MET Laboratories, Inc. *Safety Certification - EMI - Telecom Environmental Simulation*
914 WEST PATAPSCO AVENUE ● BALTIMORE, MARYLAND 21230-3432 ● PHONE (410) 354-3300 ● FAX (410) 354-3313

August 7, 2007

Multispectral Solutions, Inc.
20300 Century Road
Germantown, MD 20874-1132

Dear Lester Foster,

Enclosed is the EMC test report for compliance testing of the Multispectral Solutions, Inc., Radar Developers Kit - Lite (RaDeKL), Model # RAD635 as tested to the requirements of Title 47 of the CFR, Ch. 1 (10-1-03 ed.), Part 15 Subpart C, §15.250 for UWB Devices.

Thank you for using the services of MET Laboratories, Inc. If you have any questions regarding these results or if MET can be of further service to you, please feel free to contact me.

Sincerely yours,
MET LABORATORIES, INC.

Jesse Trawinski
Documentation Department

Reference: (\Multispectral Solutions, Inc.\ EMC22474-FCC250 REV. 2)

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Electromagnetic Compatibility Criteria
Test Report

For the

Multispectral Solutions, Inc.
Radar Developers Kit - Lite (RaDeKL), Model # RAD635

Tested under

FCC Certification Rules
Title 47 of the CFR, Part 15, Subpart C for UWB Devices

MET Report: EMC22474-FCC250 REV. 2

August 7, 2007

Prepared For:

Multispectral Solutions, Inc.
20300 Century Road
Germantown, MD 208741132

Prepared By:
MET Laboratories, Inc.
914 W. Patapsco Ave.
Baltimore, MD 21230

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Jeffrey Hazen
Project Engineer, Electromagnetic Compatibility Lab

Jesse Trawinski
Documentation Department

Engineering Statement: The measurements shown in this report were made in accordance with the procedures indicated, and the emissions from this equipment were found to be within the limits applicable. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them. It is further stated that upon the basis of the measurements made, the equipment tested is capable of operation in accordance with the requirements of Part 15, §15.250 of the FCC Rules under normal use and maintenance.

Dusmantha Tennakoon,
Wireless Coordinator, Electromagnetic Compatibility Lab

Report Status Sheet

Revision	Report Date	Reason for Revision
0	July 27, 2007	Initial Issue
1	August 2, 2007	Editorial Corrections
2	August 7, 2007	Editorial Corrections

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List of Terms and Abbreviations

AC	**A**lternating **C**urrent
ACF	**A**ntenna **C**orrection **F**actor
Cal	**Cal**ibration
d	**M**easurement **D**istance
dB	**D**eci **B**els
dBµV	**D**eci-**B**els above one **micro V**olt
dBµV/m	**D**eci-**B**els above one **micro V**olt **per m**eter
DC	**D**irect **C**urrent
DCF	**D**istance **C**orrection **F**actor
E	**E**lectric Field
DSL	**D**igital **S**ubscriber **L**ine
ESD	**E**lectro**s**tatic **D**ischarge
EUT	**E**quipment **U**nder **T**est
f	**F**requency
FCC	**F**ederal **C**ommunications **C**ommission
H	Magnetic Field
GHz	**G**iga **H**ert**z**
Hz	**H**ert**z**
ICES	**I**nterference-**C**ausing **E**quipment **S**tandard
kHz	**k**ilo**h**ert**z**
kPa	**k**ilo**pa**scal
kV	**k**ilo **V**olt
LISN	**L**ine **I**mpedance **S**tabilization **N**etwork
MHz	**M**ega**H**ertz
µH	**micro H**enry
µF	**micro F**arad
µs	**micro s**econds
RF	**R**adio **F**requency
RMS	**R**oot-**M**ean-**S**quare
V/m	**V**olts per **m**eter
UWB	**U**ltra-**W**ide**b**and

1. Requirements Summary

The following tests were performed on a sample of the equipment for the purpose of demonstrating compliance with Part 15, Subpart C, §15.250, in accordance with Multispectral Solutions, Inc. Purchase Order Number 05039.

Reference	Description	Compliance
Title 47 of the CFR, Part 15, Subpart C, §15.203	Antenna Requirements	Compliant
Title 47 of the CFR, Part 15, Subpart C, §15.207(a)	Electromagnetic Compatibility - Conducted Emissions for Intentional Radiators	Compliant
Title 47 of the CFR, Part 15, Subpart C, §15.250(a)(b)	-10 dB Bandwidth	Compliant
Title 47 of the CFR, Part 15, Subpart C, §15.250(c)	Operational Restrictions	Applicant has been advised of these restrictions.
Title 47 of the CFR, Part 15, Subpart C, §15.250(d)(1) & (d)(4)	Average Radiated Emissions - Broadband	Compliant
Title 47 of the CFR, Part 15, Subpart C, §15.250(d)(2)	Average Radiated Emissions - Narrowband	Compliant
Title 47 of the CFR, Part 15, Subpart C, §15.250(d)(3)	Peak Radiated Emissions	Compliant

Table 1. Requirements Summary of EMC Part 15.250 ComplianceTesting

2 Equipment Configuration

2.1 Overview

An EMC evaluation to determine compliance of the Multispectral Solutions, Inc., Radar Developers Kit - Lite (RaDeKL), Model # RAD635 with the requirements of Part 15, Subpart C, §15.250 was performed. All references are to the most current version of Title 47 of the Code of Federal Regulations in effect. In accordance with §2.1033, the following data is presented in support of the Certification of the Multispectral Solutions, Inc. Radar Developers Kit - Lite (RaDeKL), Model # RAD635. Multispectral Solutions, Inc. should retain a copy of this document which should be kept on file for at least two years after the manufacturing of the Radar Developers Kit - Lite (RaDeKL), Model # RAD635 has been **permanently** discontinued.

Type of Submission/Rule:	Part 15.250 for UWB Devices (Original Filing)	
Model(s) Tested:	Radar Developers Kit - Lite (RaDeKL), Model # RAD635 Pre-Production Unit	
EUT Specifications:	**FCC ID:**	QCJRADEKL
	Equipment Code:	UWB
	UWB Bandwidth:	1.25 GHz
Analysis:	The results obtained relate only to the item(s) tested.	
Evaluated by:	Jeffrey Hazen	
Date(s):	August 7, 2007	

2.2 Test Site

All testing was performed at MET Laboratories, Inc., 914 W. Patapsco Avenue, Baltimore Maryland 21230. All equipment used in making physical determinations is accurate and bears recent traceability to the National Institute of Standards and Technology.

Radiated Emissions measurements were performed inside of a semi-anechoic chamber. In accordance with §2.948(a)(3), a complete site description is contained at MET Laboratories. In accordance with §2.948(d), MET Laboratories has been accredited by the National Voluntary Laboratory Accreditation Program (Lab Code: 100273-0).

2.3 Description of Test Sample

The Radar Developers Kit - Lite (RaDeKL), Model # RAD635, Equipment Under Test (EUT), allows potential users and system integrators to evaluate the benefits of Multispectral Solutions, Inc. Ultra Wideband (UWB) radar technology to detect the presence of targets within the antenna Field of View (FOV) with precision range. Applications include robotic and vehicle collision avoidance sensors, intrusion detection sensors and presence detectors.

2.4 Equipment Configuration

The EUT was set up as outlined in Figure 1. All equipment incorporated as part of the EUT is included in the following list.

Ref. ID	Name / Description	Model Number	Serial Number
1	Radar Developer's Kit – Lite/RaDeKL Radar	RAD635	000010

Table 2. Equipment Configuration

2.5 Support Equipment

Support equipment necessary for the operation and testing of the EUT is included in the following list.

Ref. ID	Name / Description	Manufacturer	Model Number	Serial Number
1	AC/DC POWER CONVERTER	FUHUA	41135500D	NA
2	LAPTOP COMPUTER	SONY	PCG-384L	28201031 3004460
3	USB CABLE, 10 FT	ELTOP ELECTRONICS	USB-AB-1004A	NA
4	USB EXTENSION CABLE	CABLES UNLIMITED	USB-1350-16	NA

Table 3. Support Equipment

2.6 Ports and Cabling Information

Ref. ID	Port name on EUT	Cable Description or reason for no cable	Qty.	Length (m)	Shielded? (Y/N)	Termination Box ID & Port ID
1	POWER JACK	POWERS UNIT	1	2	N	POWER OUTLET TO EUT PORT ID 1
1	USB	USB + EXTENSION DATA ELECTRICAL INTERFACE	1	8	N	LAPTOP COMPUTER TO EUT PORT ID 2

Table 4. Ports and Cabling Information

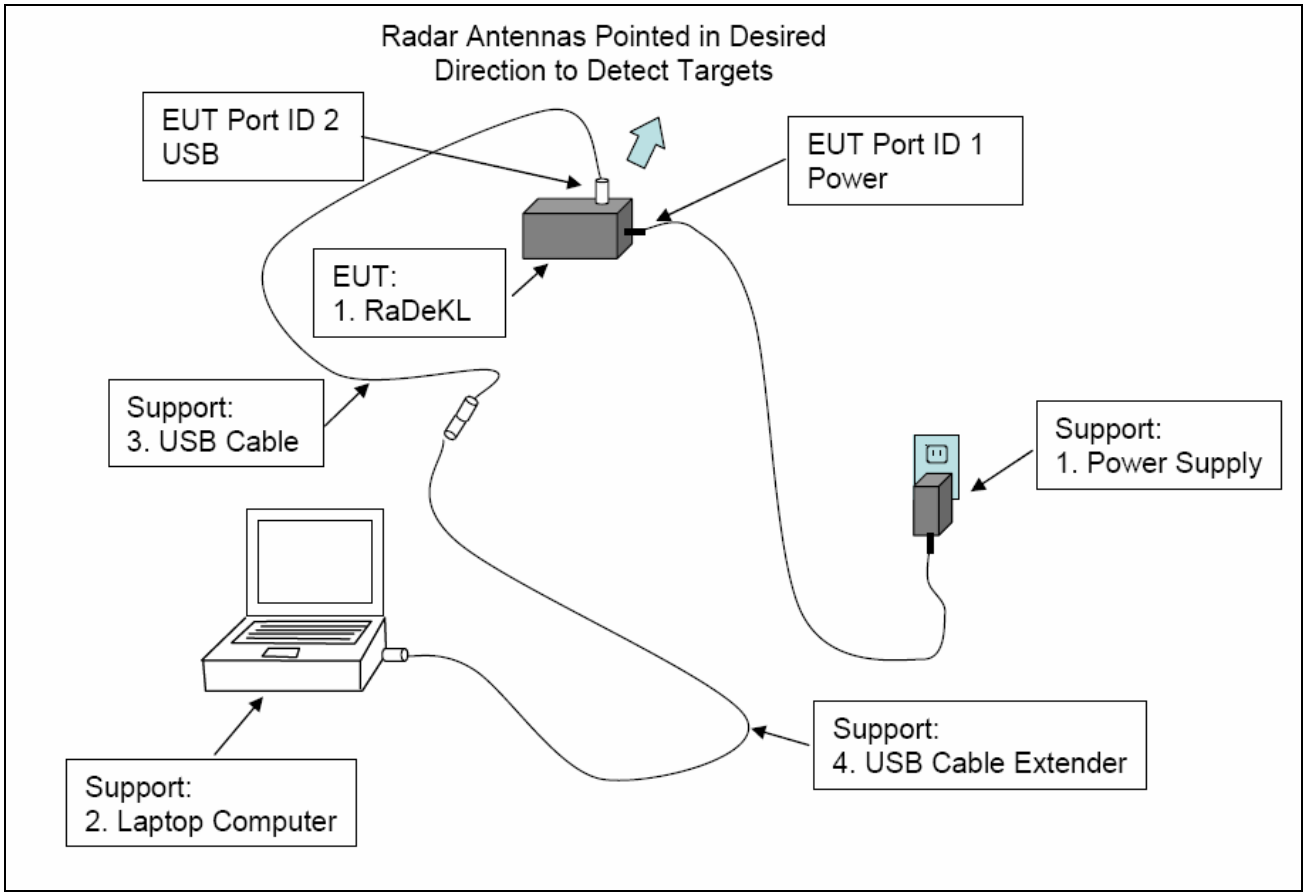


Figure 1. Block Diagram of Test Configuration

2.4 Mode of Operation

RaDeKL is stimulated by a microprocessor controlled interface using a set of predefined commands. The root commands are accessible in the included RaDeKL graphical user interface software application operating on a Windows 2000 operating system based personal computer.

The software permits control of the different sample modes of the radar. First mode is single environment snapshot. The second mode is streaming at constant sample rate with sample time steps that are multiples of 50 milliseconds. The user software permits streaming samples at the following update rates, every 50 milliseconds (20 Hz maximum rate), 100 msecs (10 Hz), 250 msecs (4 Hz), 500 msecs (2 Hz) or 1 second (1 Hz).. To generate a radar sample of the environment, a UWB pulse is transmitted 128 times with transmitted radar pulse cycle time approximately every 50 microseconds. The returns from these transmitted pulses are used to reconstruct a analog to digital conversion of the reflected return signal amplitude from objects in the radar antenna Field of View as a function of distance from the radar unit.

Other mode controls are transmitter signal magnitude from the maximum level permitted by FCC Part 15.250 rules. The reduction in transmitter power allows for close-in radar operation where even Part 15.250 levels would saturate the receiver. Signal attenuation levels from the control panel are 3 dB, 6 dB and 10 dB lower than the maximum permitted level. The radar permits half dB increments of transmitter attenuation up to 25 dB.

Final mode is to desensitize the receiver for close in radar sensing to permit near radar sensing without any receiver detection of the transmitted pulse. The receiver can be desensitized up to 30 dB.

2.5 Frequency Determining Parameters

The highest frequency employed in §15.33 to determine the frequency range over which radiated emissions are made was based on the center frequency, fc, unless a higher frequency was generated within the UWB device. For measuring emission levels, the spectrum was investigated from the lowest frequency generated in the UWB, without going below 9 kHz, up to the frequency range shown in Section 15.33(a) of the CFR 47 or up to fc +3/(pulse width in seconds), whichever was higher. There is no requirement to measure emissions beyond 40 GHz provided fc was less than 10 GHz; beyond 100 GHz if fc was at or above 10 GHz and below 30 GHz; or beyond 200 GHz if fc was at or above 30 GHz.

2.6 Modifications

2.6.1 Modifications to EUT

The customer is going to adjust the output power of his device by 1.5 dB down. The final measurements were made after this reduction of power. The EUT was placed on the edge of the table for testing. The USB connector was grounded to the chassis by conductive strips.

The conductive strip that was used was from Laird Technologies in their "Enviro-Seal" product line. It was actually 3 pieces of double-shield strip, part number 8405-0102-50, trimmed to remove one un-needed shield strip. In production, they plan to use single-shield strip 8406-0109-50.

The three pieces are cut to go around the USB connector's shield can, to give it direct contact to the inside of the metal enclosure.
Each piece is approximately 10mm in length, and one piece goes on each exposed edge (the two sides and the top) of the connector shield can.

2.6.2 Modifications to Test Standard

No modifications were made to the test standard.

2.7 Disposition of EUT

The test sample including all support equipment submitted to the Electro-Magnetic Compatibility Lab for testing was returned to Multispectral Solutions, Inc. upon completion of testing.

3. Electromagnetic Compatibility Criteria for UWB Devices

3.1. Antenna Requirement

Requirement:

§ 15.203: . The structure and application of the EUT were analyzed to determine compliance with Section 15.203 of the Rules. Section 15.203 states that the subject device must meet at least one of the following criteria:

a.) Antenna must be permanently attached to the unit.

b.) Antenna must use a unique type of connector to attach to the EUT.

c.) Unit must be professionally installed. Installer shall be responsible for verifying that the correct antenna is employed with the unit.

Results:

The EUT complied with the requirement(s) of this section. Antenna gain is 12 dB at peak. The - 3 dB beamwidth is 45 deg both in elevation and azimuth. The antenna is permanently attached to the unit.

Note: To ensure that antenna requirements are met, Multispectral will use tamperproof screws in their commercial productions. These tamperproof screws require special tools to open and therefore the antenna will not be accessible to the general public.

Photograph 1. View of Antenna Back

Photograph 2. View of Antenna Front

3.2. AC Line Conducted Emissions

Test Requirement(s): **15.207(a)**, Except as shown in paragraphs (b) and (c) of this section*, charging, AC adapters or battery eliminators the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the Table 5, as measured using a 50 µH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequencies ranges.

Frequency range (MHz)	Class A Conducted Limits (dBµV)		*Class B Conducted Limits (dBµV)	
	Quasi-Peak	Average	Quasi-Peak	Average
* 0.15- 0.45	79	66	66 - 56	56 - 46
0.45 - 0.5	79	66	56	46
0.5 - 30	73	60	60	50
Note 1 — The lower limit shall apply at the transition frequencies. Note 2 — The limit decreases linearly with the logarithm if the frequency in the range 0.15 MHz to 0.5 MHz. * -- Limits per Subsection 15.207(a).				

Table 5. Conducted Limits for Radio Frequency Devices calculated from FCC Part 15 Section 15.207(a)

Test Procedure: The EUT was placed on a non-metallic table, 80 cm above the ground plane inside a semi-anechoic chamber. The method of testing, test conditions, and test procedures of ANSI C63.4 were used. The EUT was powered through a 50Ω/50µH LISN. An EMI receiver, connected to the measurement port of the LISN, scanned the frequency range from 150 kHz to 30 MHz in order to find the peak conducted emissions. All peak emissions within 6 dB of the limit were remeasured using a quasi-peak and/or average detector as appropriate.

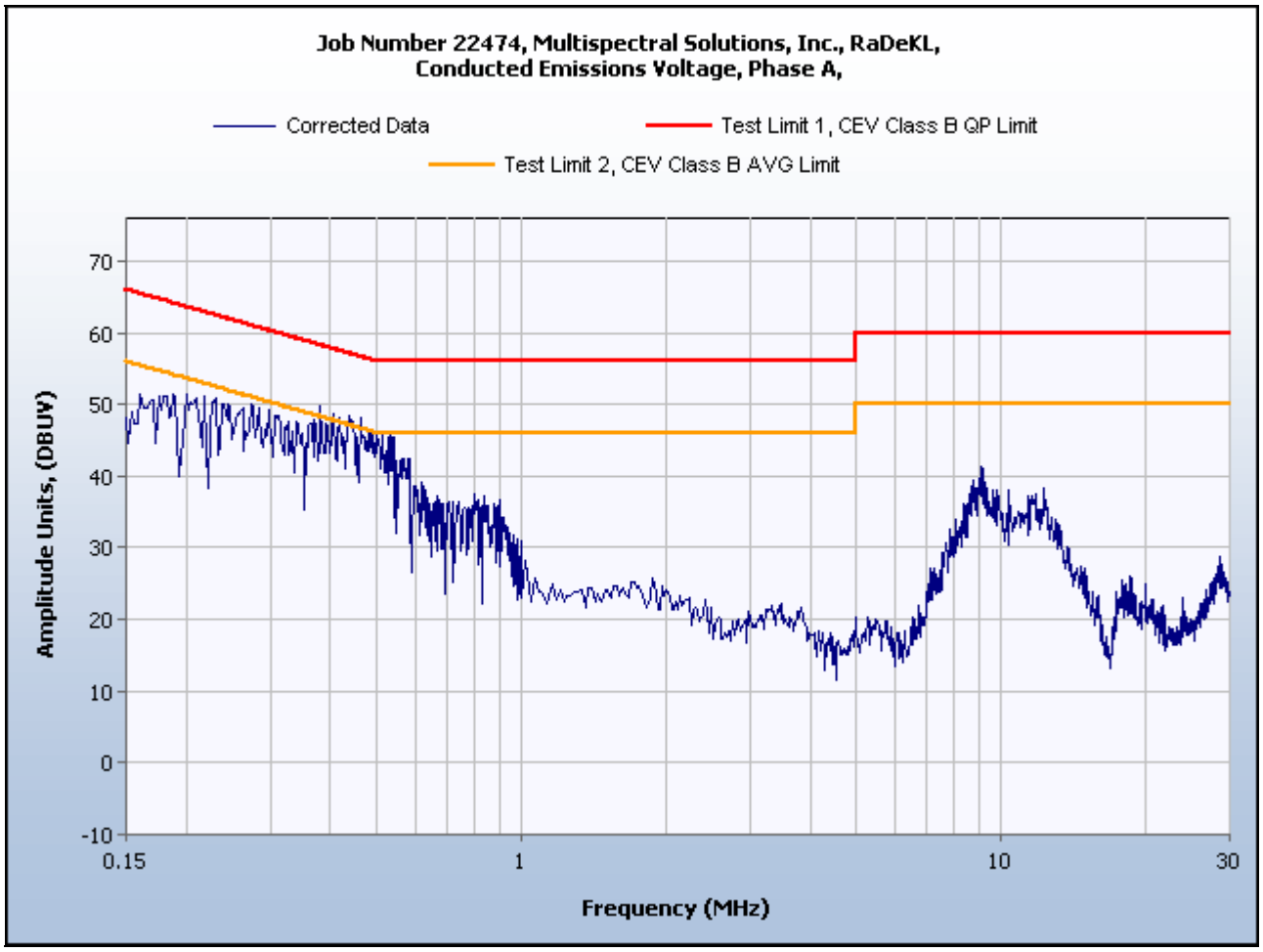
Results: The EUT complied with the Class B requirement(s) of this section. Measured emissions were below applicable limits.

Conducted Emissions - Voltage, AC Power, Phase Line

Frequency (MHz)	Uncorrected Meter Reading (dBuV) QP	Cable Loss (dB)	Corrected Measurement (dBuV) QP	Limit (dBuV) QP	Margin (dB) QP	Uncorrected Meter Reading (dBuV) Avg.	Cable Loss (dB)	Corrected Measurement (dBuV) AVG	Limit (dBuV) AVG	Margin (dB) AVG
0.17	41.2	0.119	41.319	64.96	-23.76	10.6	0.119	10.719	54.96	-44.241
0.234	38.8	0.17	38.97	62.31	-23.51	9.3	0.17	9.47	52.31	-42.84
0.25	38.8	0.17	38.97	61.76	-22.96	8.5	0.17	8.67	51.76	-43.09
0.275	38.2	0.17	38.37	60.97	-22.77	8.6	0.17	8.77	50.97	-42.2
0.286	38.2	0.17	38.37	60.64	-22.44	7.6	0.17	7.77	50.64	-42.87
0.319	37.7	0.17	37.87	59.73	-22.03	7.8	0.17	7.97	49.73	-41.76

Table 6. Conducted Emissions - Voltage, AC Power, Phase Line

Conducted Emissions - Voltage, Worst Case Emissions, AC Power



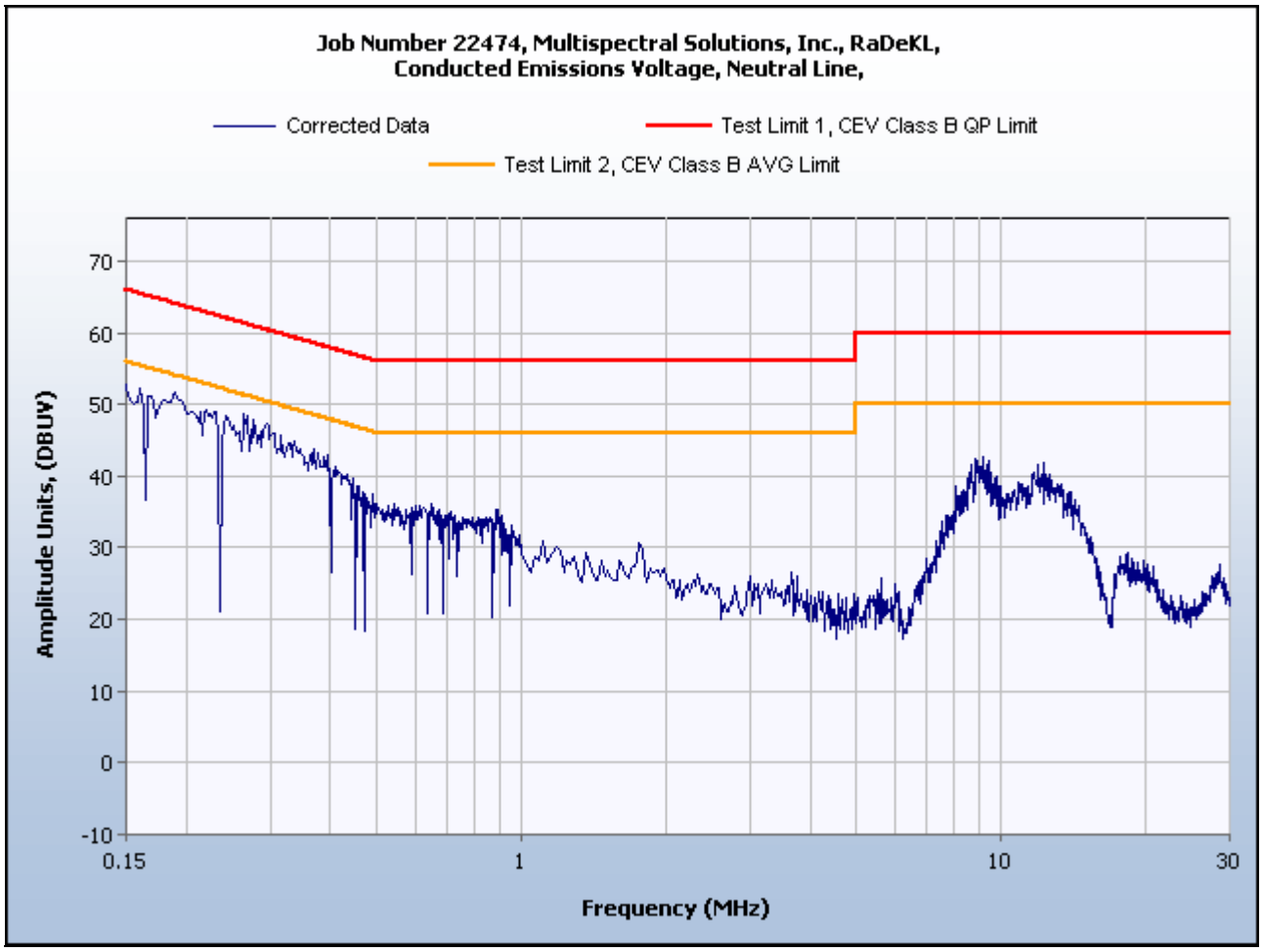
Plot 1. Conducted Emission, Phase Line Plot

Conducted Emissions - Voltage, AC Power, Neutral Line

Frequency (MHz)	Uncorrected Meter Reading (dBuV) QP	Cable Loss (dB)	Corrected Measurement (dBuV) QP	Limit (dBuV) QP	Margin (dB) QP	Uncorrected Meter Reading (dBuV) Avg.	Cable Loss (dB)	Corrected Measurement (dBuV) AVG	Limit (dBuV) AVG	Margin (dB) AVG
0.186	41.8	0.1462	41.9462	64.21	-22.41	11.9	0.1462	12.0462	54.21	-42.1638
0.236	39.8	0.17	39.97	62.24	-22.44	10.2	0.17	10.37	52.24	-41.87
0.261	39	0.17	39.17	61.4	-22.4	9.9	0.17	10.07	51.4	-41.33
0.305	36.7	0.17	36.87	60.11	-23.41	8.1	0.17	8.27	50.11	-41.84
0.339	35.4	0.17	35.57	59.23	-23.83	6.6	0.17	6.77	49.23	-42.46
0.382	33.8	0.17	33.97	58.24	-24.44	8.1	0.17	8.27	48.24	-39.97

Table 7. Conducted Emissions - Voltage, AC Power, Neutral Line

Conducted Emissions - Voltage, Worst Case Emissions, AC Power



Plot 2. Conducted Emission, Neutral Line Plot

Conducted Emission Limits Test Setup

Photograph 3. Conducted Emissions, Test Setup

Test Name: **Conducted Emissions**					Test Date(s): **June 12, 2007**
MET Asset #	**Nomenclature**	**Manufacturer**	**Model**	**Last Cal Date**	**Cal Due Date**
1T4214	SHIELD ROOM #4	UNIVERSAL SHIELD INC	NONE	01/26/2007	01/26/2008
1T4156	SPECTRUM ANALYZER; EMC	HEWLETT PACKARD	8594EM	10/06/2006	10/06/2007
1T4502	COMB GENERATOR	COM-POWER	CGC-255	08/22/2006	08/22/2007
1T4564	LISN (24 AMP)	SOLAR ELECTRONICS	9252-50-R-24-BNC	09/01/2006	09/01/2007
1T4565	LISN (24 AMP)	SOLAR ELECTRONICS	9252-50-R-24-BNC	09/01/2006	09/01/2007
1T4578	THERMO/ HYGROMETER	CONTROL COMPANY	S6-627-9	09/24/2006	09/24/2008

Table 8. Conducted Emission, Test Equipment

Note: Calibrated test equipment utilized during testing was maintained in a current state of calibration per the requirements of ANSI/NCSL Z540-1-1994 and ANSI/ISO/IEC 17025:2000.

3.3. -10 dB Bandwidth Requirements

Test Requirements: **§ 15.250(a)(b):** The -10 dB bandwidth of a UWB system operating under this section must be contained between 5925 MHz and 7250 MHz.

Test Procedure: Emissions were measured similar to the procedure used in the Radiated Emissions test section. Due to the extremely wide nature of UWB emissions, special considerations were taken to make the bandwidth measurements. The RBW was set to 1MHz and the VBW to 3MHz.

Test Results The EUT complied with the requirement(s) of this section.

f_M = 6.443 GHz, f_L = 5.997 GHz, f_H = 7.245 GHz

The 10 dB bandwidth = 1.248 GHz

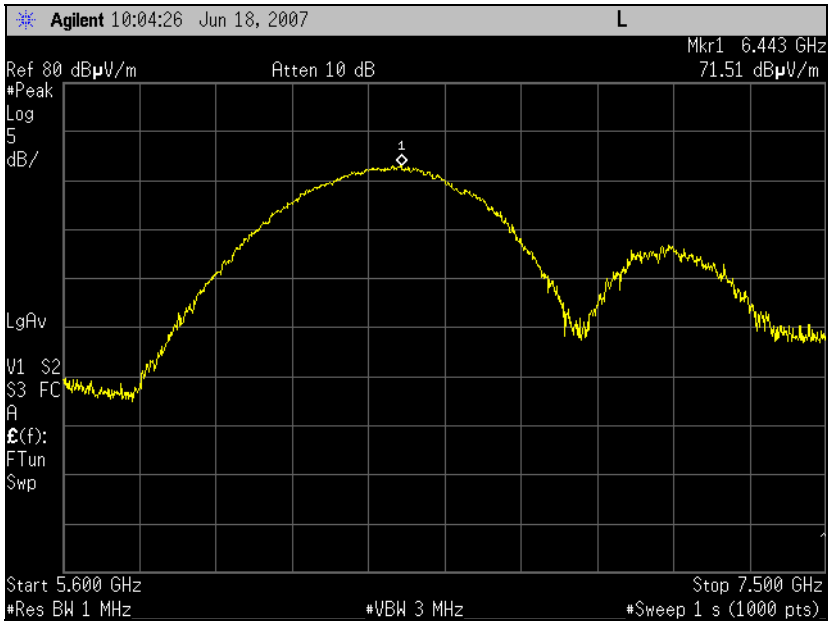


Figure 2. -10 dB Bandwidth Requirements, Peak

-10 dB Bandwidth Requirements, Test Results

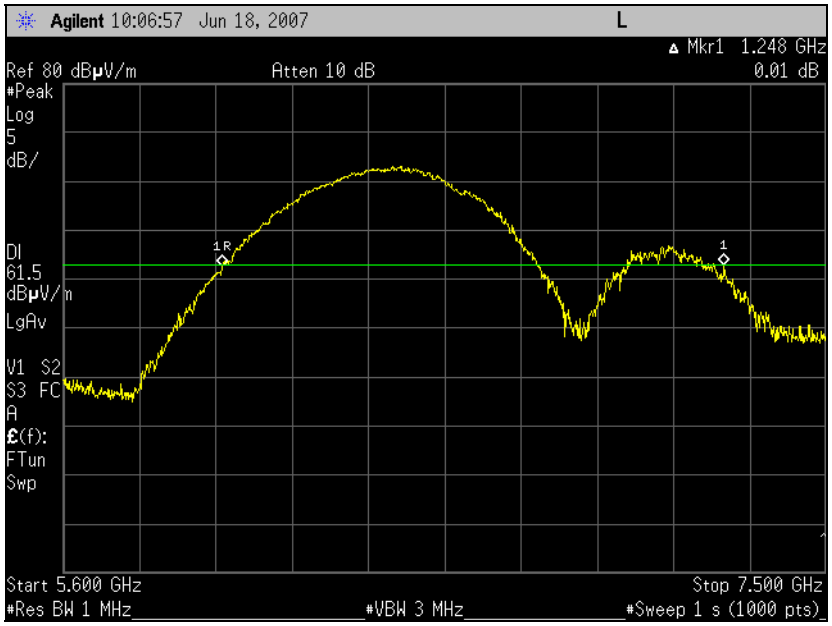


Figure 3. -10 dB Bandwidth Requirements, BW

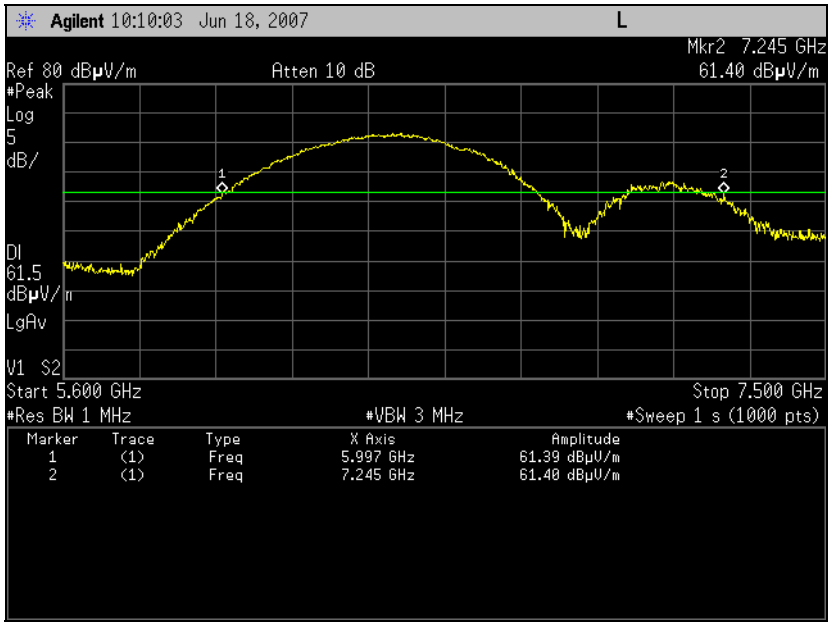


Figure 4. -10 dB Bandwidth Requirements, f_L and f_H

-10 dB Bandwidth Requirements, Test Setup

Photograph 4. -10 dB Bandwidth, Test Setup

MET #	EQUIPMENT	MANUFACTURER	MODEL#	CAL DATE	CAL DUE
1T4300	SEMI-ANECHOIC CHAMBER # 1	EMC TEST SYSTEMS	NONE	02/17/2006	01/17/2009
1T4576	ACTIVE HORN ANTENNA	COM-POWER	AHA-118	03/23/2007	03/23/2008
SN: US42070103	PSA	AGILENT	E4448A	02/20/2007	02/20/2008

Table 9. -10 dB Bandwidth, Test Equipment

Note: Calibrated test equipment utilized during testing was maintained in a current state of calibration per the requirements of ANSI/NCSL Z540-1-1994 and ANSI/ISO/IEC 17025:2000.

3.4. Radiated Emissions Requirements – Broadband

Test Requirements: **§ 15.250, § 15.209 (a):** Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in Table 10.

Frequency (MHz)	§15.209(a),Radiated Emission Limits (dBµV) @ 3m
30 - 88	40.00*
88 - 216	43.50*
216 - 960	46.00*
Above 960	54.00
* -- Except perimeter protection systems operating under paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this Subpart.	

Table 10. Radiated Emissions Limits Calculated from FCC Part 15, § 15.209 (a)

Radiated Emissions above 960 MHz from a device operating under this section shall not exceed the average limits of Table 11 when measured using a RBW of 1 MHz.

Frequency in MHz	EIRP in dBm
960 - 1610	-75.3
1610 - 1990	-63.3
1990 - 3100	-61.3
3100 - 5925	-51.3
5925-7250	-41.3
7250-10600	-51.3
Above 10600	-61.3

Table 11. Limits for Radiated Emissions (RBW = 1MHz)

Test Procedure: The EUT was placed on a 0.8 m high acrylic table inside a shielded enclosure. An antenna was placed near the EUT and measurements of frequencies and amplitudes of field strengths were recorded for reference during final measurements. For final radiated testing, measurements were performed in a semi-anechoic chamber. Measurements were performed with the EUT oriented in 3 orthogonal axis and rotated 360 degrees to determine worst case orientation for maximum emissions.

Measurements of the radiated field were made with the measurement antenna located at a distance of 1 meter from the EUT unless specified otherwise in the measurement results. The antenna was adjusted between 1 m and 4 m in height above the ground plane for maximum meter reading at each test frequency. The antenna-to-EUT azimuth was varied from zero to

360 degrees during the measurement to find the maximum field strength readings. The antenna polarization was varied (horizontal to vertical) during the measurements to find the maximum field strength readings. The EUT, where intended for tabletop use, was placed on a table whose top is 0.8m above the ground plane. The table was constructed of non-conductive materials. Its dimensions were 1m X 1.5m. Equipment setup followed the guidelines of ANSI C63.4:1991.

For frequencies from 30 MHz to 960 MHZ, measurements were made using a quasi-peak detector with a 120 kHz bandwidth. RE measurements for frequencies from 30 MHz to 1 GHz were made at 3 meters.

For frequencies above 1 GHZ, peak measurements were made with a resolution bandwidth of 1 MHz and a video bandwidth equal to or greater than 1MHz. Results were compared to the limit mathematically corrected pursuant to Section 15.521(g). Broadband average measurements were made with RBW = 1MHz, VBW $\geq$ RBW, using the RMS average detector available on the spectrum analyzer. Narrowband average measurements were made with RBW $\geq$ 1kHz, VBW $\geq$ RBW, using the RMS average detector available on the spectrum analyzer. Because measurements were performed @ 1 meter, the field strength was adjusted to obtain the 3 meter equivalent field strength. The antenna correction factors, pre-amp factors and cable loss were pre-programmed into the PSA that was used.

Frequency determining parameters: The highest frequency employed in §15.33 to determine the frequency range over which radiated emissions are made were based on the center frequency, f_c, unless a higher frequency was generated within the UWB device. For measuring emission levels, the spectrum were investigated from the lowest frequency generated in the UWB, without going below 9 kHz, up to the frequency range shown in Section 15.33(a) of the CFR 47 or up to f_c +3/(pulse width in seconds), whichever was higher. There is no requirement to measure emissions beyond 40 GHz provided f_c was less than 10 GHz; beyond 100 GHz if f_c was at or above 10 GHz and below 30 GHz; or beyond 200 GHz if f_c was at or above 30 GHz. Since f_C is 6.443 GHz, 40 GHz is the maximum frequency.

Calculation of Limit: The EIRP limit is mathematically converted to the equivalent 3 m field strength using the following equation from §15.521(g): **E(dBuv/m) = P(dBm EIRP) + 95.2**

Radiated Emissions Requirements – Broadband, Test Results

Test Results: The EUT complied with the requirement(s) of this section.

Radiated Emissions Limits Test Results, 15.250(d)(4), 15.209 (a)

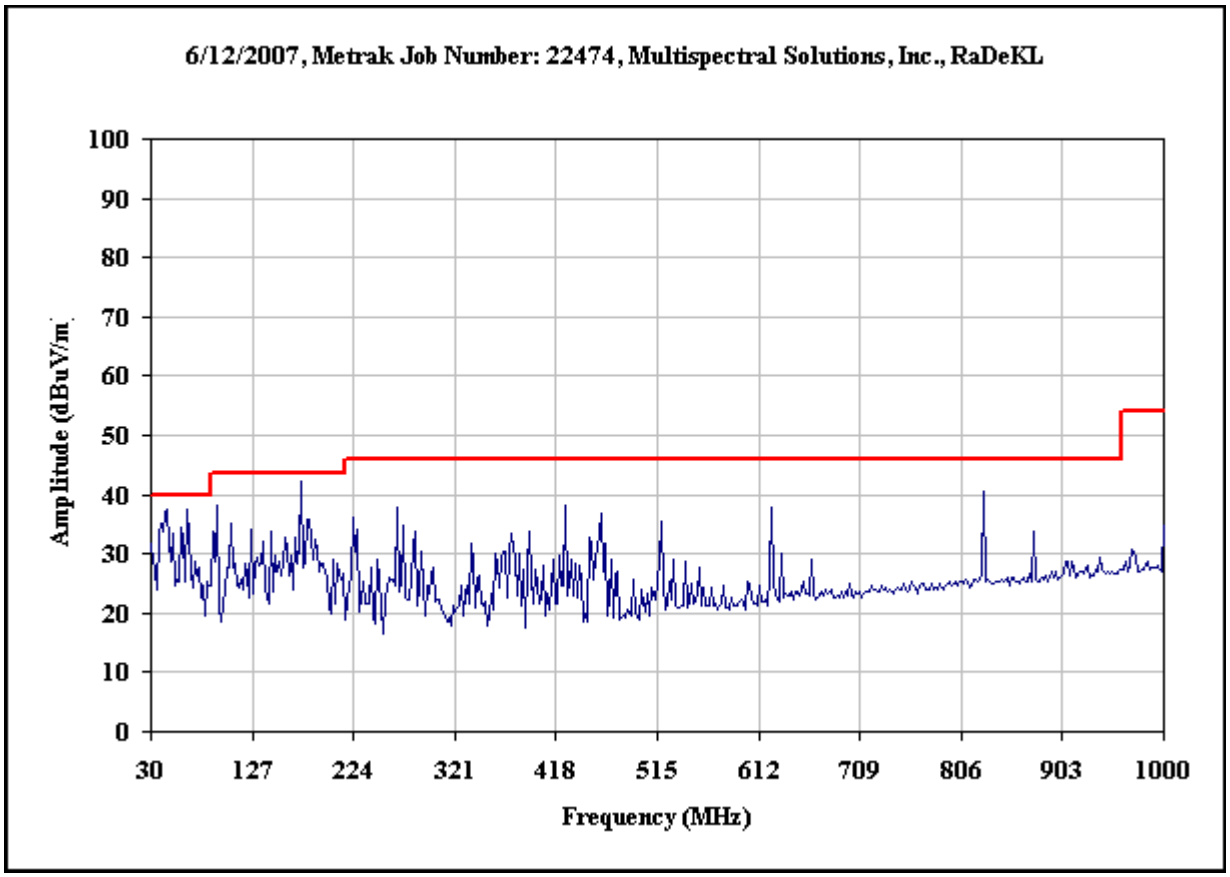
Frequency (MHz)	EUT Azimuth (Degrees)	Antenna Polarity (H/V)	Antenna HEIGHT (m)	Uncorrected Amplitude (dBuv)	Antenna Correction Factor (dB) (+)	Cable Loss (dB) (+)	Distance Correction Factor (dB) (-)	Corrected Amplitude (dBuv)	Limit (dBuv)	Margin (dB)
44.661	361	H	1.86	6.16	9.26	0.59	0.00	16.01	40.00	-23.99
44.661	34	V	0.98	26.44	8.38	0.59	0.00	35.41	40.00	-4.59
44.913	344	H	3.52	11.48	9.29	0.59	0.00	21.36	40.00	-18.64
*44.913	-1	V	0.98	30.25	8.39	0.59	0.00	39.23	40.00	-0.77
66.121	361	H	2.00	5.65	10.12	0.68	0.00	16.45	40.00	-23.55
*66.121	345	V	0.98	27.90	9.93	0.68	0.00	38.51	40.00	-1.49
174.336	152	H	1.98	8.99	9.02	1.07	0.00	19.08	43.50	-24.42
174.336	-1	V	0.98	22.70	9.07	1.07	0.00	32.85	43.50	-10.65
426.937	361	H	0.99	4.78	16.14	1.77	0.00	22.69	46.00	-23.31
426.937	70	V	1.20	9.92	16.32	1.77	0.00	28.01	46.00	-17.99
825.383	13	H	1.96	5.65	22.11	2.65	0.00	30.41	46.00	-15.59
825.383	287	V	0.97	5.72	21.51	2.65	0.00	29.88	46.00	-16.12

Table 12. Radiated Emissions Test Results with QP detector (RBW = 120 kHz)

Note: * - At this frequency, the measured electric-field strength exhibits a margin of compliance that is less than 3 dB below the specification limit. We recommend that every emission measured, have at least a 3 dB margin to allow for deviations in the emission characteristics that may occur during the production process.

Test Engineer: Jeffrey Hazen

Test Date: June 22, 2007



Plot 3. Radiated Emission Pre-Scan, 30 MHz - 1000 MHz

Average Radiated Emissions Requirements – Broadband Test Results

Average Radiated Emissions Requirements – Broadband

Test Requirements: **§15.250(d)(1):** There is a limit on the average level of the emissions contained within a 50 MHz bandwidth centered on the frequency at which the highest radiated emissions occurs, f_M. That limit is -41.3 dBm EIRP.

Calculation of Limit: Pursuant to §15.250(d)(1), the average EIRP limit = -41.3dBm. The following plots were corrected as follows:

P(dBm EIRP) = E(dBµV/m) - 95.2 @ 3m
= E(dBµV/m) – 104.74 @ 1m using $20\log\left(\frac{1m}{3m}\right)$
= E(dBm) + 107 + CL + ACF(1m) – 104.74 @ 1m
= E(dBm) + CL + ACF(1m) + 2.26 @ 1m

where
CL = Cable Loss
ACF(1m) = Antenna Correction Factor @ 1m

Measurements above 10 GHz were done with two pre-amps cascaded with each other to get the noise floor low enough to do measurements. A high-pass filter was also used to avoid damage to either pre-amp. Measurements taken at distances other than 1m were corrected by the $20\log\left(\frac{1m}{3m}\right)$ formula.

Test Results: The EUT was found to comply with the emissions requirements of §15.209(a) and §15.250(d)(1). The measurement noise floor is well below the specified limit. There were no measurable emissions between 18 – 40 GHz. Figures 6,7,8,9,10,11 show emissions profiles with transmitter "on" and when its "off". The emissions profiles are similar and therefore the emissions are not from the UWB transmitter. They are from the digital portion of the device and fall under 15.209 limits. They meet these limits.

Frequency (GHz)	Measured EIRP (dBm)	Limit (dBm)	Margin (dB)
6.437	-51.64	-41.3	-10.34

Table 9. Results - Average Radiated Emissions at 1 meter - Broadband - Fundamental

Note: There were no other significant emissions within the 1-18 GHz range except for the emission at 6.437 GHz.

Test Engineer: Jeffrey Hazen and Dusmantha Tennakoon

Test Date: June 19 & 26, 2007

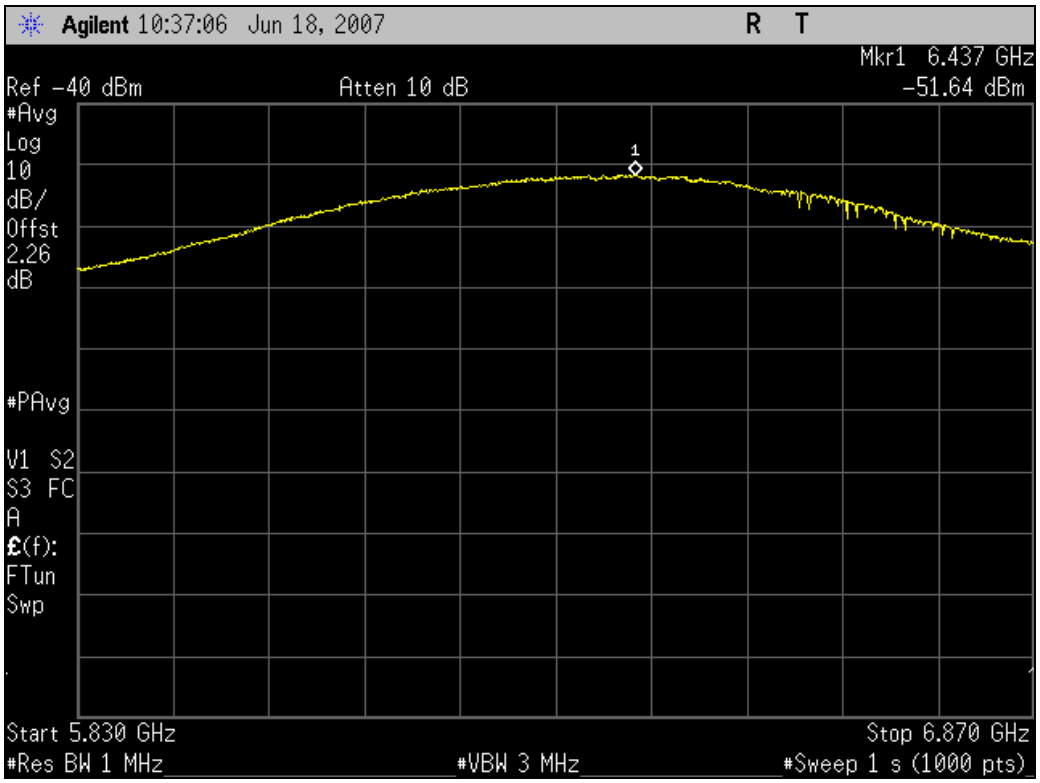


Figure 5. Average EIRP at f_M, Corrected

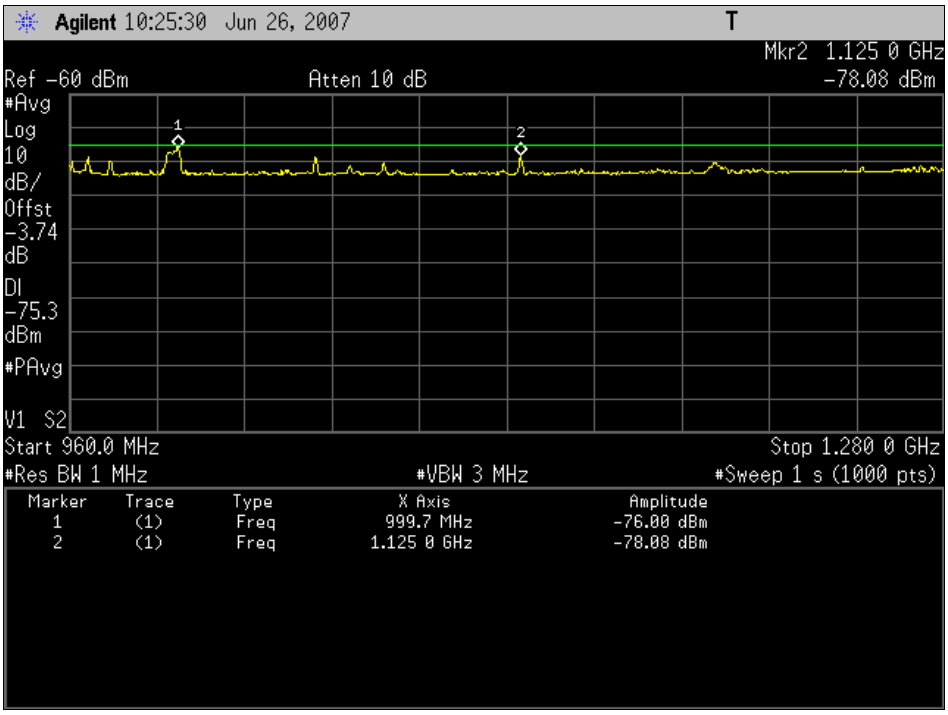


Figure 6. 960-1280 MHz EIRP, Transmitter Off, Measured at 0.5m, Corrected Plot

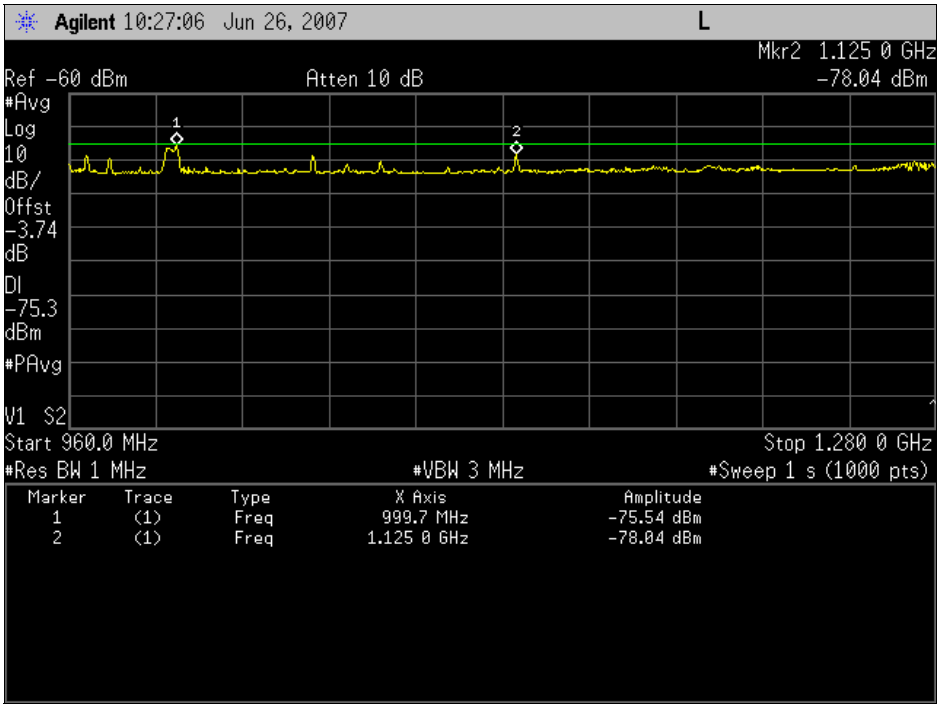


Figure 7. 960-1280 MHz EIRP, Transmitter On, Measured at 0.5m, Corrected Plot

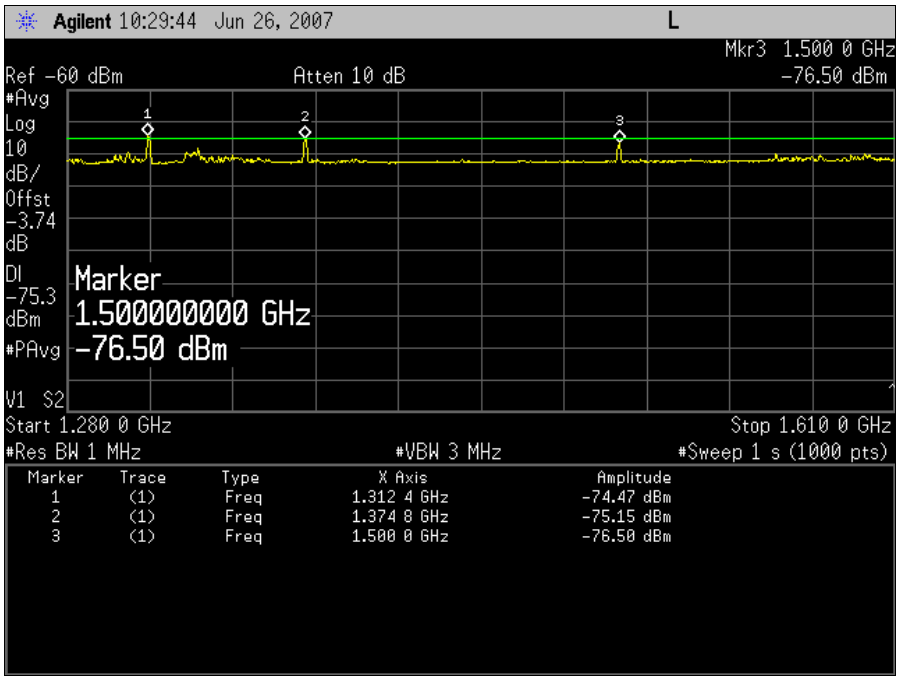


Figure 8. 1280-1610 MHz EIRP, Transmitter Off, Measured at 0.5m, Corrected Plot

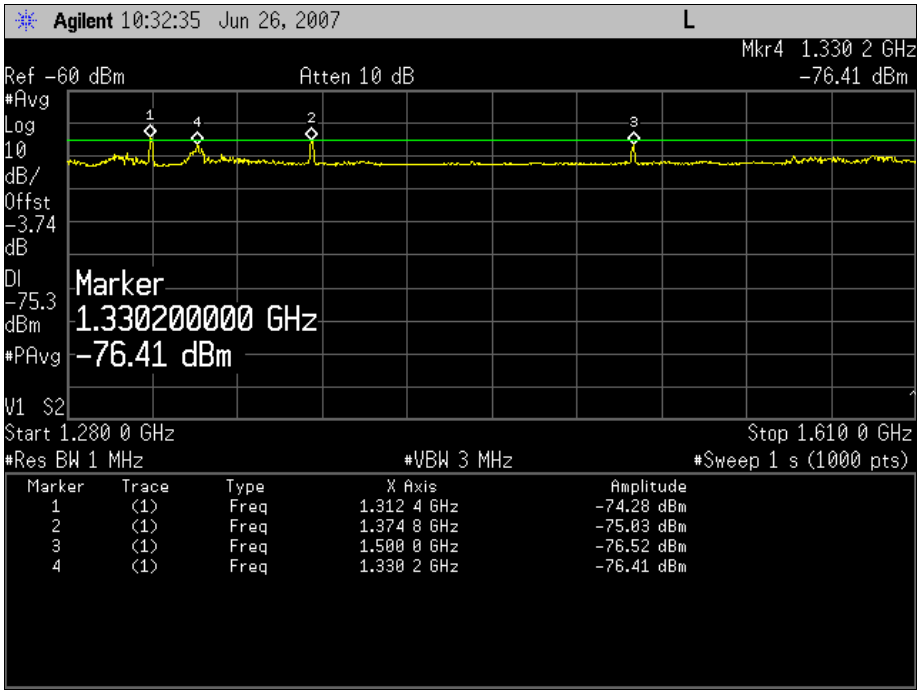


Figure 9. 1280-1610 MHz EIRP, Transmitter On, Measured at 0.5m, Corrected Plot

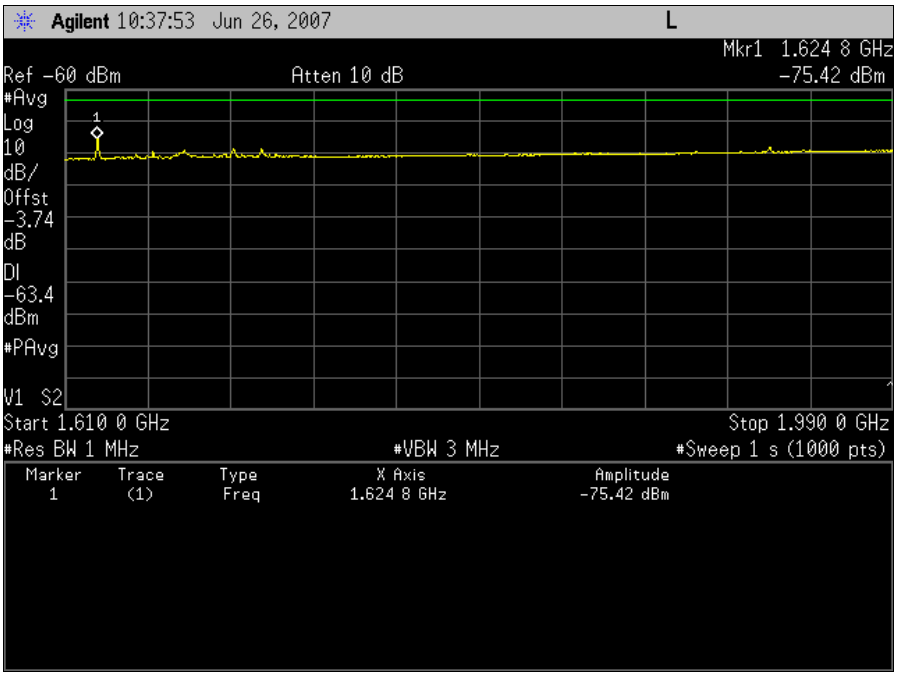


Figure 10. 1610-1990 MHz EIRP, Transmitter Off, Measured at 0.5m, Corrected Plot

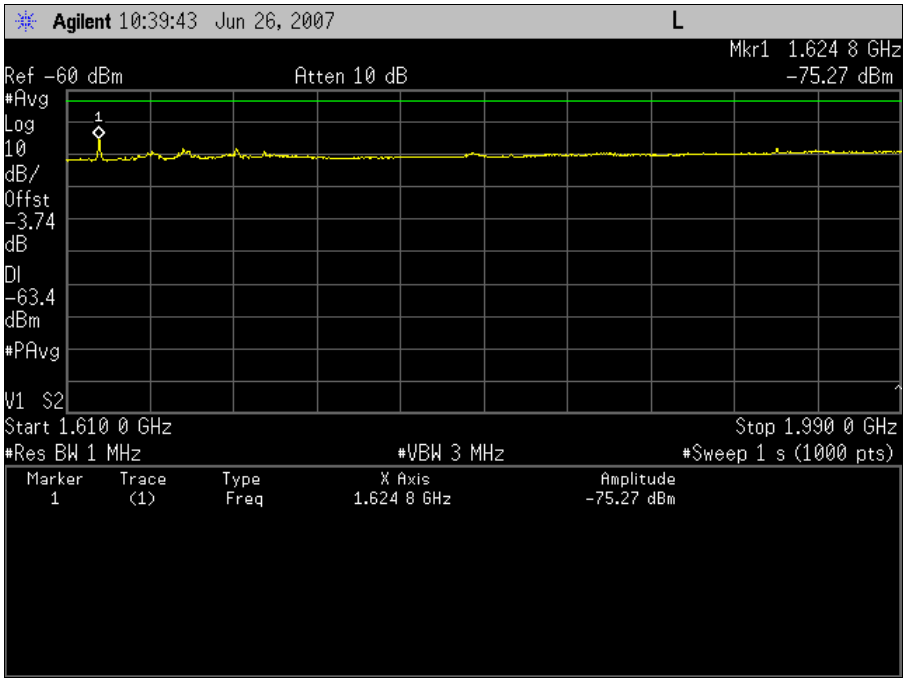


Figure 11. 1610-1990 MHz EIRP, Transmitter On, Measured at 0.5m, Corrected Plot

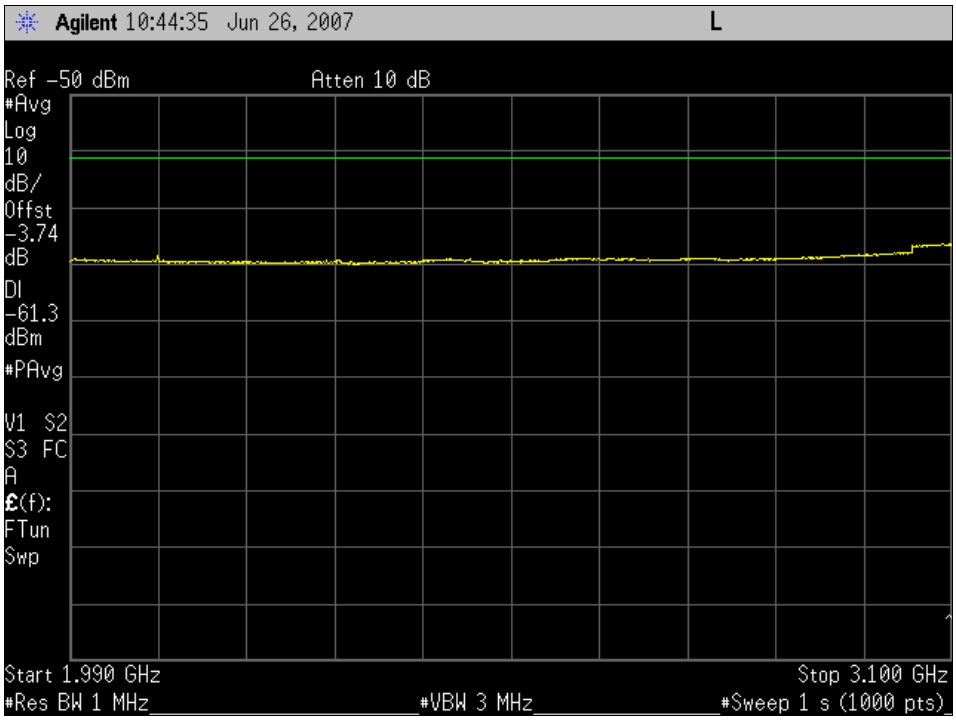


Figure 12. 1990-3100 MHz EIRP, Transmitter On, Measured at 0.5m, Corrected Plot

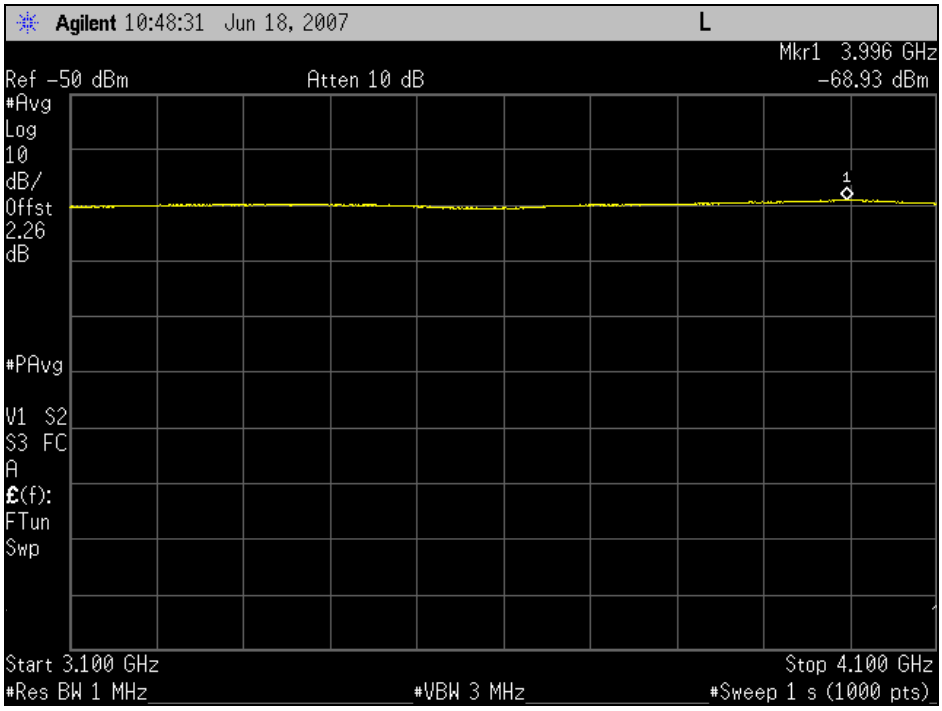


Figure 13. 3.1-4.1 GHz EIRP, Measured @ 1m, Corrected Plot

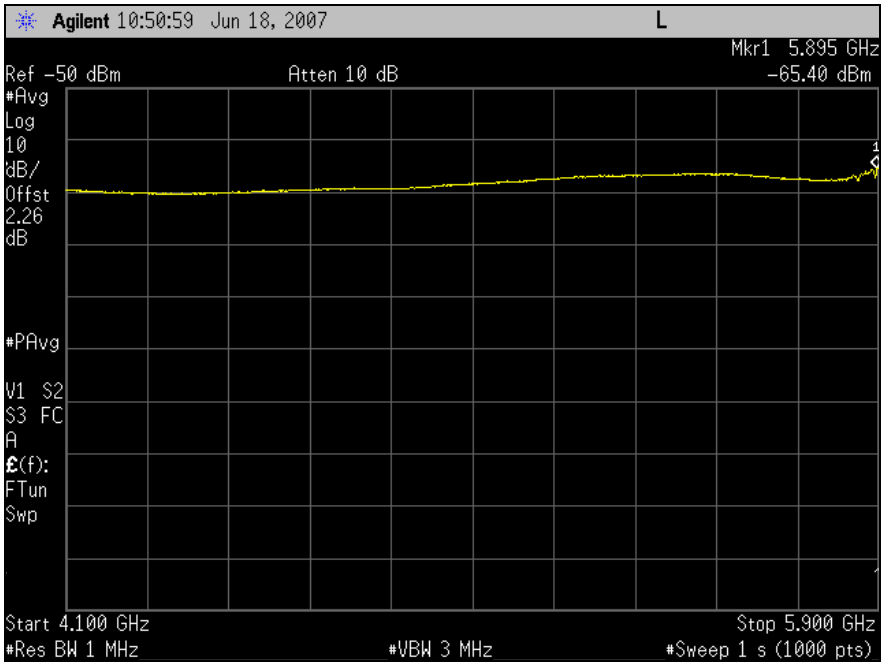


Figure 14. 4.1-5.9 GHz EIRP, Measured @ 1m, Corrected Plot

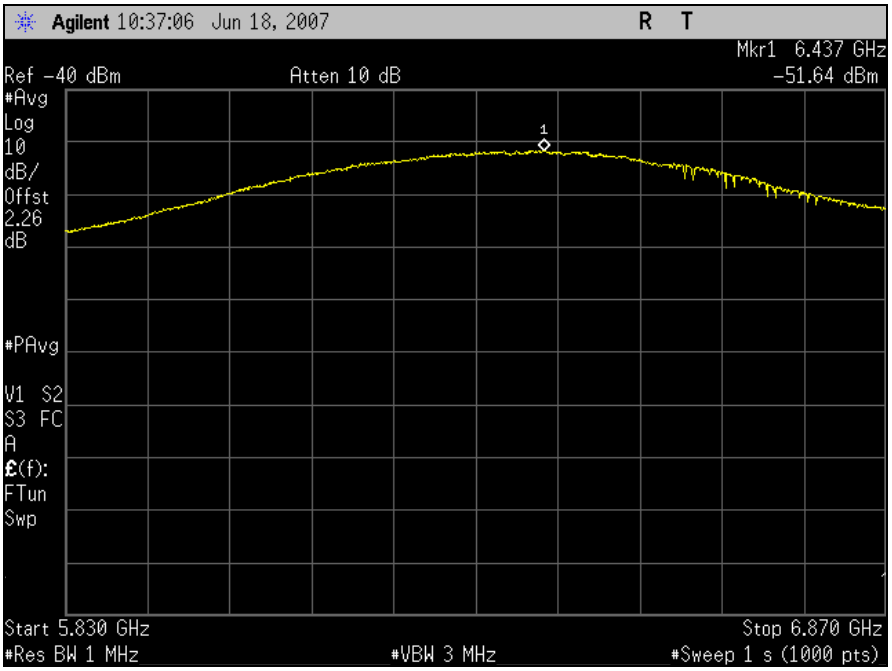


Figure 15. 5.83-6.87 EIRP, Measured @ 1m, Corrected Plot

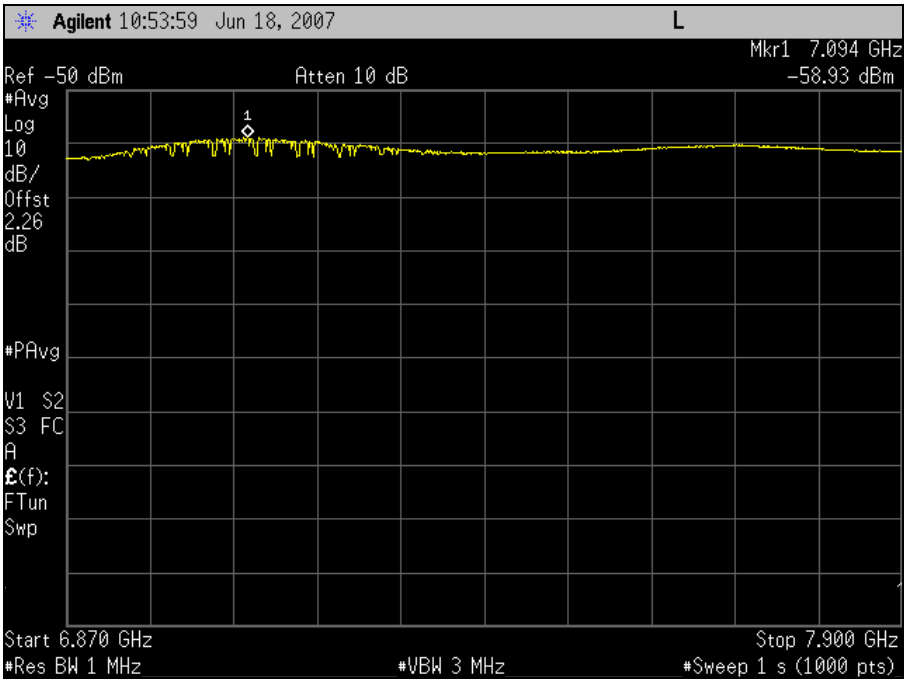


Figure 16. 6.87-7.9 GHz EIRP, Measured @ 1m, Corrected Plot

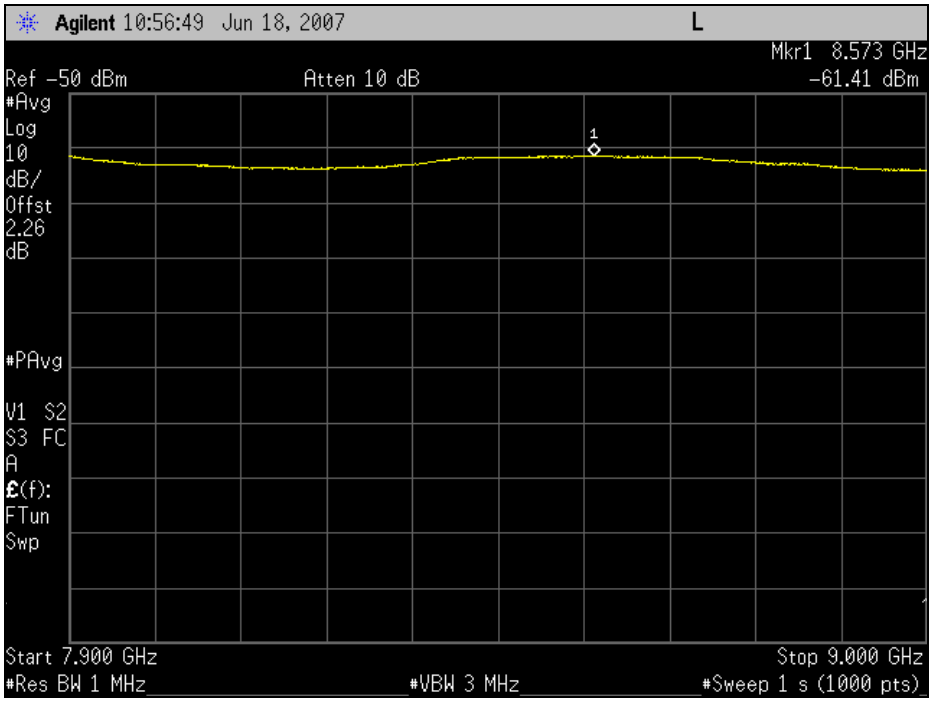


Figure 17. 7.9-9.0 GHz EIRP, Measured @ 1m, Corrected Plot

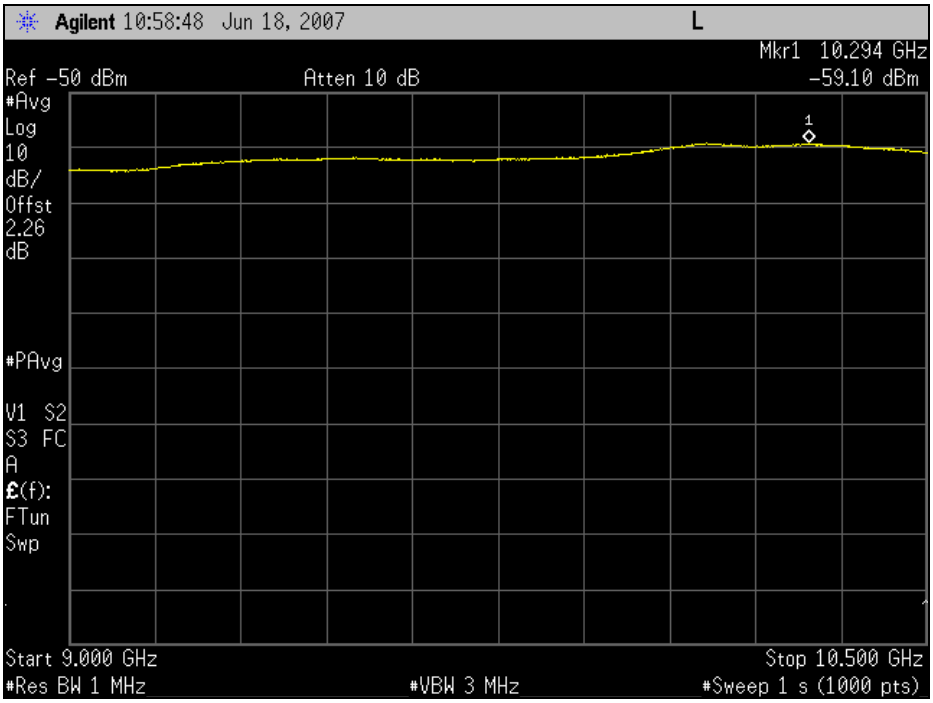


Figure 18. 9.0-10.5 GHz EIRP, Measured @ 1m, Corrected Plot

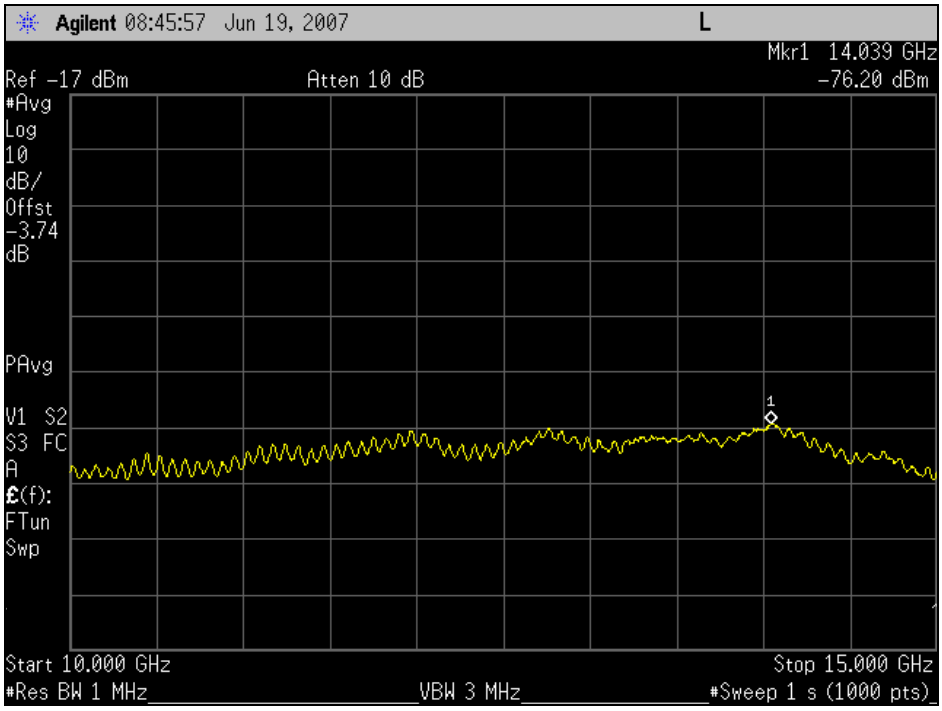


Figure 19. 10.5-15.0 GHz EIRP, Measured @ 1m, Corrected Plot

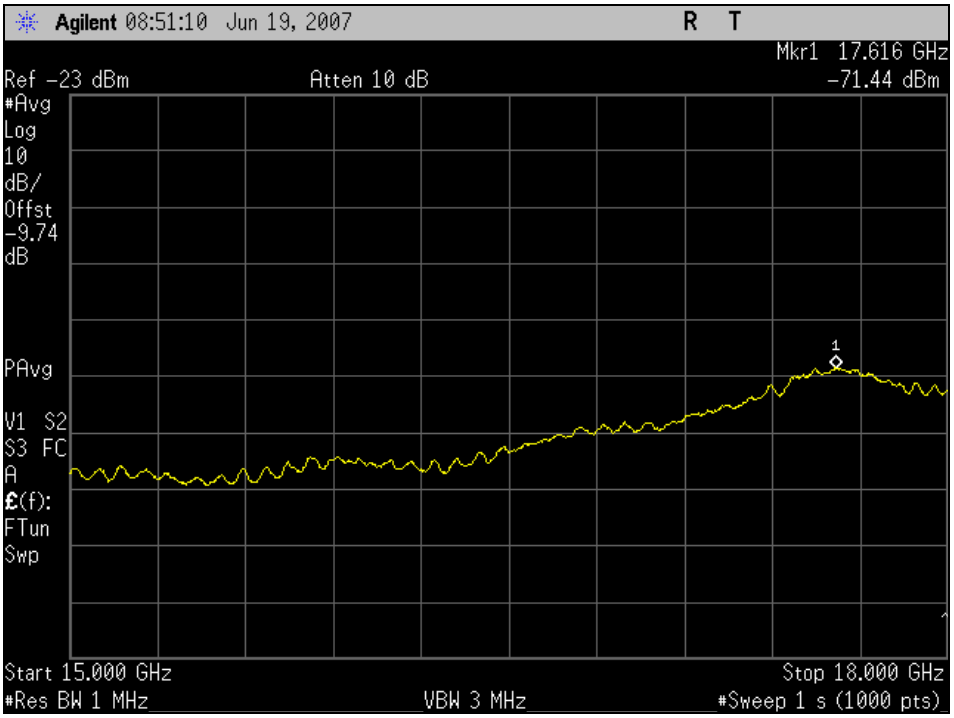
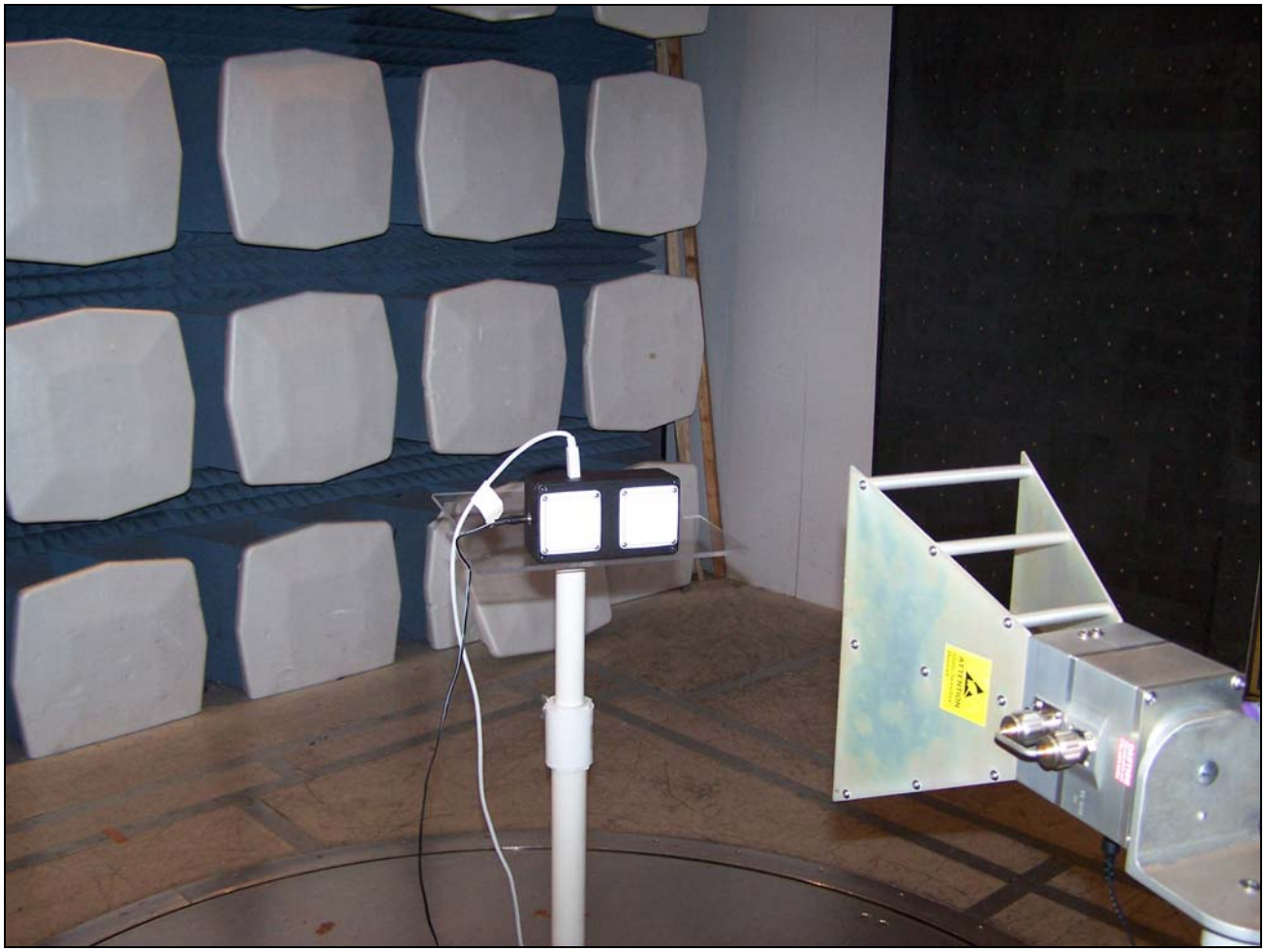


Figure 20. 15.0-18.0 GHz EIRP, Measured @ 1m, Corrected Plot



Photograph 5. Radiated Emissions Requirements – Broadband, Test Setup

MET #	EQUIPMENT	MANUFACTURER	MODEL#	CAL DATE	CAL DUE
1T4300	SEMI-ANECHOIC CHAMBER # 1	EMC TEST SYSTEMS	NONE	02/17/2006	01/17/2009
1T4576	ACTIVE HORN ANTENNA	COM-POWER	AHA-118	03/23/2007	03/23/2008
1T4414	MICROWAVE PRE-AMPLIFIER	AH SYSTEMS	PAM-0118	SEE NOTE	
SN: US42070103	PSA	AGILENT	E4448A	02/20/2007	02/20/2008

Table 13. Radiated Emissions Requirements – Broadband, Test Equipment

Note 1: Functionally verified test equipment is verified using calibrated instrumentation at the time of testing.
Note 2: Calibrated test equipment utilized during testing was maintained in a current state of calibration per the requirements of ANSI/NCSL Z540-1-1994 and ANSI/ISO/IEC 17025:2000.

3.5. Average Radiated Emissions Requirements – GPS Band

Test Requirements: **§15.250(d)(2):** Radiated Emissions above 960 MHz from a device operating under this section shall not exceed the following average limits when measured using a RBW of no less than 1 kHz.

Frequency in MHz	EIRP in dBm
1164 - 1240	-85.3
1559 - 1610	-85.3

Table 14. Limits for Radiated Emissions (RBW >/= 1kHz)

Calculation of Limit: The EIRP limit is mathematically converted to the equivalent 3 m field strength using the following equation from §15.521(g): **E(dBuv/m) = P(dBm EIRP) + 95.2**

P(dBm EIRP) = E(dBµV/m) - 95.2 @ 3m
= E(dBµV/m) – 104.74 @ 1m using $20\log\left(\frac{1m}{3m}\right)$
= E(dBm) + 107 + CL + ACF(1m) – 104.74 @ 1m
= E(dBm) + CL + ACF(1m) + 2.26 @ 1m

where
CL = Cable Loss
ACF(1m) = Antenna Correction Factor @ 1m

Test Results: The EUT was compliant with the requirement(s) of this section. The measurement system noise floor is well below the specified limit. There were no intentional emissions above the limit in these frequency bands, except those caused by digital emissions. The figures in the following pages clearly show that the emissions in the GPS bands are from the digital portion. Emissions are shown with the transmitter turned "on" and also turned "off". The emissions profiles are the same. Therefore, it is reasonable to assume that the emissions are from the digital portion. Therefore, these emissions fall under the 15.209 limits and are well under this limit.

Test Engineer: Jeffrey Hazen

Test Date: June 22, 2007

Average Radiated Emissions Requirements – Narrowband Test Results

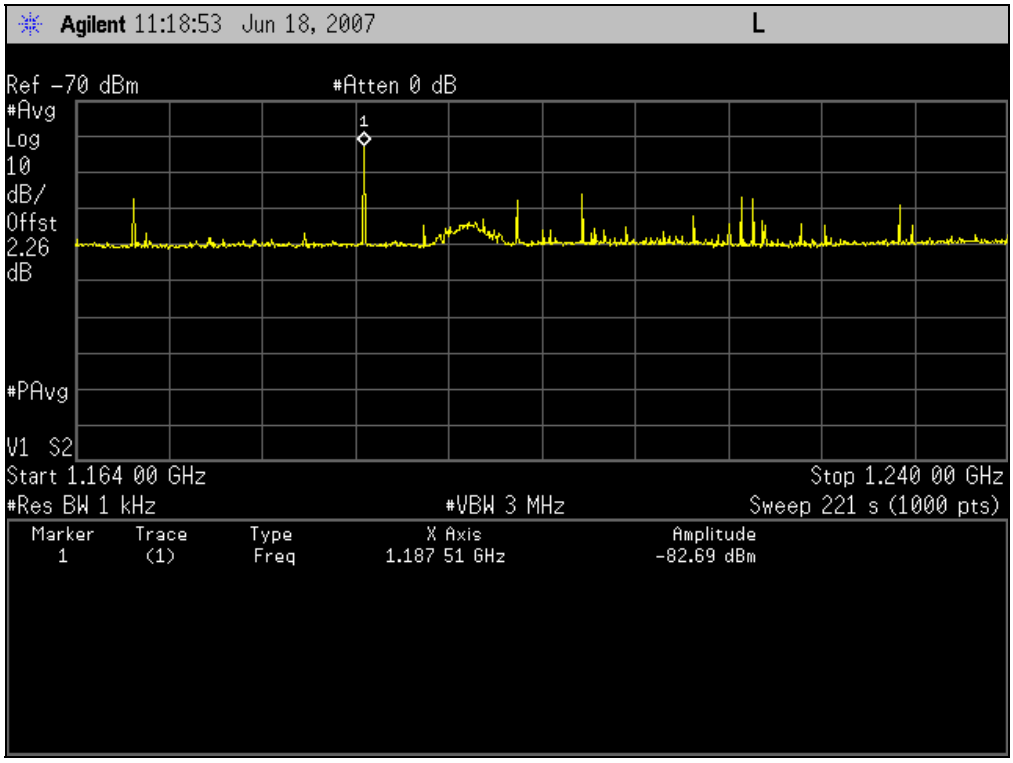


Figure 21. GPS Band 1 with Transmitter On, corrected plot

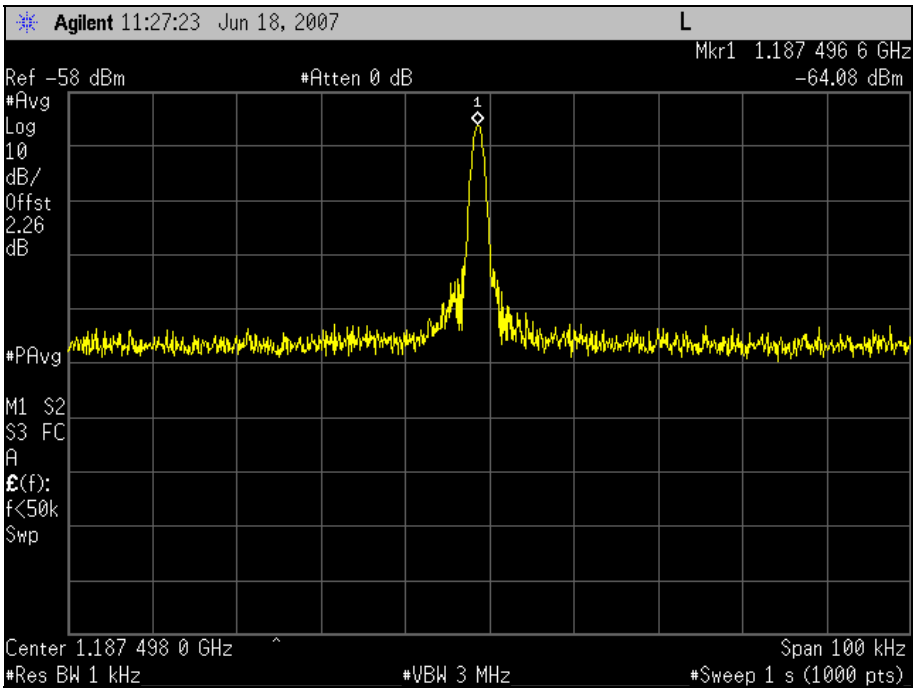


Figure 22. Measured emission with the Transmitter On, corrected plot

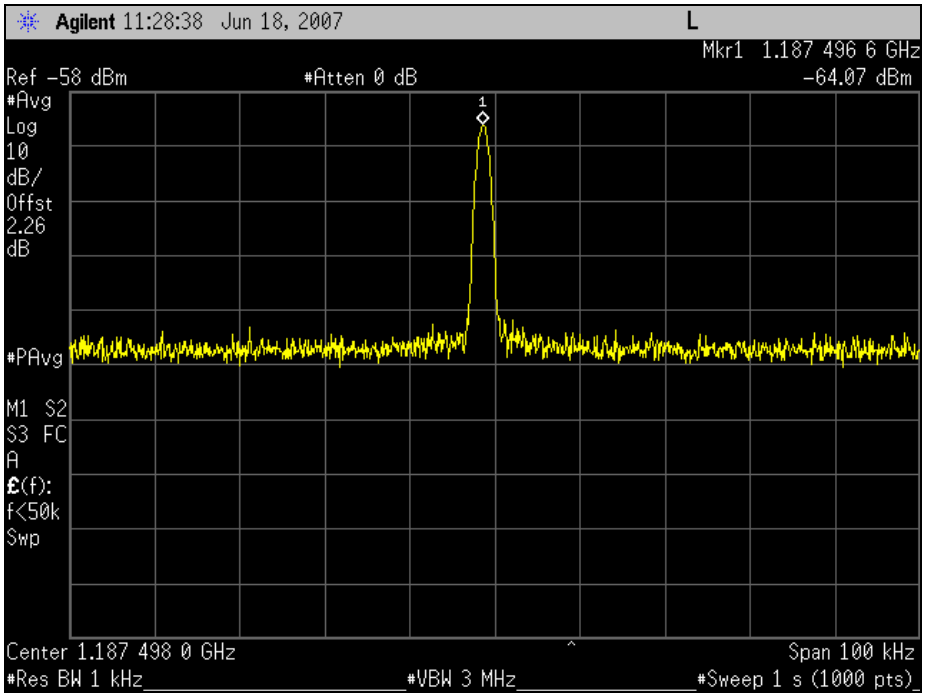


Figure 23. Measured emission with the Transmitter Off, corrected plot

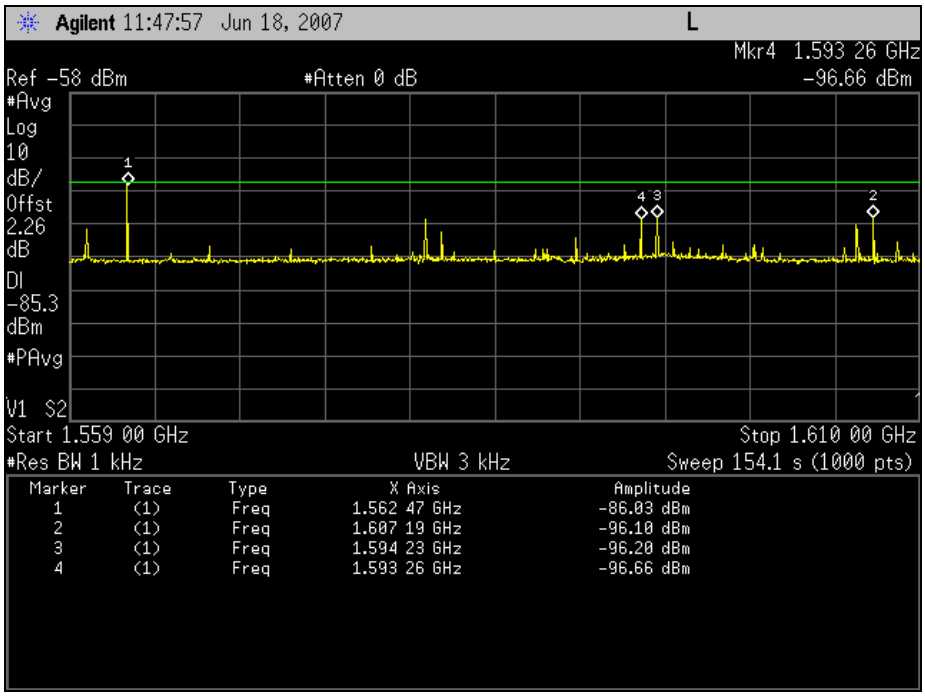


Figure 24. GPS Band 2 with Transmitter On, corrected plot

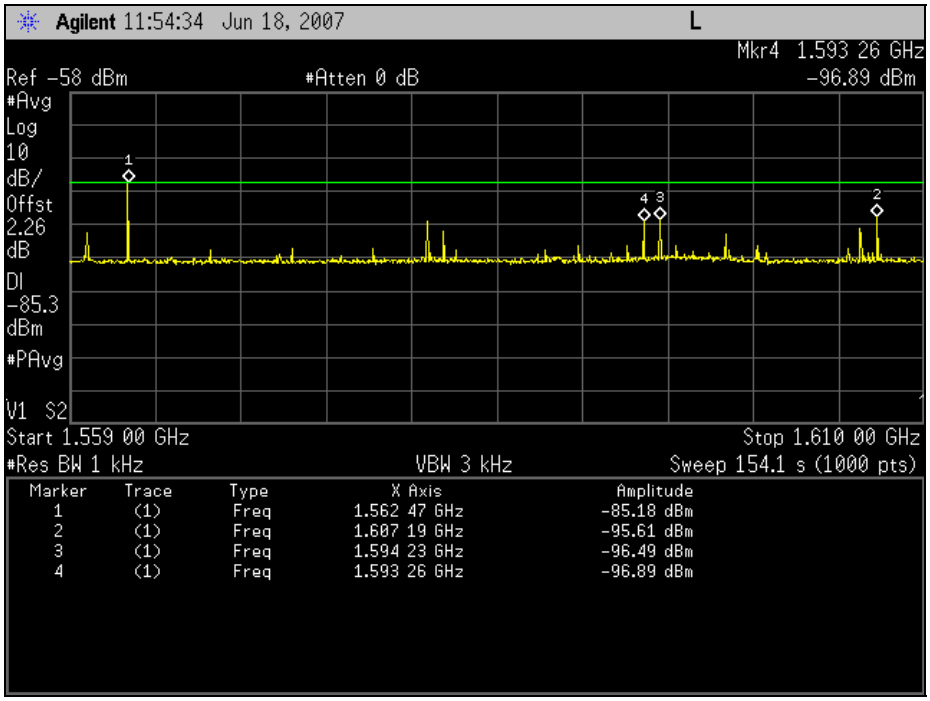


Figure 25. GPS Band 2 with Transmitter Off, corrected plot

Photograph 6. Average Radiated Emissions Requirements – Narrowband, Test Setup

MET #	EQUIPMENT	MANUFACTURER	MODEL#	CAL DATE	CAL DUE
1T4300	SEMI-ANECHOIC CHAMBER # 1	EMC TEST SYSTEMS	NONE	02/17/2006	01/17/2009
1T4576	ACTIVE HORN ANTENNA	COM-POWER	AHA-118	03/23/2007	03/23/2008
SN: US42070103	PSA	AGILENT	E4448A	02/20/2007	02/20/2008

Table 15. Average Radiated Emissions Requirements – Narrowband, Test Equipment

Note: Calibrated test equipment utilized during testing was maintained in a current state of calibration per the requirements of ANSI/NCSL Z540-1-1994 and ANSI/ISO/IEC 17025:2000.

3.6. Peak Radiated Emissions Requirements

Test Requirements: **§15.250(d) (3)**: There is a limit on the peak level of the emissions contained within a 50 MHz bandwidth centered on the frequency at which the highest radiated emissions occurs, f_M. That limit is 0 dBm EIRP. It is acceptable to employ a different RBW, and a correspondingly different peak emission limit, following the procedures in §15.250(d)(3).

Calculation of Limit: Pursuant to **§15.250(d)(3)**,
the peak EIRP limit = 20log (8 MHz/50) = -15.9 dBm.

Test Results: The EUT was found to comply with the requirements of **§15.250(d)(3)**.
The following data was measured at 1m and corrected using the Agilent PSA with the following formula;

P(dBM EIRP) = E(dBm) + CL + ACF(1m) + 2.26 @ 1m

where
CL = Cable Loss
ACF(1m) = Antenna Correction Factor @ 1m

(See page 24 of this report for more information.)

Frequency (GHz)	Corrected AmplitudeEIRP (dBm)	Limit (dBm)	Margin (dB)
6.378	-16.42	-15.9	-0.52

Table 16. Peak Radiated Emissions Test Results at 1 meter - Fundamental §15.250(d)(3)

Test Engineer: Jeffrey Hazen

Test Date: June 18, 2007

Peak Radiated Emissions Requirements Test Results

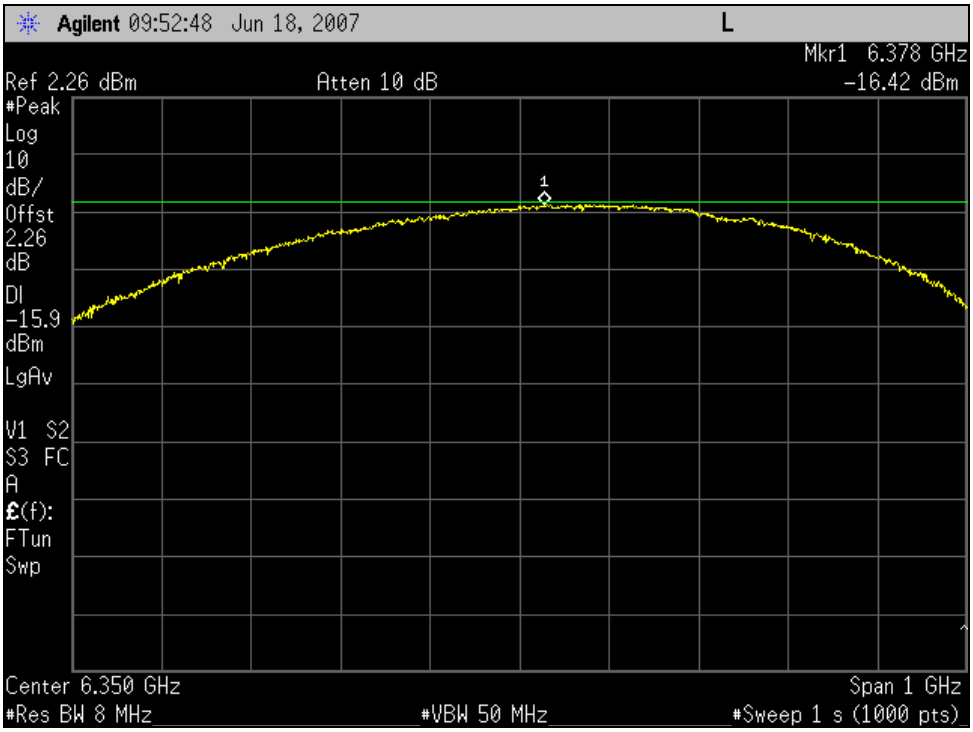


Figure 26. Peak Radiated Emissions

Radiated Emissions Requirements Test Setup

Photograph 7. Peak Radiated Emissions Requirements, Test Setup

MET #	EQUIPMENT	MANUFACTURER	MODEL#	CAL DATE	CAL DUE
1T4300	SEMI-ANECHOIC CHAMBER # 1	EMC TEST SYSTEMS	NONE	02/17/2006	01/17/2009
1T4576	ACTIVE HORN ANTENNA	COM-POWER	AHA-118	03/23/2007	03/23/2008
SN: US42070103	PSA	AGILENT	E4448A	02/20/2007	02/20/2008

Table 17. Radiated Emissions Requirements, Test Equipment

Note: Calibrated test equipment utilized during testing was maintained in a current state of calibration per the requirements of ANSI/NCSL Z540-1-1994 and ANSI/ISO/IEC 17025:2000.

3.7. Labeling Requirements

Requirements: **Part 15 Subpart C: § 15.19 Labeling requirements; § 15.21 Information to user to appear in the manual; § 15.105 Information to the user to appear in the manual**

UWB systems operating under the provisions of this section shall bear the following or similar statement in a conspicuous location on the device or in the instruction manual supplied with the device:

§ 15.19 Labeling requirements.

(a) In addition to the requirements in Part 2 of this chapter, a UWB device subject to certification shall be labeled as follows:

The following statement shall appear in a conspicuous location on the device:

> This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

(1) Where a device is constructed in two or more sections connected by wires and marketed together, the statement specified under paragraph (a) of this section is required to be affixed only to the main control unit.

(2) When the device is so small or for such use that it is not practicable to place the statement specified under paragraph (a) of this section on it, the information required by this paragraph shall be placed in a prominent location in the instruction manual or pamphlet supplied to the user or, alternatively, shall be placed on the container in which the device is marketed. However, the FCC identifier or the unique identifier, as appropriate, must be displayed on the device.

§ 15.21 Information to user to appear in the manual.

> The users manual or instruction manual for an intentional or unintentional radiator shall caution the user that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Results: The applicant has been advised of these requirements.

4. Compliance Information

4.1. Certification Information

The following is extracted from Title 47 of the Code of Federal Regulations, Part 2, Subpart I — Marketing of Radio frequency devices:

§ 2.801 Radio-frequency device defined.

As used in this part, a radio-frequency device is any device which in its operation is capable of Emitting radio-frequency energy by radiation, conduction, or other means. Radio- frequency devices include, but are not limited to:

(a) The various types of radio communication transmitting devices described throughout this chapter.

(b) The incidental, unintentional and intentional radiators defined in Part 15 of this chapter.

(c) The industrial, scientific, and medical equipment described in Part 18 of this chapter.

(d) Any part or component thereof which in use emits radio-frequency energy by radiation, conduction, or other means.

§ 2.803 Marketing of radio frequency devices prior to equipment authorization.

(a) Except as provided elsewhere in this chapter, no person shall sell or lease, or offer for sale or lease (including advertising for sale or lease), or import, ship or distribute for the purpose of selling or leasing or offering for sale or lease, any radio frequency device unless:

(1) In the case of a device subject to certification, such device has been authorized by the Commission in accordance with the rules in this chapter and is properly identified and labeled as required by §2.925 and other relevant sections in this chapter; or

(2) In the case of a device that is not required to have a grant of equipment authorization issued by the Commission, but which must comply with the specified technical standards prior to use, such device also complies with all applicable administrative (including verification of the equipment or authorization under a Declaration of Conformity, where required), technical, labeling and identification requirements specified in this chapter.

(d) Notwithstanding the provisions of paragraph (a) of this section, the offer for sale solely to business, commercial, industrial, scientific or medical users (but not an offer for sale to other parties or to end users located in a residential environment) of a radio frequency device that is in the conceptual, developmental, design or pre-production stage is permitted prior to equipment authorization or, for devices not subject to the equipment authorization requirements, prior to a determination of compliance with the applicable technical requirements *provided* that the prospective buyer is advised in writing at the time of the offer for sale that the equipment is subject to the FCC rules and that the equipment will comply with the appropriate rules before delivery to the buyer or to centers of distribution.

(e)(1) Notwithstanding the provisions of paragraph (a) of this section, prior to equipment authorization or determination of compliance with the applicable technical requirements any radio frequency device may be operated, but not marketed, for the following purposes and under the following conditions:

(i) Compliance testing;

(ii) Demonstrations at a trade show provided the notice contained in paragraph (c) of this section is displayed in a conspicuous location on, or immediately adjacent to, the device;

(iii) Demonstrations at an exhibition conducted at a business, commercial, industrial, scientific or medical location, but excluding locations in a residential environment, provided the notice contained in paragraphs (c) or (d) of this section, as appropriate, is displayed in a conspicuous location on, or immediately adjacent to, the device;

(iv) Evaluation of product performance and determination of customer acceptability, provided such operation takes place at the manufacturer's facilities during developmental, design or pre-production states; or

(v) Evaluation of product performance and determination of customer acceptability where customer acceptability of a radio frequency device cannot be determined at the manufacturer's facilities because of size or unique capability of the device, provided the device is operated at a business, commercial, industrial, scientific or medical user's site, but not at a residential site, during the development, design or pre-production stages.

(e)(2) For the purpose of paragraphs (e)(1)(iv) and (e)(1)(v) of this section, the term *manufacturer's facilities* includes the facilities of the party responsible for compliance with the regulations and the manufacturer's premises, as well as the facilities of other entities working under the authorization of the responsible party in connection with the development and manufacture, but not the marketing, of the equipment.

(f) For radio frequency devices subject to verification and sold solely to business, commercial, industrial, scientific and medical users (excluding products sold to other parties or for operation in a residential environment), parties responsible for verification of the devices shall have the option of ensuring compliance with the applicable technical specifications of this chapter at each end user's location after installation, provided that the purchase or lease agreement includes a proviso that such a determination of compliance be made and is the responsibility of the party responsible for verification of the equipment.

The following is extracted from Title 47 of the Code of Federal Regulations, Part 2, Subpart J — Equipment Authorization Procedures:

§ 2.901 Basis and Purpose

(a) In order to carry out its responsibilities under the Communications Act and the various treaties and international regulations, and in order to promote efficient use of the radio spectrum, the Commission has developed technical standards for radio frequency equipment and parts or components thereof. The technical standards applicable to individual types of equipment are found in that part of the rules governing the service wherein the equipment is to be operated.[1] *In addition to the technical standards provided, the rules governing the service may require that such equipment be verified by the manufacturer or importer*, be authorized under a Declaration of Conformity, or receive an equipment authorization from the Commission by one of the following procedures: certification or registration.

(b) The following sections describe the verification procedure, the procedure for a Declaration of Conformity, and the procedures to be followed in obtaining certification from the Commission and the conditions attendant to such a grant.

§ 2.907 Certification.

(a) Certification is an equipment authorization issued by the Commission, based on representation and test data submitted by the applicant.

(b) Certification attaches to all units subsequently marketed by the grantee which are identical (see Section 2.908) to the sample tested except for permissive changes or other variations authorized by the Commission pursuant to Section 2.1043.

[1] In this case, the equipment is subject to the rules of Part 15. More specifically, the equipment falls under Subpart B (of Part 15), which deals with unintentional radiators.

§ 2.948 Description of measurement facilities.

(a) Each party making measurements of equipment that is subject to an equipment authorization under Part 15 or Part 18 of this chapter, regardless of whether the measurements are filed with the Commission or kept on file by the party responsible for compliance of equipment marketed within the U.S. or its possessions, shall compile a description of the measurement facilities employed.

(1) If the measured equipment is subject to the verification procedure, the description of the measurement facilities shall be retained by the party responsible for verification of the equipment.

(i) If the equipment is verified through measurements performed by an independent laboratory, it is acceptable for the party responsible for verification of the equipment to rely upon the description of the measurement facilities retained by or placed on file with the Commission by that laboratory. In this situation, the party responsible for the verification of the equipment is not required to retain a duplicate copy of the description of the measurement facilities.

(ii) If the equipment is verified based on measurements performed at the installation site of the equipment, no specific site calibration data is required. It is acceptable to retain the description of the measurement facilities at the site at which the measurements were performed.

(2) If the equipment is to be authorized by the Commission under the certification procedure, the description of the measurement facilities shall be filed with the Commission's Laboratory in Columbia, Maryland. The data describing the measurement facilities need only be filed once but must be updated as changes are made to the measurement facilities or as otherwise described in this section. At least every three years, the organization responsible for filing the data with the Commission shall certify that the data on file is current.

