



Project Number: Design Qualification Test Report		Tracking Code: 170466_Report_Rev_2	
Requested by: Travis Newton		Date: 8/23/2012	Product Rev: 0
Part #: ACP-22-03-H-00.35-T-T-P-3\ACR-22-03-H-00.25-S-S1-P-3		Lot #: N/A	Tech: Craig Ryan Eng: Eric Mings
Part description: ACP /ACR			Qty to test: 45
Test Start: 11/10/2011	Test Completed: 12/13/2011		



Design Qualification Test Report

ACP \ ACR

ACP-22-03-H-00.35-T-T-P-3\ACR-22-03-H-00.25-S-S1-P-3

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

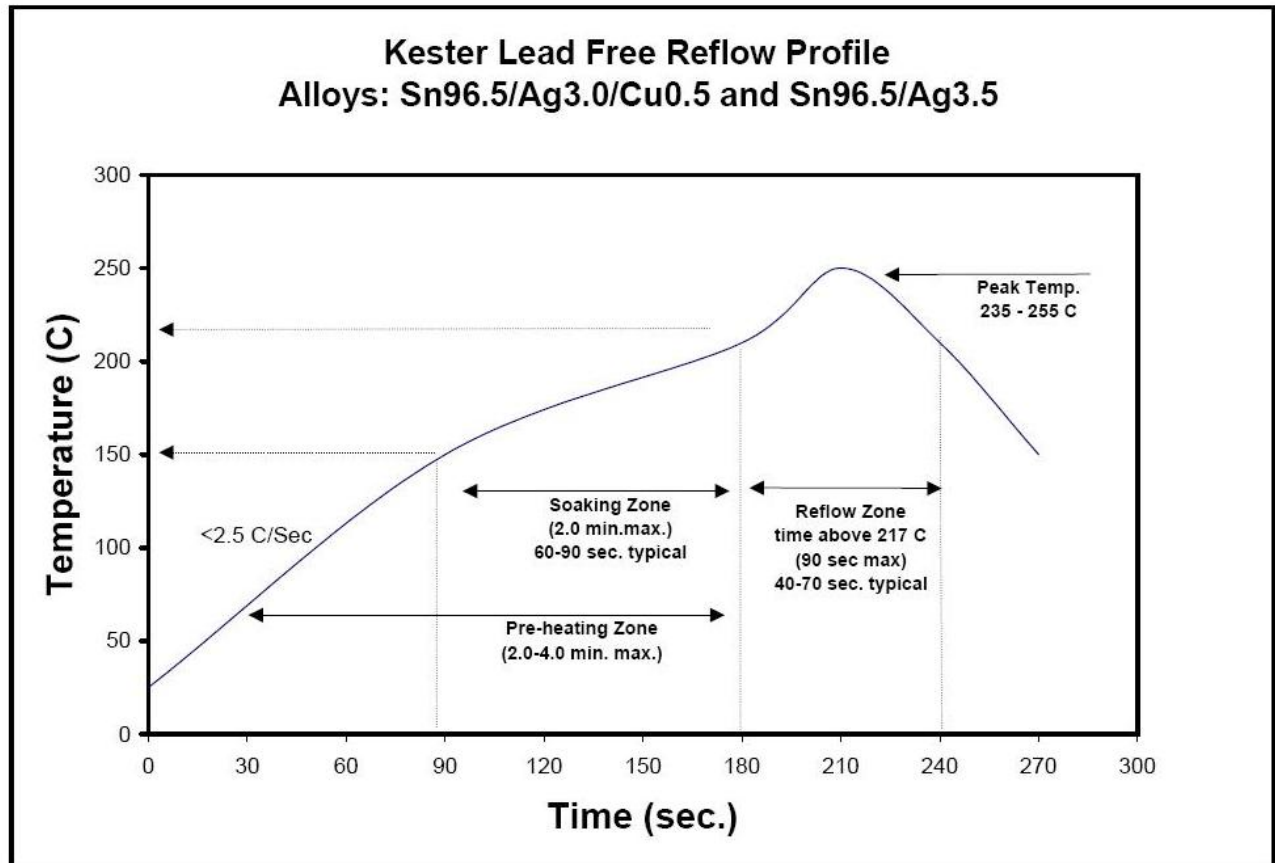
To perform the following tests: Design Qualification Test, Please see test plan.

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) Re-Flow Time/Temp: See accompanying profile.
- 10) Samtec Test PCBs used: PCB-103219-TST-XX

TYPICAL OVEN PROFILE (Soldering Parts to Test Boards)

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

TEST STEP	GROUP A1 6 Assemblies
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
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

LLCR = EIA-364-23, LLCR

20 mV Max, 100 mA Max

Use Keithley 580 or 3706 in 4 wire dry circuit mode

FLOWCHARTS Continued**IR & DWV**

TEST STEP	GROUP A1 2 Mated Sets Break Down Pin-to-Pin	GROUP A2 2 Unmated of Part # Being Tested Break Down Pin-to-Pin	GROUP A3 2 Unmated of Mating Part # Break Down Pin-to-Pin	GROUP B1 2 Mated Sets Pin-to-Pin
01	DWV/Break Down Voltage	DWV/Break Down Voltage	DWV/Break Down Voltage	IR & DWV at test voltage (on both mated sets and on each connector unmated)
02				Thermal Shock (Mated and Undisturbed)
03				IR & DWV at test voltage (on both mated sets and on each connector unmated)
04				Cyclic Humidity (Mated and Undisturbed)
05				IR & DWV at test voltage (on both mated sets and on each connector unmated)

DWV on Group B1 to be performed at Test Voltage

DWV test voltage is equal to 75% of the lowest break down voltage from Groups A1, A2 or A3

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

IR = EIA-364-21

DWV = EIA-364-20, Test Condition 1

FLOWCHARTS Continued

Current Carrying Capacity - Array

TEST STEP	GROUP A1 3 Mated Assemblies All Contacts Powered
01	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

IP67 Dust & Water

TEST STEP	GROUP A1 6 Mated Connectors	GROUP A2 6 Mated Connectors	GROUP B1 6 Connectors (Cable Dust Cover)	GROUP B2 6 Connectors (Cable Dust Cover)	GROUP C1 6 Connectors (Mating Part Dust Cover)	GROUP C2 6 Connectors (Mating Part Dust Cover)
01	Dust Test	Submersion Water Test	Dust Test	Submersion Water Test	Dust Test	Submersion Water Test
02	Check for Dust	Check for Water	Check for Dust	Check for Water	Check for Dust	Check for Water

Dust/Water Testing = Per CEI/IEC 60529 Code IP67

FLOWCHARTS Continued**IP68 Dust & Water**

TEST STEP	GROUP A1
	3 Mated Connectors For Each Depth Tested (27 Total Mated Connectors)
01	2M for 30 Minutes
02	Check for Water
03	3M for 30 Minutes
04	Check for Water
05	4M for 30 Minutes
06	Check for Water
07	5M for 30 Minutes
08	Check for Water
09	6M for 30 Minutes
10	Check for Water
11	7M for 30 Minutes
12	Check for Water
13	8M for 30 Minutes
14	Check for Water
15	9M for 30 Minutes
16	Check for Water
17	10M for 30 Minutes
18	Check for Water

Dust/Water Testing = Per CEI/IEC 60529 Code IP 68

For this test you have to use the pressure chamber

New parts should be used for each depth tested

Stop testing once parts fail

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.

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:
 - a. When the specified test voltage is applied (VDC), the insulation resistance shall not be less than 5000 megohms.

ATTRIBUTE DEFINITIONS Continued

The following is a brief, simplified description of attributes.

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. Rate of Application 500 V/Sec
 - iii. 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)..

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.

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) 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

WATER TESTING:

- 1) Reference document: CEI/IEC 60529 Code IP68
- 2) ACR torque specification for ACPN-22-P is 15 IN-LB
- 3) ACP torque specification for ACCN-22-P is 15 IN-LB

DUST TESTING:

- 1) Reference document: CEI/IEC 60529 Code IP67
- 2) ACR torque specification for ACPN-22-P is 15 IN-LB
- 3) ACP torque specification for ACCN-22-P is 15 IN-LB

RESULTS

Temperature Rise, CCC at a 20% de-rating

- CCC for a 30°C Temperature Rise-----8.3 A per contact with All powered (contact interface)

Mating&Unmating durability force:

- Initial
 - Mating
 - Min -----13.46 Lbs
 - Max-----18.95 Lbs
 - Unmating
 - Min -----6.00 Lbs
 - Max-----10.65 Lbs
- After 25 Cycles
 - Mating
 - Min -----17.69 Lbs
 - Max-----24.74 Lbs
 - Unmating
 - Min -----10.86 Lbs
 - Max-----15.15 Lbs
- After 50 Cycles
 - Mating
 - Min -----18.53 Lbs
 - Max-----26.94 Lbs
 - Unmating
 - Min -----12.87 Lbs
 - Max-----18.03 Lbs
- After 75 Cycles
 - Mating
 - Min -----22.56 Lbs
 - Max-----25.80 Lbs
 - Unmating
 - Min -----15.24 Lbs
 - Max-----19.89 Lbs
- After 100 Cycles
 - Mating
 - Min -----21.44 Lbs
 - Max-----26.19 Lbs
 - Unmating
 - Min -----14.58 Lbs
 - Max-----19.41 Lbs
- After Humidity
 - Mating
 - Min -----8.80 Lbs
 - Max-----11.64 Lbs
 - Unmating
 - Min -----3.85 Lbs
 - Max-----5.60 Lbs

RESULTS Continued**LLCR Durability (64 signal LLCR test points)**

- **Initial**-----8.38 mOhms Max
- **After 100 Cycles**
 - <= +5.0 mOhms ----- 64 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
- **After thermal shock**
 - <= +5.0 mOhms ----- 64 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
- **After humidity**
 - <= +5.0 mOhms ----- 64 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
 - >+2000 mOhms ----- 0 Points ----- Open Failure

Insulation Resistance minimums, IR**Pin-Pin**

- **Initial**
 - Mated ----- 100000 Meg Ohms ----- Pass
 - Unmated ----- 100000 Meg Ohms ----- Pass
- **Thermal**
 - Mated ----- 100000 Meg Ohms ----- Pass
 - Unmated ----- 100000 Meg Ohms ----- Pass
- **Humidity**
 - Mated ----- 25000 Meg Ohms ----- Pass
 - Unmated ----- 100000 Meg Ohms ----- Pass

Dielectric Withstanding Voltage minimums, DWV

- **Minimums**
 - Breakdown Voltage ----- 1200VAC
 - Test Voltage ----- 900VAC
 - Working Voltage ----- 300VAC

Pin - pin

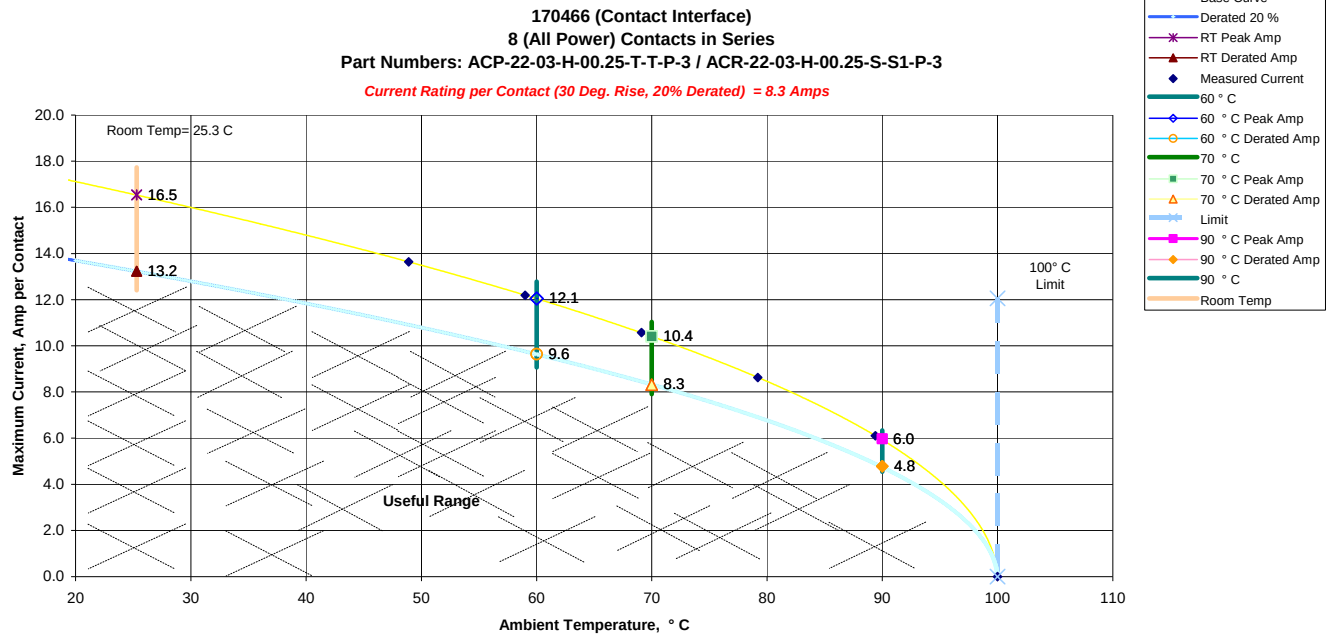
- **Initial DWV** ----- Passed
- **Thermal DWV** ----- Passed
- **Humidity DWV** ----- Passed

RESULTS Continued**IP67 Testing (Dust&Water)****Group A1****Dust****Initial (Before Exposure)**
No Dust Present**After Exposure**
No Dust Present**Group A2****Water****Initial (Before Exposure)**
No water Present**After Exposure**
No water Present**Group B1****Dust****Initial (Before Exposure)**
No Dust Present**After Exposure**
No Dust Present**Group B2****Water****Initial (Before Exposure)**
No water Present**After Exposure**
No water Present**Group C1****Dust****Initial (Before Exposure)**
No Dust Present**After Exposure**
No Dust Present**Group C2****Water****Initial (Before Exposure)**
No water Present**After Exposure**
No water Present**IPX8 Testing (Water)****Group A1 (10 m)****Water****Initial (Before Exposure)**
No Water Present**After Exposure**
No Water Present

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:



DATA SUMMARIES Continued**Mating/Unmating durability force:**

	Initial				25 Cycles			
	Mating		Unmating		Mating		Unmating	
	Newtons	Force (Lbs)	Newtons	Force (Lbs)	Newtons	Force (Lbs)	Newtons	Force (Lbs)
Minimum	59.87	13.46	26.69	6.00	78.69	17.69	48.31	10.86
Maximum	84.29	18.95	47.37	10.65	110.04	24.74	67.39	15.15
Average	68.50	15.40	35.28	7.93	91.58	20.59	59.99	13.49
St Dev	9.07	2.04	7.21	1.62	9.87	2.22	6.21	1.40
Count	8	8	8	8	8	8	8	8
	50 Cycles				75 Cycles			
	Mating		Unmating		Mating		Unmating	
	Newtons	Force (Lbs)	Newtons	Force (Lbs)	Newtons	Force (Lbs)	Newtons	Force (Lbs)
Minimum	82.42	18.53	57.25	12.87	100.35	22.56	67.79	15.24
Maximum	119.83	26.94	80.20	18.03	114.76	25.80	88.47	19.89
Average	102.32	23.00	73.03	16.42	107.28	24.12	79.56	17.89
St Dev	10.70	2.41	7.22	1.62	4.61	1.04	6.50	1.46
Count	8	8	8	8	8	8	8	8
	100 Cycles				After Humidity			
	Mating		Unmating		Mating		Unmating	
	Newtons	Force (Lbs)	Newtons	Force (Lbs)	Newtons	Force (Lbs)	Newtons	Force (Lbs)
Minimum	95.37	21.44	64.85	14.58	39.14	8.80	17.12	3.85
Maximum	116.49	26.19	86.34	19.41	51.77	11.64	24.91	5.60
Average	106.64	23.97	78.13	17.57	44.57	10.02	20.43	4.59
St Dev	6.47	1.45	7.04	1.58	3.97	0.89	2.38	0.53
Count	8	8	8	8	8	8	8	8

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

	Pin to Pin		
	Mated	Unmated	Unmated
Minimum	ACP/ACR	ACP	ACR
Initial	100000	100000	100000
Thermal	100000	100000	100000
Humidity	25000	100000	100000

DIELECTRIC WITHSTANDING VOLTAGE (DWV):

Voltage Rating Summary	
Minimum	ACP/ACR
Break Down Voltage	1200
Test Voltage	900
Working Voltage	300

Pin to Pin	
Initial Test Voltage	Passed
After Thermal Test Voltage	Passed
After Humidity Test Voltage	Passed

DATA SUMMARIES Continued**LLCR Durabiltiy:**

- 1) A total of 64 points were measured.
- 2) EIA-364-23, *Low Level Contact Resistance Test Procedure for Electrical Connectors and Sockets.*
- 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

LLCR Measurement Summaries by Pin Type				
Date	11/14/2011	11/17/2011	11/22/2011	12/8/2011
Room Temp (Deg C)	23	23	22	23
Rel Humidity (%)	41	30	37	29
Technician	Aaron McKim	Aaron McKim	Aaron McKim	Aaron McKim
mOhm values	Actual Initial	Delta 100 Cycles	Delta Therm Shck	Delta Humidity
Pin Type 1: Signal				
Average	7.04	0.10	0.29	0.20
St. Dev.	0.26	0.09	0.28	0.54
Min	6.60	0.00	0.00	0.00
Max	8.38	0.43	2.14	4.35
Summary Count	64	64	64	64
Total Count	64	64	64	64

LLCR Delta Count by Category						
	Stable	Minor	Acceptable	Marginal	Unstable	Open
mOhms	≤ 5	$>5 \text{ \& } \leq 10$	$>10 \text{ \& } \leq 15$	$>15 \text{ \& } \leq 50$	$>50 \text{ \& } \leq 1000$	>1000
100 Cycles	64	0	0	0	0	0
Therm Shck	64	0	0	0	0	0
Humidity	64	0	0	0	0	0

DATA SUMMARIES Continued**IP67 Testing (Dust&Water)****Dust:****Group A1**

<u>Sample #</u>	Visual Inspection
1	PASS
2	PASS
3	PASS
4	PASS
5	PASS
6	PASS

Group B1

<u>Sample #</u>	Visual Inspection
1	PASS
2	PASS
3	PASS
4	PASS
5	PASS
6	PASS

Group C1

<u>Sample #</u>	Visual Inspection
1	PASS
2	PASS
3	PASS
4	PASS
5	PASS
6	PASS

DATA SUMMARIES Continued**Water
Group A2**

<u>Sample #</u>	Visual Inspection
1	PASS
2	PASS
3	PASS
4	PASS
5	PASS
6	PASS

Group B2

<u>Sample #</u>	Visual Inspection
1	PASS
2	PASS
3	PASS
4	PASS
5	PASS
6	PASS

Group C2

<u>Sample #</u>	Visual Inspection
1	PASS
2	PASS
3	PASS
4	PASS
5	PASS
6	PASS

EQUIPMENT AND CALIBRATION SCHEDULES

Equipment #: MO-03

Description: Micro-ohmmeter

Manufacturer: Keithley

Model: 580

Serial #: 297288

Accuracy: Last Cal: 2011-8-06, Next Cal: 2012-8-05

Equipment #: TCT-01

Description: Normal force analyzer

Manufacturer: Mecmesin Multitester

Model: Mecmesin Multitester 2.5-i

Serial #: 08-1049-04

Accuracy: Last Cal: 2012-4-28, Next Cal: 2013-4-27

Equipment #: THC-01

Description: Humidity transmitter

Manufacturer: Thermtron

Model: HMM30C

Serial #: D0240037

Accuracy: Last Cal: 2012-3-3, Next Cal: 2013-3-2

Equipment #: MO-01

Description: Micro-ohmmeter

Manufacturer: Keithley

Model: 2700

Serial #: 1199807

Accuracy: Last Cal: 2012-4-28, Next Cal: 2013-4-27

Equipment #: PS-01

Description: Power Supply

Manufacturer: Agilent

Model: 6031A

Serial #: MY41000982

Accuracy: Last Cal: 2012-4-28, Next Cal: 2013-4-27

Equipment #: TSC-01

Description: Thermal Shock transmitter

Manufacturer: Keithley

Model: 10-VT14994

Serial #: VTS-3-6-6-SC/AC

Accuracy: Last Cal: 2011-11-1, Next Cal: 2012-11-1

EQUIPMENT AND CALIBRATION SCHEDULES Continued**Equipment #:** WATER-01**Description:** IP-67 1.0 Meter Water Column Chamber**Manufacturer:** Samtec Machine**Model:** N/A**Serial #:** N/A**Accuracy:** No Calibration Required**Equipment #:** DUST-01**Description:** IP-X6 Dust Tester**Manufacturer:** Samtec Machine**Model:** N/A**Serial #:** N/A**Accuracy:** No Calibration Required