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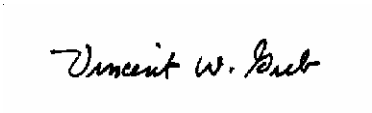
Report Number:	**TRB11003, Rev. A**
Report Type:	**MIL-STD**
Reference Standard:	**MIL-STD-461F**
Date of Report:	**26 November 2012**
Product Name:	**Profiling Radiometer**
Model Number:	**MP-3000A**
Serial Number:	**3103B**
Manufacturer:	**Radiometrics Corporation**
Representative:	**Victor Markin**
Approved By:	

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Revision	Description of Revision	Date:
Rev. -	Initial Release	21 November 2012
Rev. A	Corrected model number, per client request	26 November 2012

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APPENDIX LISTING

1.0 SCOPE

1.1 Purpose

This test report documents electromagnetic interference (EMI) characteristics (susceptibility only) of the Profiling Radiometer designed and built by Radiometrics Corporation located in Boulder, Colorado. The model number of the units tested was MP-3000A and the serial number of the unit tested was 3103B. Testing was performed on the days of 13, 14 and 15 October 2011 at EMC Integrity, Inc. The revision level of the hardware tested was as of this test date.

1.2 Description of Unit Under Test

This unit tested was a microwave radiometer. It passively measures the temperature, water vapor, and cloud liquid water profiles in the troposphere. The unit was powered with a 220 Vac/60 Hz AC input. It uses ~400 Watts on cold startup and ~200 Watts under normal operating conditions.

A block diagram of the unit is shown in Figure 1-1. Hereafter in this report, the Profiling Radiometer will be referred to the Unit Under Test, or UUT. It should be noted that the 220 Vac power provided to the UUT was run through 100 dB filters (10 kHz to 10 GHz).

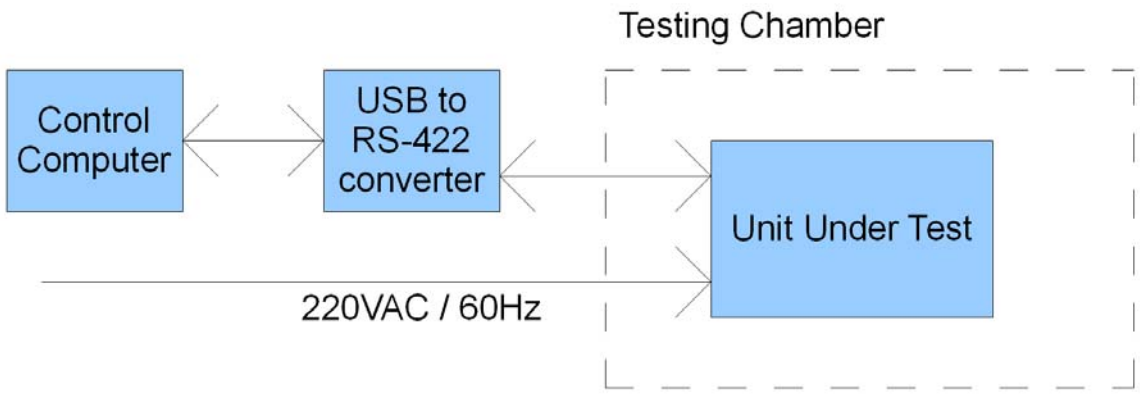


Figure 1. Block Diagram of Unit Under Test.

1.3 Format

Many of the test methods contained in this report are designated by a series of numbers in conjunction with the following lettering system:

RE = Radiated Emission	RS = Radiated Susceptibility
CE = Conducted Emission	CS = Conducted Susceptibility

1.4 Units

This report uses the International System of Units as adopted by the United States Bureau of Standards. A more complete description of this system of units, in addition to the meanings of terms used in this report, is given in MIL-STD-463.

1.5 Summary of Test Results

Results of this testing are summarized in Table 1-1. The UUT was tested to the limits specified by MIL-STD-461F.

Test	Description	Result
CS101	Conducted susceptibility, Power Input, 30 Hz to 150 kHz	Pass
CS106	Conducted susceptibility, Power Input, 5 usec Transient	Pass
CS114	Conducted susceptibility, Power and I/O, 10 kHz to 200 MHz	Pass
RS103	Radiated E-field Susceptibility, 10 kHz to 18 GHz	Pass

Table 1-1. Summary of Test Results.

1.6 Modifications

The UUT was tested as received on 13 October 2011 and no modifications were implemented for compliance.

2.0 APPLICABLE DOCUMENTS

The following documents apply to this report to the extent specified herein. Unless a specific issue or revision is listed, the applicable issue shall be that in effect on the date of release of this document. In conflicts between the listed documents and the contents of this report, this report shall take precedence.

2.1 Government Documents

MIL-STD-461F	Requirements for the Control of Electromagnetic Interference Characteristics of Subsystems and Equipment, 20 December 1999.
MIL-STD-463A	Definitions and System of Units, Electromagnetic Interference and Electromagnetic Compatibility Technology, 9 June 1966.

2.2 Radiometrics Documents

Rev. D	Profiler Operator's Manual, April 30, 2012.

3.0 REQUIREMENTS

3.1 General Requirements

General requirements pertaining to the application of this standard, the applicable test limits, and the measuring test equipment to be used for the performance of the tests included in this report are contained in the referenced documents. Details pertaining to the performance of the tests outlined in this document are contained in the following sections. All operation of the UUT's support equipment was performed by the customer. The EMI measurements were performed in accordance with the methods specified in MIL-STD-461F.

3.2 Test Conditions

3.2.1 Ambient Electromagnetic Level. - All testing was performed in electromagnetic shielded enclosure This enclosure provided enough attenuation such that the ambient electromagnetic level during testing measured with the test sample powered off and the support equipment powered on, was at least 6 dB below the allowable specified limit. This requirement applies only to radiated and conducted emission ambient levels.

3.2.2 Ground Plane. - A solid plate of copper was used as the ground/reference plane. The copper plane had a thickness of greater than 0.25 mm and an area of at least 2.25 m^2, with no side being less than 0.76 m. The ground plane was bonded to the enclosure such that the dc bonding resistance was 1.6 mΩ, thus complying with the requirement of <2.5 mΩ. In addition, the bonds between the ground plane and the shielded enclosure were spaced no greater than 0.9 meters apart.

3.2.3 Accessory Equipment Precaution. - Care was taken to insure that accessory equipment used in conjuction with the interference meters did not affect the integrity of the measurements. Care was also taken to ensure that any support equipment used was electromagnetically isolated from the UUT such that it did not confound measurements..

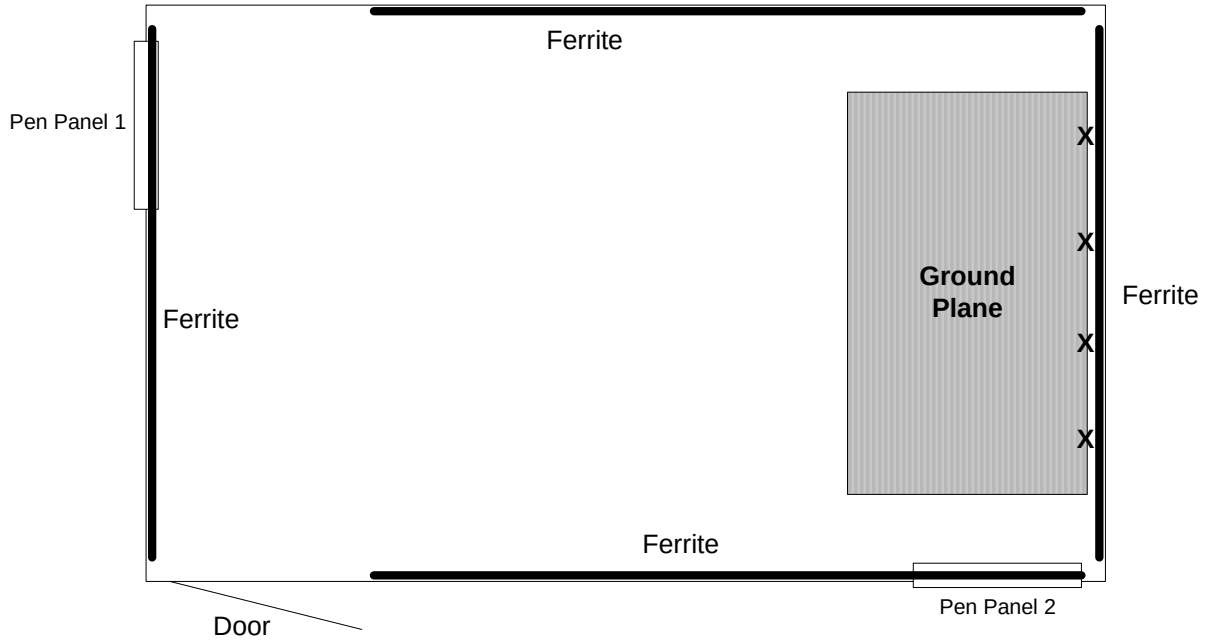
3.2.4 Support Equipment. - The interface between the UUT and the support equipment consisted of 10 cables. These cables were routed to a penetration panel made specially for this program.

3.2.5 Excess Personnel and Equipment. - The shielded enclosure was kept free of unnecessary equipment, cable racks and desks. Only the equipment essential to the test being performed was in the enclosure or in the test area. Personnel not actively involved in the test were not permitted in the enclosure.

3.2.6 Equipment Calibration. - All test equipment was calibrated traceable to the National Institute of Standards and Technology (NIST).

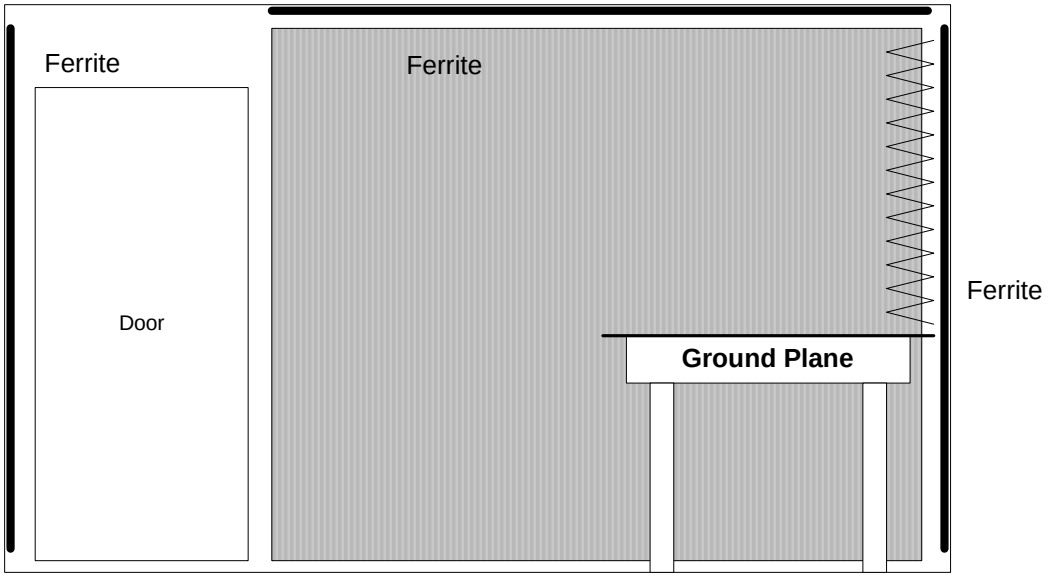
3.2.7 RF Shielded Enclosure - The RF shielded enclosure used for the UUT testing was 16 feet long, 12 feet wide and 8 feet tall. It was equipped with two penetration panels: one for interfacing to the test equipment and one for interfacing to the support equipment. The room is also equipped with two honeycomb filters for ventilation and filtered AC power (both 120 Vac, single-phase and 208 Vac, three-phase). An overview of the room is shown in Figure 3-1.

3.2.8 RF Absorber Material. - RF absorber material was used in the shielded enclosure during the EMI testing to reduce reflections from conductive surfaces within the enclosure. This is shown in Figure 3-2.



Notes
1. "X" indicates point at which ground plane is bonded to shield room wall with 2" braid.

Figure 3-1. Top View of RF Shielded Enclosure.



Notes
1. Ferrite tile covers both end walls, as well as 75% of side walls and ceiling.
2. The back wall above the ground plane is covered with 4" cones.
3. Ground plane is bonded to the end wall of the enclosure with an impedance of less than 2.5 milliohms.
4. Ground plane is positioned 80 cm above the floor of the chamber.

Figure 3-2. Side View of EMI Test Environment.

3.2.9 Use of Measuring Equipment. - The measuring equipment used to perform the tests described in this standard met the requirements of MIL-STD-461F. All laboratory equipment was operated as prescribed by the manufacturers' instruction manual unless otherwise specified by MIL-STD-461F.

3.2.10 Detector Function. - An RMS detector was used for all measurements required by MIL-STD-461C. No bandwidth correction factors were applied to the emissions data; and only narrowband measurements were taken. All bandwidth information, as well as all other settings for the HP8566B spectrum analyzer system, are given in the applicable appendices of this report.

3.2.11 Grounding of Measuring Equipment. - The grounding of EMI instrumentation was implemented in accordance with the following rules to avoid false data that might be introduced by ground loops, etc.

(a) the antenna shall be remote from the measuring equipment.
(b) the EMI measuring instrument shall be physically grounded with only one connection.
(c) the EMI measuring instrument shall be connected to the ac power mains through an isolation tranformer. This will break the chassis ground connection and ensure that rf currents do not circulate through the test equipment.

3.2.12 EMI Test Data Sheets. - All specific information pertaining to the EMI test of the UUT was recorded on the appropriate test data sheet. The emission data sheets contained corrected data as compared to the appropriate limit in dBuV, dBpT, or dBuV/m. The susceptibility data sheets contain information regarding injection level, step size, dwell time and sweep rate. All test data sheets are contained in the appropriate appendix.

3.2.13 Measurement Tolerances. - Unless otherwise stated for a particular measurement, the tolerance was as follows:

a. Distance: $\pm$5%
b. Frequency: $\pm$2%
c. Amplitude, measurement receiver: $\pm$2 dB
d. Amplitude measurement system: $\pm$3 dB
e. Time (waveforms): $\pm$5%
f. Resistors: $\pm$5%
g. Capacitors: $\pm$20%

3.2.14 Bandwidths. – In general, the narrowest bandwidths practical were used for a given frequency range. Video bandwidths were set to a minimum of three times this value. All bandwidth information is contained in the appropriate appendix of this report on the test setup sheets.

3.2.15. Frequency Scanning for Susceptibility. - For susceptibility testing, the entire range for each applicable test shall be scanned. The scan rate for these tests is given in Table 3-1. For those tests using a step and dwell technique, the maximum step sizes are also given in Table 3-1. For any "step and dwell" testing, a 3 second dwell time was used to ensure that adequate time was given to the UUT to respond to the imposed RF environment.

Frequency Range	Maximum Scan Rates Analog Scans	Maximum Step Size Stepped Scans
30 Hz - 1 MHz	$0.0333f_o$/sec	5% of f_o
1 MHz - 30 MHz	$0.00667f_o$/sec	1% of f_o
30 MHz - 1 GHz	$0.00333f_o$/sec	0.5% of f_o
1 GHz - 40 GHz	$0.00167f_o$/sec	0.25% of f_o

Table 3-2. Susceptibility Scanning.

3.2.16 Modulation of Susceptibility Signals. –For CS114 and RS103, the impinged signal was amplitude modulated with a square wave to a depth of 99.9% below 1 GHz, and was pulse modulated with a square wave having a duty cycle of 50% above 1 GHz.

3.2.17. Antenna Factors. - Factors for antennas were determined in accordance with SAE ARP-958.

3.3 Operation of the UUT

3.3.1 Overview. - For all susceptibility testing, the UUT was in a position to measure the Black Body temperature. The tolerance on this measurement was ±0.5 degrees Kelvin. The software name and revision level installed on the UUT was as follows:

a) Mp.exe code version: 6.09.
b) MCM-B code version: 0.06.
c) BBP code version: 1.16.
d) Elevation drive code version: 1.08.
e) Azimuth drive code version: 100.02.

3.3.2 Cable Configuration/Arrangement. - Interconnecting cable assemblies and supporting structures were provided by and configured by the customer.

The UUT was placed in the chamber such that it was at least 1 meter away from each wall, while still allowing 1 meter between itself and the transmit antenna for RS103 testing.

3.3.3 Bonding of the Test Sample. – The UUT was placed on the floor of the chamber. It was grounded via the green wire ground in its AC power cord.

4.0 EMI EMISSIONS AND IMMUNITY SOFTWARE

4.1 Overview

All emissions testing performed on the UUT was automated. The emissions software corrects the radiated emissions data with the antenna factor of the antenna, and conducted emissions data with transfer impedance of the current probe. In addition, cable loss, preamplifier gain and any attenuators (internal or external) are taken into account so that the corrected data is within the required ±2 dB accuracy. A pre-test calibration is performed prior to all emissions testing to ensure that the measurement accuracy is within ±3 dB.

4.1.1 Susceptibility Software. The radiated RF susceptibility software package was designed and written by EMC Integrity, Inc. (RFS, V1.4.0). It was written for the test equipment used in EMCI's immunity test facility and performs real-time feedback as well as playback functions. For radiated field susceptibility testing on the UUT, it was used in real-time feedback mode. In this mode, the user sets the following parameters on a Pentium-based computer used in a Windows XP environment.

- start frequency
- stop frequency
- percent frequency increments
- dwell time
- field strength
- modulation (type, frequency, depth)

The computer commands the signal generator, which outputs to the RF amplifier. The amplifier drives the antenna, generating the field at the UUT, which is monitored by the field sensor. The sensor then feeds back its field strength information to the computer, completing the control loop. The flow chart for this setup is shown in Figure 4-1.

4.1.2 Susceptibility Testing Above 1 GHz. For susceptibility testing above 1 GHz, the same basic process is used. However, the signal generator and TWT amplifiers are moved inside the chamber, with the computer controlling the test being still located outside the chamber. This is done because at frequencies above 1 GHz, cable losses and standing waves on coaxial cables can significantly reduce ability to generate the desired field strength. The field sensor used for radiated field susceptibility testing above 1 GHz has an operating frequency range of 10 MHz to 40 GHz.

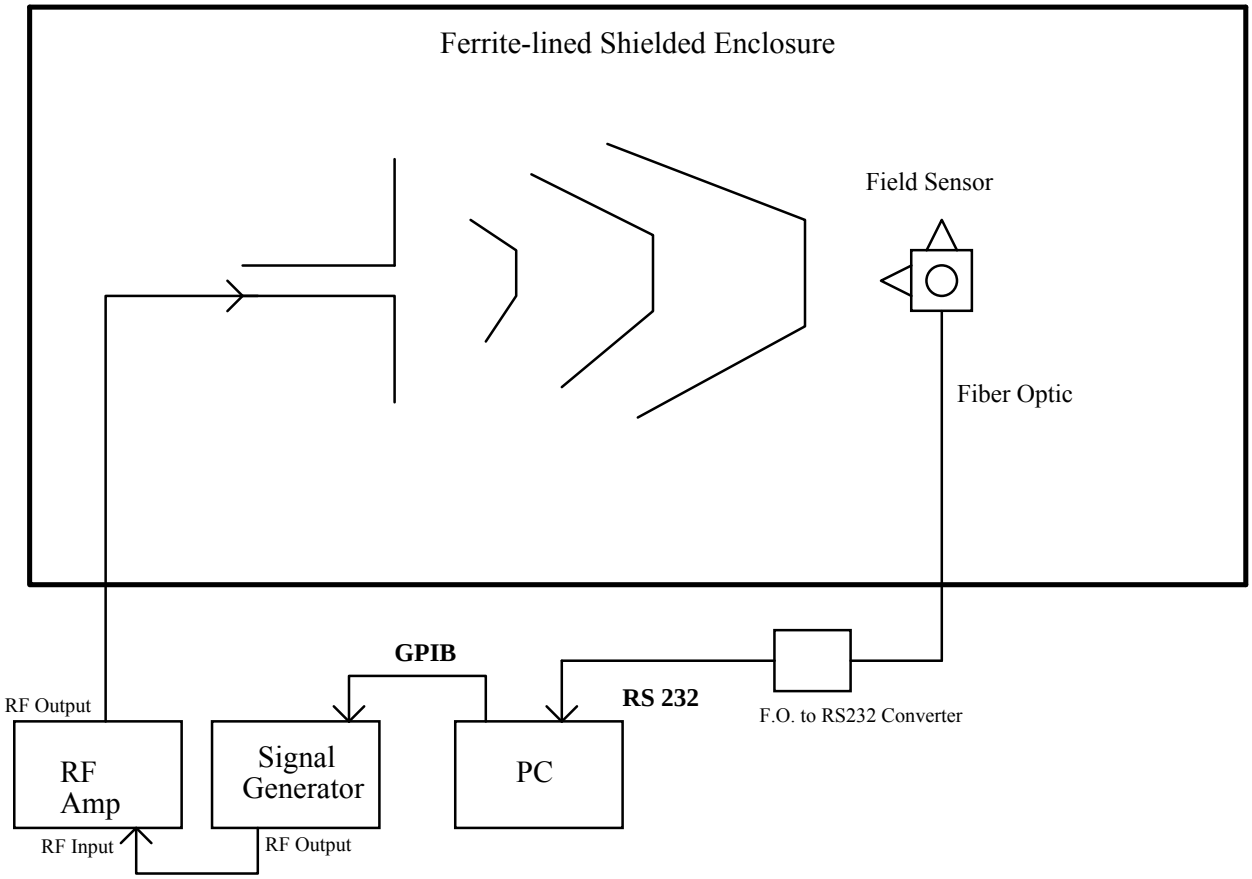


Figure 4-1. Susceptibility Hardware Flow Chart.

5.0 Conducted Susceptibility (CS101) Test Results

5.1 PURPOSE

The purpose of this test was to verify that the UUT complied with the conducted susceptibility requirements defined by the modified CS101 testing of MIL-STD-461F.

5.2 REQUIREMENTS

The AC power input of the UUT was exposed to the injection levels specified by MIL-STD-461F, Method CS101, Curve #1. All data taken for this testing is contained in Appendix A of this report.

5.3 TEST FACILITY

The facility used for this testing is outlined in Section 3.0 of this report. It complies with the requirements outlined for EMI/EMC testing, as defined in MIL-STD-461F.

5.4 TEST SETUP

Testing was performed in accordance with MIL-STD-461F. The injected signal was swept over the frequency range from 30 Hz to 150 kHz using a sweep rate that complied with Section 4.3.10.4.1, Table III of MIL-STD-461F. Prior to testing, a pre-test calibration was performed driving into a ½ ohm load at discrete frequencies. This set the maximum power delivered to the UUT. The actual test on the UUT consisted of first leveling on voltage, and in the event that voltage could not be achieved, limiting on power (as derived by the pre-test calibration). Testing was performed separately on each input power lead, excluding the ground. During testing, the UUT was configured as specified in Section 3.3.1 of this report. A photograph of the test setup, along with the software setup tables, may be found in Appendix A of this report.

5.5 TEST EQUIPMENT

All test equipement used for this testing may be found on the data sheet, in Appendix A of this report. The test equipment list contains information on the manufacturer, the model number, the serial number, hardware description, when the equipment was last calibrated and when it is next due for calibration.

5.6 TEST RESULTS

The UUT operated within acceptable parameters and therefore, **complied** with the CS101 requirements defined in MIL-STD-461F. The data documenting the results of this testing are contained in Appendix A of this report.

6.0 Conducted Susceptibility (CS106) Test Results

6.1 PURPOSE

The purpose of this test was to verify that the UUT complied with the conducted susceptibility requirements defined by the modified CS106 testing of MIL-STD-461F.

6.2 REQUIREMENTS

The AC power input of the UUT was exposed to the injection levels specified by MIL-STD-461F, Method CS106. The test level was 400 Volts and the transient had a half-amplitude pulse width of 5 usec. All data taken for this testing is contained in Appendix B of this report.

6.3 TEST FACILITY

The facility used for this testing is outlined in Section 3.0 of this report. It complies with the requirements outlined for EMI/EMC testing, as defined in MIL-STD-461F.

6.4 TEST SETUP

Testing was performed in accordance with MIL-STD-461F. Prior to testing, a pre-test calibration was performed driving into a 5 Ω load. This set the maximum output level from the pulse generator and thus, the power delivered to the UUT. A voltage amplitude of 400 Volts was used in conjection with a pulse repetition rate of 60 pulses per second (pps). Injection was performed for a minimum of 10 minutes on each AC power input lead, with the injected pulse being varied from 0 to 360 degrees along the phase of the AC waveform. During testing, the UUT was configured as specified in Section 3.3.1 of this report. A photograph of the test setup, along with the software setup tables, may be found in Appendix B of this report.

6.5 TEST EQUIPMENT

All test equipement used for this testing may be found on the data sheet, in Appendix B of this report. The test equipment list contains information on the manufacturer, the model number, the serial number, hardware description, when the equipment was last calibrated and when it is next due for calibration.

6.6 TEST RESULTS

The UUT operated within acceptable parameters and therefore, **complied** with the CS106 requirements defined in MIL-STD-461F. The data documenting the results of this testing are contained in Appendix B of this report.

7.0 Conducted Susceptibility (CS114) Test Results

7.1 PURPOSE

The purpose of this test was to verify that the UUT complied with the CS114 requirements defined in MIL-STD-461F.

7.2 REQUIREMENTS

The AC power input of the UUT, as well as all I/O cabling, was exposed to the injection levels defined by CS114, Curve #3. All data taken for this testing is contained in Appendix C of this report.

7.3 TEST FACILITY

The facility used for this testing is outlined in Section 3.0 of this report. It complies with the requirements outlined for EMI/EMC testing, as defined in MIL-STD-461F.

7.4 TEST SETUP

Testing was performed in accordance with MIL-STD-461F. A "step and dwell" technique was used for this testing, which covered the frequency range from 10 kHz to 200 MHz. The injection levels for Curve #3 were used for all frequencies.. Prior to testing, a pre-test calibration was performed driving into a 50 Ω load. This set the maximum power delivered to the UUT. The injected signal was coupled onto the cabling via bulk current injection (BCI) and the injected current was monitored throughout testing. Testing was performed on the power cable in two different configurations: power leads only (ground excluded) and the entire power cable, including ground. Testing was also performed on the RS422 I/O cable. During testing, the UUT was configured as specified in Section 3.3.1 of this report. A photograph of the test setup, along with the software setup tables, may be found in Appendix C of this report.

7.5 TEST EQUIPMENT

All test equipement used for this testing may be found on the data sheet, in Appendix C of this report. The test equipment list contains information on the manufacturer, the model number, the serial number, hardware description, when the equipment was last calibrated and when it is next due for calibration.

7.6 TEST RESULTS

The UUT **complied** with the CS114 requirements defined in MIL-STD-461F. The data documenting the results of this testing are contained in Appendix C of this report.

8.0 Radiated Susceptibility (RS103) Test Results

8.1 PURPOSE

The purpose of this test was to verify that the UUT complied with the RS103 radiated electric field susceptibility limits defined by MIL-STD-461F.

8.2 REQUIREMENTS

The UUT was exposed to a radiated electric field over the frequency range from 2 MHz to 18 GHz. Over the frequency range from 2 MHz to 1 GHz, a 10 V/m was used. From 1 to 18 GHz, a 50 V/m was used. A three second dwell time was used for all frequencies. Below 1 GHz, the impinged field was amplitude modulated with a 1 kHz square wave to a depth of 99.9%. Above 1 GHz the impinged field was pulse modulated with a square wave having a 1 kHz frequency and a duty cycle of 50%. All data taken for this testing is contained in Appendix E of this report.

8.3 TEST FACILITY

The facility used for this testing is outlined in Section 3.0 of this report. It complies with the requirements outlined for EMI/EMC testing, as defined in MIL-STD-461F.

8.4 TEST SETUP

Testing was performed in accordance with MIL-STD-461F. Testing from 2 to 30 MHz was performed using a parallel element antenna and only vertical polarization testing was performed. For all frequencies above 30 MHz, both horizontal and vertical polarities were used for the impinged RF field. A biconical antenna was used from 30 to 200 MHz and a horn antennas were used above 200 MHz. The test was set up in accordance with MIL-STD-461F. A "step and dwell" technique was used for this testing, with the maximum step sizes as defined by Section 4.3.10.4.1, Table III of MIL-STD-461F. During testing, the UUT was configured as specified in Section 3.3.1 of this report. Photographs of all test setups used for this testing may be found in Appendix D of this report.

8.5 TEST EQUIPMENT

All test equipement used for this testing may be found on the data sheet, in Appendix D of this report. The test equipment list contains information on the manufacturer, the model number, the serial number, hardware description, when the equipment was last calibrated and when it is next due for calibration.

8.6 TEST RESULTS

The UUT **complied** with the RS103 requirements defined in MIL-STD-461F. The data documenting the results of this testing are contained in Appendix D of this report.

Appendix A

Conducted Susceptibility (CS101) Test Data

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Conducted Susceptibility, Method CS101

Manufacturer:	Radiometrics Corporation	Project Number:	B11003
Customer Representative:	Fred Solheim	Test Area:	Shield Room
Model:	MP-3000A	S/N:	3103B
Standard Referenced:	MIL-STD-461F	Date:	14 October 2011
Temperature:	23 ˚C Humidity: 27 %	Pressure:	837 mb
Input Voltage:	220 Vac/60 Hz		
Configuration of Unit:	Normal Operating Mode		
Test Engineer:	V. Greb		

B11003-CS101.doc FR0100

Frequency (kHz)	Injection Level (Vrms)	Power Limit (Watts)	Scan Rate (Hz)	Comments	Pass / Fail
				Performed pre-test calibration into ½ ohm load to verify that amplifier could achieve power limit defined by 461F. OK	
0.03-5	6.3	See Curve	0.001	Injection on Phase 1 AC line. Injected at voltage limit for entire frequency range.	Pass
5 - 150	Curve #1	See Curve	0.001		Pass
0.03-5	6.3	See Curve	0.001	Injection on Phase 2 AC line. Injected at voltage limit for entire frequency range.	Pass
5 - 150	Curve #1	See Curve	0.001		Pass
No upsets, malfunctions or anomalies at any time. All pass.					

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Conducted Susceptibility, Method CS101

Manufacturer:	Radiometrics Corporation	Project Number:	B11003
Customer Representative:	Fred Solheim	Test Area:	Shield Room
Model:	MP-3000A	S/N:	3103B
Standard Referenced:	MIL-STD-461F	Date:	14 October 2011
Temperature:	23 ˚C Humidity: 27 %	Pressure:	837 mb
Input Voltage:	220 Vac/60 Hz		
Configuration of Unit:	Normal Operating Mode		
Test Engineer:	V. Greb		

B11003-CS101.doc FR0100

Frequency (kHz)	Injection Level (Vrms)	Power Limit (Watts)	Scan Rate (Hz)	Comments	Pass / Fail

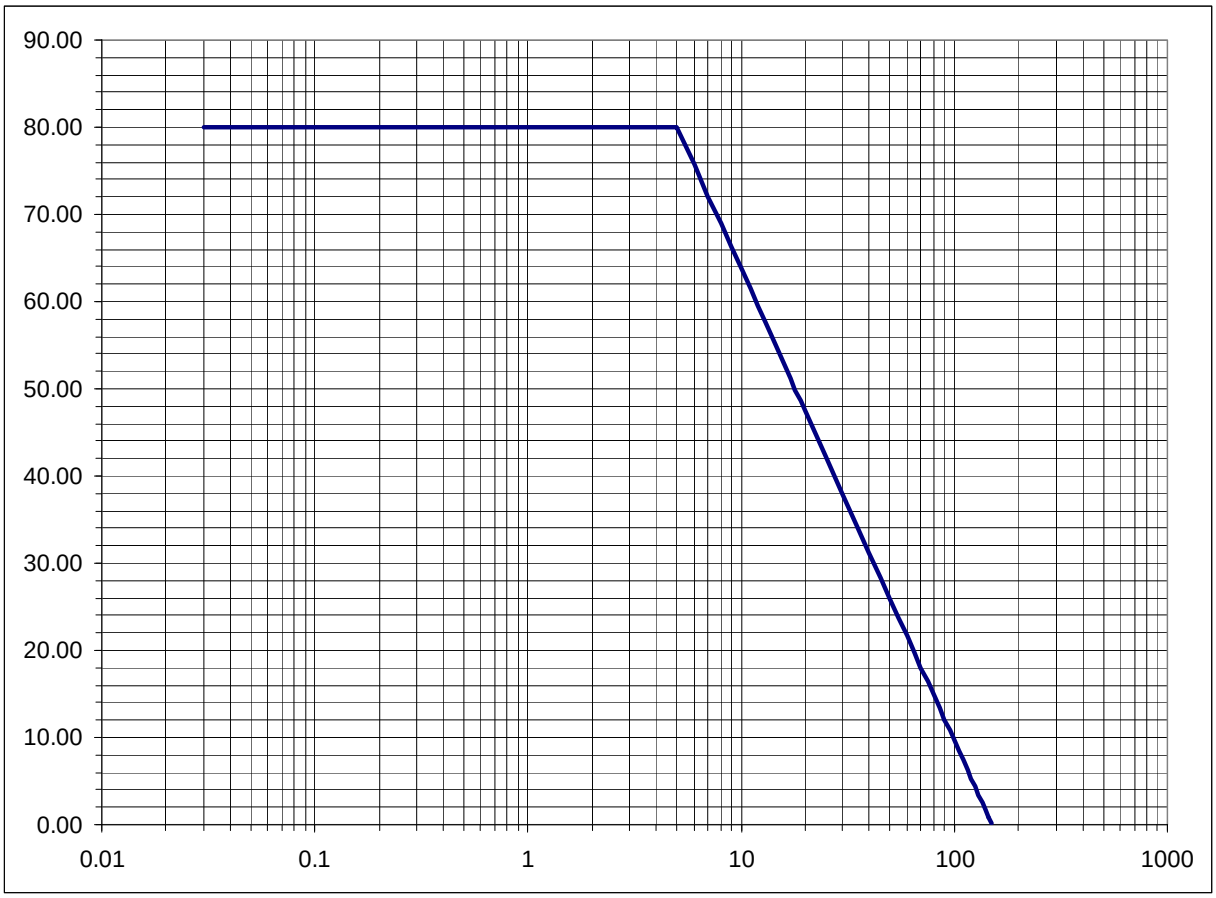

Figure A1. CS101 Power Curve (Watts)

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Conducted Susceptibility, Method CS101

Manufacturer:	Radiometrics Corporation	Project Number:	B11003
Customer Representative:	Fred Solheim	Test Area:	Shield Room
Model:	MP-3000A	S/N:	3103B
Standard Referenced:	MIL-STD-461F	Date:	14 October 2011
Temperature:	23 ˚C Humidity: 27 %	Pressure:	837 mb
Input Voltage:	220 Vac/60 Hz		
Configuration of Unit:	Normal Operating Mode		
Test Engineer:	V. Greb		

B11003-CS101.doc FR0100

Frequency (kHz)	Injection Level (Vrms)	Power Limit (Watts)	Scan Rate (Hz)	Comments	Pass / Fail

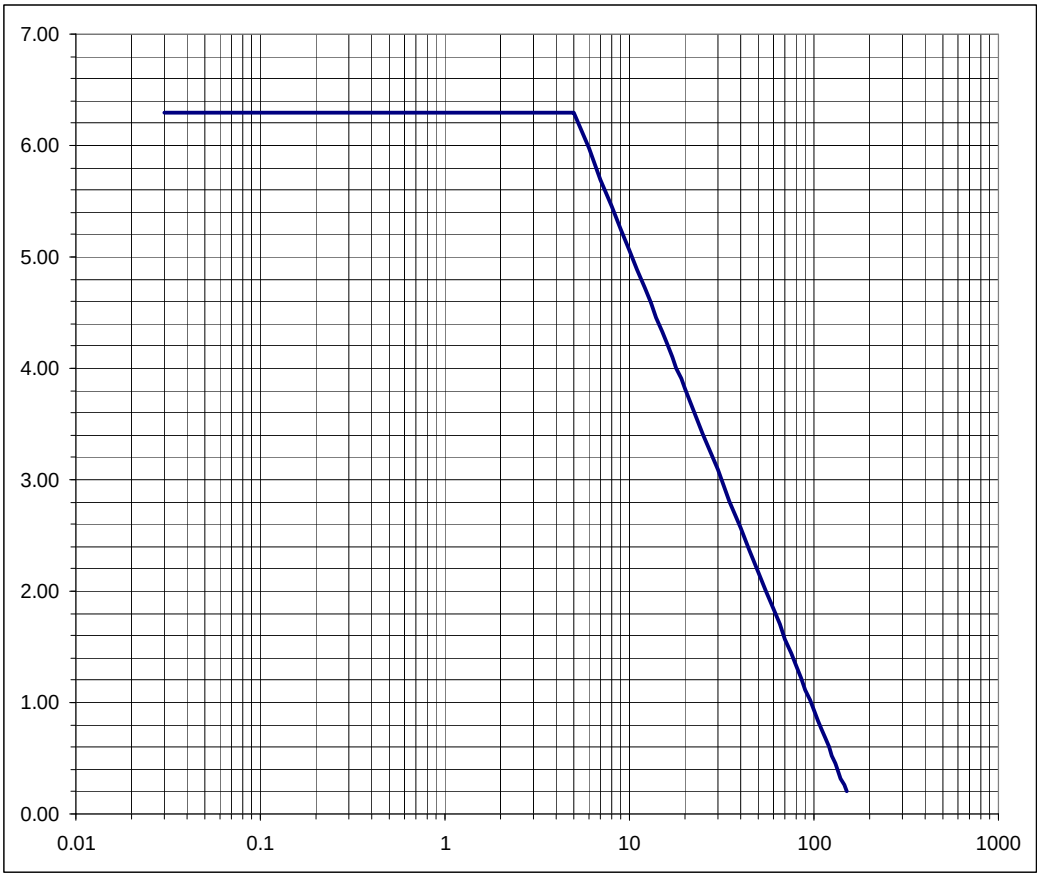

Figure A2. CS101 Voltage Curve for AC Inputs.

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Conducted Susceptibility, Method CS101

Manufacturer:	Radiometrics Corporation	Project Number:	B11003
Customer Representative:	Fred Solheim	Test Area:	Shield Room
Model:	MP-3000A	S/N:	3103B
Standard Referenced:	MIL-STD-461F	Date:	14 October 2011

B11003-CS101.doc FR0100

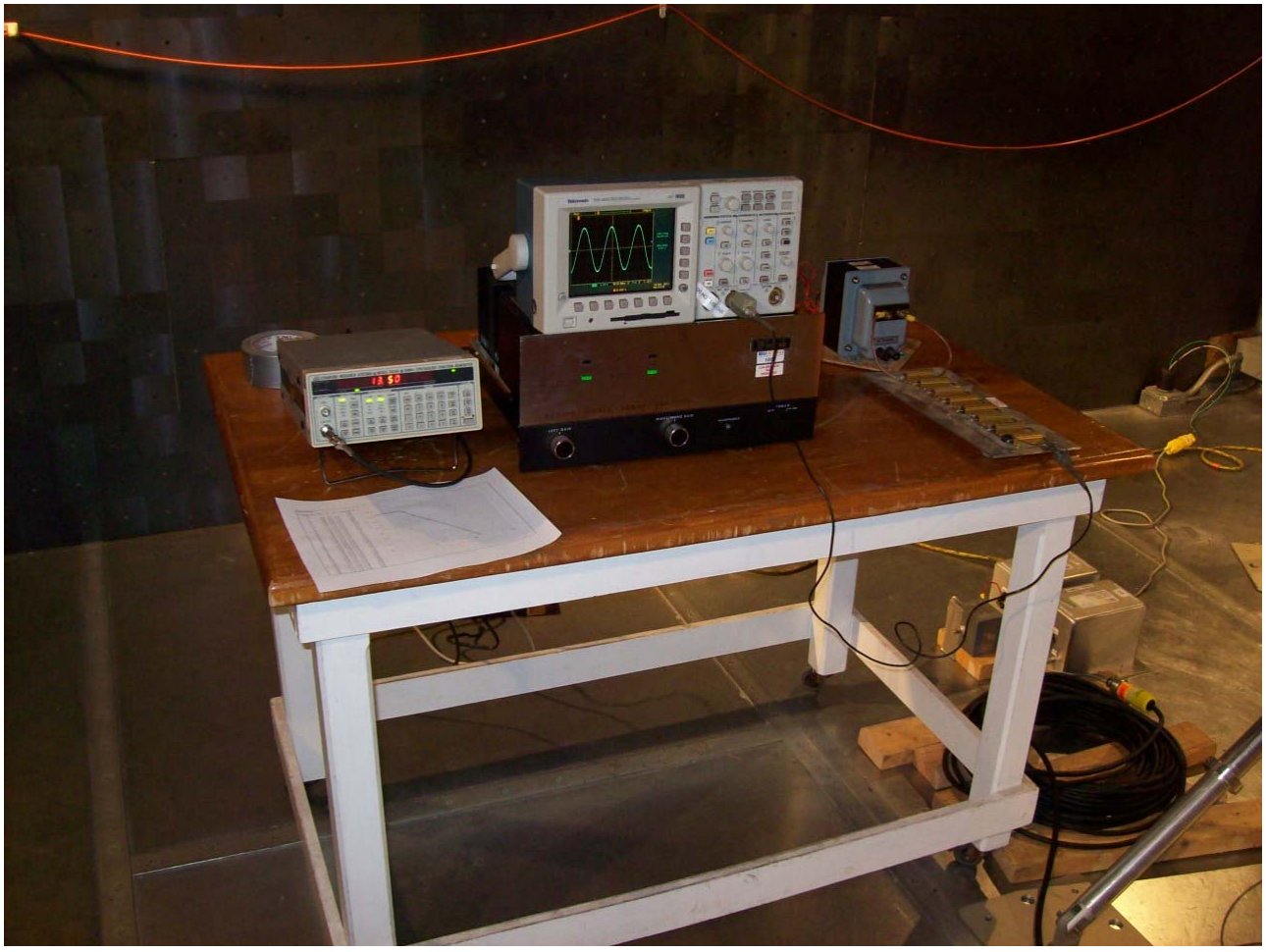

Figure A3. CS101 Pre-test Verification.

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Conducted Susceptibility, Method CS101

Manufacturer:	Radiometrics Corporation	Project Number:	B11003
Customer Representative:	Fred Solheim	Test Area:	Shield Room
Model:	MP-3000A	S/N:	3103B
Standard Referenced:	MIL-STD-461F	Date:	14 October 2011

B11003-CS101.doc FR0100

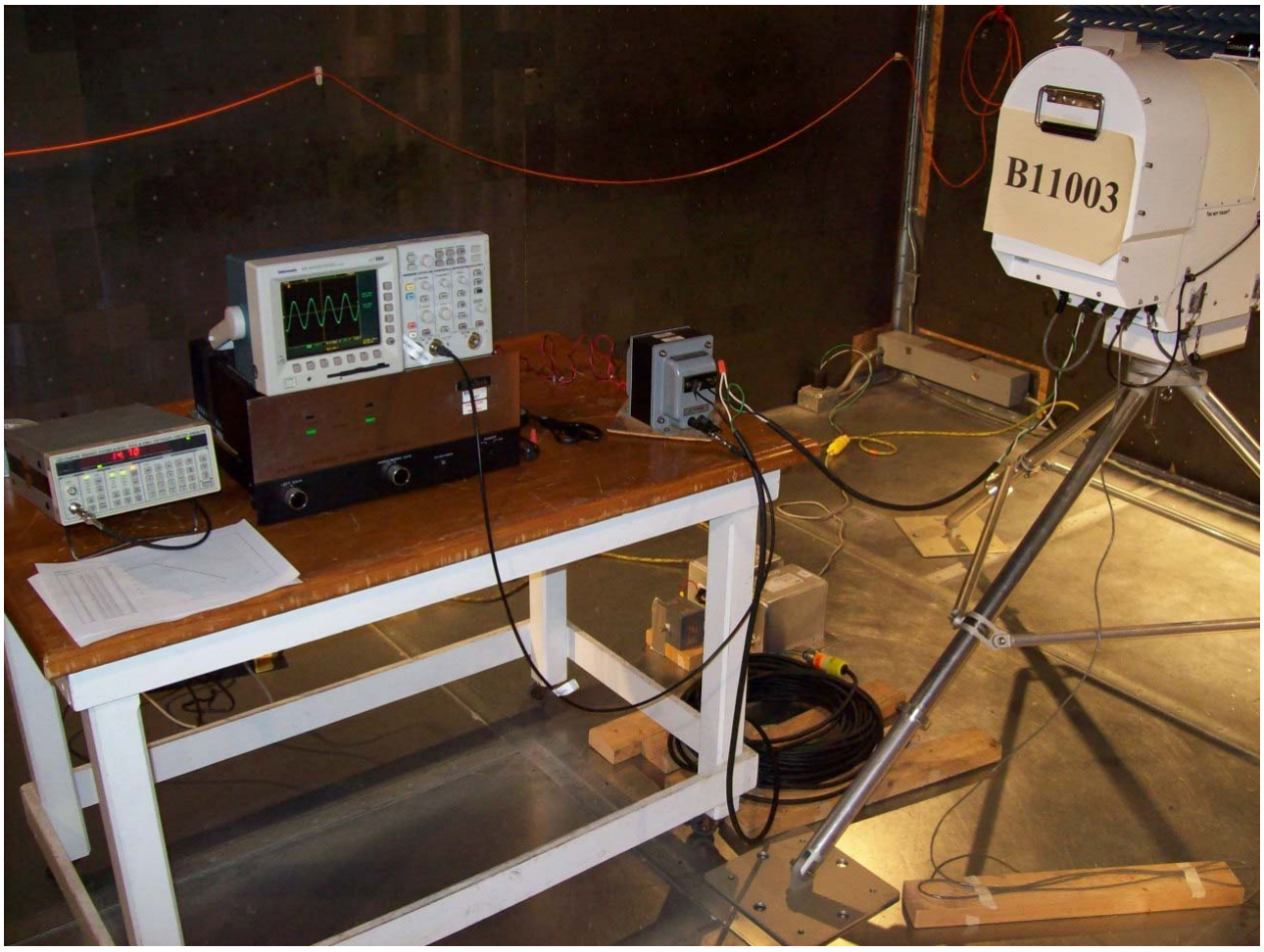

Figure A4. CS101 Test Setup.

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Conducted Susceptibility, Method CS101

Manufacturer:	Radiometrics Corporation	Project Number:	B11003
Customer Representative:	Fred Solheim	Test Area:	Shield Room
Model:	MP-3000A	S/N:	3103B
Standard Referenced:	MIL-STD-461F	Date:	14 October 2011

B11003-CS101.doc FR0100

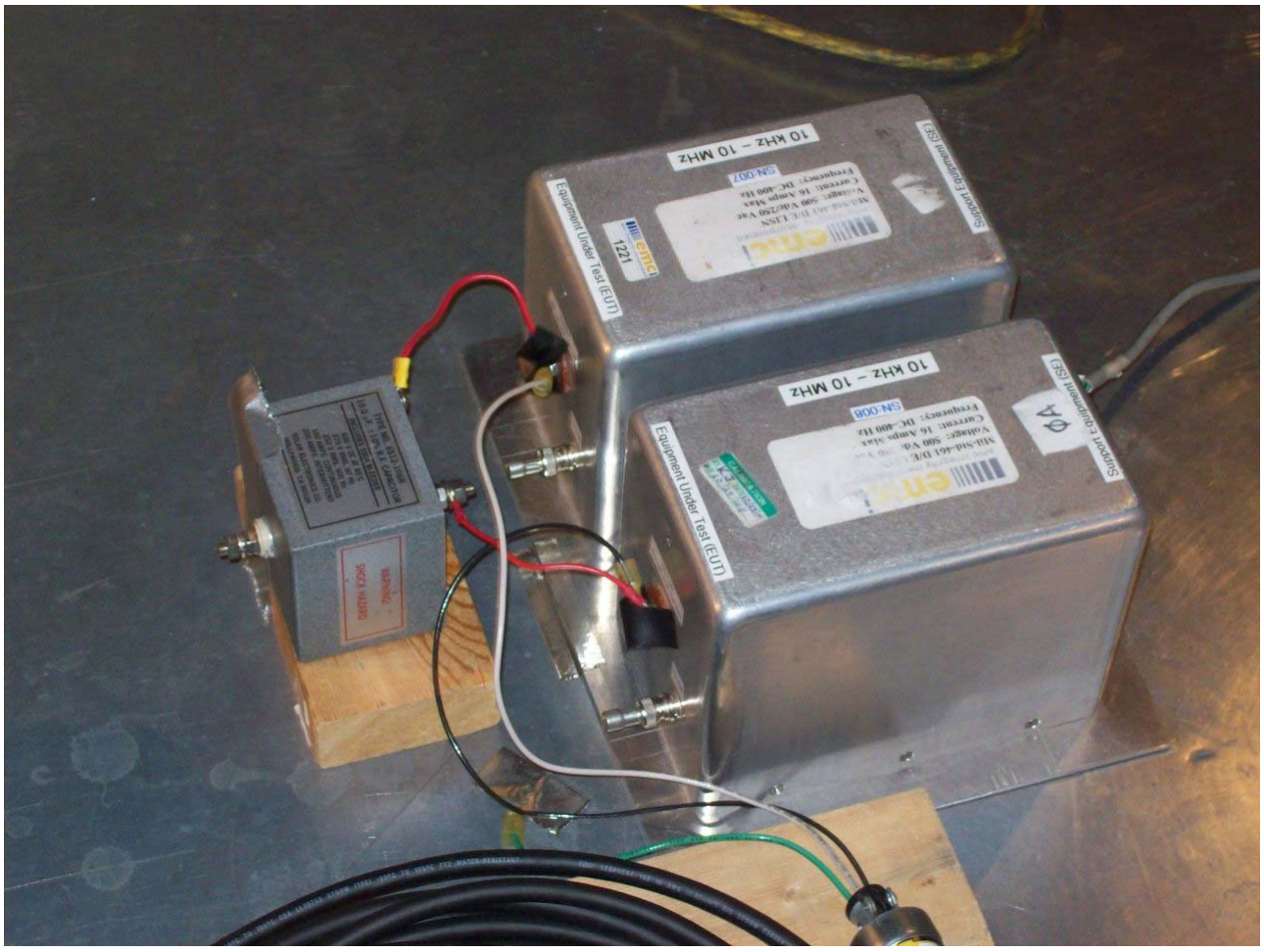

Figure A5. Close-up of LISNs and 10 uF Capacitor.

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Conducted Susceptibility, Method CS101

Manufacturer:	Radiometrics Corporation	Project Number:	B11003
Customer Representative:	Fred Solheim	Test Area:	Shield Room
Model:	MP-3000A	S/N:	3103B
Standard Referenced:	MIL-STD-461F	Date:	14 October 2011

B11003-CS101.doc FR0100

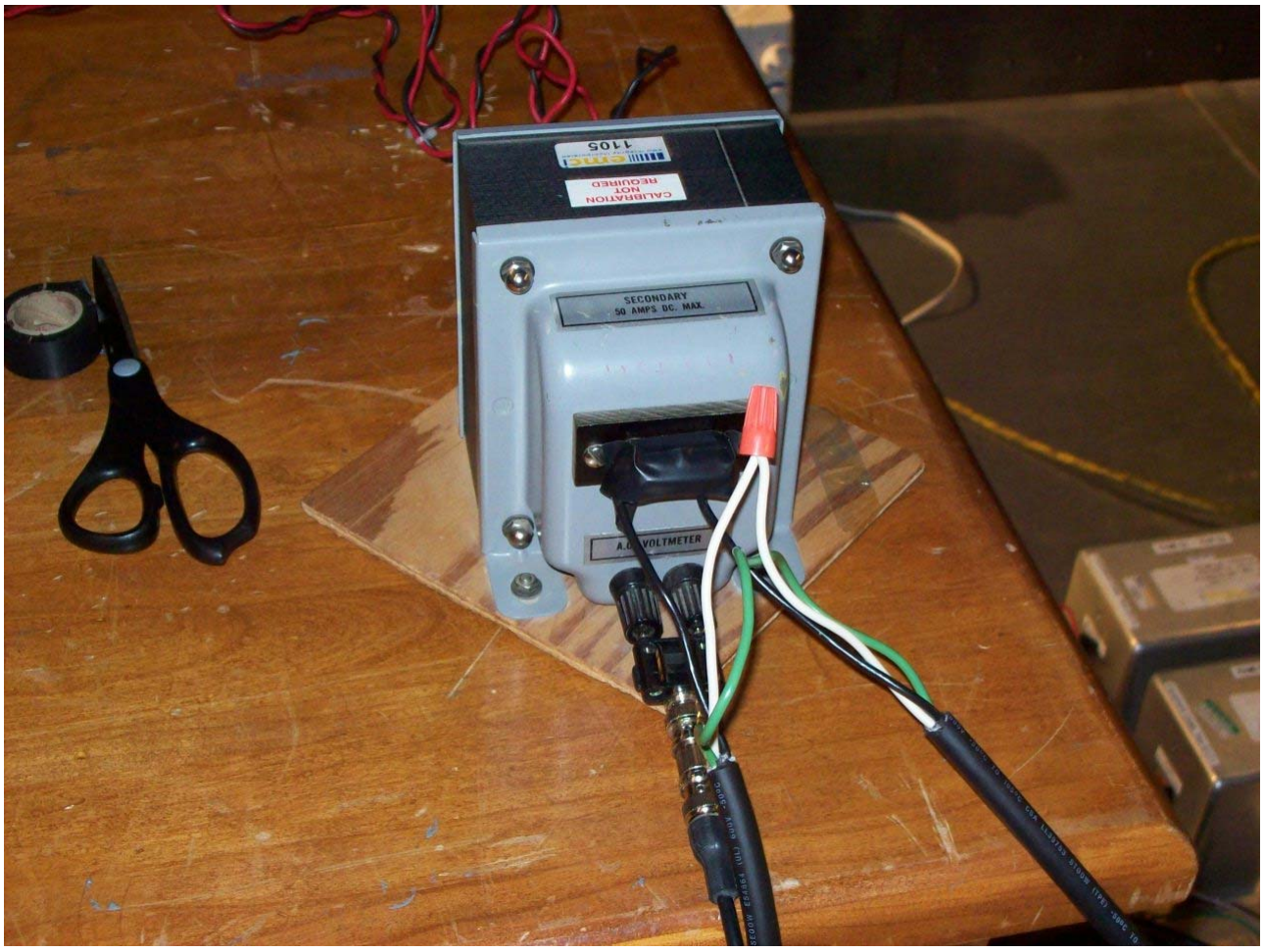

Figure A6. Close-up of Injection on Phase 1.

emc integrity incorporated

Conducted Susceptibility, Method CS101

Manufacturer:	Radiometrics Corporation	Project Number:	B11003
Customer Representative:	Fred Solheim	Test Area:	Shield Room
Model:	MP-3000A	S/N:	3103B
Standard Referenced:	MIL-STD-461F	Date:	14 October 2011

B11003-CS101.doc FR0100

Figure A7. Close-up of Injection on Phase 1.

emc integrity incorporated

Conducted Susceptibility, Method CS101

Manufacturer:	Radiometrics Corporation	Project Number:	B11003
Customer Representative:	Fred Solheim	Test Area:	Shield Room
Model:	MP-3000A	S/N:	3103B
Standard Referenced:	MIL-STD-461F	Date:	14 October 2011

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Test Equipment List

ID Number	Manufacturer	Model #	Serial #	Description	Cal Date	Cal Due
1060	Stanford Research Systems	DS345	28898	30 MHz Function Generator	01/21/2011	01/21/2012
1057	McIntosh	MC2200	AU2901	Audio Power Amplifier	NA	NA
1374	Tektronix	TDS 3052	B014699	500 MHz oscilloscope, 2-channel color digital phos	01/21/2011	01/21/2012
1105	Solar	6220-1A	EMCI 001	CS01 Audio Isolation Transformer	NA	NA
1221	EMCI	Mil-Std-461DE/LISN	007/008	LISN, Mil-Std-461 D&E, 500 VDC / 250 VAC, 16 Amps,	09/29/2010	10/29/2011
1364	Solar Electronics	6512-106R	9930	10.0uF, R.F. Capacitor	NA	NA
1104	Ray Proof	RF Shield Room	SL2384	Semi Anechoic Lined Chamber	NA	NA
1405	EXTECH Instruments	445715	N/A	Hygro-Thermometer	08/17/2011	08/17/2012
Note: Calibration on LISN extended by one month; LISN passed pre-test verification on CE102.						

Appendix B

Conducted Susceptibility (CS106) Test Data

emc integrity incorporated

Conducted Susceptibility, Method CS06

Manufacturer:	Radiometrics Corporation	Project Number:	B11003
Customer Representative:	Fred Solheim	Test Area:	Shield Room
Model:	MP-3000A	S/N:	3103B
Standard Referenced:	MIL-STD-461F	Date:	13 October 2011
Temperature:	23 ˚C Humidity: 30 %	Pressure:	837 mb
Input Voltage:	220 Vac/60 Hz		
Configuration of Unit:	Normal Operating Mode		
Test Engineer:	V. Greb		

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Spike Voltage	Polarity + / -	Pulses per Second	Line Sync (Y/N)	Phase Angle (deg)	Dwell Time (sec)	Comments	Pass / Fail
400	+	60	Yes	0	>300	Injection on Phase 1. 60 pps used because the "line sync" function on the CS106 generator was used. Dwelled at 0, 90, 180 and 270 degrees for one minute (each phase angle) and then rolled injection spike along AC waveform for one minute.	Pass
400	-	60	Yes	0	>300	Repeated for negative polarity	Pass
400	+	60	Yes	0	>300	Injection on Phase 2. 60 pps used because the "line sync" function on the CS106 generator was used. Dwelled at 0, 90, 180 and 270 degrees for one minute (each phase angle) and then rolled injection spike along AC waveform for one minute.	Pass
400	-	60	Yes	0	>300	Repeated for negative polarity	Pass

emc integrity incorporated

Conducted Susceptibility, Method CS06

Manufacturer:	Radiometrics Corporation	Project Number:	B11003
Customer Representative:	Fred Solheim	Test Area:	Shield Room
Model:	MP-3000A	S/N:	3103B
Standard Referenced:	MIL-STD-461F	Date:	13 October 2011

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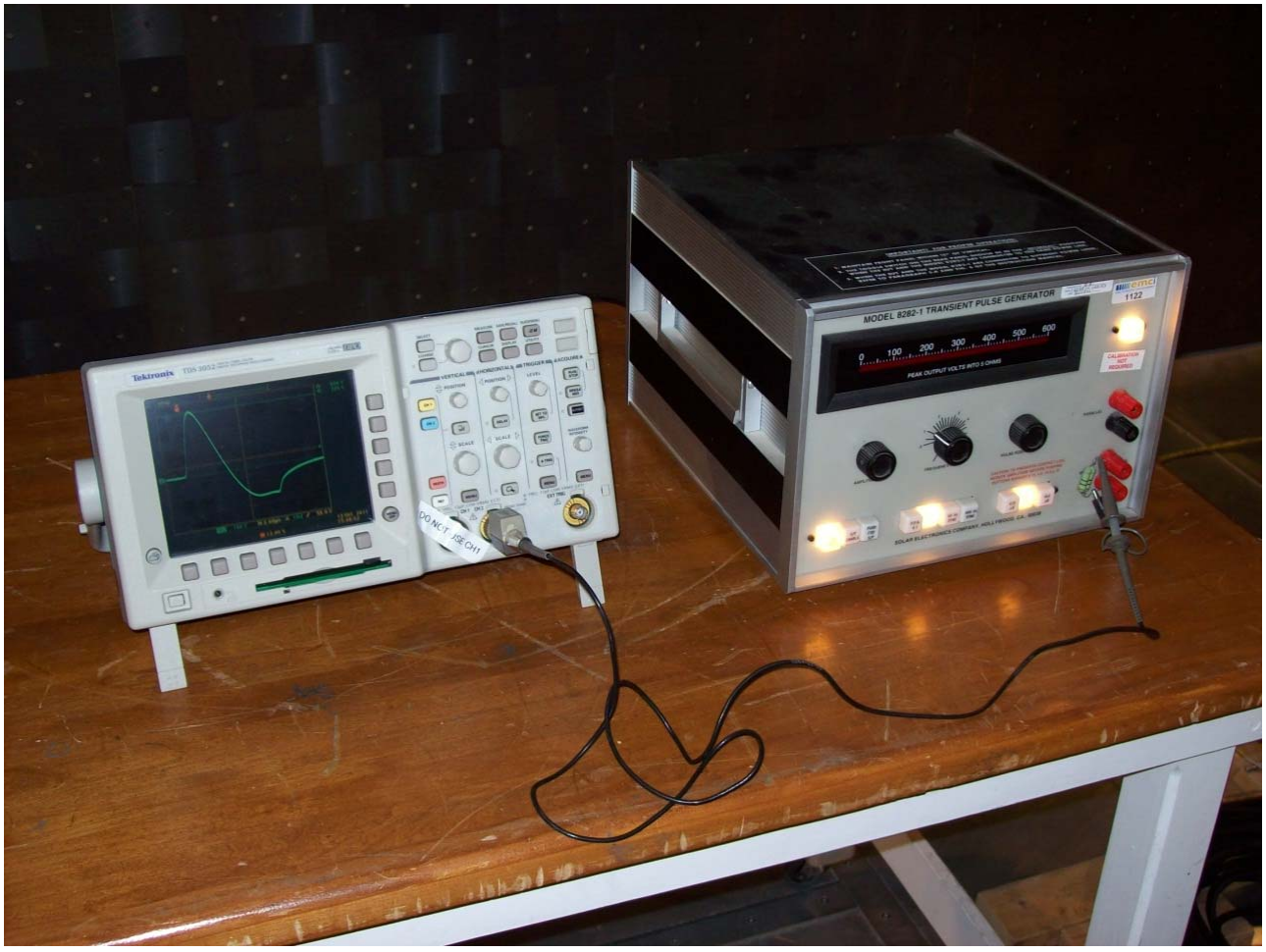

Figure B1. CS06 Pre-test Calibration into 5 Ohms.

emc integrity incorporated

Conducted Susceptibility, Method CS06

Manufacturer:	Radiometrics Corporation	Project Number:	B11003
Customer Representative:	Fred Solheim	Test Area:	Shield Room
Model:	MP-3000A	S/N:	3103B
Standard Referenced:	MIL-STD-461F	Date:	13 October 2011

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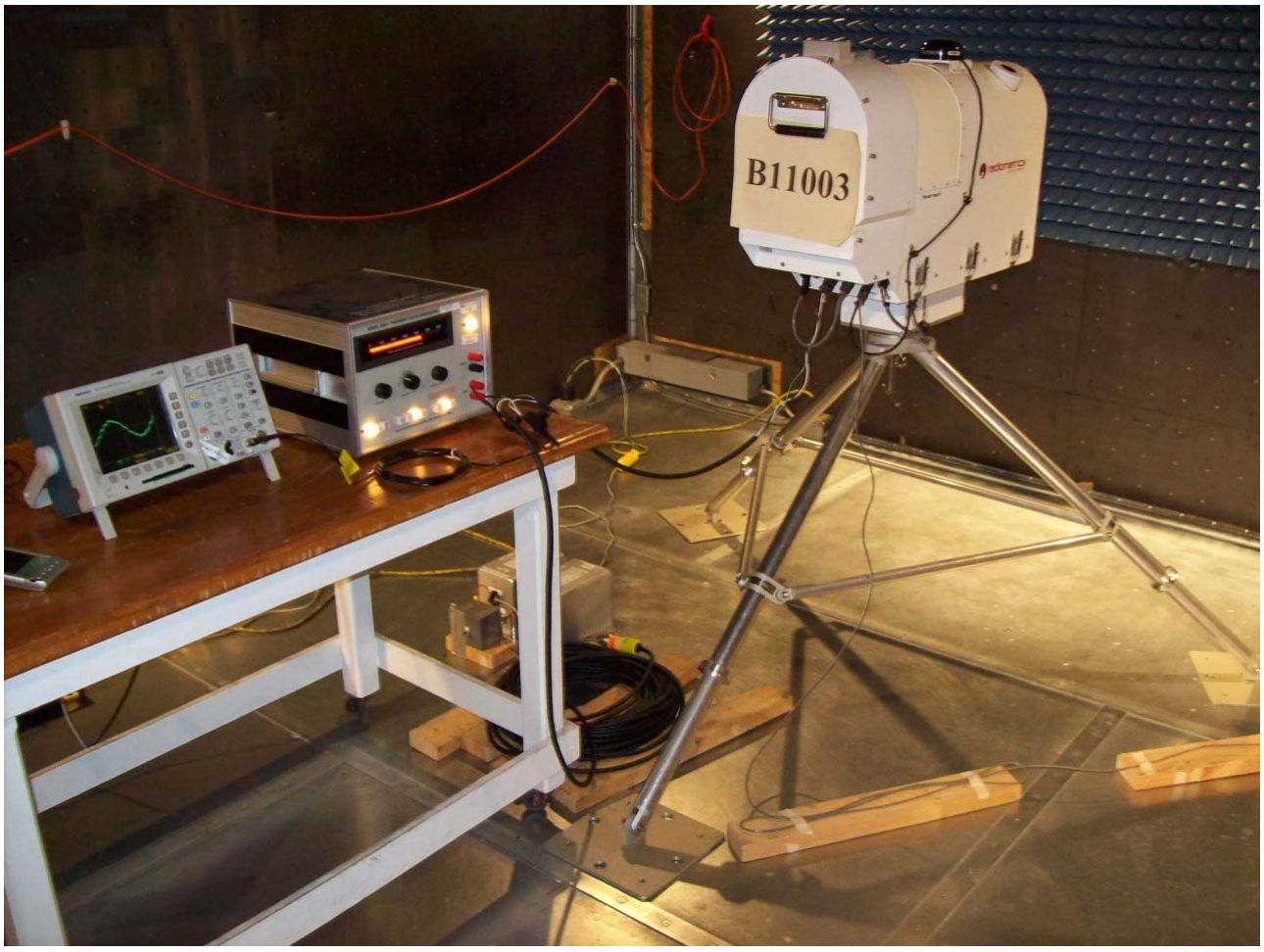

Figure B2. CS06 Test Setup.

emc integrity incorporated

Conducted Susceptibility, Method CS06

Manufacturer:	Radiometrics Corporation	Project Number:	B11003
Customer Representative:	Fred Solheim	Test Area:	Shield Room
Model:	MP-3000A	S/N:	3103B
Standard Referenced:	MIL-STD-461F	Date:	13 October 2011

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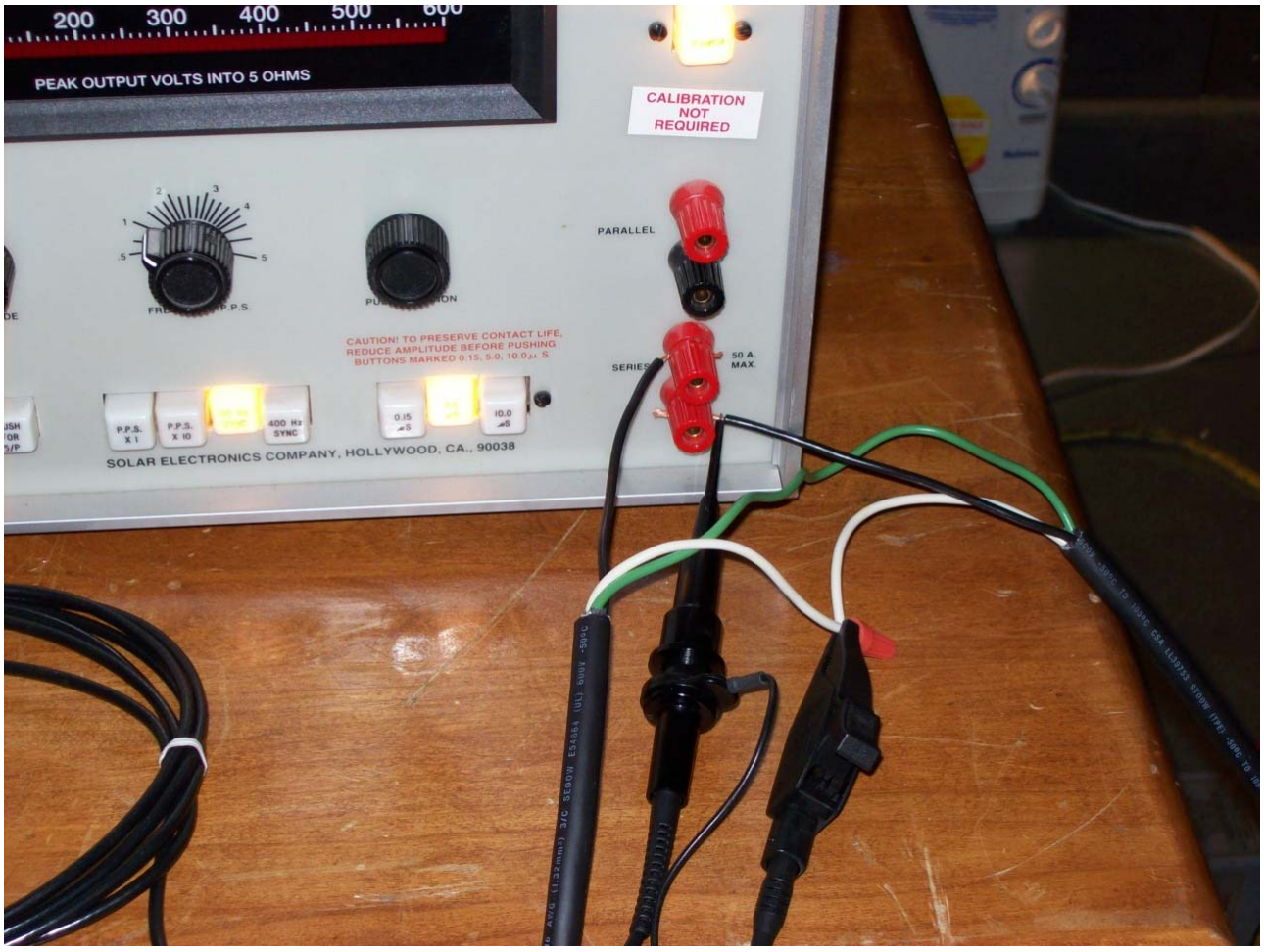

Figure B3. Close-up of Injection on Phase 1.

emc integrity incorporated

Conducted Susceptibility, Method CS06

Manufacturer:	Radiometrics Corporation	Project Number:	B11003
Customer Representative:	Fred Solheim	Test Area:	Shield Room
Model:	MP-3000A	S/N:	3103B
Standard Referenced:	MIL-STD-461F	Date:	13 October 2011

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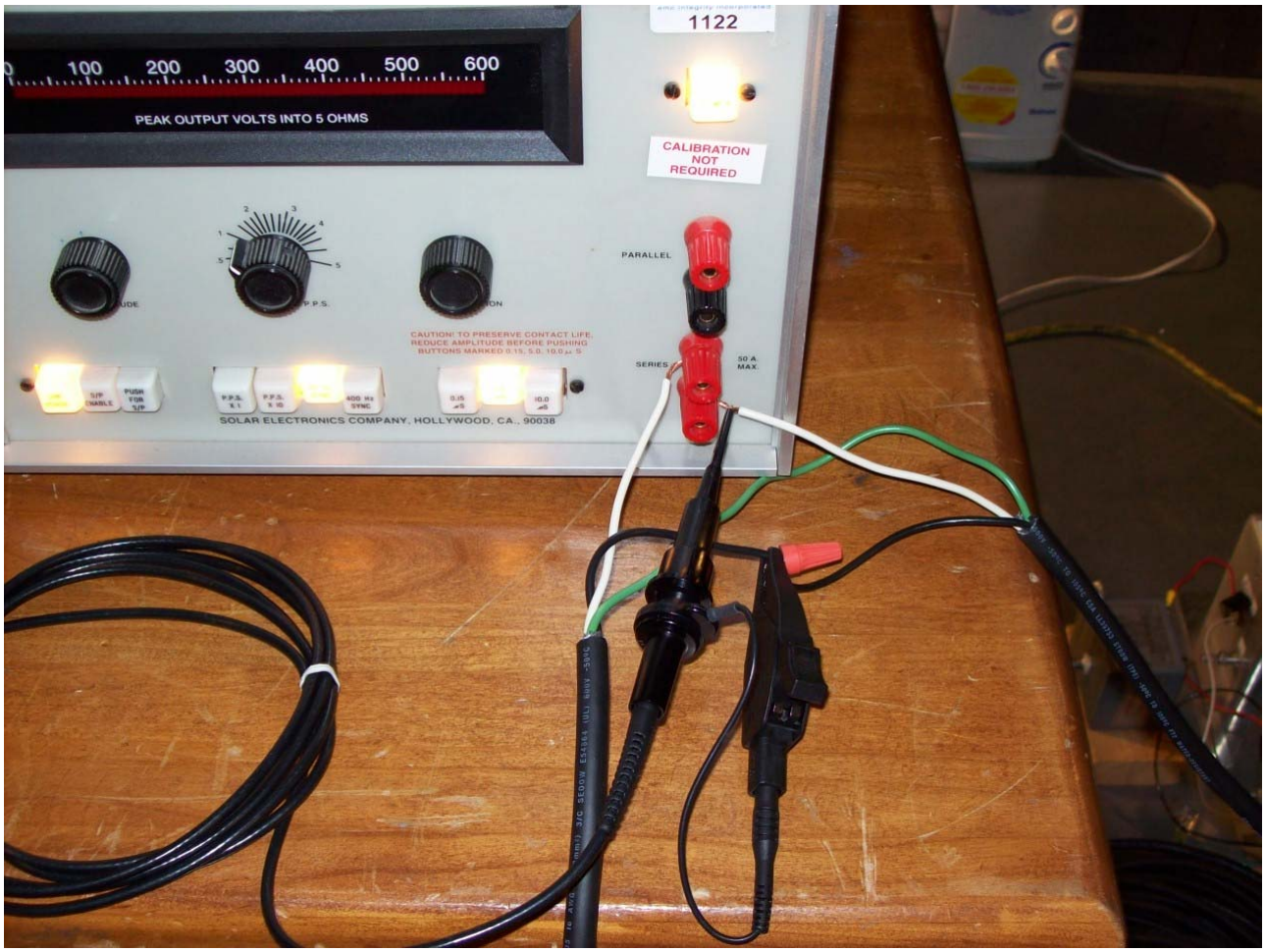

Figure B4. Close-up of Injection on Phase 2.

emc integrity incorporated

Conducted Susceptibility, Method CS06

Manufacturer:	Radiometrics Corporation	Project Number:	B11003
Customer Representative:	Fred Solheim	Test Area:	Shield Room
Model:	MP-3000A	S/N:	3103B
Standard Referenced:	MIL-STD-461F	Date:	13 October 2011

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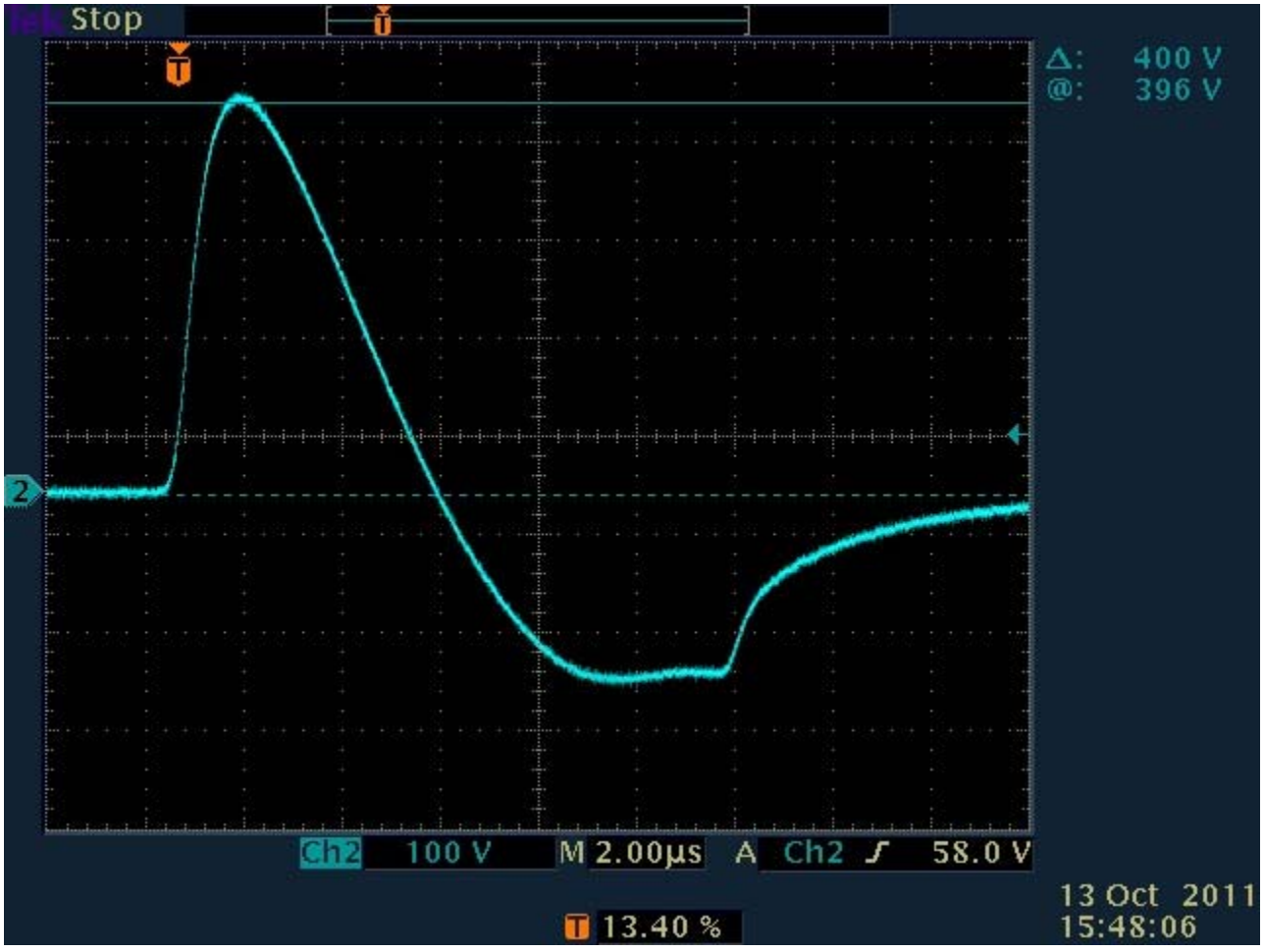

Figure B5. CS106 Calibration Waveform.

emc integrity incorporated

Conducted Susceptibility, Method CS06

Manufacturer:	Radiometrics Corporation	Project Number:	B11003
Customer Representative:	Fred Solheim	Test Area:	Shield Room
Model:	MP-3000A	S/N:	3103B
Standard Referenced:	MIL-STD-461F	Date:	13 October 2011

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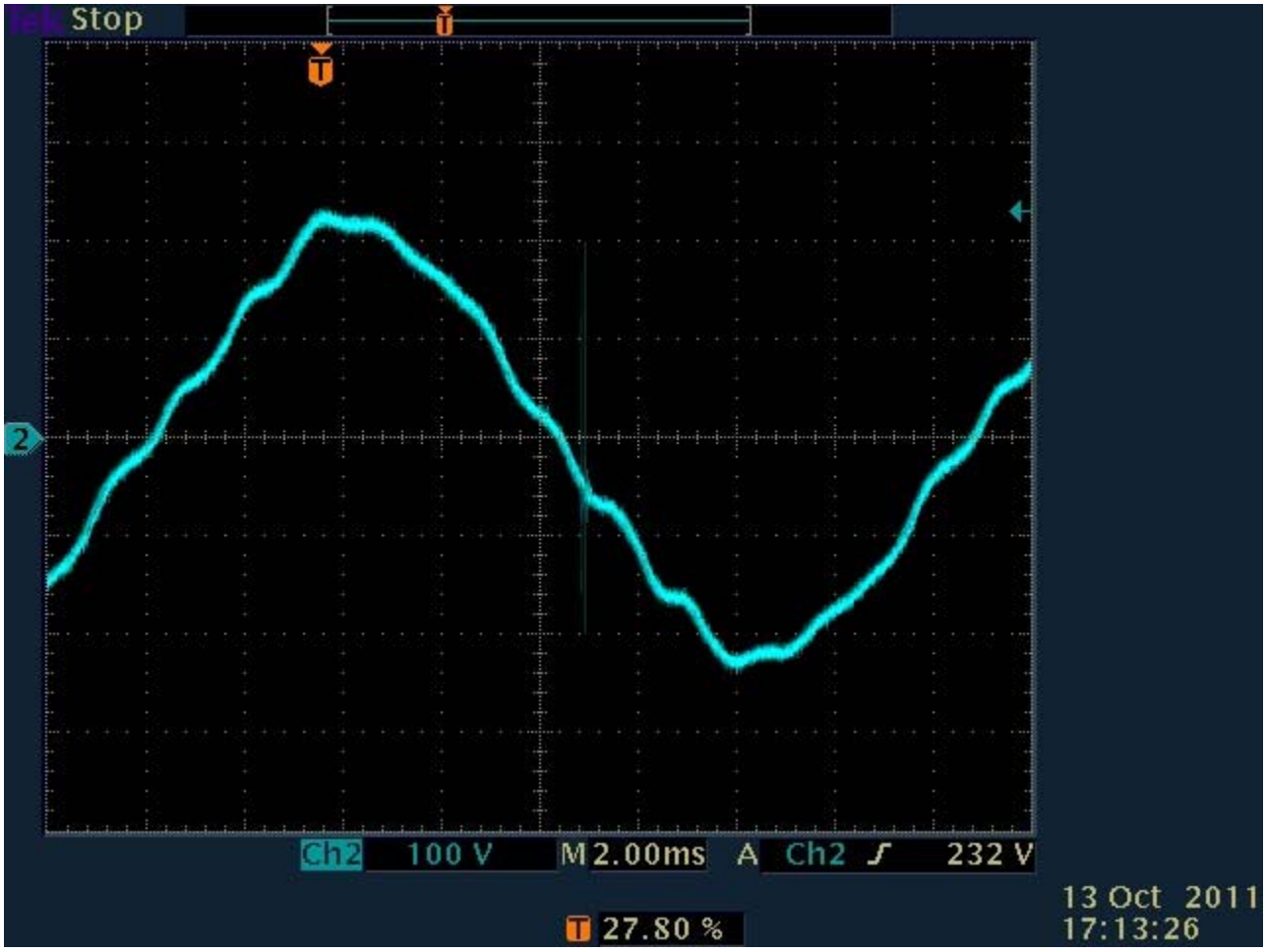

Figure B6. CS106 Injection on Phase 1.

emc integrity incorporated

Conducted Susceptibility, Method CS06

Manufacturer:	Radiometrics Corporation	Project Number:	B11003
Customer Representative:	Fred Solheim	Test Area:	Shield Room
Model:	MP-3000A	S/N:	3103B
Standard Referenced:	MIL-STD-461F	Date:	13 October 2011

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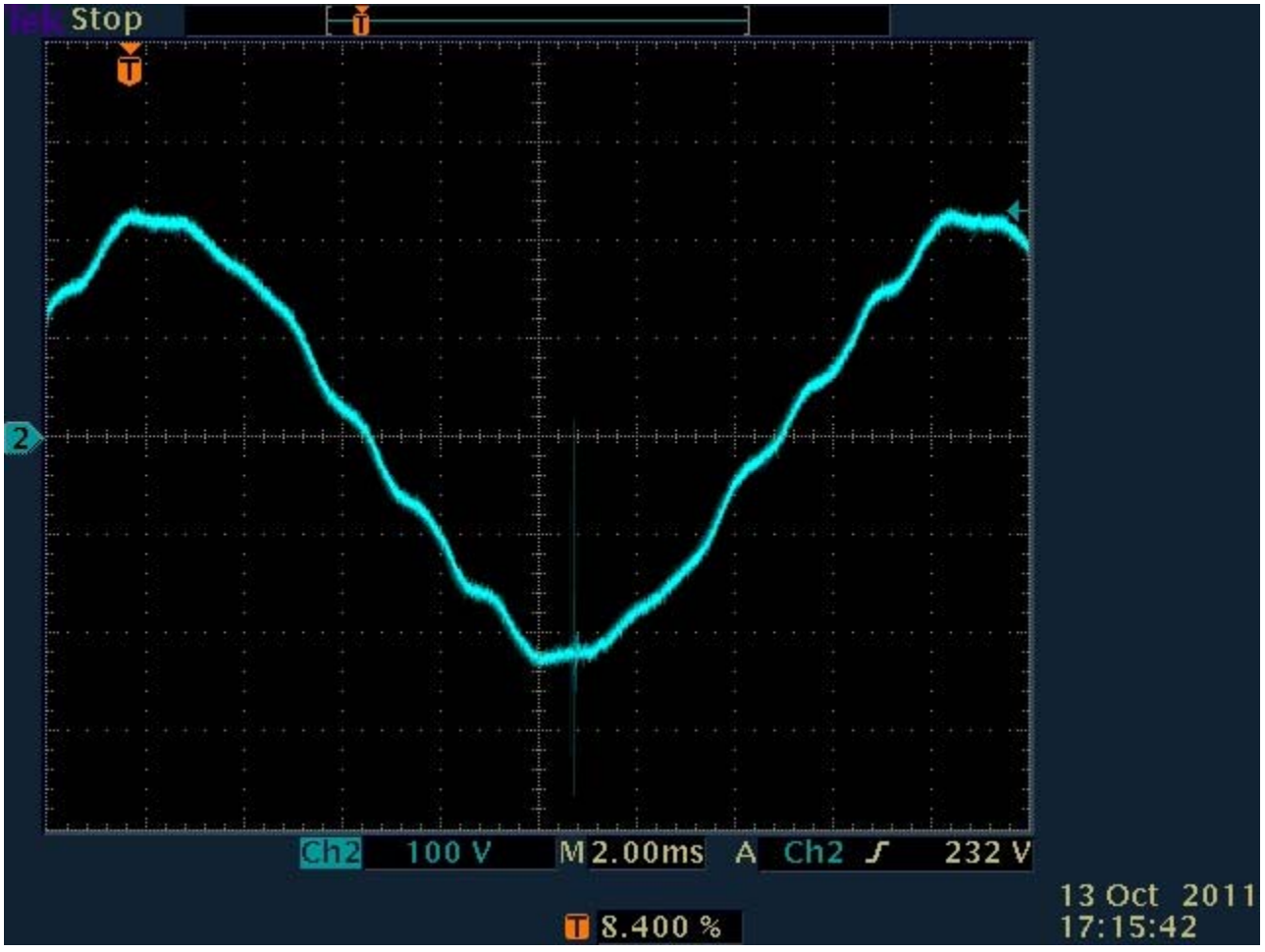

Figure B7. CS106 Injection on Phase 2.

emc integrity incorporated

Conducted Susceptibility, Method CS06

Manufacturer:	Radiometrics Corporation	Project Number:	B11003
Customer Representative:	Fred Solheim	Test Area:	Shield Room
Model:	MP-3000A	S/N:	3103B
Standard Referenced:	MIL-STD-461F	Date:	13 October 2011

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Test Equipment List

ID Number	Manufacturer	Model #	Serial #	Description	Cal Date	Cal Due
1122	Solar	8282-1	851051	Transient Pulse Generator	NA	NA
1374	Tektronix	TDS 3052	B014699	500 MHz oscilloscope, 2-channel color digital phos	01/21/2011	01/21/2012
1364	Solar Electronics	6512-106R	9930	10.0uF, R.F. Capacitor	NA	NA
1221	EMCI	Mil-Std-461DE/LISN	007/008	LISN, Mil-Std-461 D&E, 500 VDC / 250 VAC, 16 Amps,	09/29/2010	09/29/2011
1104	Ray Proof	RF Shield Room	SL2384	Semi Anechoic Lined Chamber	NA	NA
1405	EXTECH Instruments	445715	N/A	Hygro-Thermometer	08/17/2011	08/17/2012
Note: Calibration on LISN extended by one month; LISN passed pre-test verification on CE102.						

Appendix C

Conducted Susceptibility (CS114) Test Data

emc integrity incorporated

Conducted Susceptibility, Method CS114

Manufacturer:	Radiometrics Corporation	Project Number:	B11003
Customer Representative:	Fred Solheim	Test Area:	Shield Room
Model:	MP-3000A	S/N:	3103B
Standard Referenced:	MIL-STD-461F	Date:	13 October 2011
Temperature:	23 ˚C Humidity: 29 %	Pressure:	837 mb
Input Voltage:	220 Vac/60 Hz		
Configuration of Unit:	Normal Operating Mode		
Test Engineer:	V. Greb		

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Frequency (MHz)	Modulation			Current (dBuA)	Step Size (%)	Dwell Time (sec)	Comments	Pass / Fail
	Type	%	Freq					
							Performed pre-test verification into 50 ohm calibration fixture. (See table below.)	
.01-1	AM	99.9	1kHz	See Curve #3	5	3	Injection on power lead – common mode (power leads and ground wire)	Pass
1 - 30	AM	99.9	1kHz	See Curve #3	1	3		Pass
30 - 200	AM	99.9	1kHz	See Curve #3	0.5	3	No upsets or malfunctions at any time.	Pass
.01-1	AM	99.9	1kHz	See Curve #3	5	3	Injection on RS422 serial interface	Pass
1 - 30	AM	99.9	1kHz	See Curve #3	1	3		Pass
30 - 200	AM	99.9	1kHz	See Curve #3	0.5	3	No upsets or malfunctions at any time.	Pass
.01-1	AM	99.9	1kHz	See Curve #3	5	3	Injection on power lead – power only (ground wire excluded)	Pass
1 - 30	AM	99.9	1kHz	See Curve #3	1	3		Pass
30 - 200	AM	99.9	1kHz	See Curve #3	0.5	3	No upsets or malfunctions at any time.	Pass

emc integrity incorporated

Conducted Susceptibility, Method CS114

Manufacturer:	Radiometrics Corporation	Project Number:	B11003
Customer Representative:	Fred Solheim	Test Area:	Shield Room
Model:	MP-3000A	S/N:	3103B
Standard Referenced:	MIL-STD-461F	Date:	13 October 2011
Temperature:	23 ˚C Humidity: 29 %	Pressure:	837 mb
Input Voltage:	220 Vac/60 Hz		
Configuration of Unit:	Normal Operating Mode		
Test Engineer:	V. Greb		

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Frequency (MHz)	Modulation Type	Modulation %	Modulation Freq	Current (dBuA)	Step Size (%)	Dwell Time (sec)	Comments	Pass / Fail

Frequency (MHz)	Level (dBuA)	Voltage (dBuV)	S.G. Out (dBm)	Raw Fwd Power (dBm)	Corrected Fwd Power (dBm)
0.01	49	83	-27	-12	28
0.03	59	93	-34	-18	22
0.05	64	98	-36	-20	20
0.1	69	103	-38	-22	18
0.3	79	113	-38	-21	19
0.5	84	118	-36	-17	23
1	89	123	-33	-13	27
3	89	123	-33	-13	27
5	89	123	-32	-13	27
10	89	123	-32	-13	27
20	89	123	-34	-12	28
30	89	123	-33	-12	28
50	87	121	-35	-16	24
100	85	119	-35	-19	21
200	81	115	-39	-22	18

emc integrity incorporated

Conducted Susceptibility, Method CS114

Manufacturer:	Radiometrics Corporation	Project Number:	B11003
Customer Representative:	Fred Solheim	Test Area:	Shield Room
Model:	MP-3000A	S/N:	3103B
Standard Referenced:	MIL-STD-461F	Date:	13 October 2011

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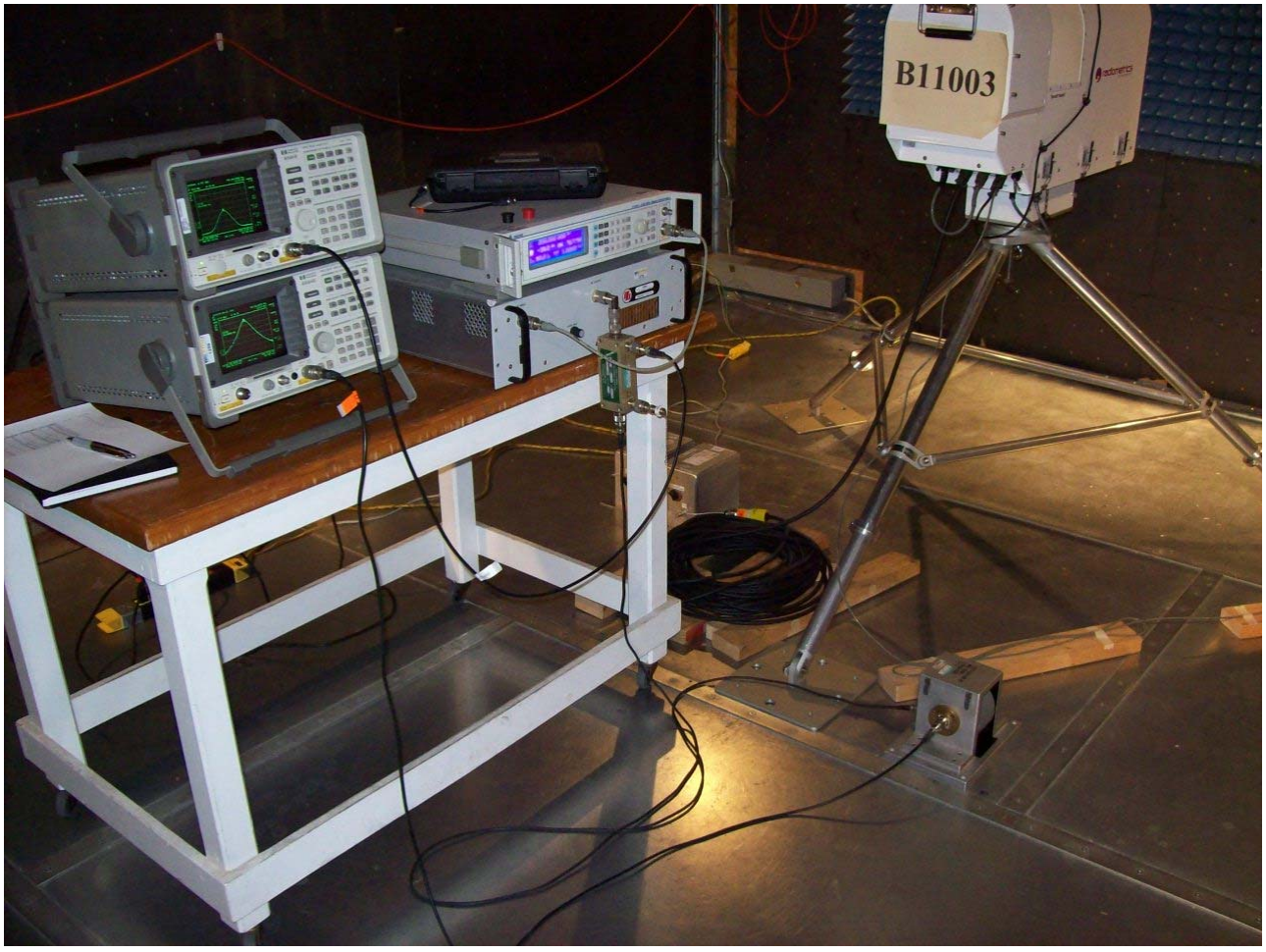

Figure C1. CS114 Pre-test Calibration.

emc integrity incorporated

Conducted Susceptibility, Method CS114

Manufacturer:	Radiometrics Corporation	Project Number:	B11003
Customer Representative:	Fred Solheim	Test Area:	Shield Room
Model:	MP-3000A	S/N:	3103B
Standard Referenced:	MIL-STD-461F	Date:	13 October 2011

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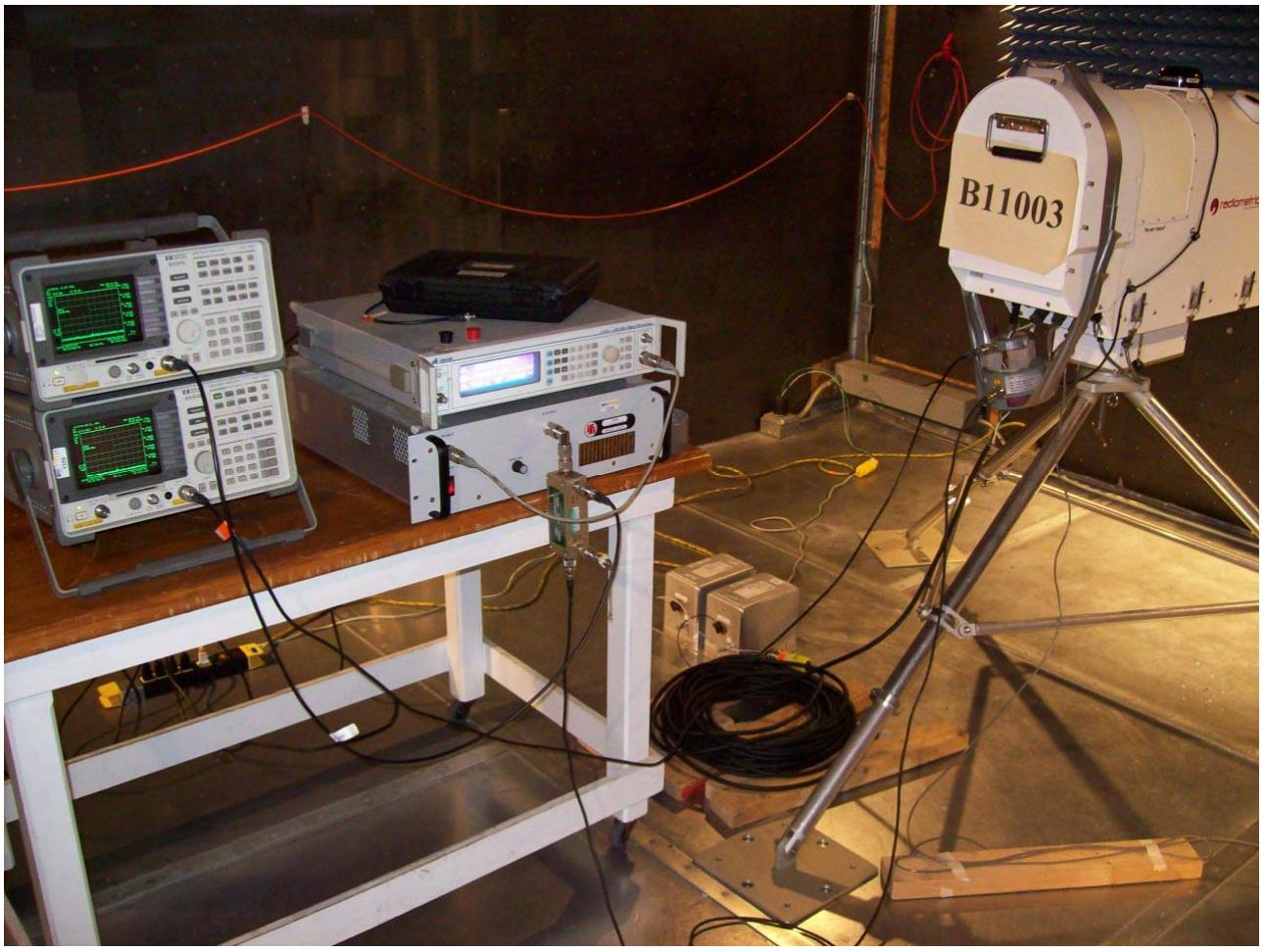

Figure C2. CS114 Test Setup.

emc integrity incorporated

Conducted Susceptibility, Method CS114

Manufacturer:	Radiometrics Corporation	Project Number:	B11003
Customer Representative:	Fred Solheim	Test Area:	Shield Room
Model:	MP-3000A	S/N:	3103B
Standard Referenced:	MIL-STD-461F	Date:	13 October 2011

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Figure C3. Closeup of Common Mode Injection on Power Line.

emc integrity incorporated

Conducted Susceptibility, Method CS114

Manufacturer:	Radiometrics Corporation	Project Number:	B11003
Customer Representative:	Fred Solheim	Test Area:	Shield Room
Model:	MP-3000A	S/N:	3103B
Standard Referenced:	MIL-STD-461F	Date:	13 October 2011

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Figure C4. Closeup of Injection on RS422 I/O Cable.

emc integrity incorporated

Conducted Susceptibility, Method CS114

Manufacturer:	Radiometrics Corporation	Project Number:	B11003
Customer Representative:	Fred Solheim	Test Area:	Shield Room
Model:	MP-3000A	S/N:	3103B
Standard Referenced:	MIL-STD-461F	Date:	13 October 2011

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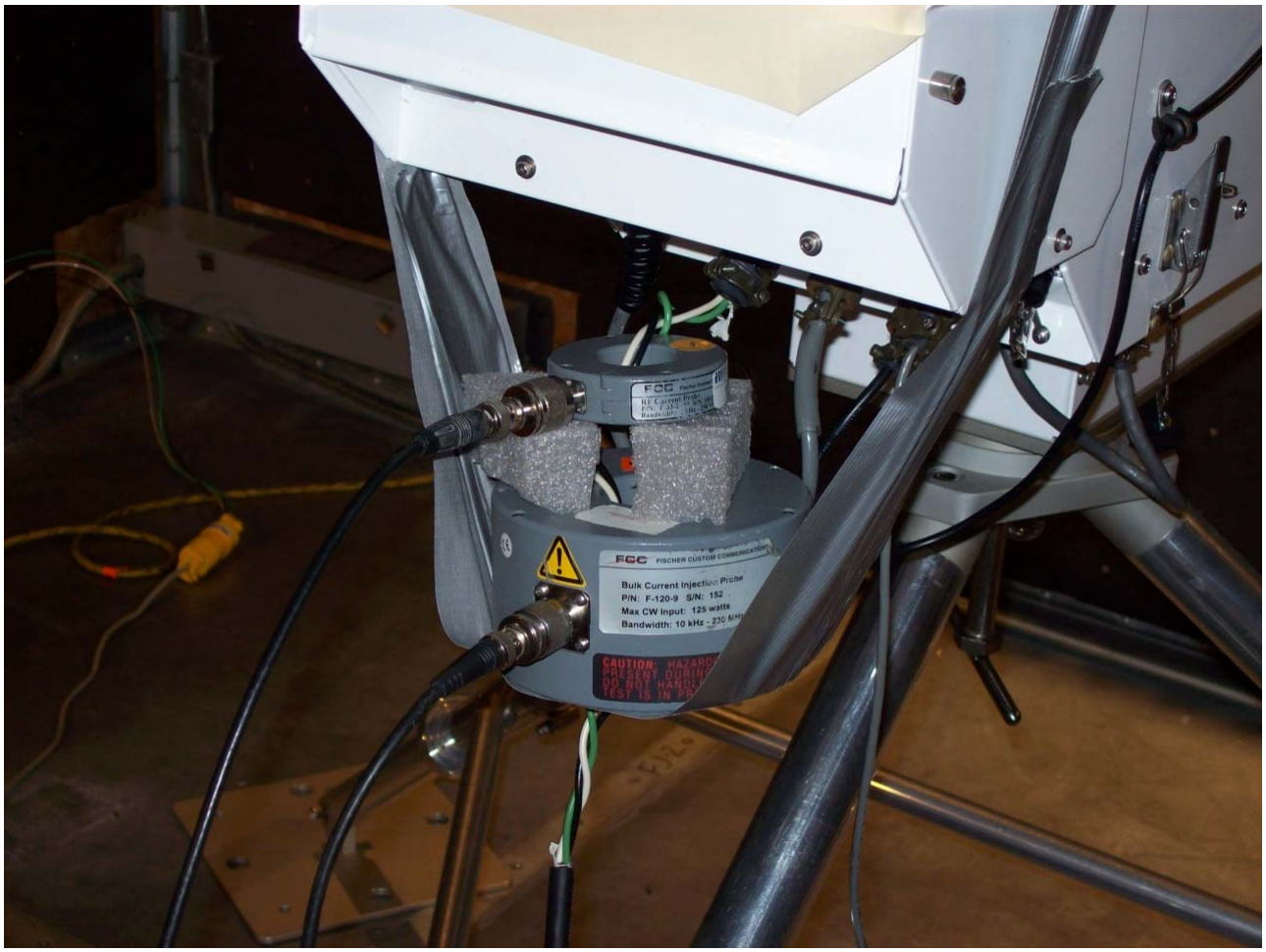

Figure C5. Closeup of Injection on Power Line – Hot Leads Only.

emc integrity incorporated

Conducted Susceptibility, Method CS114

Manufacturer:	Radiometrics Corporation	Project Number:	B11003
Customer Representative:	Fred Solheim	Test Area:	Shield Room
Model:	MP-3000A	S/N:	3103B
Standard Referenced:	MIL-STD-461F	Date:	13 October 2011

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Test Equipment List

ID Number	Manufacturer	Model #	Serial #	Description	Cal Date	Cal Due
1054	IFR	2023B	202302/817	Signal Generator (9 kHz - 2 GHz)	10/27/2010	10/27/2011
1379	IFI	M100	O1200-0111	100W Power Amplifier, 0.01 MHz to 220 MHz	NA	NA
1138	Werlatone	C2630	5519	Directional Coupler, 10 kHz to 1 GHz, 40 dB		
1035	Fischer Custom	F-120-9	152	Current Injection Probe (10 kHz - 230 MHz)	03/25/2011	03/25/2012
1048	Hewlett Packard	8591E	3916A07553	Spectrum Analyzer, 9 kHz - 1.8 GHz	01/21/2011	01/21/2012
1259	Hewlett Packard	8594E	3440A01325	Spectrum Analyzer with Tracking Generator, 9kHz to	08/15/2011	08/15/2012
1081	Fischer Custom	FCC-BCICF-1	77	Cal. Fixture	09/08/2011	09/08/2012
1349	Fischer Custom Communications, Inc.	F-33-2 Current Probe	100222	RF Current Probe	03/06/2011	03/06/2012
1104	Ray Proof	RF Shield Room	SL2384	Semi Anechoic Lined Chamber	NA	NA
1405	EXTECH Instruments	445715	N/A	Hygro-Thermometer	08/17/2011	08/17/2012
1221	EMCI	Mil-Std-461DE/LISN	007/008	LISN, Mil-Std-461 D&E, 500 VDC / 250 VAC, 16 Amps,	09/29/2010	10/29/2011
Note: Calibration on LISN extended by one month since LISN passed pre-test verification on CE102.						

Appendix D

Radiated E-field Susceptibility (RS103) Test Data

emc integrity incorporated

Radiated Electric Field Susceptibility, Method RS103

Manufacturer:	Radiometrics Corporation	Project Number:	B11003
Customer Representative:	Fred Solheim	Test Area:	Shield Room
Model:	MP-3000A	S/N:	3103B
Standard Referenced:	MIL-STD-461F	Date:	14 October 2011
Temperature:	23˚C Humidity: 32 %	Pressure:	837 mb
Input Voltage:	220 Vac/60 Hz		
Configuration of Unit:	Normal Operating Mode		
Test Engineer:	V. Greb		

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Frequency (MHz)	Modulation			Field (V/m)	Polarity (V or H)	Step Size (%)	Dwell Time (sec)	Comments	Pass / Fail
	Type	%	Freq						
2 - 30	AM	99.9	1kHz	10	V	1	3	Parallel element antenna	Pass
30 - 200	AM	99.9	1kHz	10	V	0.5	3	Biconical antenna	Pass
30 - 200	AM	99.9	1kHz	10	H	0.5	3		Pass
200-1000	AM	99.9	1kHz	10	V	0.5	3	Large horn antenna	Pass
200-1000	AM	99.9	1kHz	10	H	0.5	3		Pass
1G-2.3G	PM	50	1kHz	50	V	0.1	3	Octave horn antenna	Pass
1G-2.3G	PM	50	1kHz	50	H	0.1	3		Pass
2.3G–4.2G	PM	50	1kHz	50	V	0.1	3	Octave horn antenna	Pass
2.3G–4.2G	PM	50	1kHz	50	H	0.1	3		Pass
4.2G – 8G	PM	50	1kHz	50	V	0.1	3	Broadband horn antenna	Pass
4.2G – 8G	PM	50	1kHz	50	H	0.1	3		Pass
8G – 18G	PM	50	1kHz	50	V	0.1	3		Pass
8G – 18G	PM	50	1kHz	50	H	0.1	3		Pass
Saw minor anomalies in the 1-4 GHz range, but everything well within tolerance. All pass.									

emc integrity incorporated

Radiated Electric Field Susceptibility, Method RS103

Manufacturer:	Radiometrics Corporation	Project Number:	B11003
Customer Representative:	Fred Solheim	Test Area:	Shield Room
Model:	MP-3000A	S/N:	3103B
Standard Referenced:	MIL-STD-461F	Date:	14 October 2011

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Figure D1. RS103 Test Setup, 2 to 30 MHz.

emc integrity incorporated

Radiated Electric Field Susceptibility, Method RS103

Manufacturer:	Radiometrics Corporation	Project Number:	B11003
Customer Representative:	Fred Solheim	Test Area:	Shield Room
Model:	MP-3000A	S/N:	3103B
Standard Referenced:	MIL-STD-461F	Date:	14 October 2011

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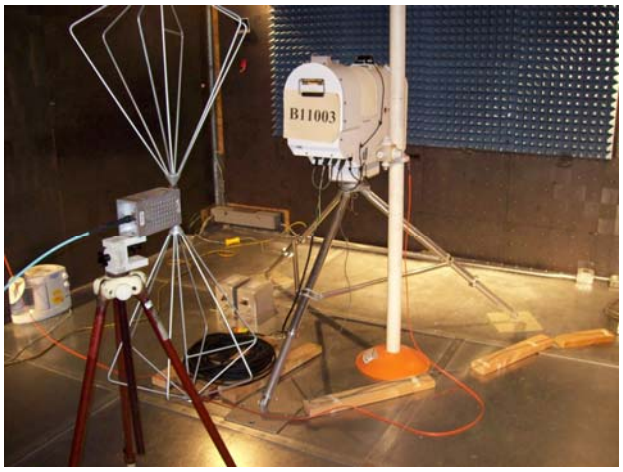

Figure D2. RS103, 30 to 200 MHz, V-pole.

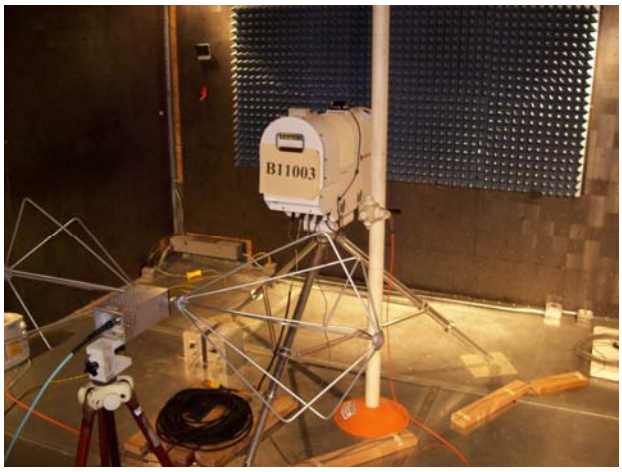

Figure D3. RS103, 30 to 200 MHz, H-pole.

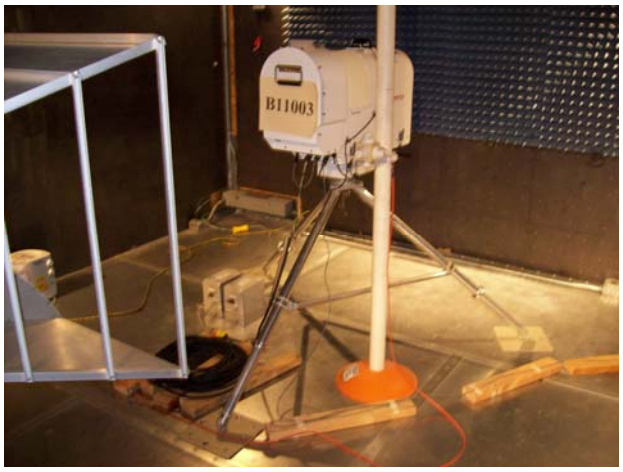

Figure D4. RS103, 0.2 to 1.0 GHz, V-pole.

Figure D5. RS103, 0.2 to 1.0 GHz, H-pole.

emc integrity incorporated

Radiated Electric Field Susceptibility, Method RS103

Manufacturer:	Radiometrics Corporation	Project Number:	B11003
Customer Representative:	Fred Solheim	Test Area:	Shield Room
Model:	MP-3000A	S/N:	3103B
Standard Referenced:	MIL-STD-461F	Date:	14 October 2011

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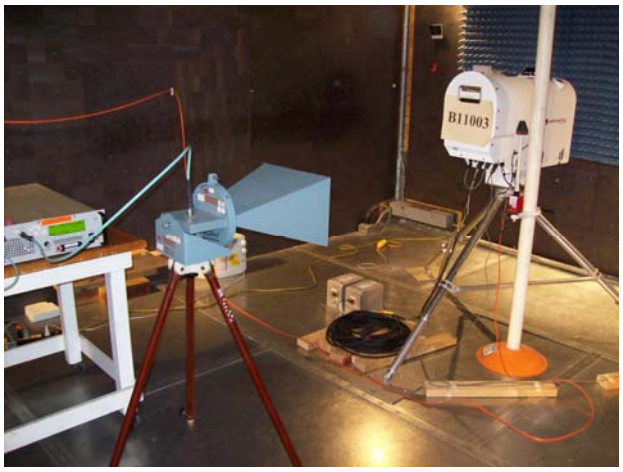

Figure D6. RS103, 1.0 to 4.2 GHz, V-pole.

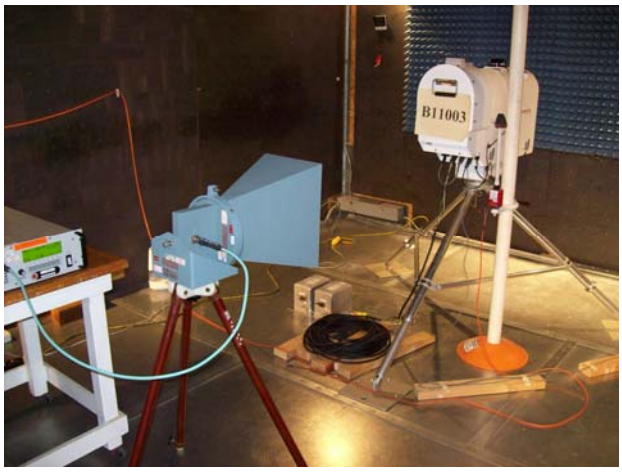

Figure D7. RS103, 1.0 to 4.2 GHz, H-pole.

emc integrity incorporated

Radiated Electric Field Susceptibility, Method RS103

Manufacturer:	Radiometrics Corporation	Project Number:	B11003
Customer Representative:	Fred Solheim	Test Area:	Shield Room
Model:	MP-3000A	S/N:	3103B
Standard Referenced:	MIL-STD-461F	Date:	14 October 2011

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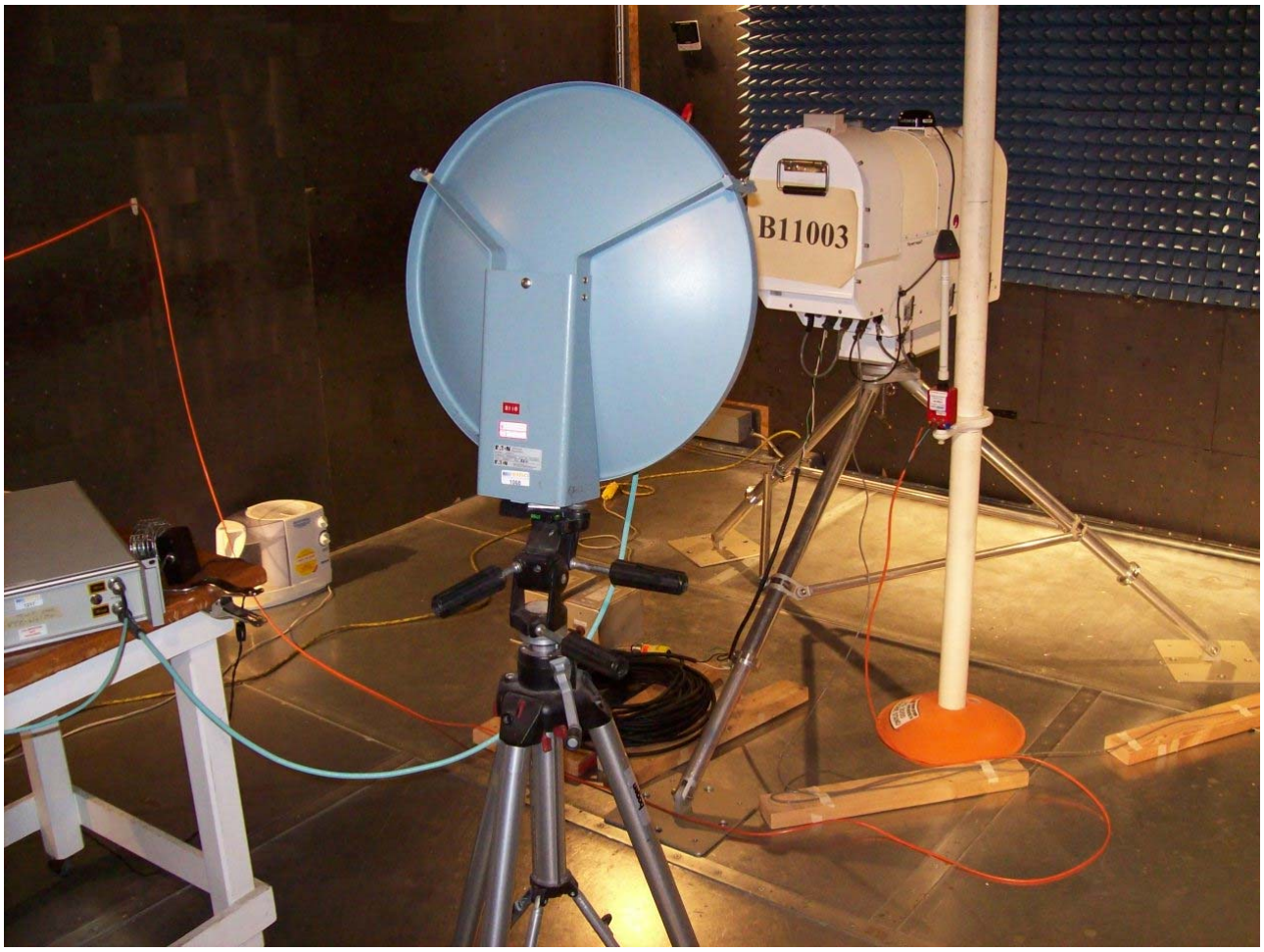

Figure D8, RS103, 4.2 to 8.0 GHz, V and H-poles.

emc integrity incorporated

Radiated Electric Field Susceptibility, Method RS103

Manufacturer:	Radiometrics Corporation	Project Number:	B11003
Customer Representative:	Fred Solheim	Test Area:	Shield Room
Model:	MP-3000A	S/N:	3103B
Standard Referenced:	MIL-STD-461F	Date:	14 October 2011

B11003-RS103.doc FR0100

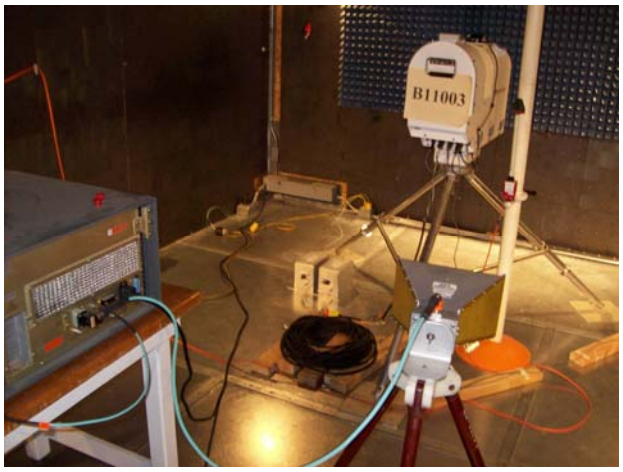

Figure D9. RS103, 8.0 to 18 GHz, V-pole.

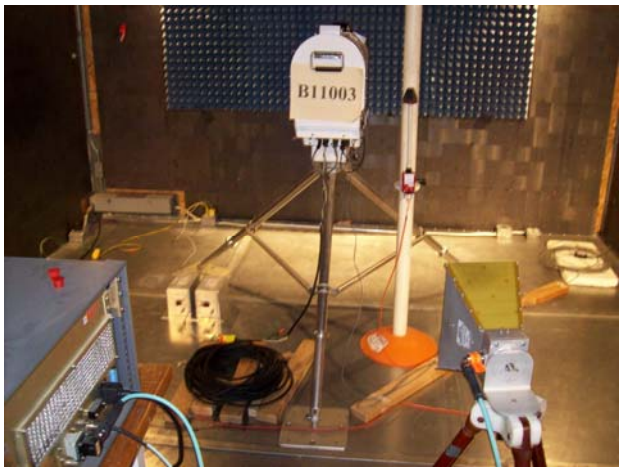

Figure D10. RS103, 8.0 to 18 GHz, H-pole.

emc integrity incorporated

Radiated Electric Field Susceptibility, Method RS103

Manufacturer:	Radiometrics Corporation	Project Number:	B11003
Customer Representative:	Fred Solheim	Test Area:	Shield Room
Model:	MP-3000A	S/N:	3103B
Standard Referenced:	MIL-STD-461F	Date:	14 October 2011

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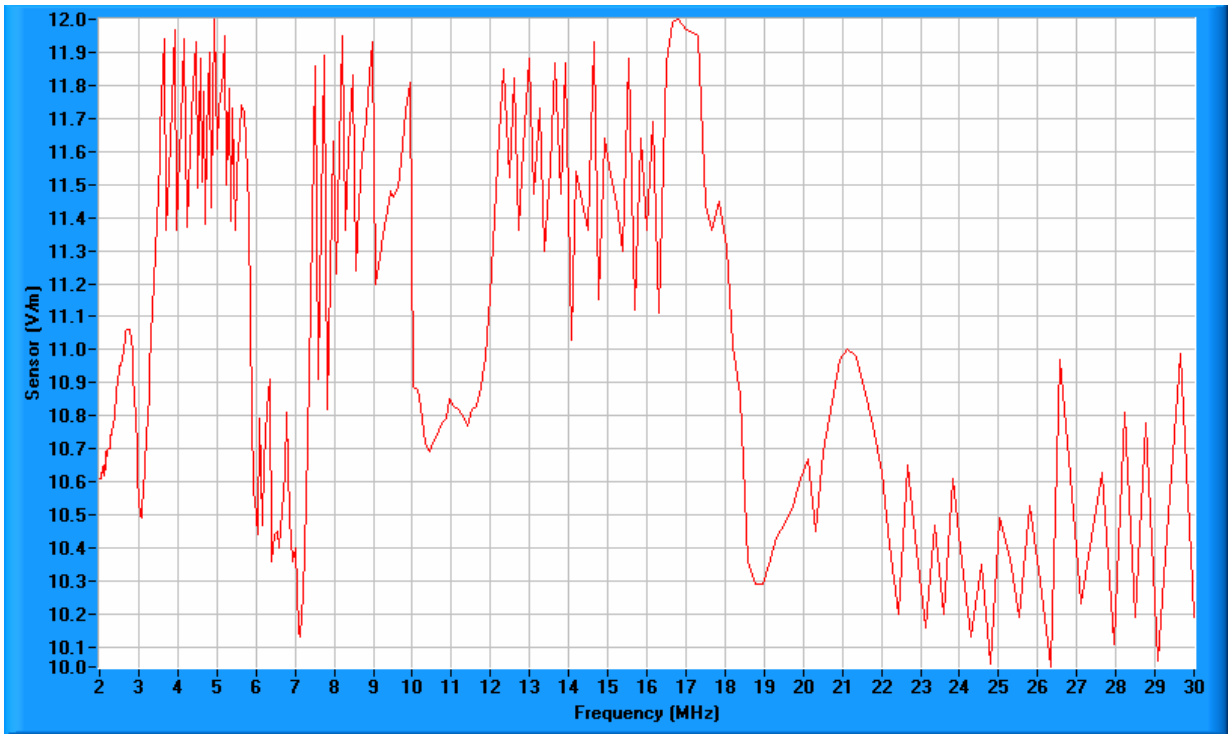
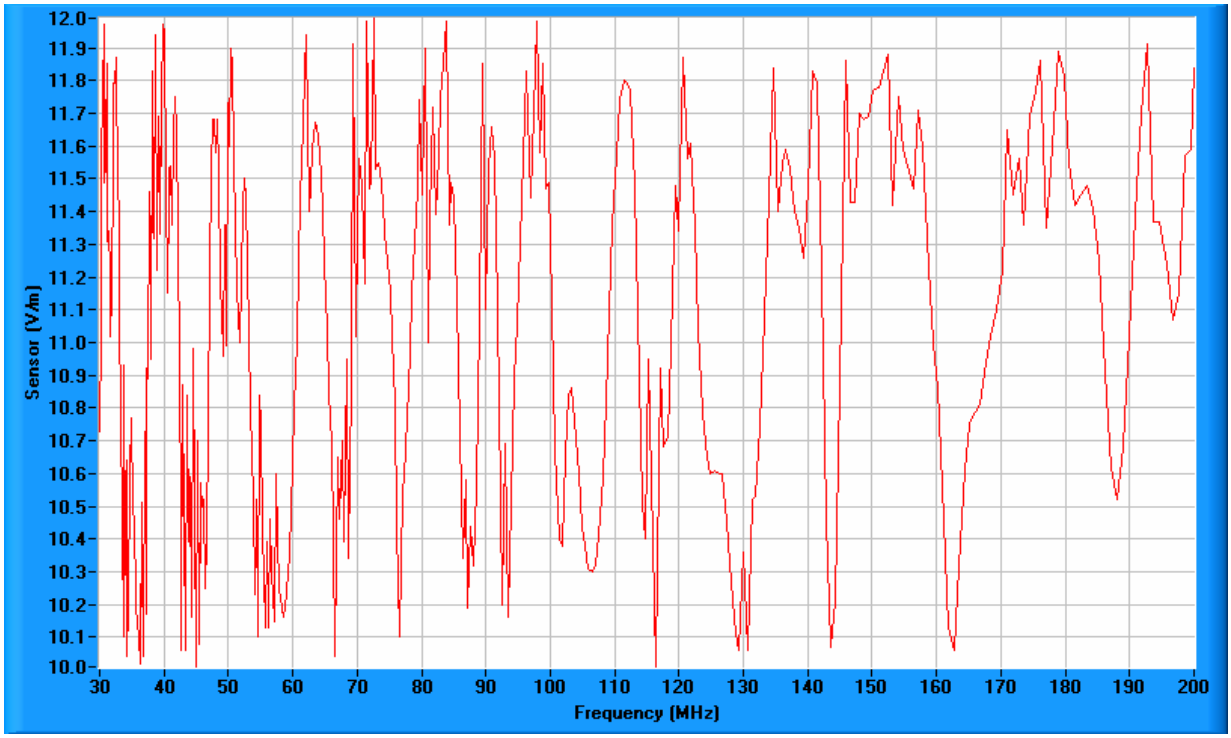
Test Equipment List

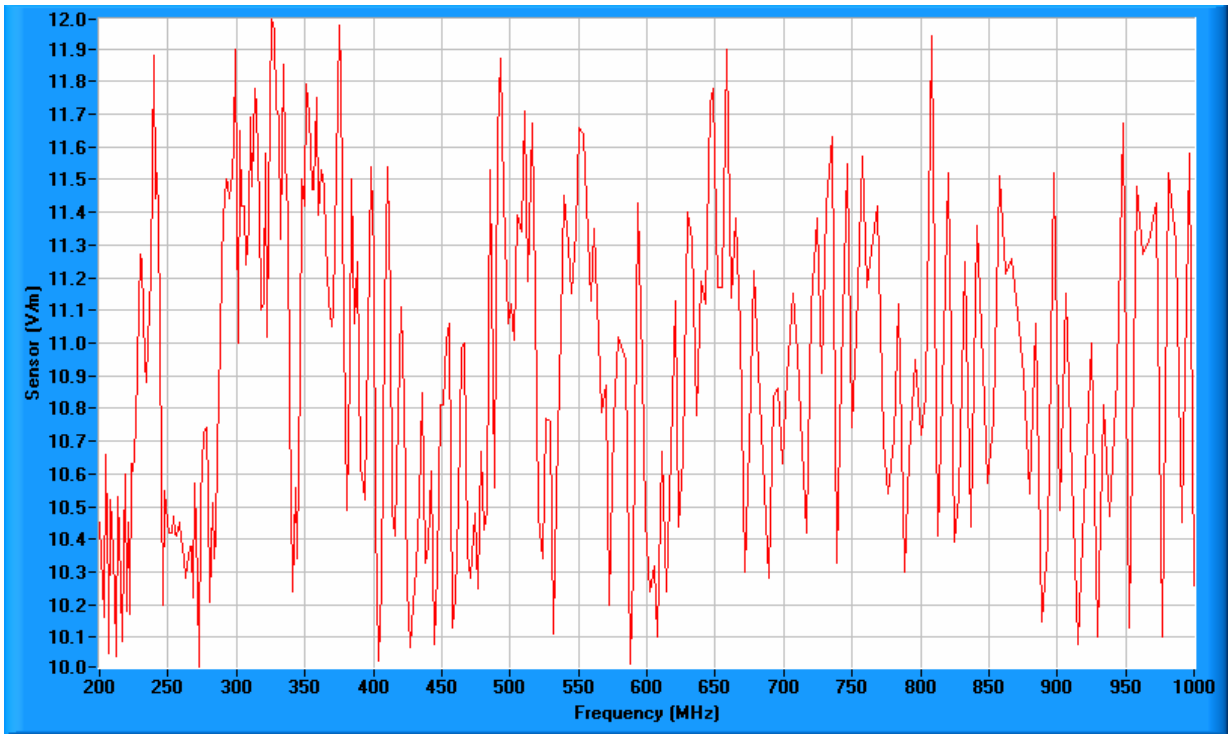
ID Number	Manufacturer	Model #	Serial #	Description	Cal Date	Cal Due
1055	Marconi	2024	112113/027	Signal Generator (9 kHz - 2.4 GHz)	05/10/2011	05/10/2012
1139	Wiltron	68369B	675016	Synthesized Signal Generator, 10 MHz - 40 GHz	08/25/2011	08/25/2012
1399	Instruments for Industry (IFI)	S41-50	01203-0711	Solid State Amplifier	NA	NA
1217	Varian	VZC6961D7C 1	1607	TWT Amplifier, 4-8GHz, 80 W	NA	NA
1260	Amplifier Research	200T8G18A	27443	7.5 - 18 GHz TWT Amplifier, 200W	NA	NA
1397	IFI	M404	O1201-0411	500W Amplifier 10 kHz - 220 MHz	NA	NA
1203	OPHIR	5125F	1004	RF Amplifier 20-1000MHz 70 Watts	NA	NA
1065	Amplifier Research	AT3000	302772	E-Field Generator	NA	NA
1031	EMCO	3109	9607-3006	High Field Biconical Antenna (20 MHz - 300 MHz)	04/13/2011	04/13/2012
1075	EMCO	3106	9906-2748	Double-ridged Horn (200 MHz - 2 GHz)	09/13/2011	09/13/2012
1024	Amplifier Research	FP4000	18358	Isotropic Field Probe (10 kHz - 1 GHz)	08/15/2011	08/15/2012
1285	ETS-Lindgren	HI-6053	00082800	Isotropic Field Probe 10 MHz-40 GHz	02/15/2011	02/15/2012
1104	Ray Proof	RF Shield Room	SL2384	Semi Anechoic Lined Chamber	NA	NA
1405	EXTECH Instruments	445715	N/A	Hygro-Thermometer	08/17/2011	08/17/2012



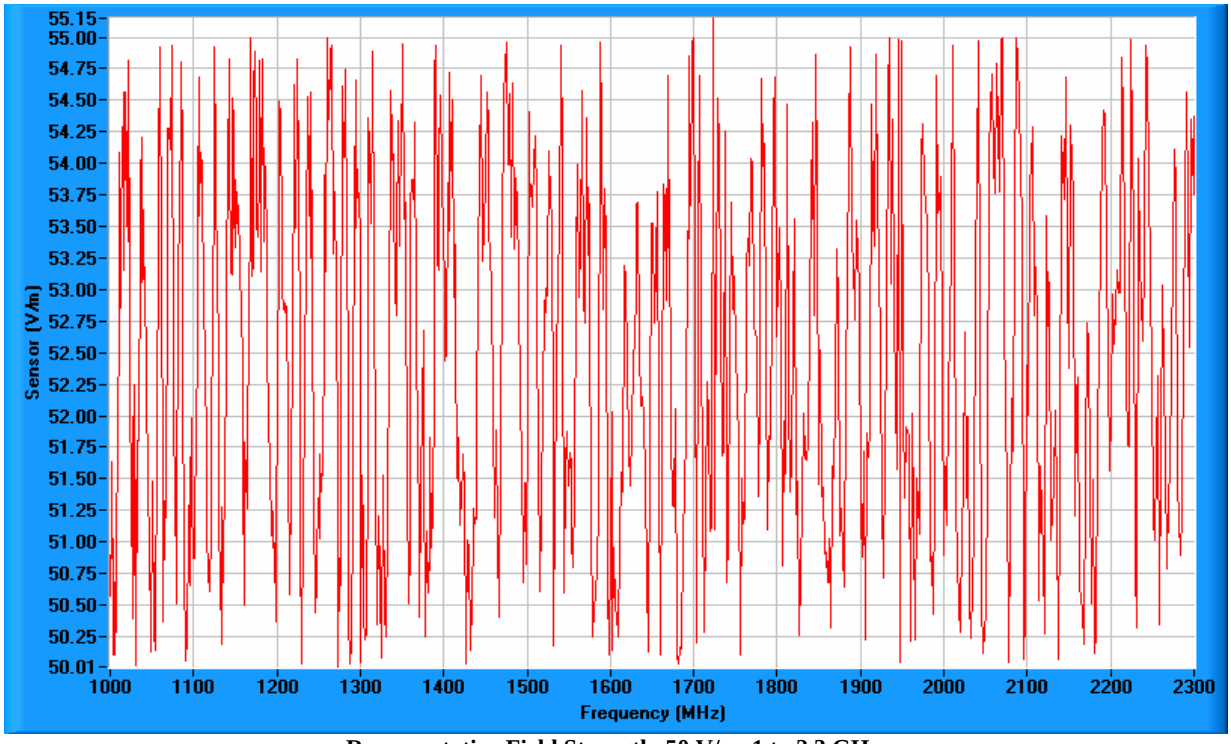
Representative Field Strength, 10 V/m, 2 to 30 MHz.



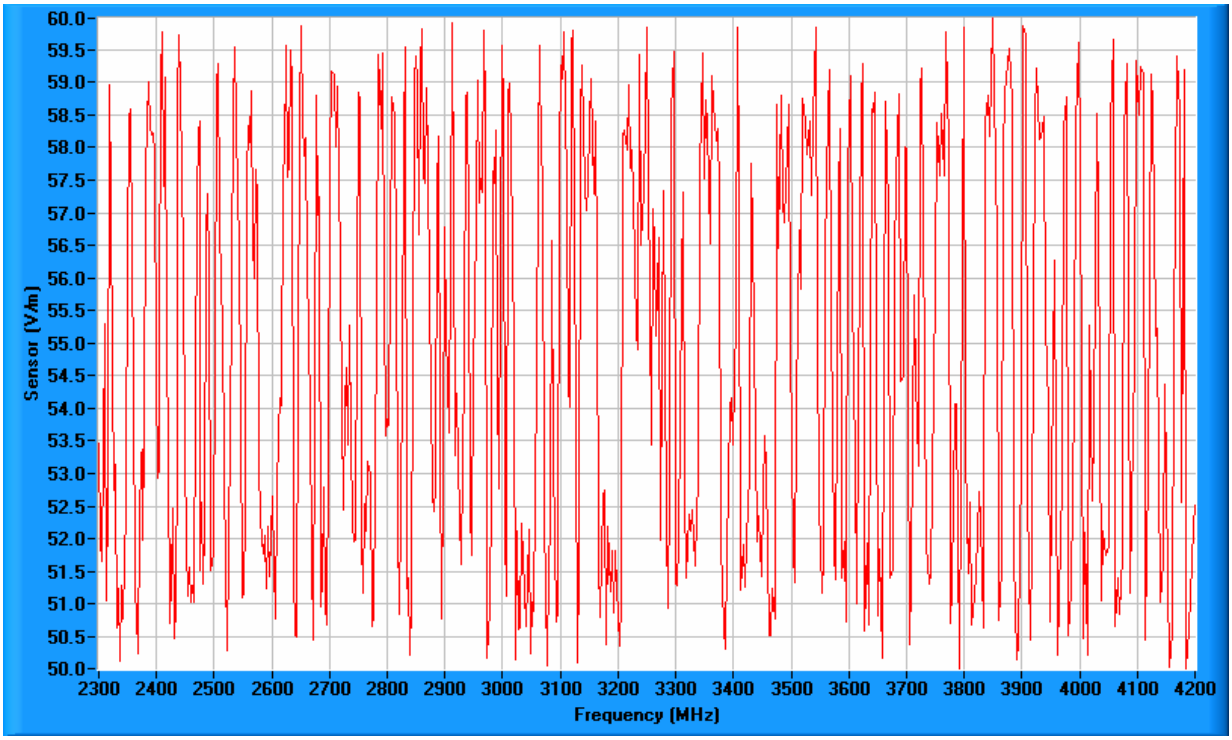
Representative Field Strength, 10 V/m, 30 to 200 MHz.



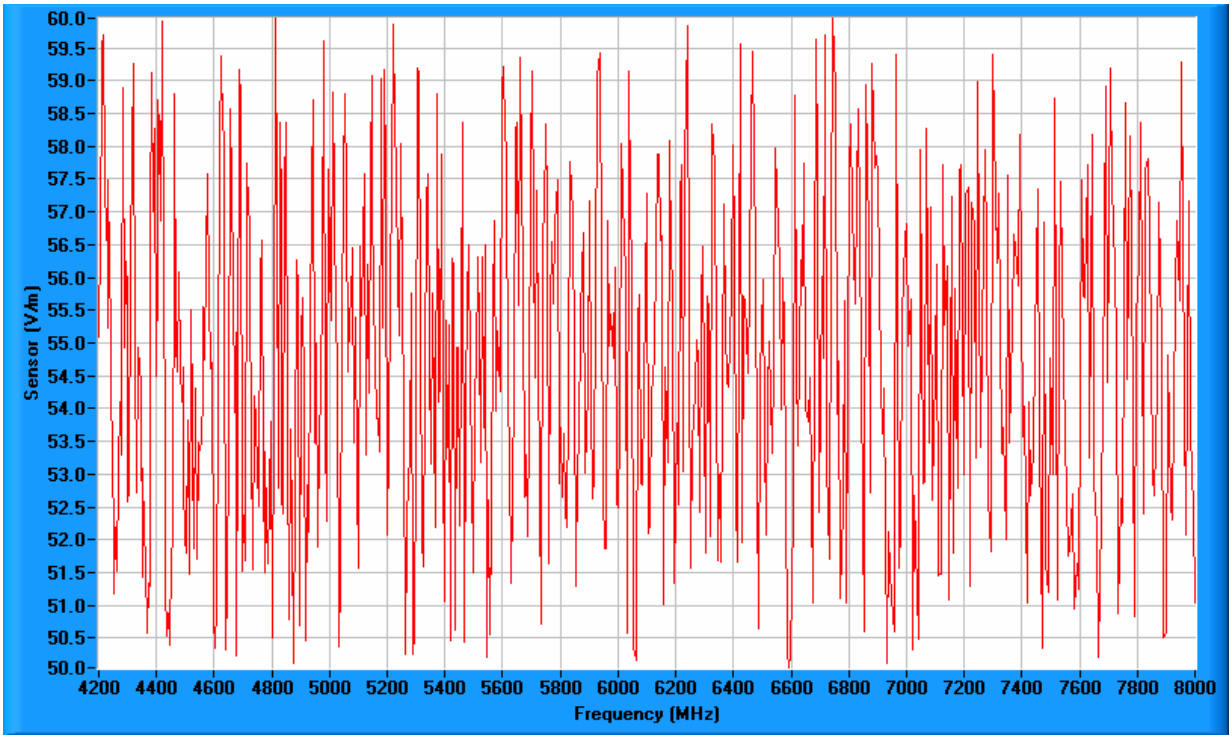
Representative Field Strength, 10 V/m, 200 to 1000 MHz.



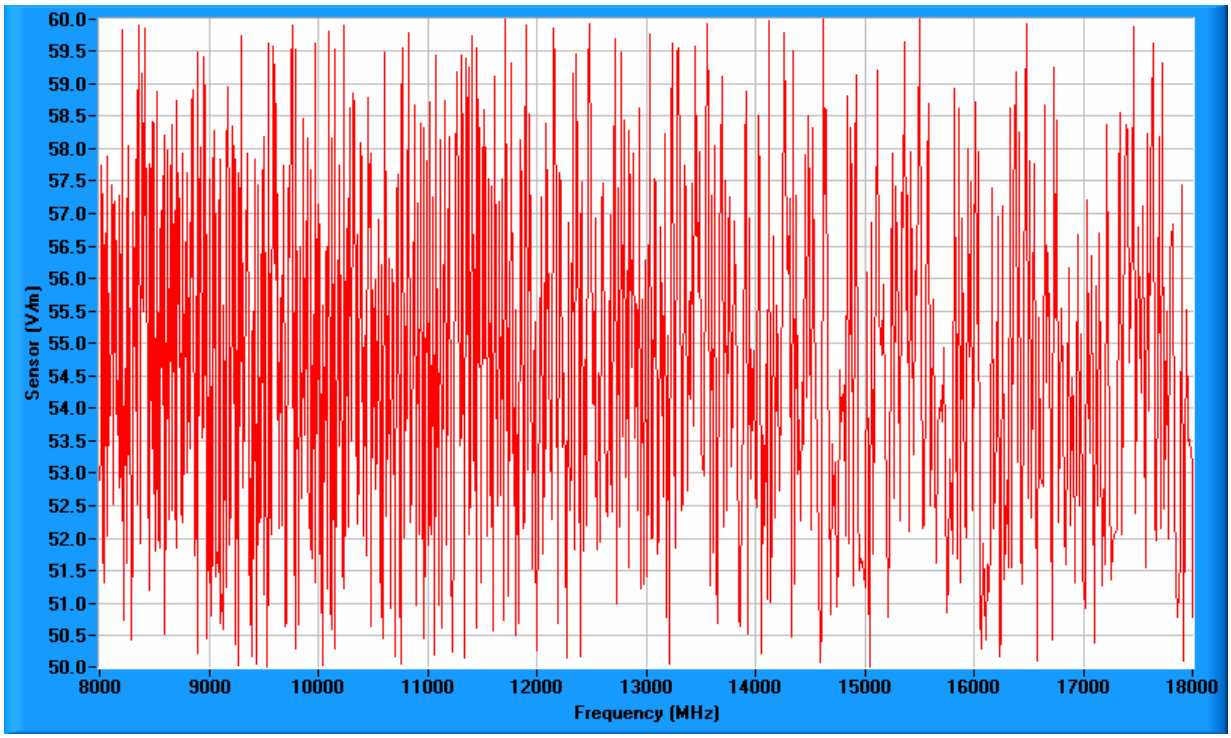
Representative Field Strength, 50 V/m, 1 to 2.3 GHz.



Representative Field Strength, 50 V/m, 2.3 to 4.2 GHz.



Representative Field Strength, 50 V/m, 4.2 to 8.0 GHz.



Representative Field Strength, 50 V/m, 8.0 to 18.0 GHz.

End of Report