Garwood Laboratories, Inc.
Testing and Engineering Services

ENVIRONMENTAL TEST REPORT

Report Number: ENV5175 **Revision:** NC

FOR

AMPTEC RESEARCH CORPORATION

14121 Hwy 290 West, Bldg 3A
Austin, TX 78737

ON

HIGH RESOLUTION BONDING MILLI-OHMMETER

Part Number: AMPTEC 620LK **Serial Numbers:** 620LK-5001

***PERFORMED BY*:**

GARWOOD LABORATORIES, INC.

143 Calle Iglesia
San Clemente, CA 92672

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Prepared By:	STEPHEN HEYMAN, *Technical Writer*	**Date:**	March 16, 2012
Approved By:	RICHARD SANCHEZ, *Lab Manager, San Clemente*	**Date:**	March 16, 2012
Approved By:	***For Heather Armstrong-Bennett*** HEATHER ARMSTRONG-BENNETT, *Quality Manager*	**Date:**	March 16, 2012

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Document History

Revision	Creation Date	Description Of Modifications	Revised By	Approved By
NC	February 29, 2012	*Initial release*		

CLIENT INFORMATION

Purchase Order	1003KC
Quote Number	GARQ5175
EUT Arrival Date	February 17, 2012
Company Name	Amptec Research Corporation
Address	14121 Hwy 290 West, Bldg 3A
City, State Zip	Austin, TX 78737
Contact Name	Kerry Clark
Phone	512-484-3660
Fax	512-301-9303

GARWOOD INFORMATION

Test Laboratory	Garwood Laboratories, Inc.
Address	143 Calle Iglesia
City, State, Zip Code	San Clemente, CA 92672
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SUMMARY OF TESTS PERFORMED

Test Name	*Test Personnel*	*Date Tested*	*Results*
Explosive Atmosphere	Shaun Paysen	February 17, 2012	Complied

1.0 PURPOSE

1.1 The purpose of this report is to present the procedures employed and results obtained while conducting the environmental tests on one High Resolution Milli-Ohmmeter, part number: AMPTEC 620LK, serial number: 620LK-5001, which is hereinafter, referred to as the equipment under test (EUT).

1.2 The High Resolution Bonding Milli-Ohmmeter was submitted by Amptec Research Corporation.

1.3 The environmental tests, as specified in this report were performed in accordance with MIL STD-810F, dated January 1, 2000.

1.4 The test result summarizes, test setup photographs, detailed test data sheets and/or plots, and test equipment lists are included in the specific test section as numbered and summarized in the Table of Contents.

2.0 PRELIMINARY INFORMATION

2.1 REFERENCES

- MIL STD-810F — Department of Defense Test Method Standard for Environmental Engineering Consideration and Laboratory Tests, dated January 1, 2000.
- ANSI/NCSL Z540-1-1994 — Calibration Laboratories and Measuring and Test Equipment -- General Requirements

2.2 TEST LOCATION

Testing was performed at the Orange County facility of Garwood Laboratories, Incorporated, located at 143 Calle Iglesia, San Clemente, California, 92672. All tests were performed using the test set-ups of the relevant standards for tests performed in laboratory conditions.

2.3 TEST CONDITIONS AND EQUIPMENT

2.3.1 AMBIENT CONDITIONS:

- **Temperature:** +65ºF ± 20º F
- **Relative Humidity:** Not greater than 85%
- **Barometric Pressure:** Station (site) pressure (84kPa to 107 kPa)

2.3.2 INSTRUMENTATION AND EQUIPMENT:

2.3.2.1 Measuring and test equipment, utilized in the performance of these tests, was calibrated in accordance with ANSI/NCSL Z540-1-1994, by Garwood Laboratories, Inc., or a commercial facility, utilizing reference standards (or interim standards) whose calibrations have been certified as being traceable to the National Institute of Standards & Technology (NIST). All reference standards utilized in the above calibration system are supported by certificates, reports, or data sheets attesting to the date, accuracy, and conditions under which the results furnished were obtained. All subordinate standards, measuring and test equipment are supported by like data, when such information is essential to achieve the accuracy control required by the procedure.

2.3.2.2 Garwood Laboratories, Inc., attests that the commercial sources providing calibration services on the above referenced equipment, other than the NIST Standards are in fact capable of performing the required services to the satisfaction of Garwood Laboratories, Inc., Quality Assurance. Certifications of all calibrations performed are retained on file in the Garwood Laboratories, Inc., Quality Assurance Department, and are available for inspection upon request by customer representatives.

2.3.2.3 The test equipment utilized during this test program is listed following the Detailed Test Results of each applicable section.

2.3.3 TOLERANCES:

Unless otherwise stated, test conditions were maintained within the tolerances specified with the documents in section 2.1.

3.0 EXPLOSIVE ATMOSPHERE TEST RESULTS

3.1 EXPLOSIVE ATMOSPHERE TEST SUMMARY

3.1.1 The Explosive Atmosphere test was conducted on the High Resolution Bonding Milli-Ohmmeter, part number: AMPTEC 620LK, serial number: 620LK-5001, in accordance with Method 511.1, Procedure I, MIL STD-810F, dated January 1, 2000.

3.1.2 The High Resolution Bonding Milli-Ohmmeter was placed into the explosive atmosphere chamber. The EUT was pre-tested to verify functionality.

3.1.3 The chamber temperature was raised to a high operating temperature of +50°C at 14.7 PSIA (sea level). The chamber was allowed to dwell until the temperature stabilized within tolerance. Once the chamber, EUT and air temperatures had stabilized, and the required quantity of n-Hexane (112.3 ml) was introduced into the chamber and allowed to circulate for at least three minutes. At this time, a sample of the mixture was isolated from the main chamber and ignited to verify the potential explosiveness of the mixture.

3.1.4 Test Results

3.1.4.1 After the initial atmosphere ignition, the EUT shut down. The customer believed that the unit turned off due to interference from the shock used to ignite sample chamber. Chamber was quickly opened and EUT was restarted and customer performed 100 cycles. Monitor the chamber for possible EUT related ignition.

3.1.4.2 After the second atmosphere ignition, the EUT again shut down. The customer believed the cause to be EMI interference from the shock due to the fact the EMI cover had been removed exposing the interior circuit board. Chamber was opened and EUT was restarted. Customer performed the second set of 100 cycles.

3.1.4.3 At the third atmosphere ignition, the mixture was not explosive. The chamber had been opened too many times, and released too much of the Hexane gas. The customer requested to begin the 400 cycles at the three minute mark after the Hexane had been released into the chamber, and then have the sample taken, to avoid the interference. This would prove the cycles were taken in an explosive atmosphere, but not interfere with the EUT's operation.

3.1.4.4 The chamber was purged and wiped clean of residual Hexane. The n-Hexane (112.3ml) was re-introduced into the chamber and allowed to circulate for at least three minutes. Customer operated the EUT for 400 cycles. A sample of the test mixture was then isolated and ignited to verify the potential explosiveness of the mixture.

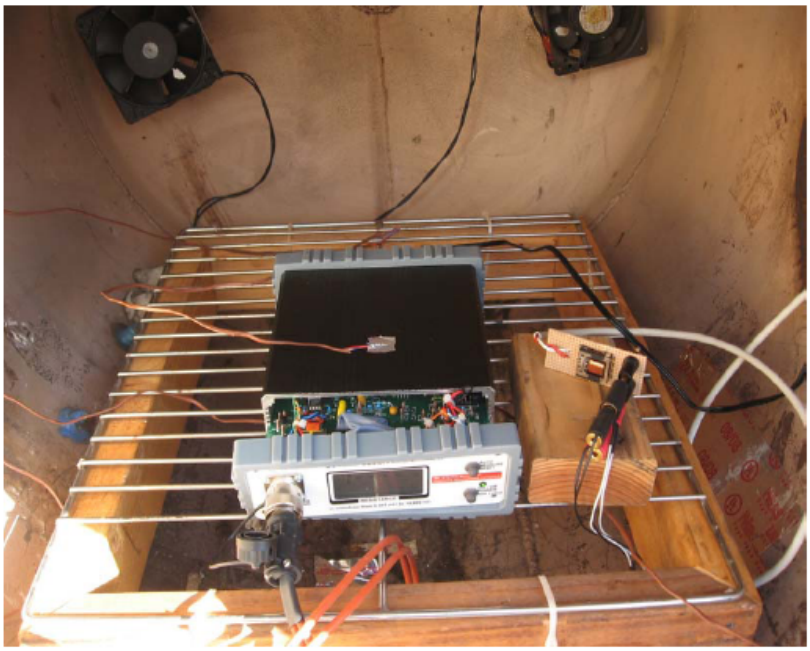
3.1.4.5 The door was opened briefly to re- energize EUT to verify operational post sample. No anomalies noted EUT operated and ran more cycle in temp and explosive condition. See "Request for Clarification of Test Specification" located in Section 3.4.

3.1.5 The temperature of the chamber walls, air, & EUT; along with the chamber pressure was monitored on a circular chart.

3.1.6 The High Resolution Bonding Milli-Ohmmeter, part number: AMPTEC 620LK, serial number: 620LK-5001, met the requirements of the Explosive Atmosphere test in accordance with Method 511.1, Procedure I, MIL STD-810F. Final disposition will be determined by the customer.

3.2 TEST PHOTOGRAPHS

Test Title: Explosive Atmosphere
Specify Set Up: Test Set-Up
Customer Name: Amptec Research
Test Item: High Resolution Bonding Milli-Ohmmeter
Part Number: AMPTEC 620LK
Serial Number: 620LK-5001
Date: 02/17/12
Job Number: 5175P



Test Title: Explosive Atmosphere
Specify Set Up: Test Set-Up
Customer Name: Amptec Research
Test Item: High Resolution Bonding Milli-Ohmmeter
Part Number: AMPTEC 620LK
Serial Number: 620LK-5001
Date: 02/17/12
Job Number: 5175P

3.3 EXPLOSIVE ATMOSPHERE DETAILED TEST RESULTS

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FUEL DATA

Job No: 5175P	Customer Name: Amptec Research		
Date: 02/17/12	Test Description: Explosive Atmosphere		
Quantity: 1	Test Item: High Resolution Bonding Milli-Ohmmeter		
Part No: AMPTEC 620LK	Serial No:	620LK-5001	
Specification: MIL-STD 810F Procedure I	Rev: ---	Para/Mthd: 511.1	

Fuel Mixture Quantity Calculations

Mixture quantity calculation for Low Altitude (Site Level)

$$\left(\frac{19.5\ ft^3}{122°F + 459.67)°R} \times \frac{14.7\ PSIA}{.66} \right) 112.3\ ml$$

Difference between Low Altitude and High Altitude = 0ml

Sub-Page: 1 of 1	Test Technician(s): Shaun Paysen Test Engineer(s): R.S.
	Inspector: DCMC:

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TEST LOG

Job No:	5175P	Customer Name:	Amptec Research		
Date:	02/17/12	Test Description:	Explosive Atmosphere		
Quantity:	1	Test Item:	High Resolution Bonding Milli-Ohmmeter		
Part No:	AMPTEC 620LK	Serial No:	620LK-5001		
Specification:	MIL-STD 810F Procedure I			Rev: ---	Para/Mthd: 511.1

Test Log

Date	Time	Log Entries
02/17/12	---	This test consists of placing the EUT into the explosive atmosphere chamber. The EUT will then be pre-tested to verify functionality, then the chamber will then be sealed and the temperature will be raised to the EUTs high operating temperature of +50°C at 14.7 PSIA (sea level). The chamber air and EUT will be permitted to rise to within tolerance of the set point, and the chamber will be left to dwell until the temperatures stabilize within tolerance. Once the chamber, EUT and air temperatures have stabilized, and the required quantity of n-Hexane (112.3 ml) will be introduced into the chamber and allowed to circulate for at least 3 minutes. At this time, a sample of the mixture will be isolated from the main chamber and ignited to verify the potential explosiveness of the mixture. With proper sample ignition, the EUT will be energized and allowed to operate 100 operational cycles. After the 1st set of cycles is complete another sample will be taken. Following the sample, the EUT will then be energized and allowed to operate 100 operational cycles, (for a total of 200 cycles). After the 2nd set of cycles is complete another sample will be taken. Following the sample, the EUT will then be energized and allowed to operate 100 operational cycles, (for a total of 300 cycles). After the 3rd set of cycles is complete another sample will be taken. Following the sample, the EUT will then be energized and allowed to operate 100 operational cycles, (for a total of 400 cycles). At this point a final sample will be taken of the chamber and the test will be complete. The chamber will be returned to ambient temperature venting off of Hexane. The UUT will then be de- energized and the chamber will be allowed to return to ambient temperature. If at any time during the test, verification of the explosiveness of the mixture does not yield ignition of the mixture sample, the chamber will be purged and the test will be restarted. The Technician will monitor the EUT for operation during the test. The temperature of the chamber walls, air, & EUT; along with the chamber pressure will be monitored on a circular chart.
		----Continued on Page 2 of 3

Sub-Page: 1 of 3	Test Technician(s): *Shaun Paysen* Test Engineer(s): R. S. Inspector: _____ DCMC: _____

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TEST LOG

Job No: 5175P	Customer Name: Amptec Research		
Date: 02/17/12	Test Description: Explosive Atmosphere		
Quantity: 1	Test Item: High Resolution Bonding Milli-Ohmmeter		
Part No: AMPTEC 620LK	Serial No: 620LK-5001		
Specification: MIL-STD 810F Procedure I		Rev: ---	Para/Mthd: 511.1

Test Log

Date	Time	Log Entries
02/17/12	---	Chart Recorder Channels: Ch 1 = Chamber Walls Ch 2 = Chamber Air Ch 3 = UUT Ch 4 = Chamber Pressure
02/17/12	1630	Perform Pre-Test functional check. Seal the chamber and raise temperature to +50°C Chamber wall, air, and UUT temperatures are stabilized
02/17/12	1700	Chamber at +50°C, and site altitude. (14.7 PSIA)
12/12/11	1712	Introduce the required quantity of n-Hexane (112.3. ml), will allow it to circulate for at least 3 minutes.
12/12/11	1715	Isolate a sample of the test mixture and ignite to verify the potential explosiveness of the mixture. **Results: Mixture is Explosive** Customer attempted to operate the EUT for 100 cycles. The customer had to open chamber to turn EUT back on, customer believes that the unit is turning off due to interference from the shock used to ignite sample chamber. Chamber was then opened quickly and EUT was turned back on and customer performed 100 cycles. Monitor the chamber for possible EUT related ignition.
12/12/11	1724	Isolate a sample of the test mixture, ignite to verify the potential explosiveness of the mixture. **Results: Mixture is Explosive** Customer attempted to operate the EUT for 2nd set of 100 cycles. The same issue occurred the EUT shut down as soon as the sample was taken, believed to be EMI interference from the shock due to the fact the EMI cover is removed exposing the interior circuit board to it. Chamber was opened and EUT was turned back on. Customer performed 2nd set of 100 cycles.
		----*Continued on Page 3 of 3*

Sub-Page: 2 of 3	Test Technician(s): Shaun Payson Test Engineer(s): R. S. Inspector: DCMC:

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TEST LOG

Job No: 5175P	Customer Name: Amptec Research		
Date: 02/17/12	Test Description: Explosive Atmosphere		
Quantity: 1	Test Item: High Resolution Bonding Milli-Ohmmeter		
Part No: AMPTEC 620LK	Serial No: 620LK-5001		
Specification: MIL-STD 810F Procedure I		Rev: ---	Para/Mthd: 511.1

Test Log

Date	Time	Log Entries
12/12/11	1750-1813	Isolate a sample of the test mixture and ignite to verify the potential explosiveness of the mixture. **Results: Mixture is Not Explosive, The chamber had been opened too many times and released too much of the Hexane gas.** Customer request to begin the 400 cycles at the 3 minute mark after Hexane is released into the chamber, then have the sample taken, to avoid the interference. This would prove the cycles were taken in an explosive atmosphere, but not interfere with the EUT's operation. The chamber was purged and wiped clean of residual Hexane.
12/12/11	1827	Re-Introduce the required quantity of n-Hexane (112.3ml), allowed to circulate for at least 3 minutes.
	1831	Customer operates the EUT for 400 cycles. Upon completion of the 400 cycles, Isolate a sample of the test mixture and ignite to verify the potential explosiveness of the mixture. **Results: Mixture is Explosive** Monitor the chamber for possible UUT related ignition
12/12/11	1845-1855	Opened door briefly to re- energize EUT to verify operational post sample. No anomalies noted EUT operated and ran more cycle in temp and explosive condition.
12/12/11	1900	De-energize the EUT. Adjust chamber to ambient conditions. **Testing Complete**
		RESULTS: The test was performed according to the test specifications stated above. Upon completion of testing a visual inspection was performed, during the inspection no damage or degradation was observed. Though no anomalies reported, customer retains all functional test results.

Sub-Page: 3 of 3	Test Technician(s): Shawn Paysen Test Engineer(s): R. S. Inspector: _____ DCMC: _____

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CHARTS

Job No: 5175P	Customer Name:	Amptec Research	
Date: 02/17/12	Test Description:	Explosive Atmosphere	
Quantity: 1	Test Item:	High Resolution Bonding Milli-Ohmmeter	
Part No: AMPTEC 620LK	Serial No:	620LK-5001	
Specification: MIL-STD 810F Procedure I	Rev: ---	Para/Mthd: 511.1	

Circular Chart Display

3.4 REQUEST FOR CLARIFICATION OF TEST SPECIFICATION

GARWOOD LABORATORIES, INC.
Testing & Engineering Services

JOB NO.: 5175P____
PAGE NO.: ___1____

DATE: 02/17/12

REQUEST FOR CLARIFICATION OF TEST SPECIFICATION

Customer:	Amptec Research	
Test Title:	Explosive Atmosphere	
Test Item:	620LK Explosive Safety Bonding Millohmeter	
Specification:	MIL-STD 810 Procedure I	Rev.: G
Paragraph(s):	511.1	

Clarification Requested:

Original statement of work (Job Card) stated that the test was to be run at 40°C. Upon the arrival of the customer they were expecting the test to be run as an old test at 50°C. As a result, at the customer's request, the chamber was stabilized to 50°C.

During the testing the EUT was unable to stay operational while the sample was being taken. The conclusion was that this was due to the EMI discharge from the spark during the sample. This conclusion was drawn by the timing of the incident and the fact that the cover that protects the EUT from EMI waves was partially removed. In order to resolve the issue and still have the EUT perform functional checkout in an explosive atmosphere, the EUT would have to perform all 400 functional checkouts 3 min. after Hexane was released into chamber, to allow Hexane to circulate in chamber. Then take one sample to verify that the checkouts were taken in an explosive environment.

Signatures:

GLI Program Manager — Date: 17 FEB 2012

Customer Representative — Date: 17 FEB 2012

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3.5 EXPLOSIVE ATMOSPHERE EQUIPMENT LIST

GARWOOD LABORATORIES INC.
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TEST EQUIPMENT LIST

Job No:	5175P	Customer Name:	Amptec Research		
Date:	02/17/12	Test Description:	Explosive Atmosphere		
Quantity:	1	Test Item:	High Resolution Bonding Milli-Ohmmeter		
Part No:	AMPTEC 620LK	Serial No:	620LK-5001		
Specification:	MIL-STD 810F Procedure I	Rev:	---	Para/Mthd:	511.1

Equipment

Asset No.	Description	Manufacturer	Model No.	Calibration Date	Cal Recall Date
1012	Explosive Chamber	Garwood	MG1	Maintain	Maintain
1424	Temp Control	Watlow	96	8-18-2011	8-20-2012
1425	Temp Control	Watlow	96	8-18-2011	8-20-2012
0382	X Ducer	Omega	PX176-050A5V	2-18-11	2-18-12
1211	Chart Recorder	Honeywell	DR4500-AT	8-18-11	8-20-12
N/A	n-Hexanes	Spectrum	H1010	N/A	N/A

Sub-Page: 1 of 1	Test Technician(s): Shaun Paysen	Test Engineer(s): R. S.
	Inspector:	DCMC:

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4.0 CONCLUSION

Environmental Test Performed:	• Explosive Atmosphere Test
Results:	The High Resolution Bonding Milli-Ohmmeter, part number: AMPTEC 620LK, serial number: 620LK-5001, met the requirements of Method 511.1, Procedure I, MIL STD-810F, dated January 1, 2000.
Completion:	The High Resolution Bonding Milli-Ohmmeter was returned to the Amptec Research Corporation's representative after completion of the environmental tests.