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

September 26, 2006

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

Dear Belinda Turner,

Enclosed is the EMC test report for compliance testing of the Multispectral Solutions, Inc., PAL651 1x1 Tag 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.

Christina. M. Karlhoff
Documentation Department

Reference: (\Multispectral Solutions, Inc.\ PAL651 1x1 Tag \ EMC16838-FCC250)

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

Electromagnetic Compatibility Criteria
Test Report

For the

Multispectral Solutions, Inc.
PAL651 1x1 Tag

Tested under

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

MET Report: EMC16838-FCC250

September 26, 2006

Prepared For:

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

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

Electromagnetic Compatibility Criteria
Test Report

For the

Multispectral Solutions, Inc.
PAL651 1x1 Tag

Tested Under

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

Kevin A. Mehaffey
Electromagnetic Compatibility Lab

Christina. M. Karlhoff
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.

Liming Xu
Electromagnetic Compatibility Lab

Report Status Sheet

Revision	Report Date	Reason for Revision
∅	March 7, 2005	Initial Issue.
1	September 25, 2006	Correct unit location.
2	September 26, 2006	Customer requested revisions.

Table of Contents

1 Requirements Summary 1
2 Equipment Configuration 2
2.1 Overview 2
2.2 Test Site 2
2.3 Description of Test Sample 3
2.4 Mode of Operation 4
2.5 Frequency Determining Parameters 4
2.6 Modifications 4
2.6.1 Modifications to EUT 4
2.6.2 Modifications to Test Standard 4
2.7 Disposition of EUT 4
3 Electromagnetic Compatibility Criteria for UWB Devices 5
3.1 Antenna Requirement 5
3.2 AC Line Conducted Emissions 6
3.3 - 10 dB Bandwidth Requirements 7
3.4 Operational Restrictions 10
3.5 Average Radiated Emissions Requirements – Broadband 11
3.6 Average Radiated Emissions Requirements – Narrowband 16
3.7 Peak Radiated Emissions 20
3.8 Labeling Requirements 24
4 Test Equipment 25
5 Compliance Information 26
5.1 Certification Information 26

List of Tables

Table 1. Requirements Summary of EMC Part 15.250 ComplianceTesting 1
Table 2. Conducted Limits for Radio Frequency Devices calculated from FCC Part 15 Section 15.207(a) 6
Table 3. Radiated Emissions Limits Calculated from FCC Part 15, § 15.209 (a) 11
Table 4. Limits for Radiated Emissions (RBW = 1MHz) 11
Table 5. Radiated Emissions Test Results (low) with QP detector (RBW = 100 kHz) 13
Table 6. Limits for Radiated Emissions (RBW >/= 1kHz) 16
Table 7. Results - Average Radiated Emissions - Narrowband at 1 meter - §15.250(d)(2) 17
Table 8. Peak Radiated Emissions Test Results at 1 meter - Fundamental §15.250(d)(3) 20

List of Figures

Figure 1. Block Diagram of Test Configuration 3

List of Photographs

Photograph 1. FCC Intentional Radiators Test Setup Photograph 1 22
Photograph 2. FCC Intentional Radiators Test Setup Photograph 2 22
Photograph 3. FCC Intentional Radiators Test Setup Photograph 3 23

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**er**z**
Hz	**H**er**z**
ICES	**I**nterference-**C**ausing **E**quipment **S**tandard
kHz	**k**ilo**h**er**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, §15.207(a)	Electromagnetic Compatibility - Conducted Emissions for Intentional Radiators	N/A EUT is a DC-powered device.
Title 47 of the CFR, Part 15, Subpart C, §15.209(a)	Electromagnetic Compatibility - Radiated Emissions for Intentional Radiators	Completed & Compliant
Title 47 of the CFR, Part 15, Subpart C, §15.250(a)(b)	-10 dB Bandwidth	Completed & Compliant
Title 47 of the CFR, Part 15, Subpart C, §15.250(c)	Operational Restrictions	Applicant has been advised of these requirements
Title 47 of the CFR, Part 15, Subpart C, §15.250(d)(1)	Average Radiated Emissions - Broadband	Completed & Compliant
Title 47 of the CFR, Part 15, Subpart C, §15.250(d)(2)	Average Radiated Emissions - Narrowband	Completed & Compliant
Title 47 of the CFR, Part 15, Subpart C, §15.250(d)(3)	Peak Radiated Emissions	Completed & Compliant
Title 47 of the CFR, Part 15, Subpart C	Labeling Requirements	Applicant has been advised of these requirements

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., PAL651 1x1 Tag 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. PAL651 1x1 Tag. 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 PAL651 1x1 Tag has been **permanently** discontinued.

Type of Submission/Rule:	Part 15.250 for UWB Devices
Model(s) Tested:	PAL651 1x1 Tag Pre-Production Unit
EUT Specifications:	**FCC ID:** QCJPAL6511X1
	Equipment Code: UWB
	UWB Bandwidth: 1187 MHz
Analysis:	The results obtained relate only to the item(s) tested.
Evaluated by:	Liming Xu
Date(s):	01/26/2005; 03/07/2005

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 PAL651 1x1 Tag, Equipment Under Test (EUT), is a wireless tagging and identification system designed for the real-time inventory and tracking of indoor/outdoor assets. Applications include hospitals, warehouses, sea freight, supermarkets, retail stores, robotic vehicles, manufacturing and security. Utilizing MSSI's patented ultra wideband (UWB) technology, the PAL651 1X1 TAG system has a real-time, 2-D or 3-D resolution capability of one foot. Much higher resolutions can be achieved with software averaging techniques. With the use of short pulse, UWB technology, the system is highly immune to multi-path effects which plague other wireless tagging solutions (e.g., spread spectrum) designed for indoor/outdoor operation. The individual tags are programmed with unique ID codes which are used for inventory and tracking. Because of the unique properties of UWB technology, the tags have an extremely long battery life of better than five years.

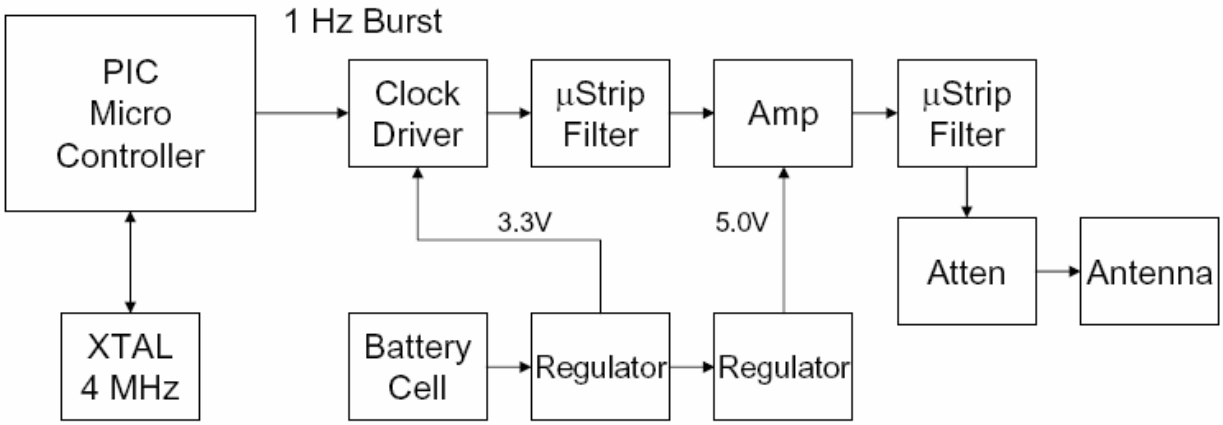


Figure 1. Block Diagram of Test Configuration

2.4 Mode of Operation

The Multispectral Solutions, Inc. PAL651 1X1 TAG was configured in accordance with the manufacturer's instructions and was operated as follows for all testing contained in this report unless stated otherwise:

The EUT had been operating continuously since its receipt by MET Labs. It is designed to have a battery life of at least 5 years.

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.

The center frequency fc was found to be 6219 MHz.

The frequency at which the highest radiated emission occurs is fM (7124 MHz)

The pulse width of the EUT was 2 ns.

Therefore, the highest frequency to be measured was 40 GHz.

2.6 Modifications

2.6.1 Modifications to EUT

No modifications were made to the EUT.

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.

See Photograph in Exhibits

Results:

The EUT complied with the requirement(s) of this section. The EUT meets the criteria of this rule by virtue of having a permanently attached internal antenna.

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 2, 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.

Note: *Testing is applicable except to carrier current systems operating as intentional radiators on frequencies below 30 MHz, containing their fundamental emission within the frequency band 535–1705 kHz and intended to be received using a standard AM broadcast receiver, or devices which only employ battery power for operation and which do not operate from the AC power lines or contain provisions for operation while connected to the AC power lines *15.207 (b)*, or for an intentional radiator that is designed to be connected to the public utility (AC) power line*15.207 (c)*.

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

Test Procedure: Not applicable.

Results: Not applicable. The EUT is a DC-powered device.

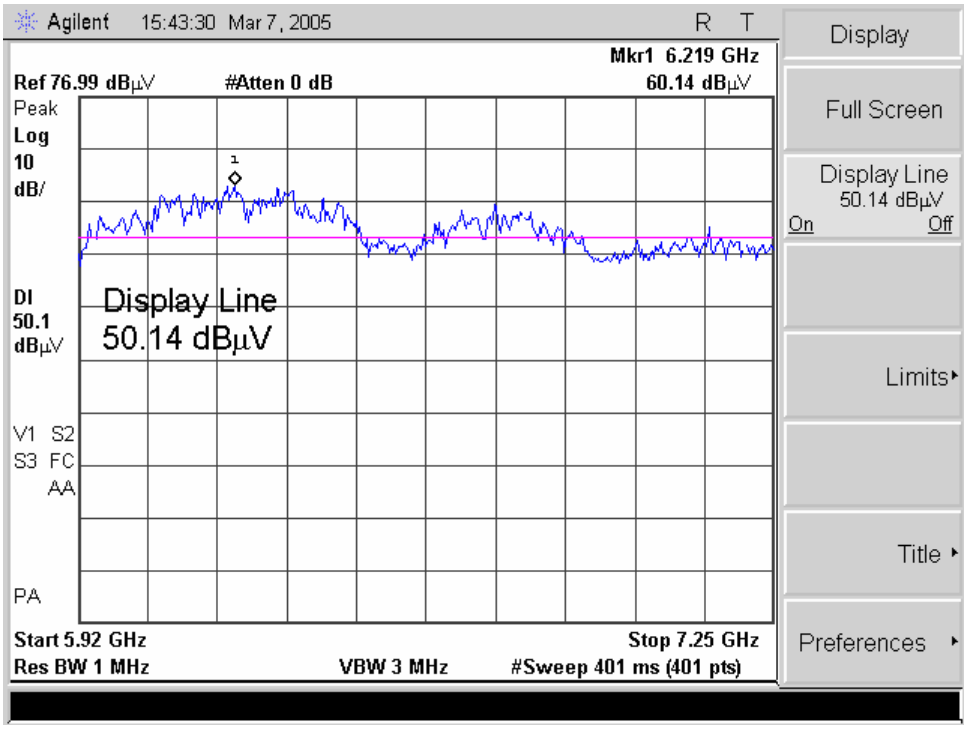
3.3. -10 dB Bandwidth Requirements

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 1MHz.

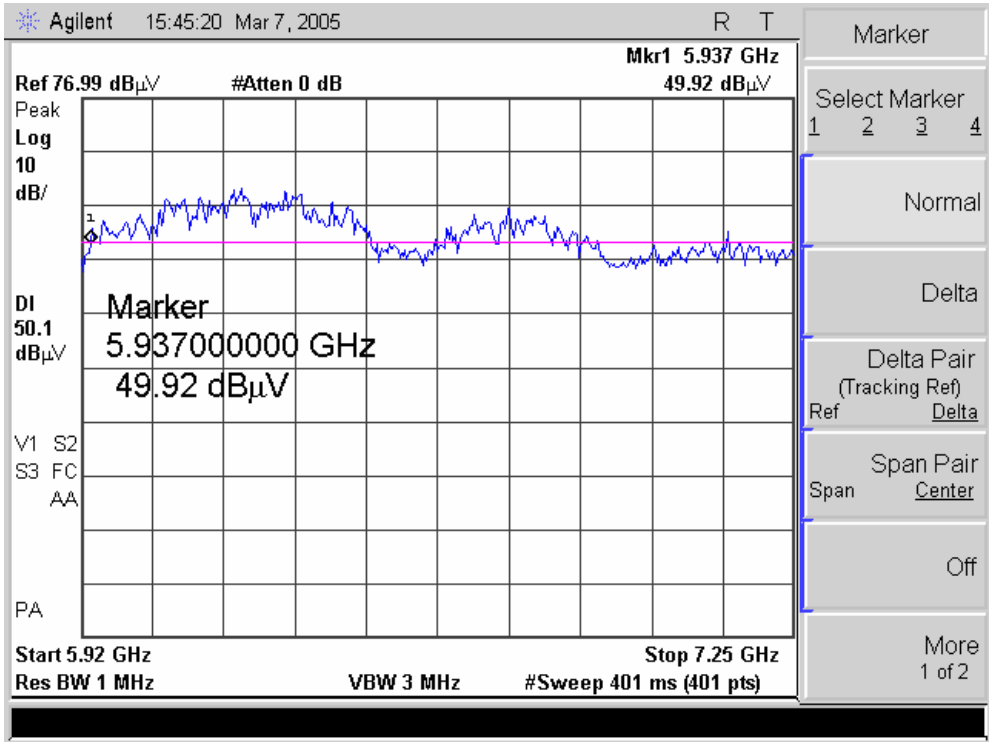
Test Results The EUT complied with the requirement(s) of this section. The bandwidth plots were taken at 0.3 meters distance as follows:

f_L = 5.937 GHz, f_H = 7.124 GHz, f_M = 6.219 GHz, and UWB Bandwidth = 1187 MHz



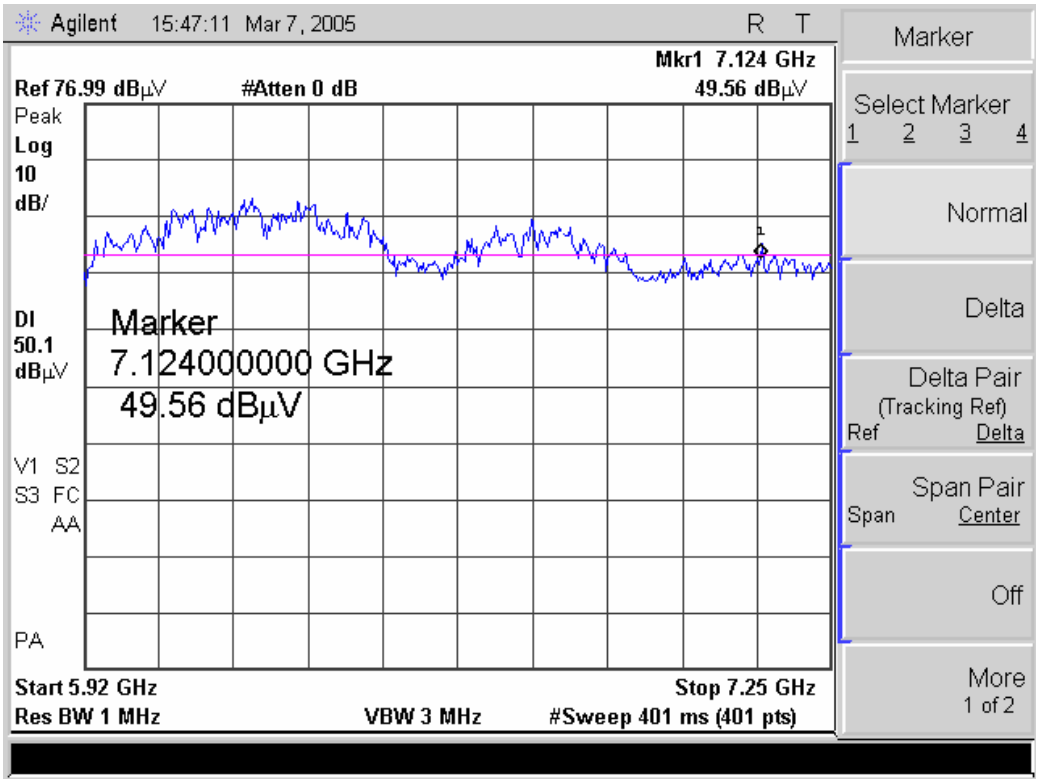
Plot 1. fM = 6.219 GHz

-10 dB Bandwidth Requirements, Test Results



Plot 2. fL = 5.937 GHz

-10 dB Bandwidth Requirements, Test Results



Plot 3. fH = 7.124 GHz

3.4. Operational Restrictions

Transmitter Requirements: **§15.250(c): Technical Requirements for UWB systems.**

Operation under the provisions of this section is limited to UWB transmitters employed in the following limitations;

(1) Operation on board an aircraft or a satellite is prohibited.

(2) Devices operating under this section may not be employed for the operation of toys.

(3) Except for operation onboard a ship or a terrestrial transportation vehicle, the use of a fixed outdoor infrastructure is prohibited. A fixed infrastructure includes antennas mounted on outdoor structures, e.g., antennas mounted on the outside of a building or on a telephone pole.

Results: The User Guide clearly states the application of this system and it is in accordance with the standard.

3.5. Radiated Emissions Requirements – Broadband

Test Requirements: **§ 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 3.

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 3. 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 3 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 4. Limits for Radiated Emissions (RBW = 1MHz)

Test Procedure: The EUT was placed on a 0.8 m high wooden 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.

The "signal substitution method", as used by the FCC Laboratory, was employed. Once the emission under investigation was maximized, the reading shown on the analyzer was recorded. The cable was removed at the antenna and connected to a signal generator. The output of the signal generator was adjusted until the level of the signal on the analyzer was equal to the recorded reading. This adjusted output level now takes cable loss and pre-amp gain into account, and is added to the measurement horn antenna factor in order to obtain the field strength. Because measurements were performed @ 1 meter, the field strength was adjusted to obtain the 3 meter equivalent field strength.

For pre-scanning, the EMI receiver scanned the frequency range from 30 MHz to 10 GHZ, per §15.33(a)(4) to obtain an Emission profile of the EUT. For each point of measurement, the turntable was rotated, the positions of the interface cables were varied, and the antenna height was varied between 1 m and 4 m, in order to find the maximum radiated Emissions. Measurements were taken using this technique with the antenna in two polarizations: horizontal and vertical.

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.

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. There are no detectable emissions from 30 MHz to 40 GHz. All measurement points in Table 5 are the noise floor.

Radiated Emissions Limits Test Results, 15.209 (a)

Frequency (MHz)	EUT Azimuth (Degrees)	Antenna Polarity (H/V)	Antenna Height (m)	Amplitude (dBuv) @3 m	ACF (dB) (+)	Cable Loss (dB) (-)	DCF 3 m to 10 m (dB) (-)	Corrected Amplitude @ 10 m (dBuv)	Class A Limit @ 10 m (dBuv)	Margin (dB)
33	0	H	1	7.2	7.64	1.34	0	16.18	40	-23.82
33	0	V	1	7.2	7.22	1.34	0	15.76	40	-24.24
66	0	H	1	7	10.00	1.89	0	18.89	40	-21.11
66	0	V	1	7.1	8.68	1.89	0	17.67	40	-22.33
168	0	H	1	7.1	8.34	2.77	0	18.21	43.5	-25.29
168	0	V	1	7.1	8.76	2.77	0	18.63	43.5	-24.87
201	0	H	1	7.1	10.86	3.01	0	20.97	43.5	-22.53
201	0	V	1	7.2	10.12	3.01	0	20.33	43.5	-23.17
680	0	H	1	5.6	20.20	5.21	0	31.01	46	-14.99
680	0	V	1	5.7	19.90	5.21	0	30.81	46	-15.19
902	0	H	1	6.9	22.30	5.58	0	34.78	46	-11.22
902	0	V	1	6.9	21.90	5.58	0	34.38	46	-11.62

Table 5. Radiated Emissions Test Results (low) with QP detector (RBW = 100 kHz)

Notes: *There were no detectable emissions from 30MHz to 40 GHz. All measurement points in Table 7 are within the noise floor.

Test Engineer: Liming Xu

Test Date: 02/01/2005

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 equivalent field strength at 3m = (-41.3) + 95.2 = 53.9 dBuV/m.

Test Results: The EUT was found to comply with the emissions requirements of §15.209(a) and §15.250(d)(1). There were no measurable emissions between the highest reported emission in the table below and 40 GHz. The measurement noise floor is well below the specified limit.

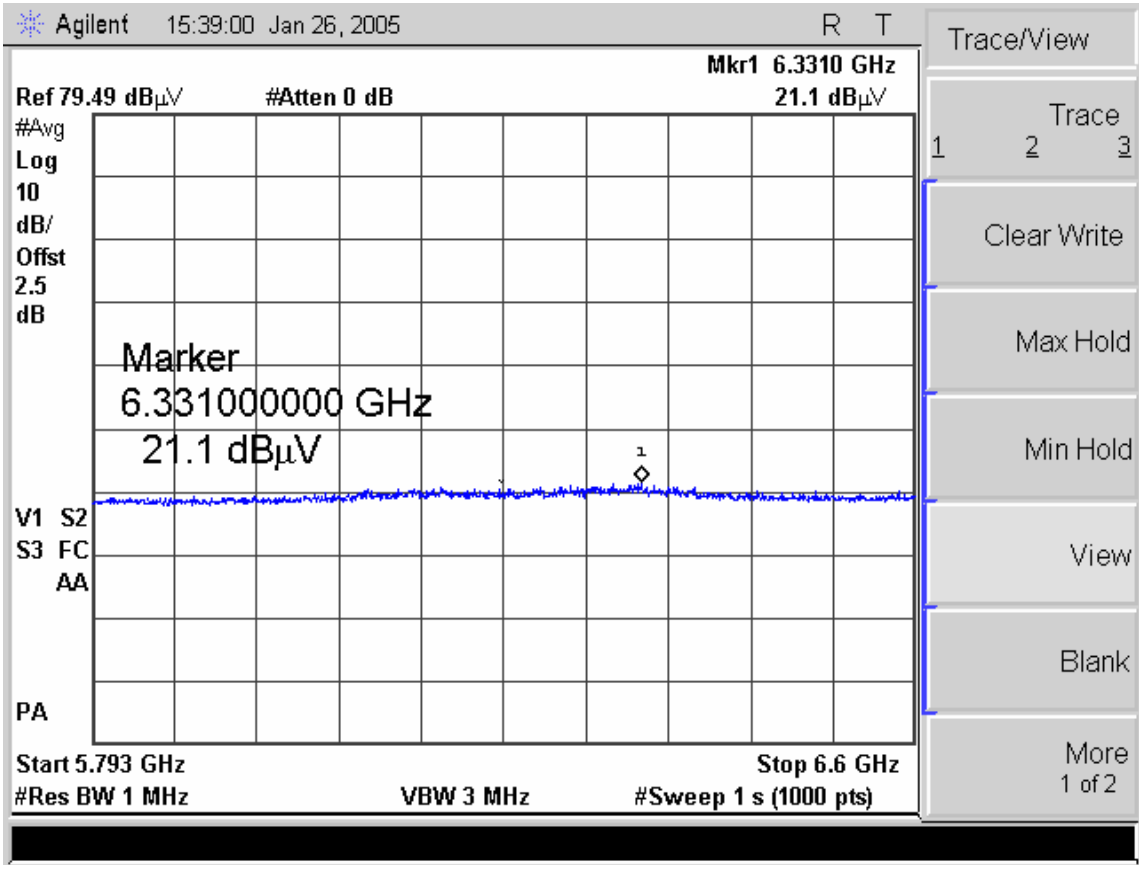
Frequency (GHz)	EUT Azimuth (Degrees)	Antenna Polarity (H/V)	Antenna Height (m)	Uncorrected Amplitude (dBuv)	Antenna Correction Factor (dB) (+)	Distance Correction Factor (dB) (-)	Corrected Amplitude (dBuv)	Limit (dBuv)	Margin (dB)
6.331	0	V	1	21.1	35.80	9.54	47.36	53.9	-6.54

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

Test Engineer: Liming Xu

Test Date: 01/26/2005

Average Radiated Emissions Requirements – Broadband Test Results



Plot 4. Average Radiated Emissions - §15.250(d)(1)

3.6. Average Radiated Emissions Requirements – Narrowband

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 (9.9 dBuv)
1559 - 1610	-85.3 (9.9 dBuv)

Table 6. 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**

Test Results: The EUT was compliant with the requirement(s) of this section. There were no intentional emissions above the measurement noise floor within these bands. The measurement system noise floor is well below the specified limit.

Test Engineer: Liming Xu

Test Date: 02/01/2005

Average Radiated Emissions Requirements – Narrowband Test Results

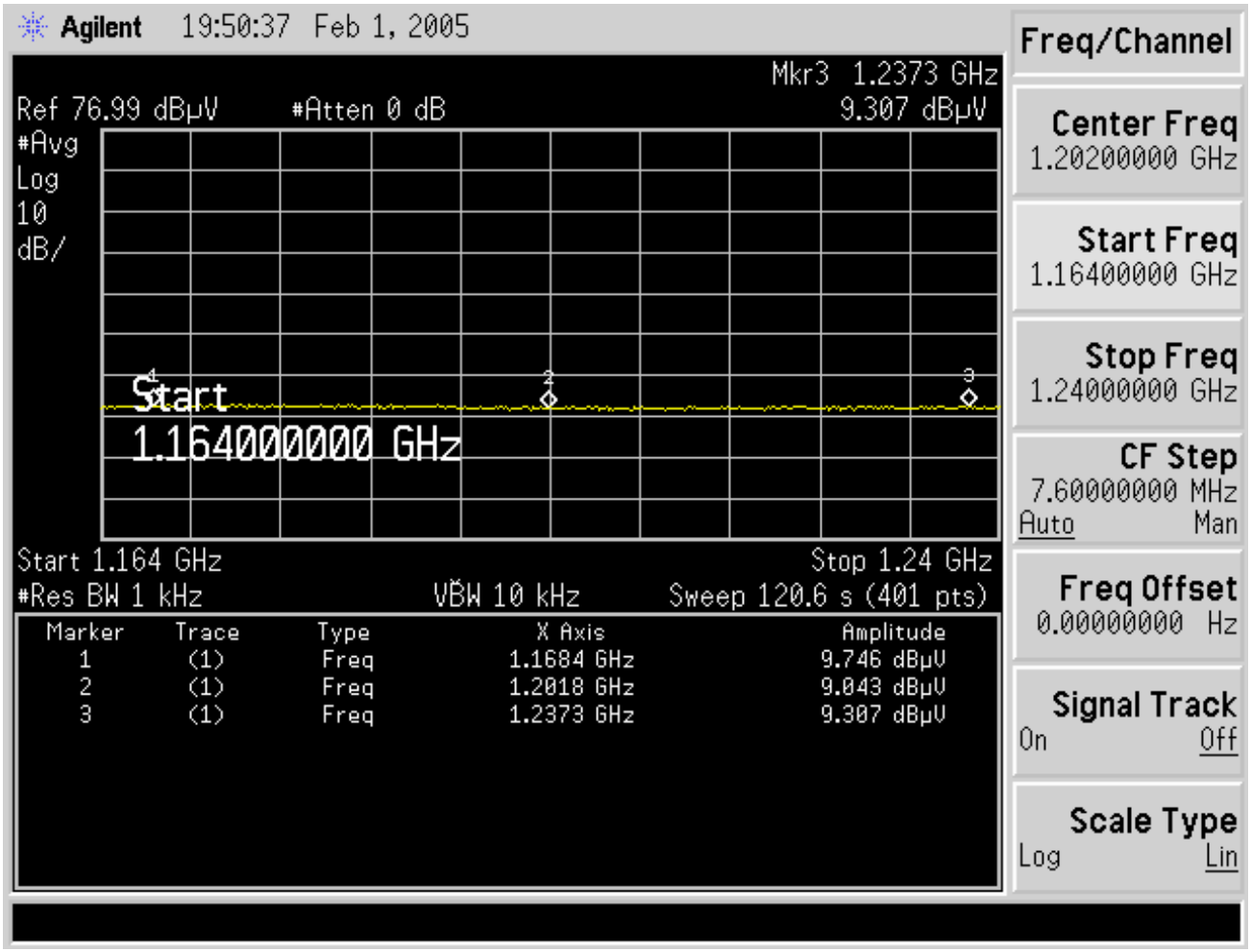
Peak Radiated Emissions Requirements Test Results

Frequency (GHz)	EUT Azimuth (Degrees)	Antenna Polarity (H/V)	Antenna Height (m)	Uncorrected Amplitude (dBuv)	Antenna Correction Factor (dB) (+)	System Gain and Cable Loss (dB) (-)	Distance Correction Factor (dB) (-)	Corrected Amplitude (dBuv)	Limit (dBuv)	Margin (dB)
1.1684	0	H	1	9.746	24.77	28.5	9.54	-3.524*	9.9	-13.43
1.5846	0	H	1	8.56	24.77	25.5	9.54	-0.4 *	9.9	-10.3

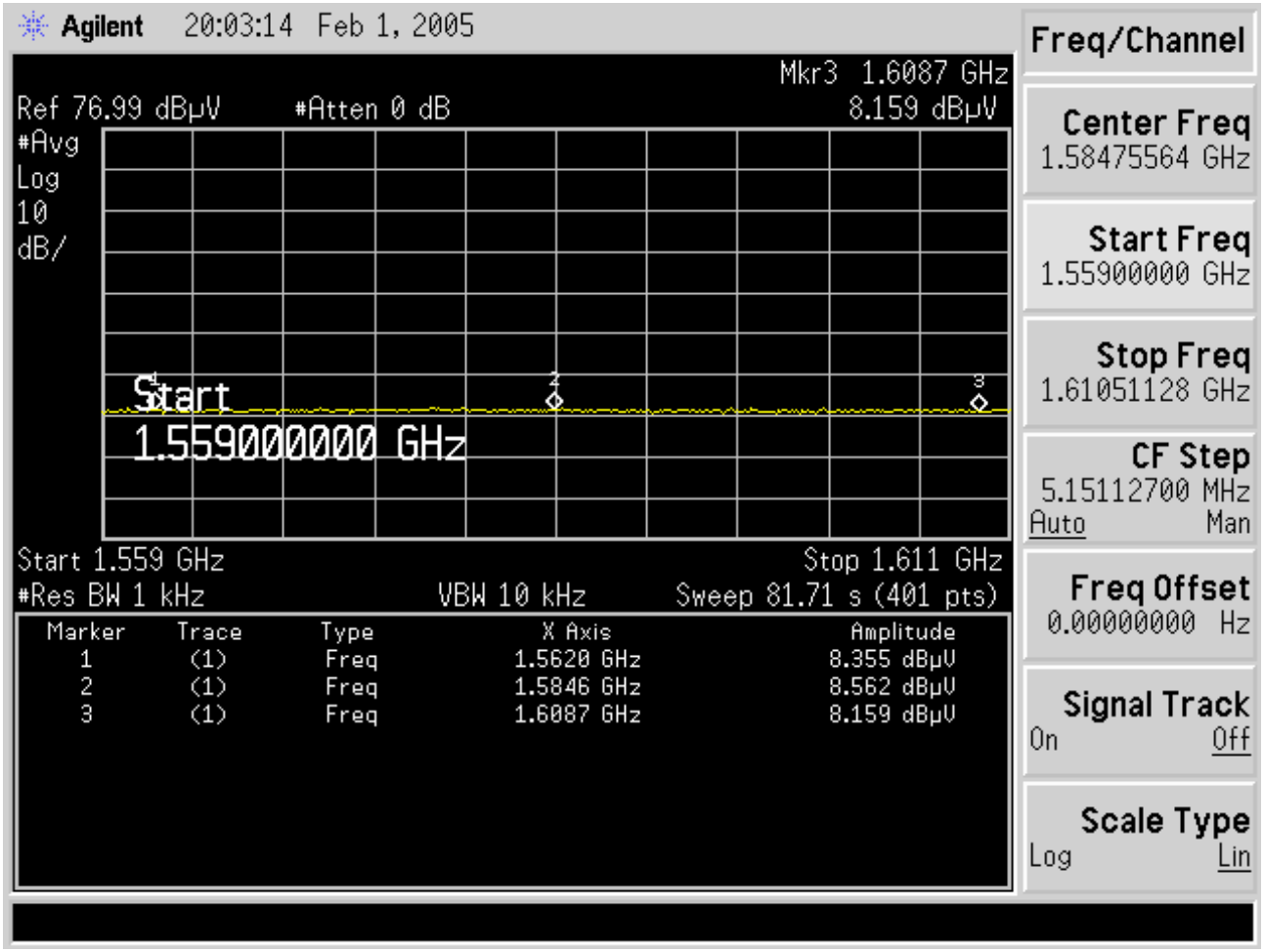
Table 7. Results - Average Radiated Emissions - Narrowband at 1 meter - §15.250(d)(2)

Notes: * Noise Floor - highest level in 1164 - 1240 MHz band (Low GPS band)
** Noise Floor - highest level in 1559 - 1610 MHz band (Up GPS band)

Average Radiated Emissions Requirements – Narrowband Test Results



Plot 5. Lower GPS Band Noise Floor



Plot 6. Upper GPS Band Noise Floor

3.7. 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 (1MHz/50) = -34dBm. The equivalent field strength at 3m = (-34) + 95.2 = 61.2 dBuV/m.

Test Results: The EUT was found to comply with the requirements of **§15.250(d)(3)**.

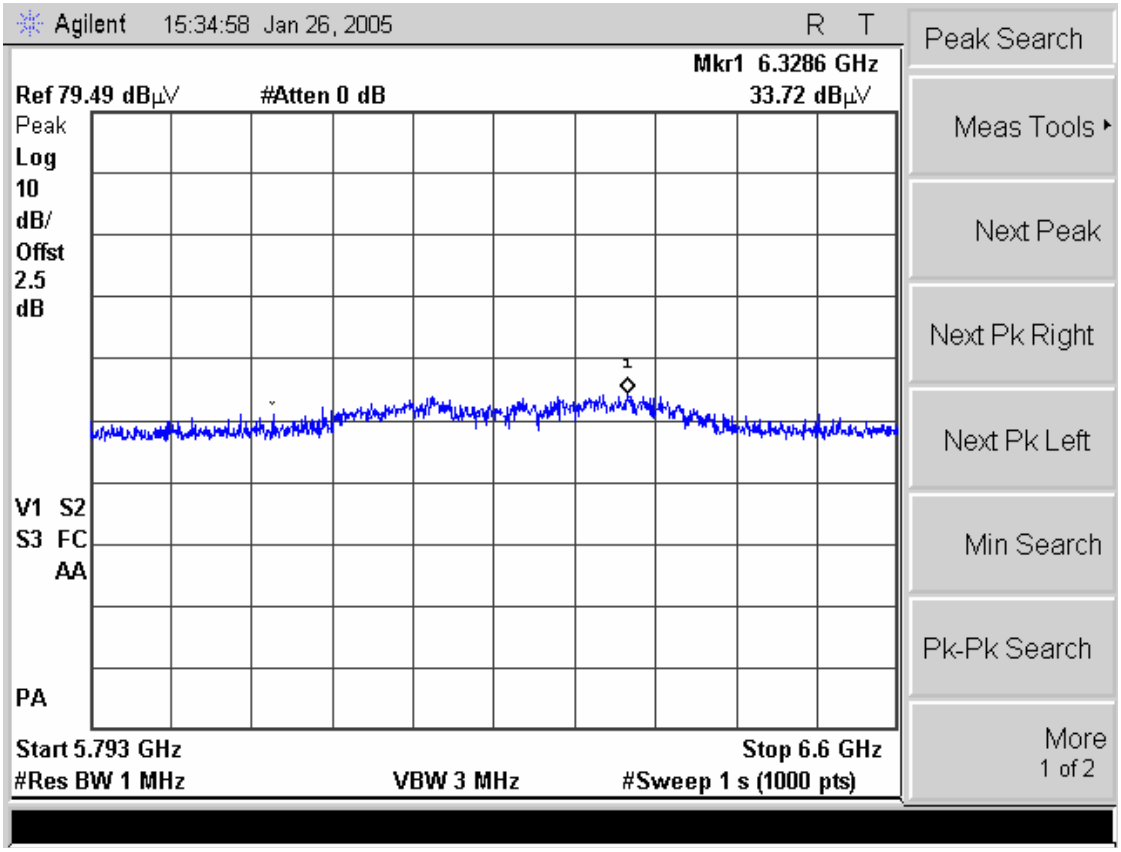
Frequency (GHz)	EUT Azimuth (Degrees)	Antenna Polarity (H/V)	Antenna HEIGHT (m)	Uncorrected Amplitude (dBuv)	Antenna Correction Factor (dB) (+)	Distance Correction Factor (dB) (-)	Corrected Amplitude (dBuv)	Limit (dBuv)	Margin (dB)
6.3286	0	V	1	33.72	35.8	9.54	59.98	61.2	-1.22

Table 8. Peak Radiated Emissions Test Results at 1 meter - Fundamental §15.250(d)(3)

Test Engineer: Liming Xu

Test Date: 01/26/2005

Peak Radiated Emissions Requirements Test Results



Plot 7. Peak Radiated Emissions - §15.250(d)(3)

Radiated Emissions Requirements Test Setup

Photograph 1. FCC Intentional Radiators Test Setup Photograph 1

Photograph 2. FCC Intentional Radiators Test Setup Photograph 2

Radiated Emissions Requirements Test Setup

Photograph 3. FCC Intentional Radiators Test Setup Photograph 3

3.8. 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. Test Equipment

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.

MET Asset #	Nomenclature	Manufacturer	Model	Last Cal Date	Cal Due Date
1T4300	SEMI-ANECHOIC CHAMBER # 1	EMC TEST SYSTEMS	NONE	5/3/2003	5/3/2005
1T4303	ANTENNA; BILOG	SCHAFNER - CHASE EMC	CBL6140A	4/22/04	4/22/05
1T4351	SPECTRUM ANALYZER	AGILENT	E 7405A	8/21/04	8/21/05
1T2665	HORN ANTENNA	EMCO	3115	3/12/04	3/12/05
1T4302	EMI RECEIVER	HEWLETT PACKARD	8546A	10/6/04	10/6/05

Note: Functionally verified test equipment is verified using calibrated instrumentation at the time of testing.

5. Compliance Information

5.1. 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.

