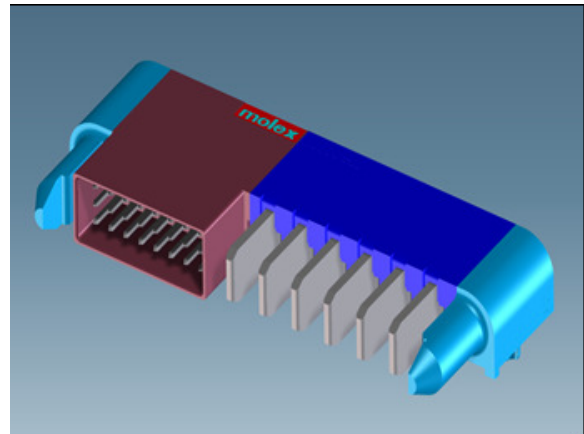
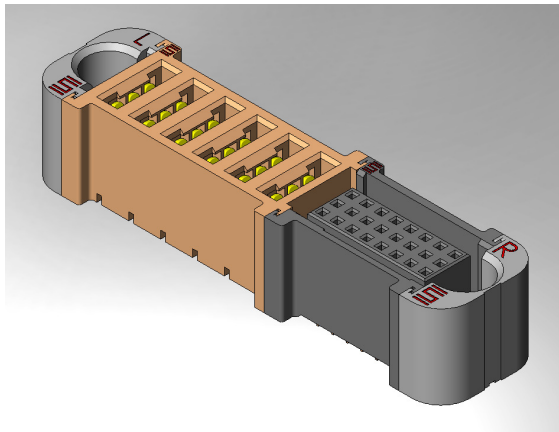




Project Number: Design Qualification Test Report		Tracking Code: 234464_Report_Rev_3	
Requested by: Steven Xu		Date: 06/26/2013	Product Rev: 1
Part #: ET60S-00-24-06-S-VT1-GP/Molex RA Header P/N: 46437-1390		Lot #: N/A	Tech: Tony Wagoner Kason He
			Eng: Eric Mings Vico Zhao
Part description: ET60S/ Molex RA Header			Qty to test: 20
Test Start: 12/26/2012	Test Completed: 03/15/2013		



DESIGN QUALIFICATION TEST REPORT

ET60S/Molex RA Header
ET60S-00-24-06-S-VT1-GP/Molex RA Header P/N: 46437-1390

REVISION HISTORY

DATA	REV.NUM.	DESCRIPTION	ENG
04/03/2013	1	Initial Issue	KH
05/20/2013	2	Add New CCC graph	CE
06/26/2013	3	Update CCC graph	KH

CERTIFICATION

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

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SCOPE

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

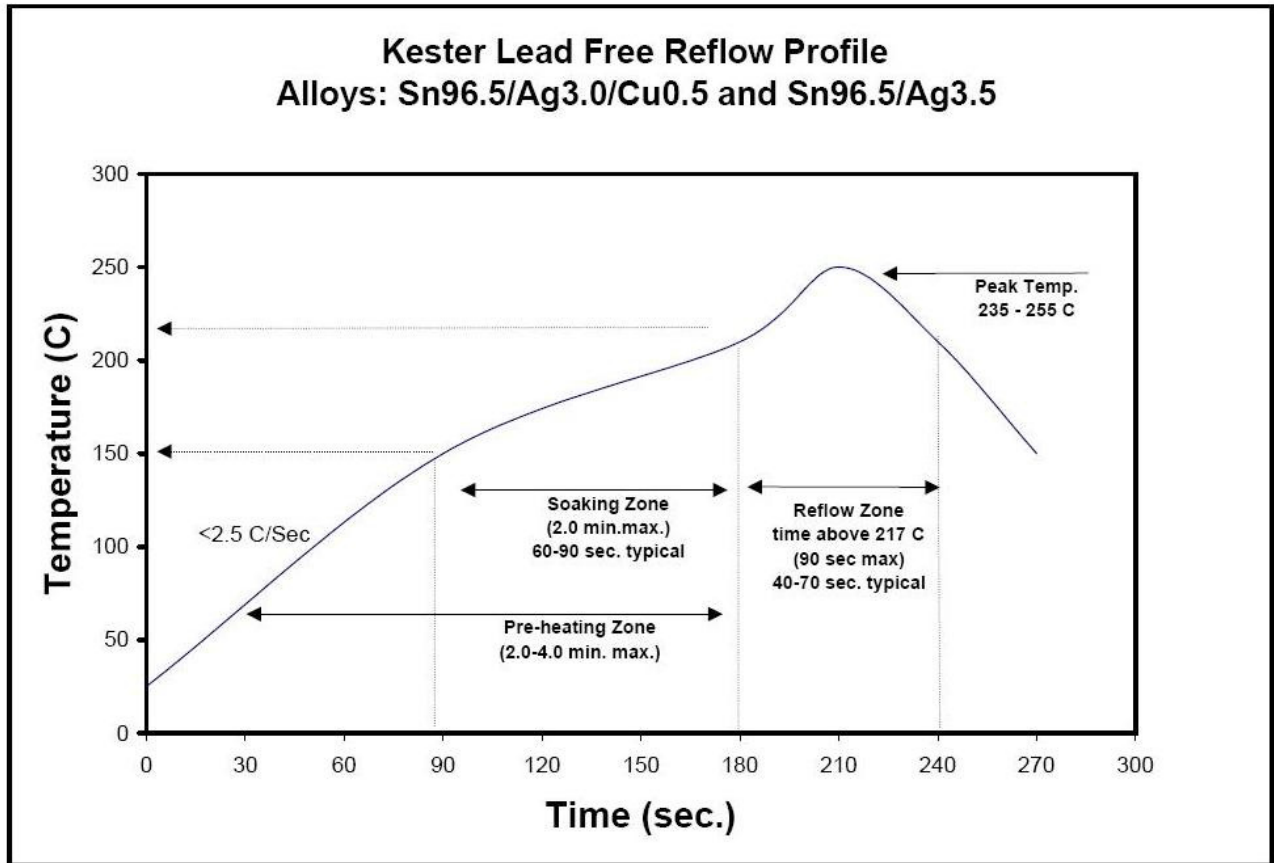
APPLICABLE DOCUMENTS

Standards: EIA Publication 364

TEST SAMPLES AND PREPARATION

- 1) All materials were manufactured in accordance with the applicable product specification.
- 2) All test samples were identified and encoded to maintain traceability throughout the test sequences.
- 3) After soldering, the parts to be used for LLCR 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 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) Re-Flow Time/Temp: See accompanying profile.
- 10) Samtec Test PCBs used: PCB-103728-TST/PCB-103819-TST

TYPICAL OVEN PROFILE (Soldering Parts to Test Boards)



FLOWCHARTS**Durability/Mating/Unmating/Gaps**

TEST STEP	GROUP B1 8 Boards (largest position submitted)
01	Contact Gaps
02	LLCR-1
03	Forces - Mating / Unmating
04	25 Cycles
05	Forces - Mating / Unmating
06	25 Cycles (50 Total)
07	Forces - Mating / Unmating
08	25 Cycles (75 Total)
09	Forces - Mating / Unmating
10	25 Cycles (100 Total)
11	Forces - Mating / Unmating
12	Clean w/Compressed Air
13	Contact Gaps
14	LLCR-2
15	Thermal Shock (Mated and Undisturbed)
16	LLCR-3
17	Cyclic Humidity (Mated and Undisturbed)
18	LLCR-4
19	Forces - Mating / Unmating

Thermal Shock = EIA-364-32, Table II, Test Condition I:

-55°C to +85°C 1/2 hour dwell, 100 cycles

Humidity = EIA-364-31, Test Condition B (240 Hours)

and Method III (+25°C to +65°C @ 90% RH to 98% RH)
ambient pre-condition and delete steps 7a and 7b

Mating / Unmating Forces = EIA-364-13

Contact Gaps / Height - No standard method. Usually measured optically.

Gaps to be taken on a minimum of 20% of each part tested

LLCR = EIA-364-23, LLCR

20 mV Max, 100 mA Max

Use Keithley 580 or 3706 in 4 wire dry circuit mode

FLOWCHARTS Continued**POWER PINS****Current Carrying Capacity - Power Pins**

TEST STEP	GROUP A1 3 Mated Assemblies 1 Contact Powered	GROUP A2 3 Mated Assemblies 2 Contacts Powered	GROUP A3 3 Mated Assemblies 3 Contacts Powered	GROUP A4 3 Mated Assemblies 4 Contacts Powered	GROUP A5 3 Mated Assemblies All Contacts Powered
01	CCC	CCC	CCC	CCC	CCC

(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

CCC, Temp rise = EIA-364-70

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 three temperature points are reported:
 - a. Ambient
 - b. 80° C
 - c. 95° C
 - d. 115° C
- 8) Typically, neighboring contacts (in close proximity to maximize heat build up) are energized.
- 9) The thermocouple (or temperature measuring probe) will be positioned at a location to sense the maximum temperature in the vicinity of the heat generation area.
- 10) A computer program, *TR 803.exe*, ensures accurate stability for data acquisition.
- 11) Hook-up wire cross section is larger than the cross section of any connector leads/PC board traces, jumpers, etc.
- 12) Hook-up wire length is longer than the minimum specified in the referencing standard.

MATING/UNMATING:

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

ATTRIBUTE DEFINITIONS Continued

The following is a brief, simplified description of attributes.

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 $+2000$ mOhms:----- Unstable
 - f. $>+2000$ mOhms:----- Open Failure

RESULTS

Temperature Rise, CCC at a 20% de-rating

- CCC for a 30°C Temperature Rise-----67.7A per contact with 1 adjacent contacts powered
- CCC for a 30°C Temperature Rise-----61.6A per contact with 2 adjacent contacts powered
- CCC for a 30°C Temperature Rise ----- 55.8A per contact with 3 adjacent contacts powered
- CCC for a 30°C Temperature Rise-----53.7A per contact with 4 adjacent contacts powered
- CCC for a 30°C Temperature Rise-----48.5A per contact with all adjacent contacts powered

Mating – Unmating Forces

ET60S-00-24-06-S-VT1-GP/Molex RA Header P/N: 46437-1390

- **Initial**
 - **Mating**
 - Min ----- 8.49 Lbs
 - Max-----10.38 Lbs
 - **Unmating**
 - Min ----- 7.30 Lbs
 - Max----- 9.34 Lbs
- **After 25 Cycles**
 - **Mating**
 - Min -----10.35 Lbs
 - Max-----13.58 Lbs
 - **Unmating**
 - Min ----- 8.74 Lbs
 - Max-----11.89 Lbs
- **After 50 Cycles**
 - **Mating**
 - Min -----11.04 Lbs
 - Max-----15.04 Lbs
 - **Unmating**
 - Min ----- 9.69 Lbs
 - Max-----13.10 Lbs
- **After 75 Cycles**
 - **Mating**
 - Min -----11.71 Lbs
 - Max-----15.55 Lbs
 - **Unmating**
 - Min -----10.30 Lbs
 - Max-----13.68 Lbs
- **After 100 Cycles**
 - **Mating**
 - Min -----12.25 Lbs
 - Max-----16.19 Lbs
 - **Unmating**
 - Min -----10.78 Lbs
 - Max-----14.54 Lbs
- **After Humidity**
 - **Mating**
 - Min ----- 5.89 Lbs
 - Max----- 6.90 Lbs
 - **Unmating**
 - Min ----- 5.83 Lbs
 - Max----- 6.83 Lbs

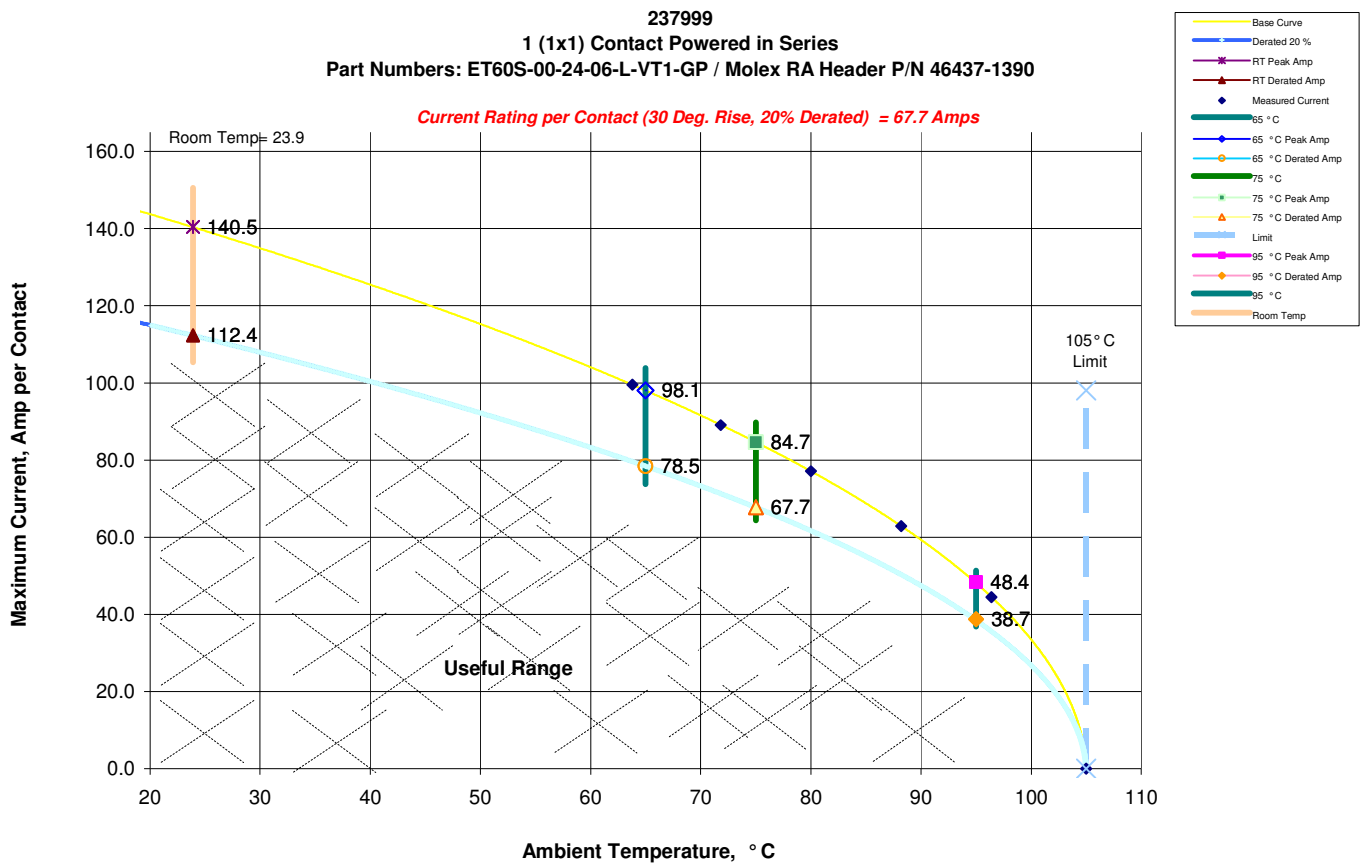
RESULTS Continued**LLCR Mating/Unmating Durability (192 LLCR test points)****ET60S-00-24-06-S-VT1-GP/Molex RA Header P/N: 46437-1390**

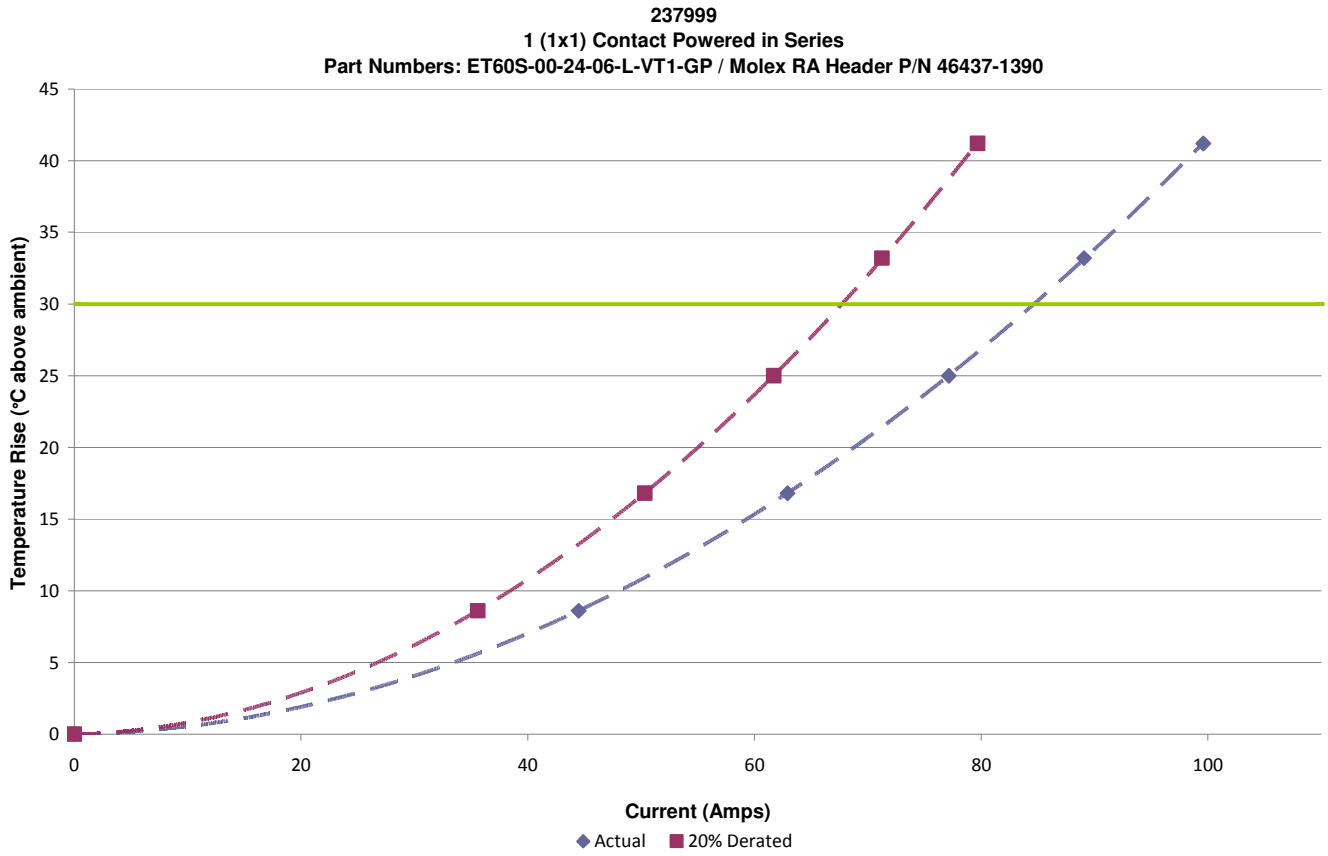
- **Signal pin Initial ----- 10.82mOhms Max**
- **Power pin Initial -----0.22mOhms Max**
- **Durability, 100 Cycles**
 - **<= +5.0 mOhms ----- 192 Points ----- Stable**
 - **+5.1 to +10.0 mOhms -----0 Points ----- Minor**
 - **+10.1 to +15.0 mOhms -----0 Points ----- Acceptable**
 - **+15.1 to +50.0 mOhms -----0 Points ----- Marginal**
 - **+50.1 to +2000 mOhms-----0 Points ----- Unstable**
 - **>+2000 mOhms -----0 Points ----- Open Failure**
- **Thermal Shock**
 - **<= +5.0 mOhms ----- 192 Points ----- Stable**
 - **+5.1 to +10.0 mOhms -----0 Points ----- Minor**
 - **+10.1 to +15.0 mOhms -----0 Points ----- Acceptable**
 - **+15.1 to +50.0 mOhms -----0 Points ----- Marginal**
 - **+50.1 to +2000 mOhms-----0 Points ----- Unstable**
 - **>+2000 mOhms -----0 Points ----- Open Failure**
- **Humidity**
 - **<= +5.0 mOhms ----- 192 Points ----- Stable**
 - **+5.1 to +10.0 mOhms -----0 Points ----- Minor**
 - **+10.1 to +15.0 mOhms -----0 Points ----- Acceptable**
 - **+15.1 to +50.0 mOhms -----0 Points ----- Marginal**
 - **+50.1 to +2000 mOhms-----0 Points ----- Unstable**
 - **>+2000 mOhms -----0 Points ----- Open Failure**

DATA SUMMARIES

TEMPERATURE RISE (Current Carrying Capacity, CCC):

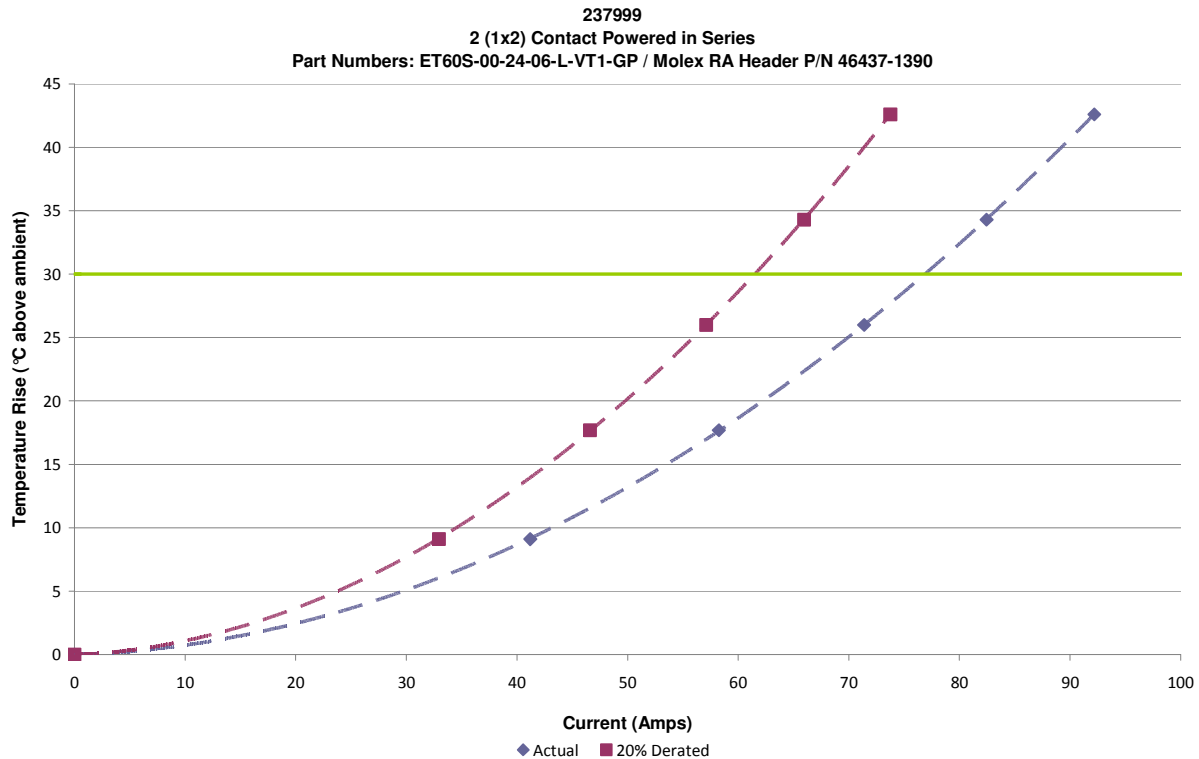
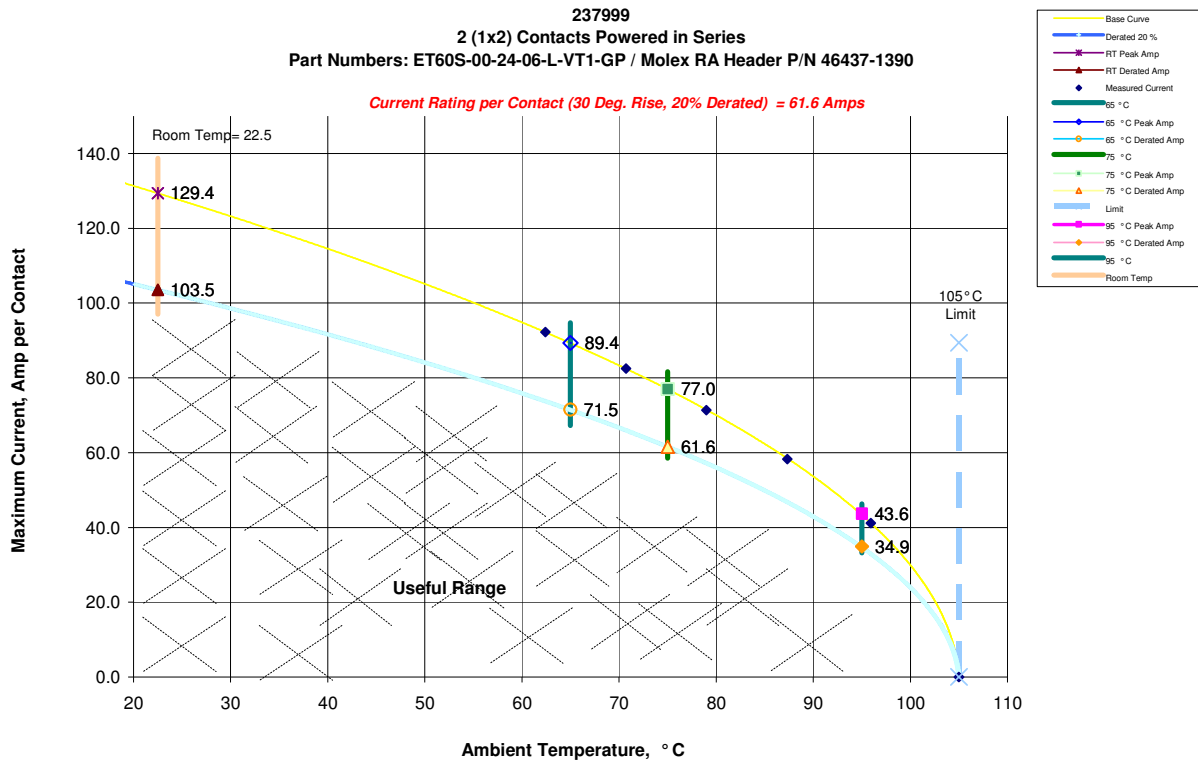
- 1) High quality thermocouples whose temperature slopes track one another were used for temperature monitoring.
- 2) The thermocouples were placed at a location to sense the maximum temperature generated during testing.
- 3) Temperature readings recorded are those for which three successive readings,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





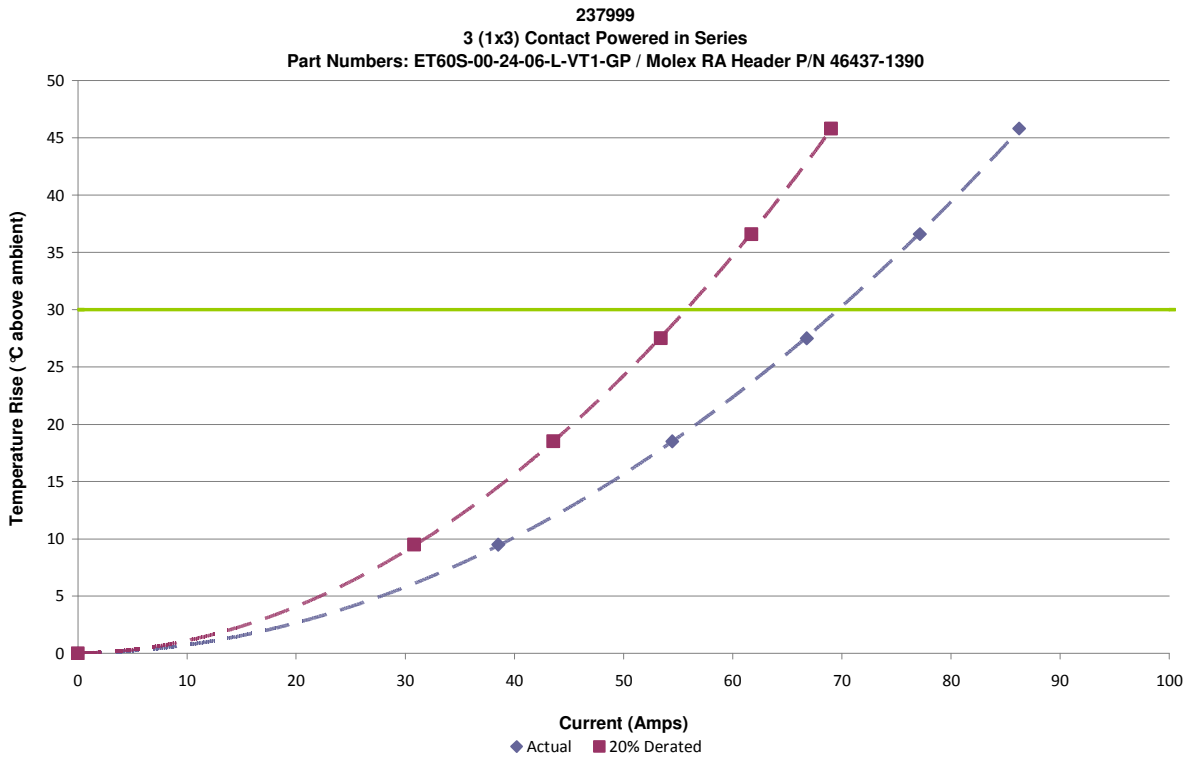
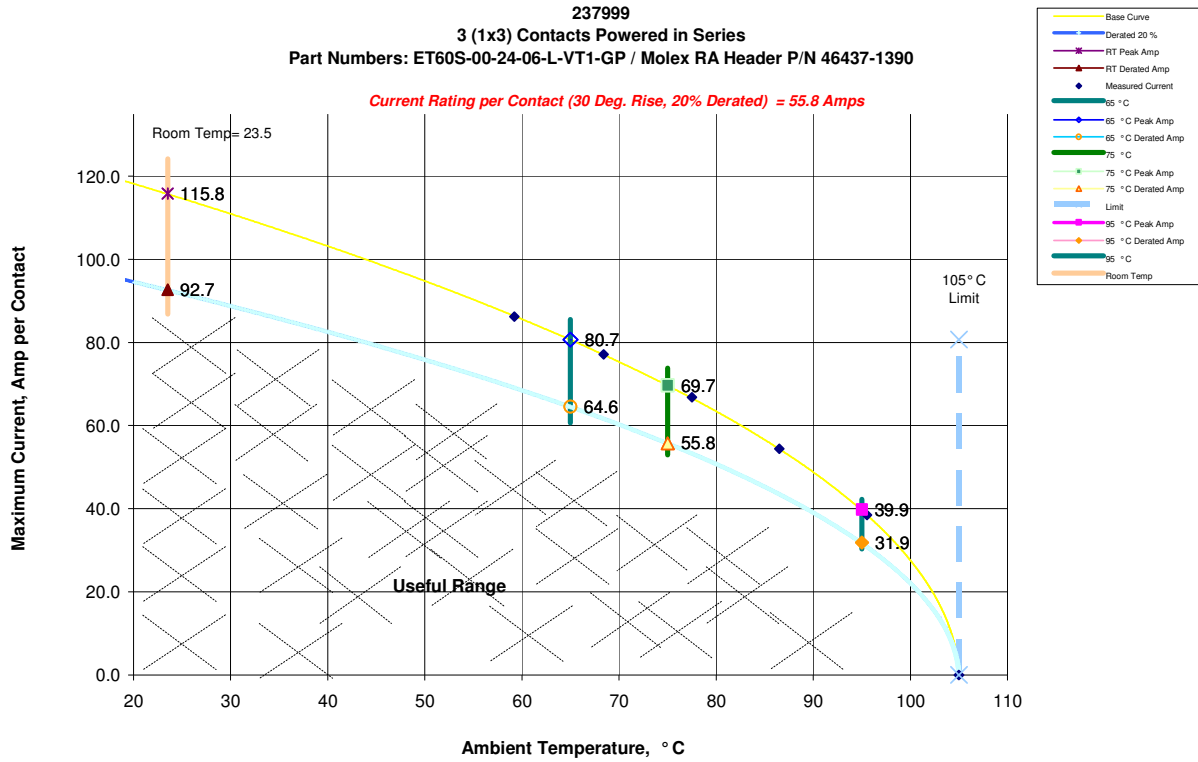
DATA SUMMARIES Continued

b. Linear configuration with 2 adjacent conductors/contacts powered



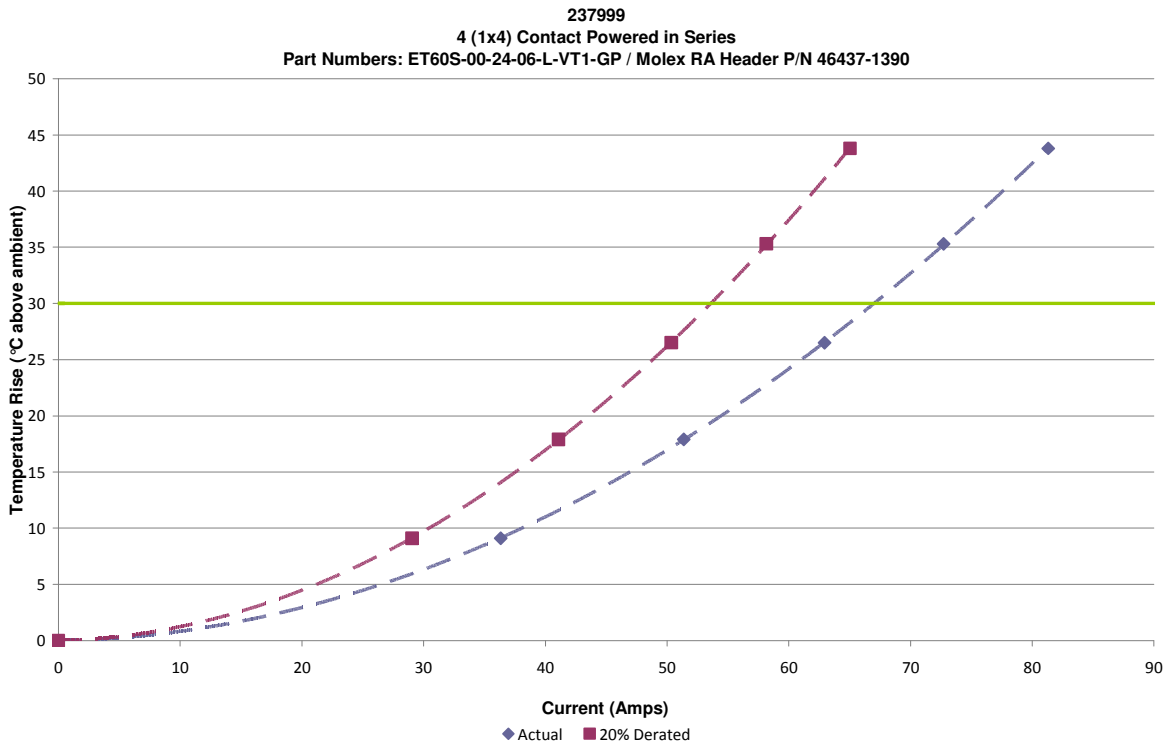
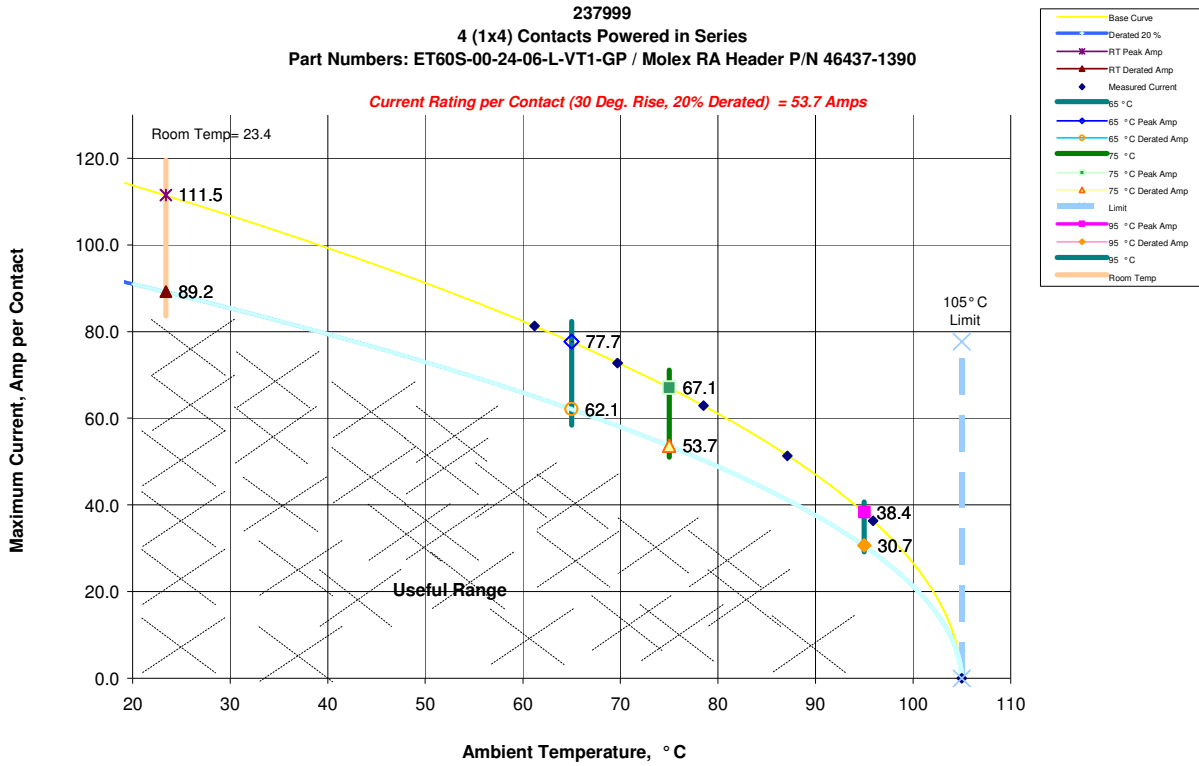
DATA SUMMARIES Continued

c. Linear configuration with 3 adjacent conductors/contacts powered



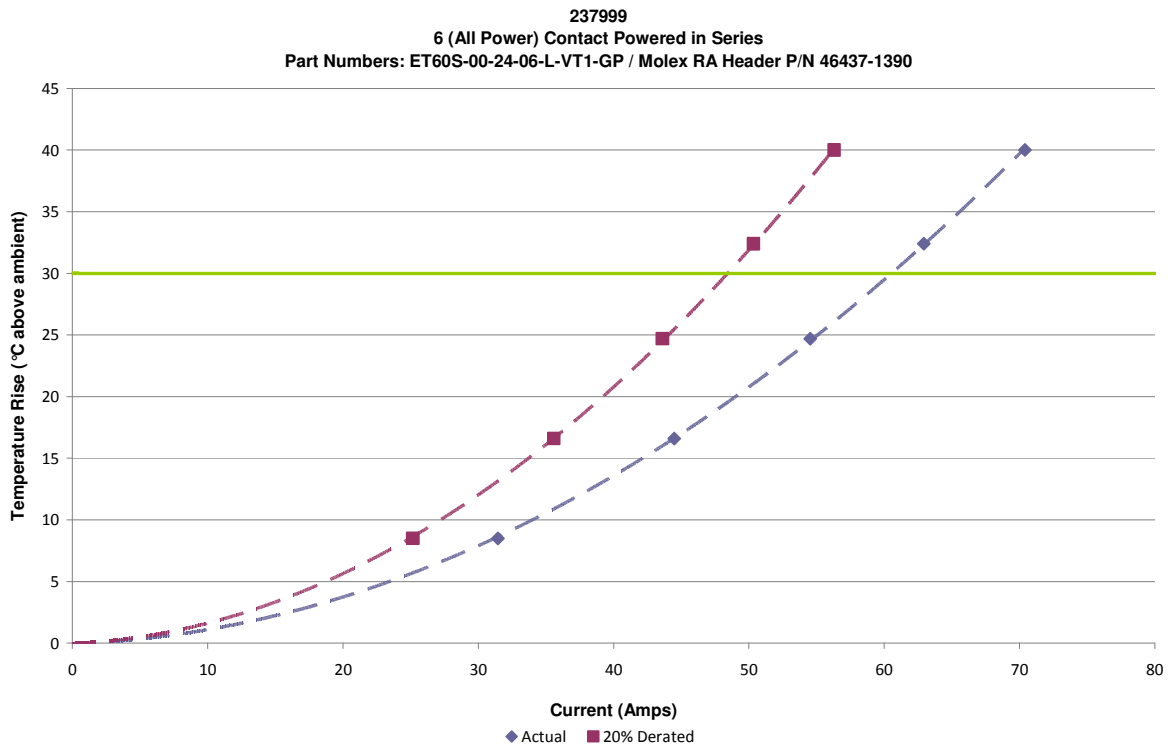
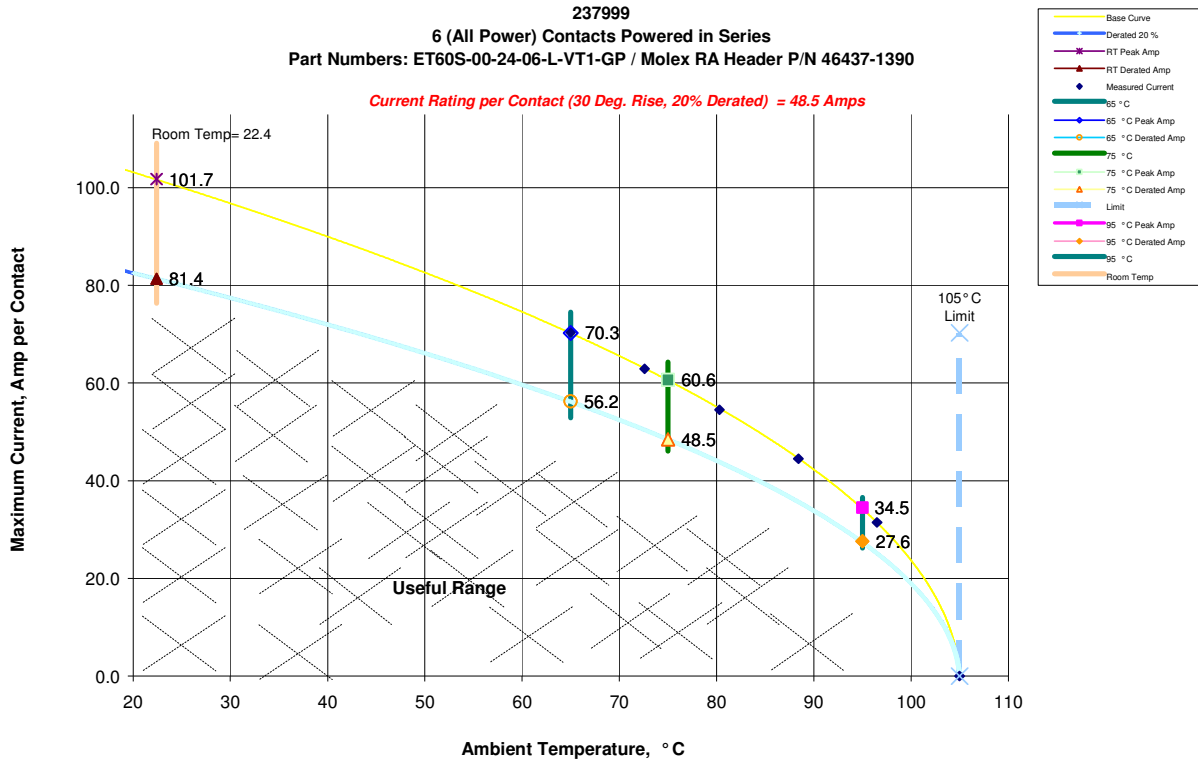
DATA SUMMARIES Continued

d. Linear configuration with 4 adjacent conductors/contacts powered



DATA SUMMARIES Continued

e. Linear configuration with all adjacent conductors/contacts powered



DATA SUMMARIES Continued**Mating/Unmating Force:****ET60S-00-24-06-S-VT1-GP/Molex RA Header P/N: 46437-1390**

	Initial				After 25 Cycles			
	Mating		Unmating		Mating		Unmating	
	Newton	Force (Lbs)	Newton	Force (Lbs)	Newton	Force (Lbs)	Newton	Force (Lbs)
Minimum	37.76	8.49	32.47	7.30	46.04	10.35	38.88	8.74
Maximum	46.17	10.38	41.54	9.34	60.40	13.58	52.89	11.89
Average	41.85	9.41	37.84	8.51	50.58	11.37	44.87	10.09
St Dev	2.70	0.61	3.07	0.69	4.80	1.08	4.75	1.07
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	49.11	11.04	43.10	9.69	52.09	11.71	45.81	10.30
Maximum	66.90	15.04	58.27	13.10	69.17	15.55	60.85	13.68
Average	55.25	12.42	48.89	10.99	58.70	13.20	52.16	11.73
St Dev	5.96	1.34	4.96	1.12	5.64	1.27	5.01	1.13
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	54.49	12.25	47.95	10.78	26.20	5.89	25.93	5.83
Maximum	72.01	16.19	64.67	14.54	30.69	6.90	30.38	6.83
Average	61.95	13.93	54.91	12.34	29.00	6.52	28.14	6.33
St Dev	5.50	1.24	5.36	1.20	1.59	0.36	1.78	0.40
Count	8	8	8	8	8	8	8	8

DATA SUMMARIES Continued

LLCR Mating/Unmating Durability

ET60S-00-24-06-S-VT1-GP/Molex RA Header P/N: 46437-1390

- 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 $+2000$ mOhms----- Unstable
 - f. $> +2000$ mOhms: ----- Open Failure

LLCR Measurement Summaries by Pin Type				
Date	12/26/2012	12/29/2012	1/8/2013	1/21/2013
Room Temp (Deg C)	20	23	20	21
Rel Humidity (%)	52	54	45	58
Technician	Kason He	Kason He	Kason He	Kason He
mOhm values	Actual Initial	Delta 100 Cycles	Delta Therm Shck	Delta Humidity
Pin Type 1: Signal				
Average	9.89	0.23	0.17	0.32
St. Dev.	0.55	0.45	0.15	0.28
Min	8.62	0.00	0.00	0.00
Max	10.82	4.15	0.89	1.75
Summary Count	144	144	144	144
Total Count	144	144	144	144
Pin Type 2: Power				
Average	0.20	0.01	0.01	0.01
St. Dev.	0.01	0.01	0.01	0.01
Min	0.18	0.00	0.00	0.00
Max	0.22	0.02	0.02	0.03
Summary Count	48	48	48	48
Total Count	48	48	48	48

LLCR Delta Count by Category						
	Stable	Minor	Acceptable	Marginal	Unstable	Open
mOhms	≤ 5	>5 & ≤ 10	>10 & ≤ 15	>15 & ≤ 50	>50 & ≤ 1000	>1000
100 Cycles	192	0	0	0	0	0
Therm Shck	192	0	0	0	0	0
Humidity	192	0	0	0	0	0

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

... Last Cal: 04/30/2012, Next Cal: 04/30/2013

Equipment #: PS-07**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-TCT-01**Description:** Normal force analyzer**Manufacturer:** Mecmesin Multitester**Model:** Mecmesin Multitester 2.5-i**Serial #:** 08-1049-04**Accuracy:** Last Cal: 4/27/2012, Next Cal: 4/26/2013**Equipment #:** HZ-THC-01**Description:** Humidity transmitter**Manufacturer:** Thermtron**Model:** HMM30C**Serial #:** D0240037**Accuracy:** Last Cal: 3/1/2012, Next Cal: 2/28/2013**Equipment #:** HZ-MO-05**Description:** Micro-ohmmeter**Manufacturer:** Keithley**Model:** 3706**Serial #:** 1285188**Accuracy:** Last Cal: 11/15/2012, Next Cal: 11/14/2013**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: 06/28/2012, Next Cal: 06/27/2013