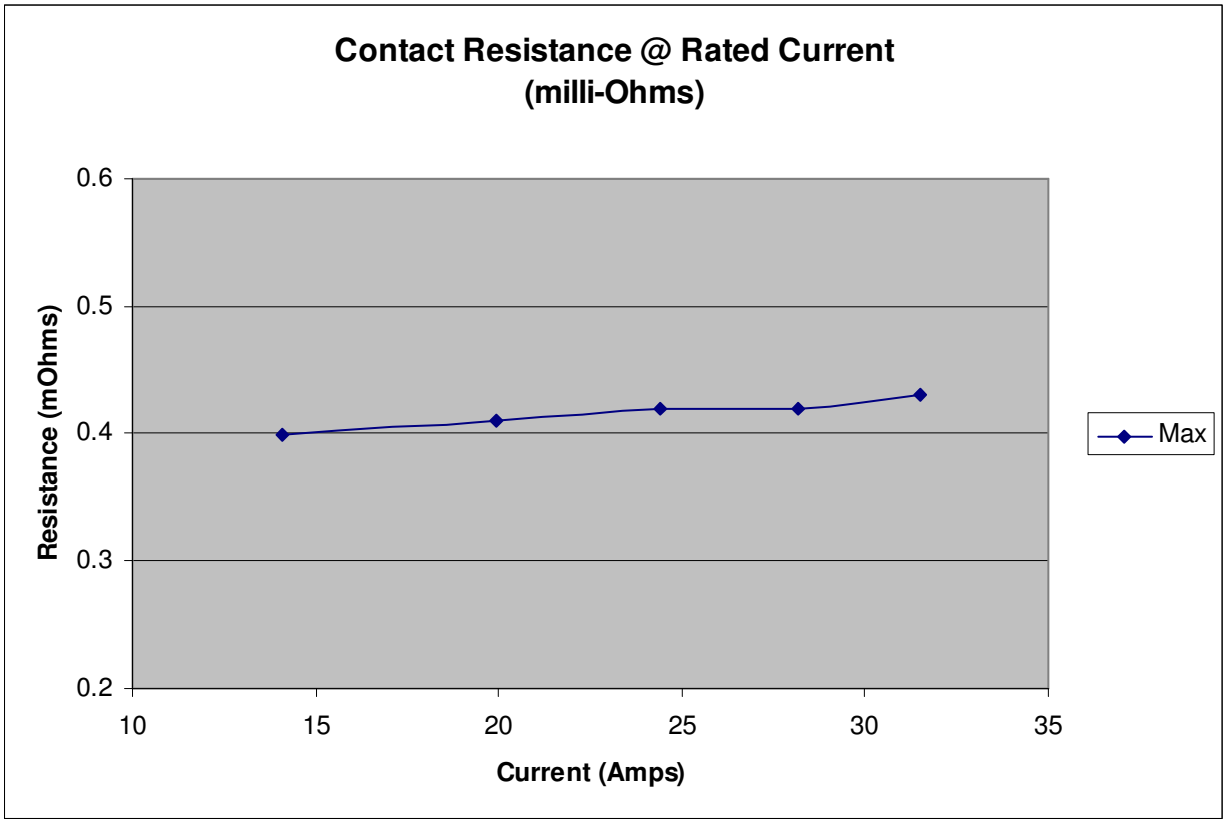
- **Contact Resistances, Measured 40 minutes into the FIRST and LAST ON cycle**
  - **Initial**
    - **Min ---------- 0.23 mOhms**
    - **Max---------- 0.42 mOhms**
  - **Final**
    - **Min ---------- 0.22 mOhms**
    - **Max---------- 0.40 mOhms**

- **Temperature Change, Measured 40 minutes into the FIRST and LAST ON cycle**
  - **Initial Temperature Change ----------30.0°C**
  - **Final Temperature Change ----------28.9°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:

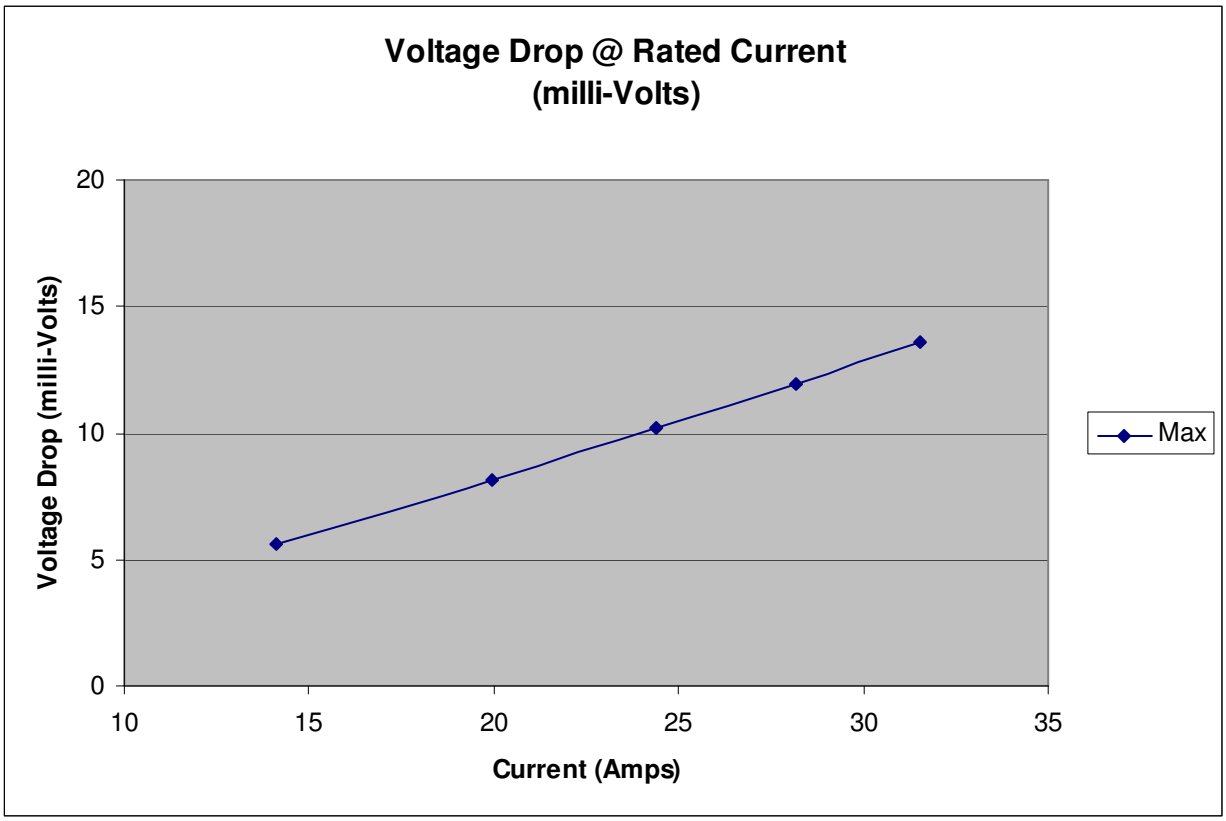


CONTACT RESISTANCE DATA ALL CONTACTS ENERGIZED (mΩ)					
TEST CURRENT AMPS	14.12	19.94	24.41	28.2	31.51
Min	0.22	0.22	0.23	0.23	0.24
Max	0.4	0.41	0.42	0.42	0.43
Avg	0.29	0.3	0.3	0.3	0.31

TEST DATA

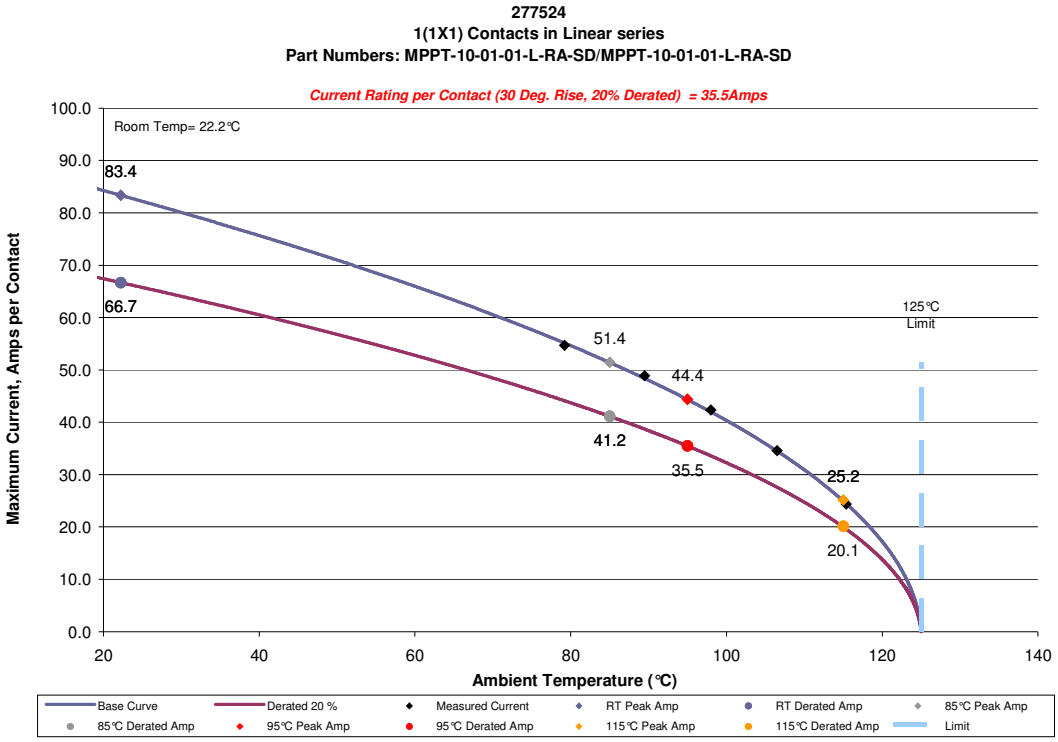
VOLTAGE DROP @ RATED CURRENT

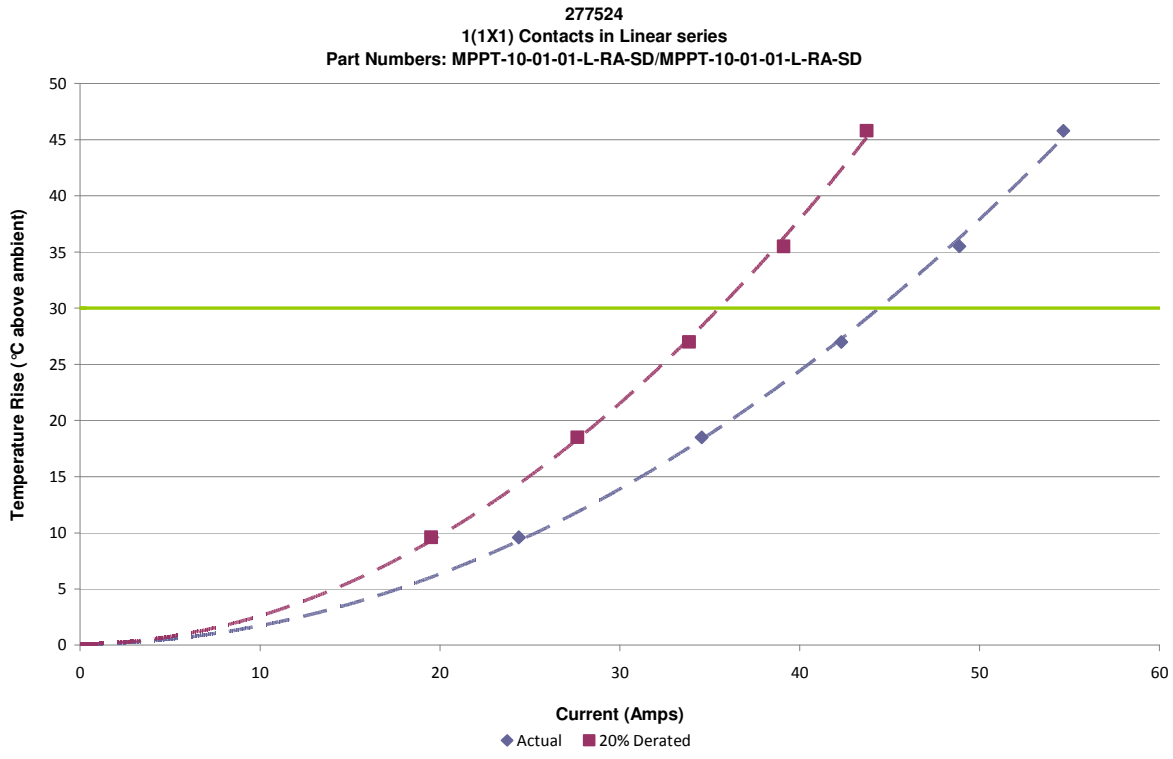
The following data represents the Voltage drop at Rated Current for the 100% energized samples:



VOLTAGE DROP DATA ALL CONTACTS ENERGIZED (mV)					
TEST CURRENT AMPS	14.12	19.94	24.41	28.2	31.51
Min	3.07	4.42	5.53	6.52	7.43
Max	5.64	8.17	10.17	11.96	13.61
Avg	4.22	6.09	7.57	8.88	10.09

CURRENT CARRYING CAPACITY DATA

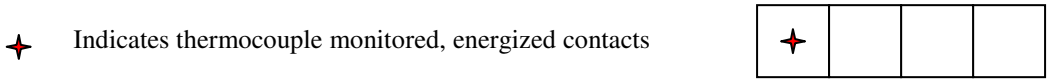




TEMPERATURE RISE DATA
TWO CONTACT ENERGIZED
(Degrees Celsius above ambient)

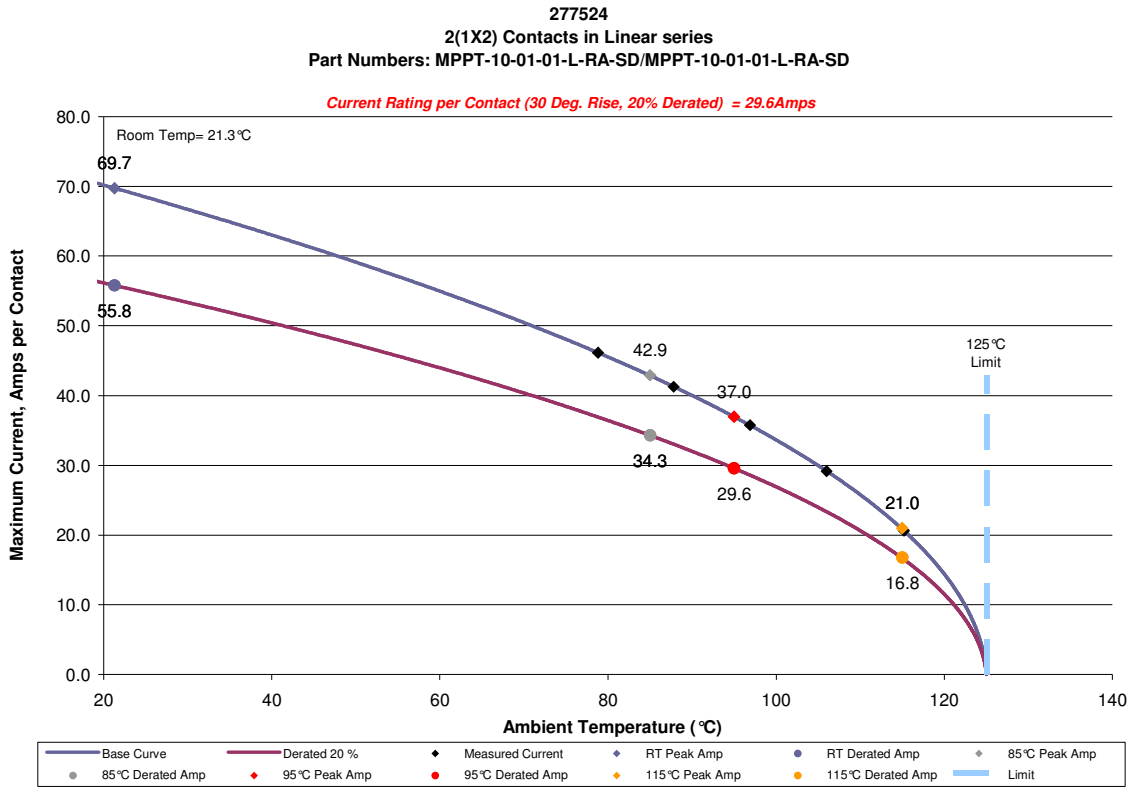
TEST CURRENT AMPS	24.4	34.55	42.32	48.88	54.65
Sample 1	9.3	17.8	25.9	33.9	44.7
Sample 2	10.2	19.6	28.9	38.1	47.1
Sample 3	9.4	18	26.3	34.4	45.6
Min	9.3	17.8	25.9	33.9	44.7
Max	10.2	19.6	28.9	38.1	47.1
Avg	9.63	18.47	27.03	35.47	45.8

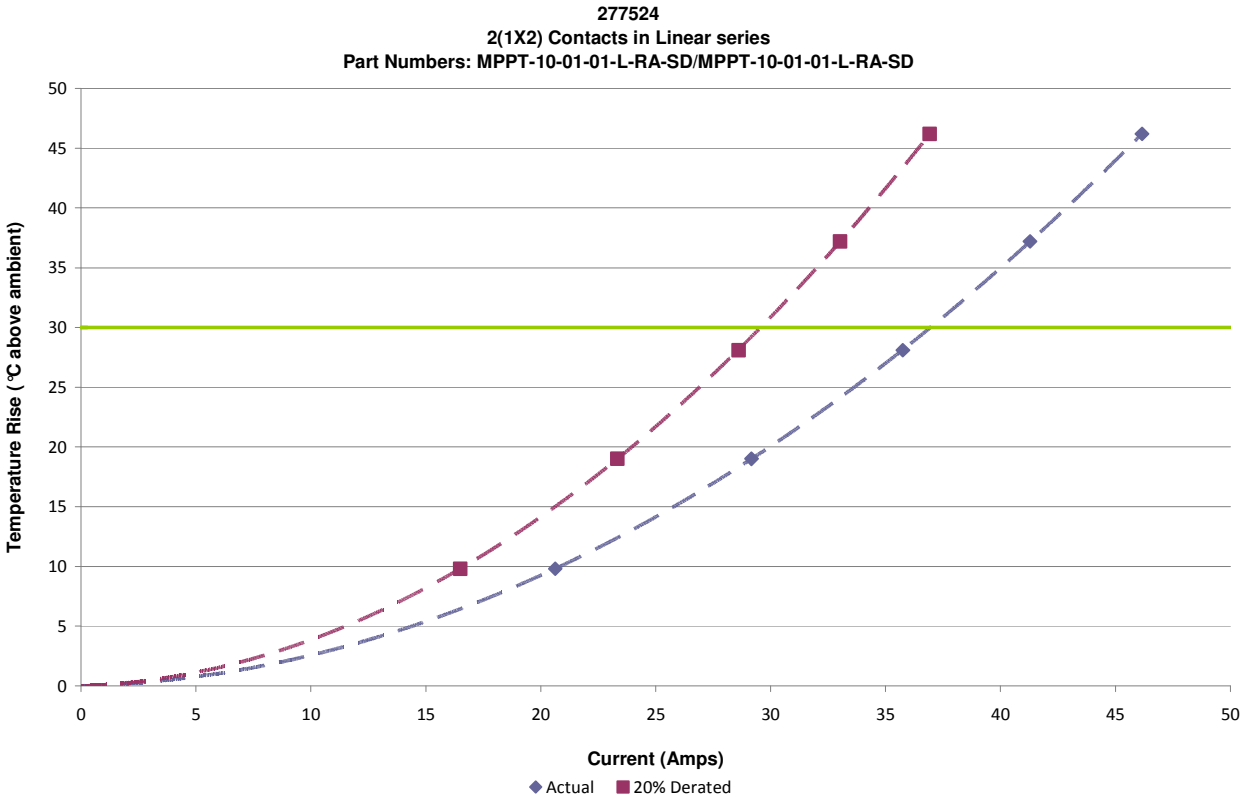
Single Row Configuration



✧ Indicates energized contacts

✦ Indicates thermocouple monitored, energized contacts


277524
2(1X2) Contacts in Linear series
Part Numbers: MPPT-10-01-01-L-RA-SD/MPPT-10-01-01-L-RA-SD
Current Rating per Contact (30 Deg. Rise, 20% Derated) = 29.6Amps
Room Temp= 21.3°C
69.7
55.8
42.9
37.0
34.3
29.6
21.0
16.8
125°C Limit
Maximum Current, Amps per Contact
Ambient Temperature (°C)
Base Curve
Derated 20 %
Measured Current
RT Peak Amp
RT Derated Amp
85°C Peak Amp
85°C Derated Amp
95°C Peak Amp
95°C Derated Amp
115°C Peak Amp
115°C Derated Amp
Limit

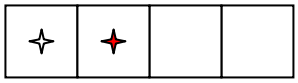

277524
2(1X2) Contacts in Linear series
Part Numbers: MPPT-10-01-01-L-RA-SD/MPPT-10-01-01-L-RA-SD
Temperature Rise (°C above ambient)
Current (Amps)
Actual
20% Derated

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

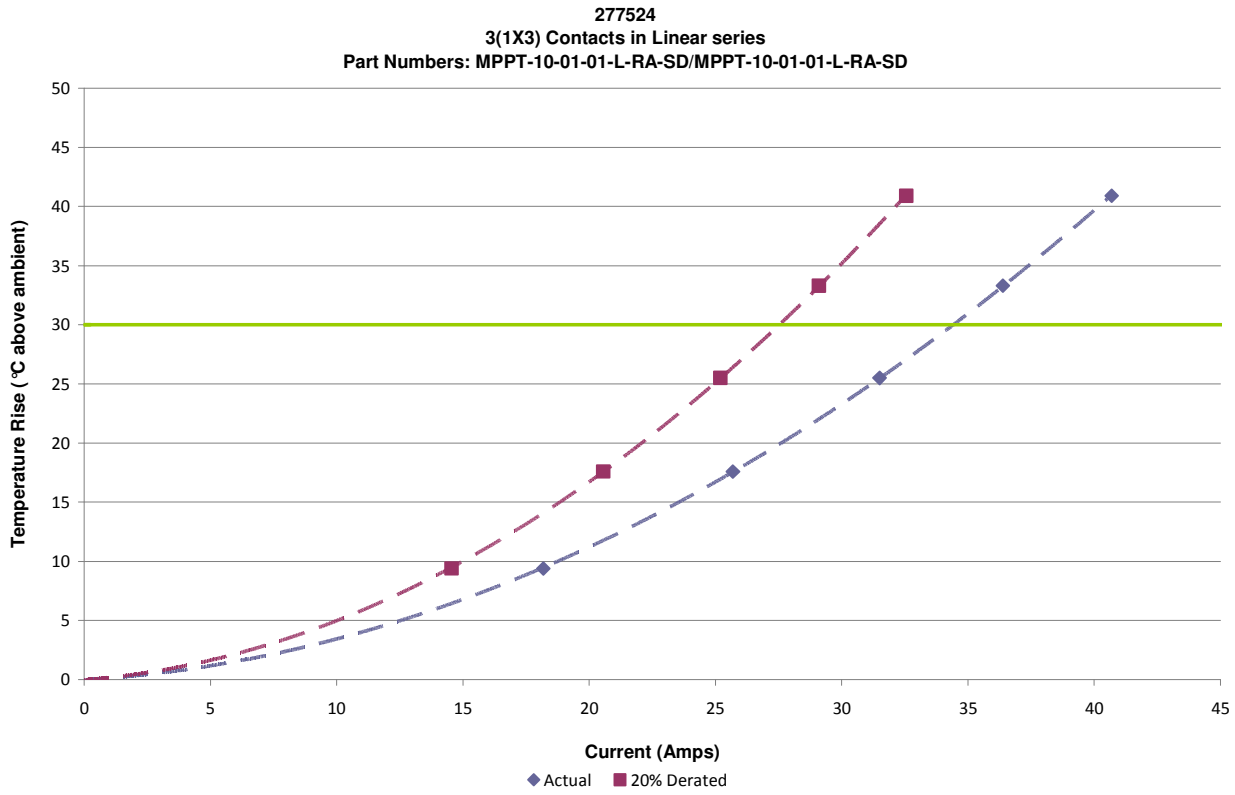
TEST CURRENT AMPS	20.63	29.16	35.75	41.28	46.16
Sample 4	9.5	18.3	26.9	35.5	44
Sample 5	10.1	19.7	29.3	38.8	48.3
Sample 6	9.8	19	28.1	37.2	46.4
Min	9.5	18.3	26.9	35.5	44
Max	10.1	19.7	29.3	38.8	48.3
Avg	9.8	19	28.1	37.17	46.23

✧ Indicates energized contacts

✦ Indicates thermocouple monitored, energized contacts




277524
3(1X3) Contacts in Linear series
Part Numbers: MPPT-10-01-01-L-RA-SD/MPPT-10-01-01-L-RA-SD
Current Rating per Contact (30 Deg. Rise, 20% Derated) = 27.6Amps
Room Temp= 20.9℃
Maximum Current, Amps per Contact
Ambient Temperature (℃)
66.4
53.1
40.2
34.5
32.1
27.6
19.0
15.2
125℃ Limit
Base Curve
Derated 20 %
Measured Current
RT Peak Amp
RT Derated Amp
85℃ Peak Amp
85℃ Derated Amp
95℃ Peak Amp
95℃ Derated Amp
115℃ Peak Amp
115℃ Derated Amp
Limit

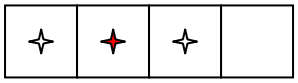

277524
3(1X3) Contacts in Linear series
Part Numbers: MPPT-10-01-01-L-RA-SD/MPPT-10-01-01-L-RA-SD
Temperature Rise (℃ above ambient)
Current (Amps)
Actual
20% Derated

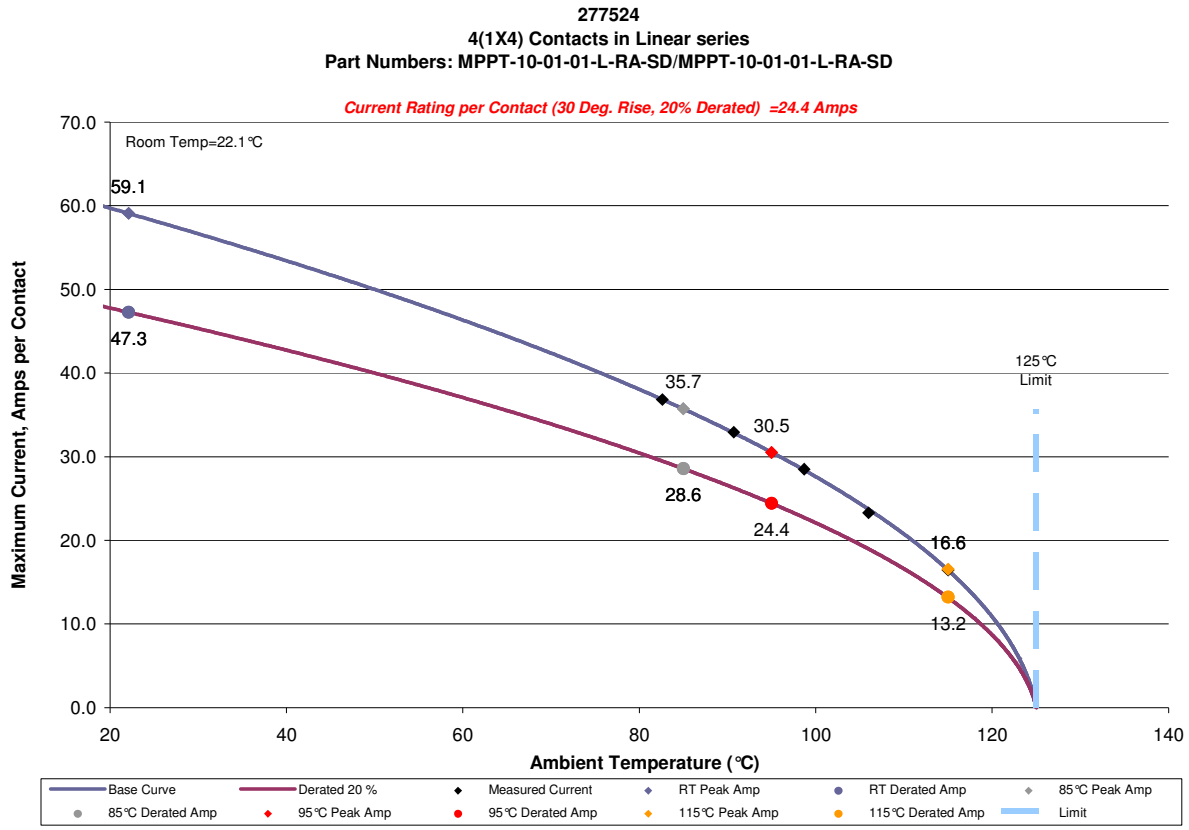
TEMPERATURE RISE DATA
SIX CONTACTS ENERGIZED
(Degrees Celsius above ambient)

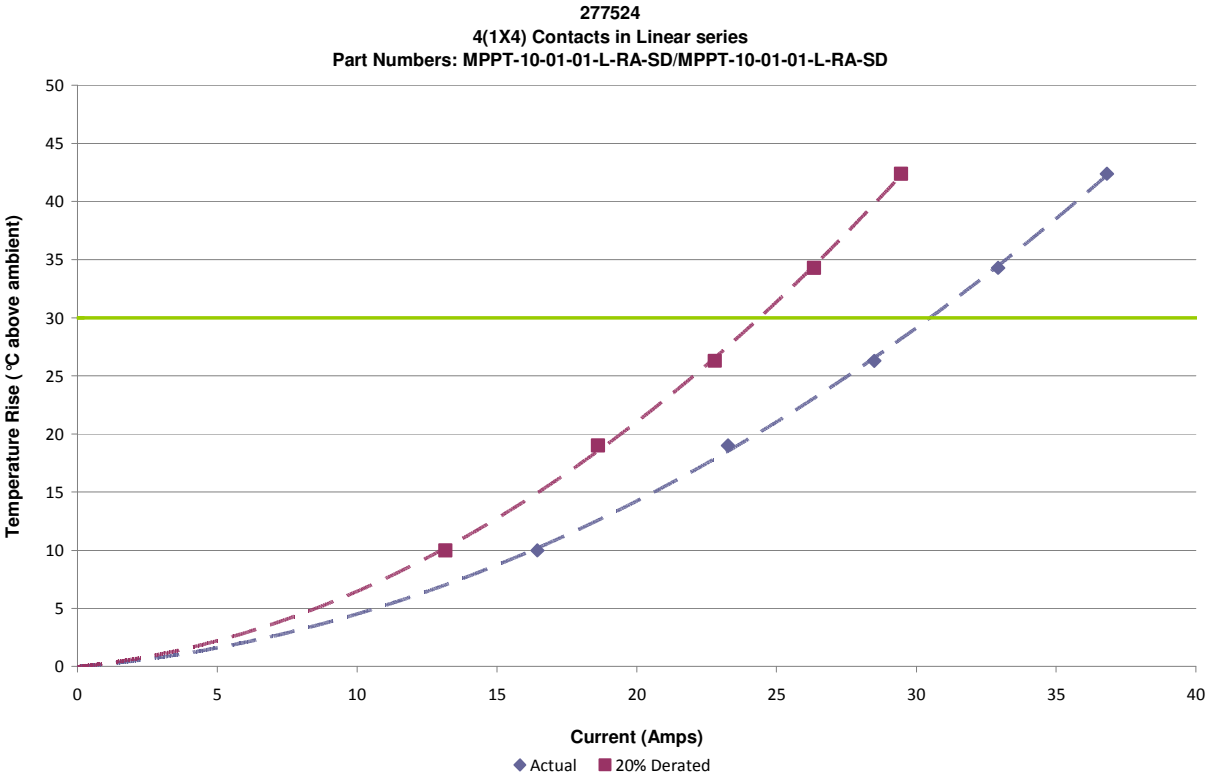
TEST CURRENT AMPS	18.19	25.7	31.5	36.38	40.69
Sample 7	9.4	17.4	25.2	32.9	40.5
Sample 8	9.6	18.2	26.5	34.7	42.7
Sample 9	9.1	17.1	24.9	32.3	39.6
Min	9.1	17.1	24.9	32.3	39.6
Max	9.6	18.2	26.5	34.7	42.7
Avg	9.37	17.57	25.53	33.3	40.93

✧ Indicates energized contacts

✦ Indicates thermocouple monitored, energized contacts




277524
4(1X4) Contacts in Linear series
Part Numbers: MPPT-10-01-01-L-RA-SD/MPPT-10-01-01-L-RA-SD
Current Rating per Contact (30 Deg. Rise, 20% Derated) =24.4 Amps
Room Temp=22.1℃
59.1
47.3
35.7
30.5
28.6
24.4
16.6
13.2
125℃ Limit
Maximum Current, Amps per Contact
Ambient Temperature (℃)
Base Curve
Derated 20 %
Measured Current
RT Peak Amp
RT Derated Amp
85℃ Peak Amp
85℃ Derated Amp
95℃ Peak Amp
95℃ Derated Amp
115℃ Peak Amp
115℃ Derated Amp
Limit

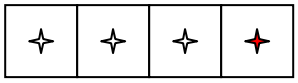

277524
4(1X4) Contacts in Linear series
Part Numbers: MPPT-10-01-01-L-RA-SD/MPPT-10-01-01-L-RA-SD
Temperature Rise (℃ above ambient)
Current (Amps)
Actual
20% Derated

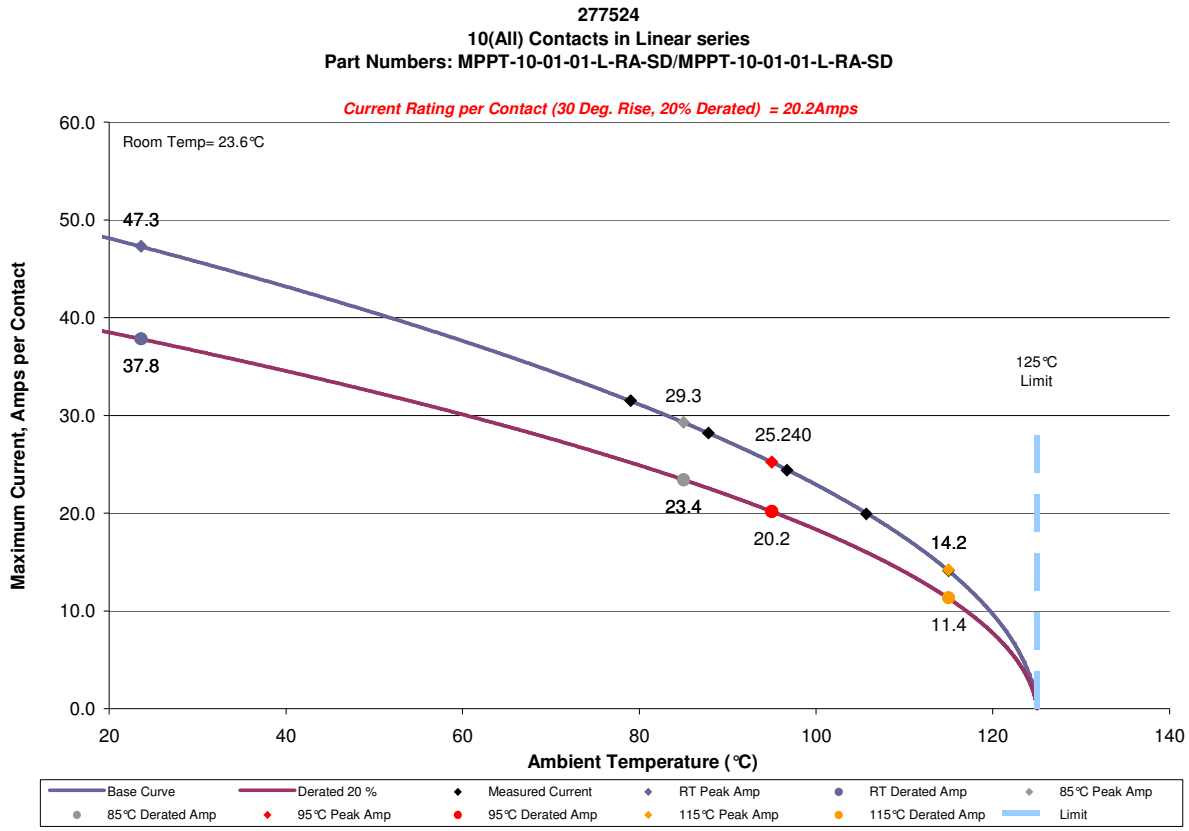
TEMPERATURE RISE DATA
EIGHT CONTACTS ENERGIZED
(Degrees Celsius above ambient)

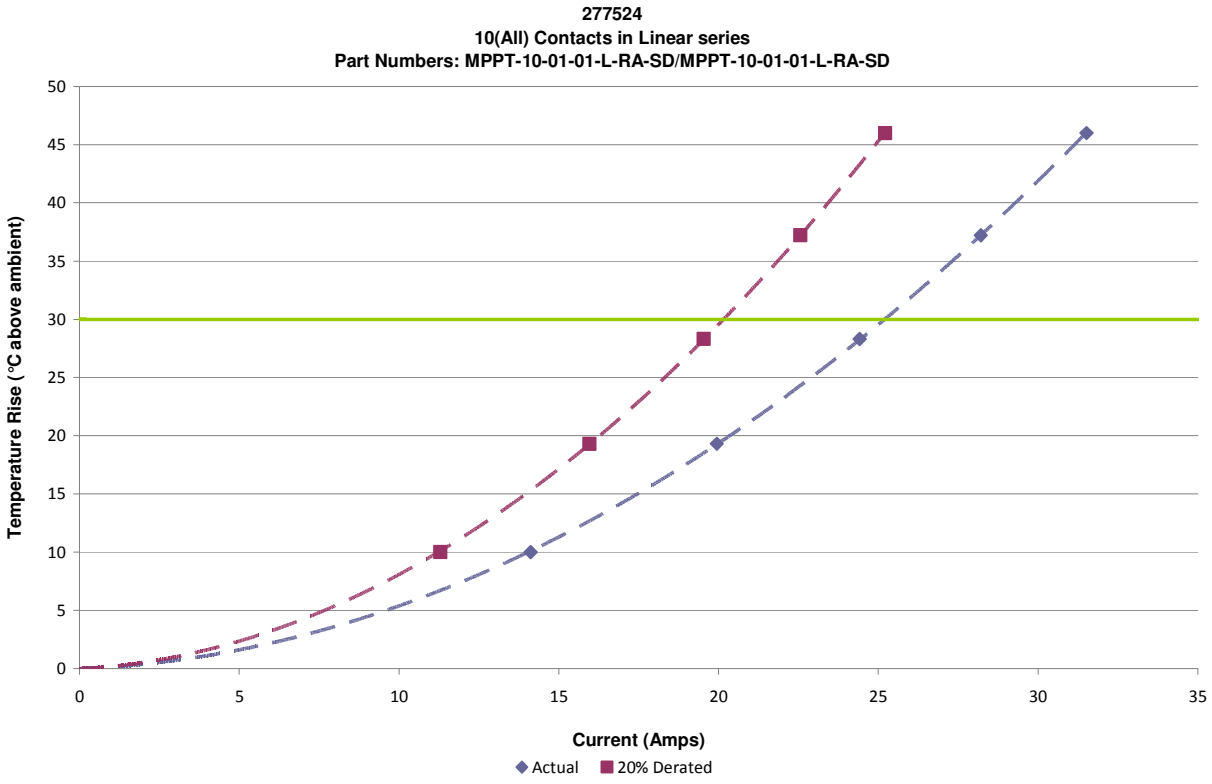
TEST CURRENT AMPS	16.45	23.27	28.5	32.92	36.82
Sample 10	10	18.9	28.5	37.9	46.3
Sample 11	10.3	20	30.1	38.9	47.9
Sample 12	9.7	18.1	28.2	37.1	45.9
Min	9.7	18.1	28.2	37.1	45.9
Max	10.3	20	30.1	38.9	47.9
Avg	10	19	28.93	37.97	46.7

✧ Indicates energized contacts

✦ Indicates thermocouple monitored, energized contacts




277524
10(All) Contacts in Linear series
Part Numbers: MPPT-10-01-01-L-RA-SD/MPPT-10-01-01-L-RA-SD
Current Rating per Contact (30 Deg. Rise, 20% Derated) = 20.2Amps
Room Temp= 23.6℃
47.3
37.8
29.3
25.240
23.4
20.2
14.2
11.4
125℃ Limit
Maximum Current, Amps per Contact
Ambient Temperature (℃)
Base Curve
Derated 20 %
Measured Current
RT Peak Amp
RT Derated Amp
85℃ Peak Amp
85℃ Derated Amp
95℃ Peak Amp
95℃ Derated Amp
115℃ Peak Amp
115℃ Derated Amp
Limit

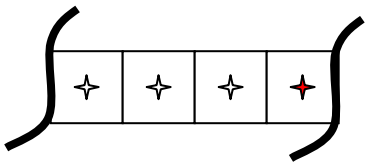

277524
10(All) Contacts in Linear series
Part Numbers: MPPT-10-01-01-L-RA-SD/MPPT-10-01-01-L-RA-SD
Temperature Rise (°C above ambient)
Current (Amps)
Actual
20% Derated

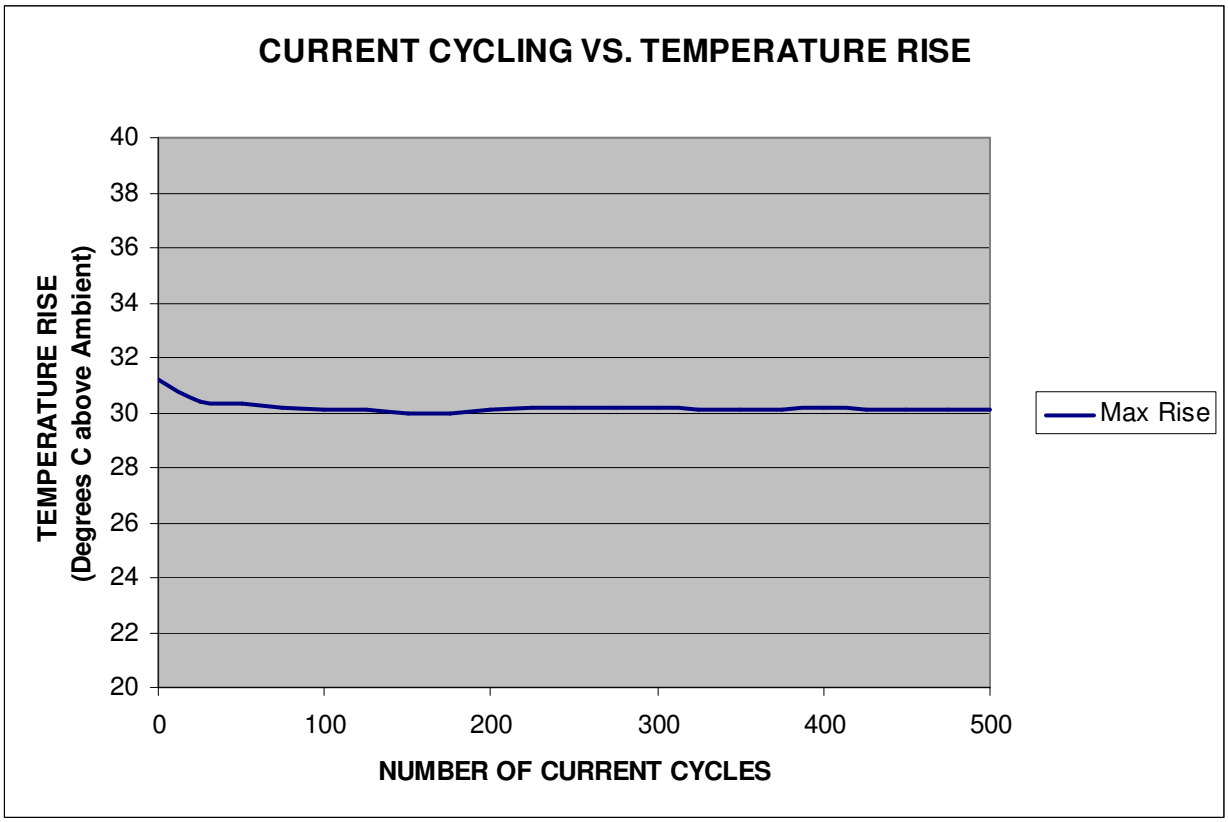
TEMPERATURE RISE DATA
ALL CONTACTS ENERGIZED
(Degrees Celsius above ambient)

TEST CURRENT AMPS	14.12	19.94	24.41	28.2	31.51
Sample 13	9.6	18.6	27	35.5	43.6
Sample 14	10.3	20.2	29.7	39.1	48.3
Sample 15	10	19.2	28.1	37.1	46.1
Min	9.6	18.6	27	35.5	43.6
Max	10.3	20.2	29.7	39.1	48.3
Avg	9.97	19.33	28.27	37.23	46

Indicates energized contacts

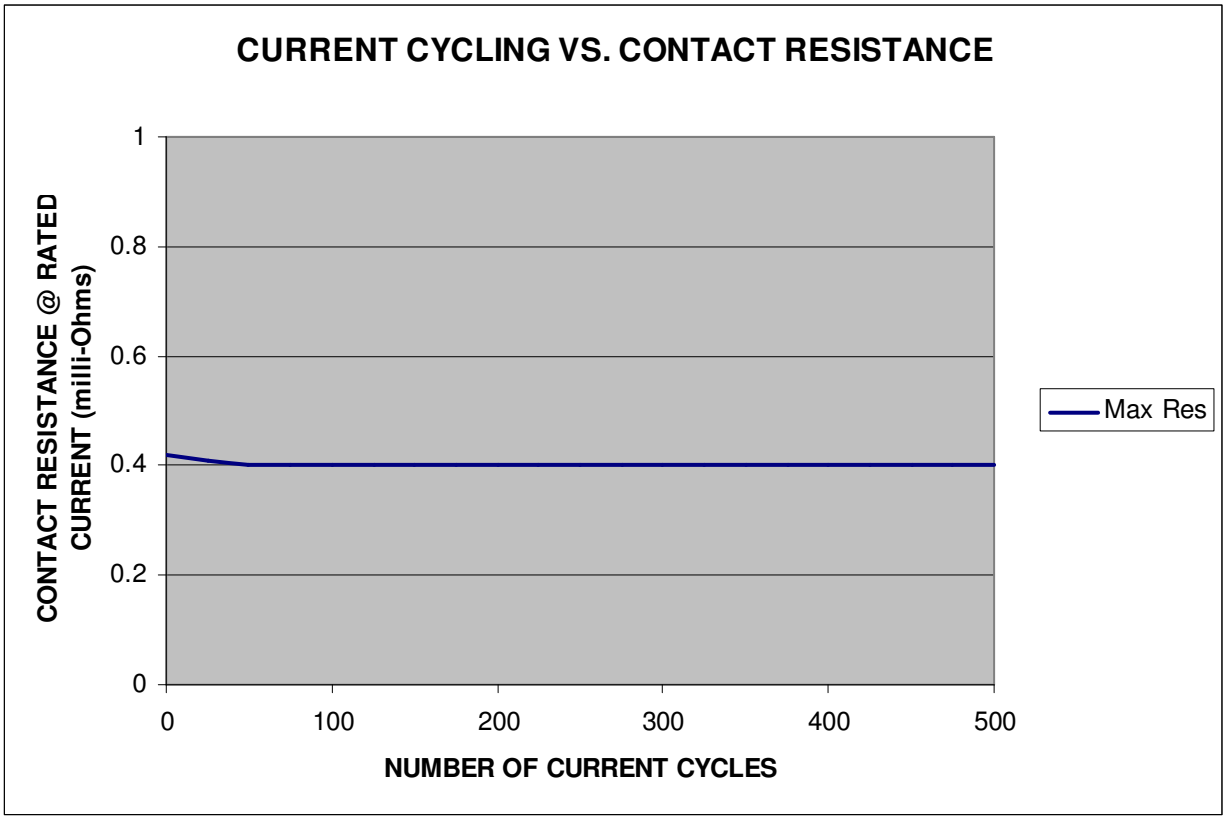
Indicates thermocouple monitored, energized contacts



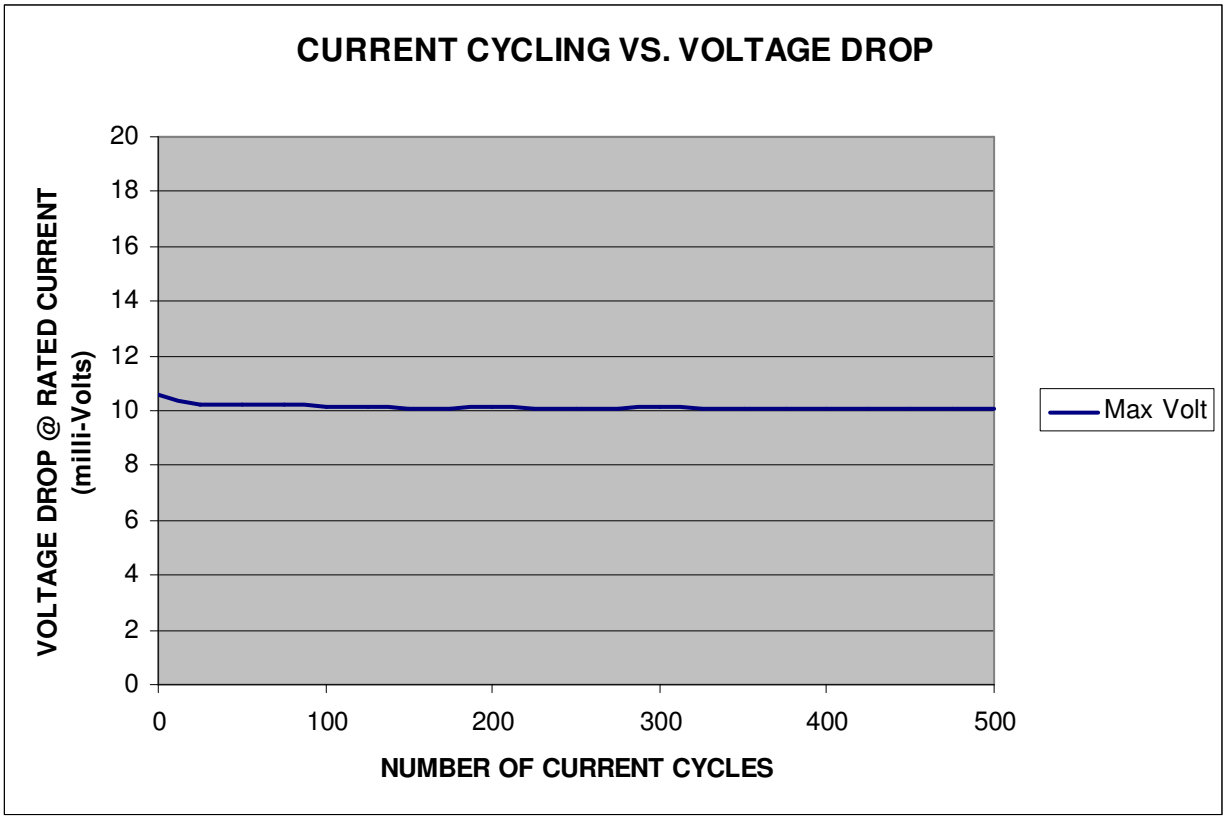


TEMPERATURE RISE DATA
ALL CONTACTS ENERGIZED
(Degrees Celsius above ambient)

	INITIAL	50 CYCLES	100 CYCLES	200 CYCLES	500 CYCLES
Min	28.9	28.3	27.9	28.1	28.5
Max	31.2	30.3	30.1	30.1	30.1
Avg	30	29.1	28.9	28.8	28.9



CONTACT RESISTANCE DATA ALL CONTACTS ENERGIZED (mΩ)					
	INITIAL	50 CYCLES	100 CYCLES	200 CYCLES	500 CYCLES
Min	0.23	0.22	0.22	0.22	0.22
Max	0.42	0.4	0.4	0.4	0.4
Avg	0.32	0.3	0.3	0.3	0.29



VOLTAGE DROP DATA ALL CONTACTS ENERGIZED (MV)					
	INITIAL	50 CYCLES	100 CYCLES	200 CYCLES	500 CYCLES
Min	5.78	5.62	5.6	5.57	5.53
Max	10.61	10.21	10.18	10.13	10.06
Avg	7.96	7.58	7.53	7.47	7.4

EQUIPMENT AND CALIBRATION SCHEDULES

Equipment #: HZ-MO-06
Description: Multimeter /Data Acquisition System
Manufacturer: Keithley
Model: 2750
Serial #: 1310732C
Accuracy: See Manual
… Last Cal: 01/30/2013, Next Cal: 01/29/2014

Equipment #: HZ-PS-03
Description: 30 Amp Power Supply
Manufacturer: Agilent
Model: 6033A
Serial #: 3329A-07330
Accuracy: See Manual
… Last Cal: 02/02/2013, Next Cal: 02/01/2013

Equipment #: HZ-MO-01
Description: Multimeter/Switch System
Manufacturer: Keithley
Model: 2700
Serial #: 1199807
Accuracy: See Manual
… Last Cal: 07/02/2013, Next Cal: 07/01/2014

Equipment #: HZ-PS-01
Description: 120 Amp Power Supply
Manufacturer: Agilent
Model: 6031A
Serial #: MY41000982
Accuracy: See Manual
… Last Cal: 07/02/2013, Next Cal: 07/01/2014